Character Amnesia:
A Sociolinguistic Study on the Different Effects in the Decline of Handwriting Literacy of Chinese Characters

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Abstract

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In the past few years, researchers have begun to empirically study character amnesia, finally providing trial-tested answers for the phenomenon and relieving many from the reliance on anecdotal evidence, which was previously the only kind available. The recent studies, however, have all focused on variables in relation to character amnesia on the lexical level with little attention paid to the participants themselves. The current study presents a first-of-its-kind empirical investigation of the effects of sociolinguistic variables and the degree to which they predict character amnesia in L1 Chinese speakers of varying ages living in the Pacific Northwestern United States. Using a dictation task, the study had 84 participants handwrite a range of 24 to 106 Chinese characters. The results showed that length of residency in the US, age, gender, and input method editor (IME) preference are among the most important predictors of character amnesia. Key behavioral variables that were assumed to yield significant results, such as handwriting frequency and keyboarding frequency, showed no significance in the data set prompting suspicion. These variables will require deeper exploration in future studies to verify their non-significance in predicting character amnesia in individuals.

Acknowledgements

The journey to writing this thesis has been a long process in the making. Since the time I graduated from Portland State University in 2014, I've wanted to continue my studies and research this topic of digitized Chinese characters and the phenomenon of "character amnesia." There are several people I want to thank who have cheered me on and helped me succeed in one way or another in this pursuit. I'd like to thank Professors Stephen Wadley and Jonathan Pease who both enriched my experience at PSU, taught me much about the Chinese language, and connected me with Zev Handel nearly six years ago. I'd like to thank John Ramig who has been a constant champion of my endeavors and who wrote me a referral when applying to UW. I'm so very grateful to the professors at UW who've instructed me over the past 2 years: Bill Boltz, Chris Hamm, Ping Wang, Chan Lü, Zev Handel, David Bachman, and Haeree Park. Thanks also to many colleagues from whom I have learned much and continue to learn: Zhifan Sheng, Yifan Wu, Hongyun Liu, Sam Patwell, and Chad Westra.

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准发音 (*standard pronunciation*). Thanks to Jun Da and Guy Almog for speaking with me over Zoom and for your patience in answering so many of my questions. To my advisors, Zev Handel and Chan Lü, I'm so very grateful for all your patience, guidance, and advice. Zev, I appreciate all the time you spent with me brainstorming and plotting out the path forward. A special thanks to your flexibility with me when my son was born during your Winter '22 CHIN 531 class.

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C.K.C.

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Preface

I first encountered the term *character amnesia* several years ago near the end of my undergraduate studies when I found myself forgetting how to write many of the characters I had used in essays and coursework in my Chinese language classes. Around that same time (2012), journalists were splashing *character amnesia* across headlines bringing global attention to the new "problem" facing China in the internet age. Scholarly interaction with the topic at that point, however, was scant with only a handful of academics mentioning it, predominantly so for its novel existence and as a topic for "another day." Another day has come and scholarly attention is increasingly attentive to character amnesia with studies, articles, theses, and dissertations making it their main topic (this current thesis being no exception). Remembering back, if I had to cite a couple of influences that drew my attention to this topic, the first would be, as I stated above, my own experience with character amnesia in college as I began using the computer and pīnyīn input to write essays in my senior year.[1] Another would be my fascination with the digitization of Chinese characters, particularly in light of their longevity throughout the millennia (roughly 3,000 years) and continuing to the digital age.[2] Their survival continues to impress me, especially considering the number of different events the script has endured over the centuries be it foreign conquerors ruling the Chinese empire, different technologies being adopted such as the printing press, the typewriter, and computers, or the decades of revolution in the first half of the 20th

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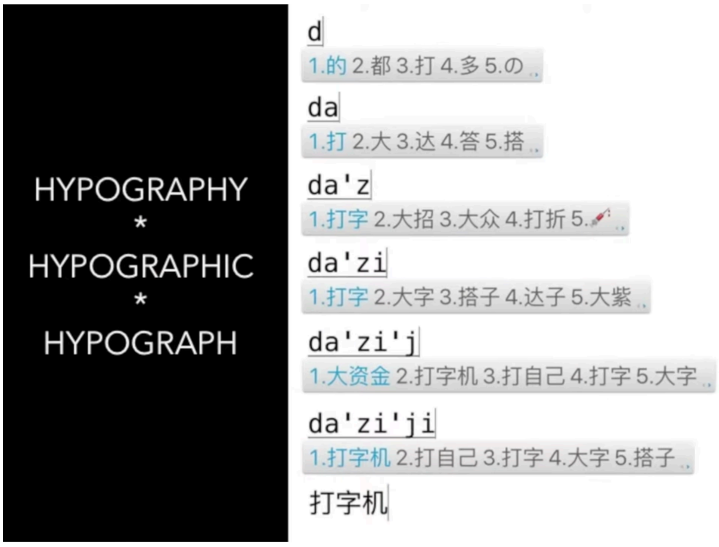
[1] Pīnyīn is a phonetic Chinese transcription system developed in the 1950s which became a critical component to mass literacy in China in the 2nd half of the 20th century and has become one the the predominantly used methods in the digital age for typing Chinese words phonetically on a QWERTY computer keyboard. More discussion of pīnyīn will take place further on in this paper.

[2] Jerry Norman, *Chinese* (Cambridge: Cambridge University Press, 1988), 58.



century.[3] Thomas Mullaney's *The Chinese Typewriter: A History* further developed my curiosity around the way Chinese characters interacted with computers, particularly their function in regard to input and output. In a lecture he gave in June 2019 discussing Chinese keyboards for the typewriter, computer, and input method editors (IME), Mullaney talked about the concept of *hypography*[4] (*hypo-* meaning "beneath, below, or less than normal;" *-graph* meaning "something written or drawn"). Mullaney invented this term to take what he calls the "quasi-text" of Chinese input on a device (whether typing pīnyīn or graphic writing with a stylus or finger) and contrast it with the "real text" of historical standard orthography. He makes the claim that, since its inception and before the computer age, writing fundamentally adhered to a set of criteria, namely: 1) there was a one-to-one relationship between the transcription and the orthography, 2) some kind of instrument was used to inscribe the script, 3) the primary text was

[3] For more see Tsu, Jing, *Kingdom of Characters* (Hartford: Yale Press, 2021).

[4] Thomas Mullaney, "The Chinese Typewriter: A History," Letterform Lecture Series, San Francisco Public Library, San Francisco, CA, June 18, 2019, video of lecture, https://www.youtube.com/watch?v=KSEoHLnIXYk.

Figure 1: Slide from Mullaney's lecture showing example of pīnyīn input with character retrieval options.

simply what one wrote down, and 4) the script itself, in order to be recognized as script, needed to be complete (as opposed to half-scribbled or partially typed). Mullaney believes that Chinese has become hypographic when synthesized through digital IME because it has no one-to-one relationship between its action and outcome (for example, typing "t-b-w-z-" and getting "提笔忘字"), it utilizes retrieval and not inscription (for example, writing a few strokes of a character and summoning a menu from which one can choose the target character among several options), it throws out the primary transcript and retains the secondary transcript as the target (as in the first example "tbwz" is discarded leaving behind 提笔忘字 as the desired outcome), and it doesn't require completion (meaning one doesn't need to finish writing or typing a complete character, word, or phrase before being able to select the target text, producing a quasi-text or hypographic text). What kind of writing is this? In his lecture, he opens up by introducing the concept of character amnesia as a sort of condition that "takes our basic understanding of epidemiology and turns it on its head" — that the disease of character amnesia doesn't affect the poor, underserved, and illiterate but rather the affluent, elite, and educated.[5] The more connected (in a digital sense) one is in modern Chinese society, the more susceptible one is to character amnesia. He also points out that the English terms used for tíbǐwàngzì 提笔忘字, *amnesia* (an untreatable cognitive impairment associated with the inability to recall things from memory) or *dysgraphia* (a learning disability sometimes associated with brain damage) are rather serious descriptions for tíbǐwàngzì (which literally translates to "lift the pen, forget the character"). Guy Almog, a Ph.D. graduate from the University of Haifa who made

[5] Mullaney, "Chinese Typewriter," lecture.

character amnesia the subject of his dissertation, would likely agree that these terms are quite exaggerated. In his articles, Dr. Almog observes an alarmist tone noting that Chinese sources frequently use words such as 'crisis' (危机), 'problem' (问题), 'embarrassment' (尴尬), and 'illness' (通病) when discussing the phenomenon of character amnesia.[6] Mullaney's concluding point with hypography and character amnesia is that these diagnoses are outdated. In other words, some linguists are using antiquated methodologies to explain the "problems" that are affecting the Chinese script, which Mullaney believes is the wrong approach because Chinese is on the precipice of a completely new way of writing. Again from his 2019 lecture, Mullaney says:

> We are in year 40 or 50 — which from historical perspectives is like the flap of a butterfly's wings — right at the doorstep, right at the eve of an entire epoch of a new form of writing; and yet our vocabulary and our theoretical models [are] still trapped and born in the previous epoch, so there is a mismatch. And it's this mismatch that gives us words like 'character amnesia' [...].[7]

This empirical study is humbly placed within this larger context with the understanding that the Chinese script is uniquely undergoing a metamorphosis like never before. As with all other writing systems, Chinese has been and will continue to be influenced by technology,[8] but the logographic nature of Chinese sets it on a different plane than its alphabetic counterparts. This thesis doesn't deal with Mullaney's hypography in any direct way, but I believe character amnesia and hypography are closely related.

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[6] Guy Almog, "Getting Out of Hand? Examining the Discourse of 'Character Amnesia,'" *Modern Asian Studies* 53, no. 2 (2019): 695. DOI:10.1017/S0026749X1700035X.

[7] Mullaney, "Chinese Typewriter," lecture.

[8] James Pfrehm, *Technolingualism: The Mind and the Machine,* (London: Bloomsbury Publishing, 2018) 249.

Mullaney and Almog's message shouldn't be misunderstood. They aren't dismissing the cultural concerns around character amnesia but, rather, are offering another perspective — a reframing— that points to character amnesia as one of the signs of a new era of the Chinese script.

Introduction

Character amnesia is a phenomenon that occurs when literate Chinese speakers can't remember how to write characters (logographs) that they likely mastered in grade school or knew at some previous point in life.[9] In the past few years, an increasing number of academic papers discussing character amnesia has emerged with pioneering research investigating Chinese handwriting literacy and the effects digitization and technology are having on it, particularly among Chinese youth. There have been three recent empirical studies researching the phenomenon (Wang et al., 2019; Huang et al., 2021a; Huang et al., 2021b) each one covering several effects of lexical-level variables on character amnesia. None of these studies, however, include an in-depth look into the sociolinguistic aspects of character amnesia, which neglect the effects of demographic and behavioral variables such as age, gender, education level, habitual writing and keyboarding frequencies, and more. Not testing how these sociolinguistic variables influence character amnesia only maintains the gap in our understanding for how character amnesia functions, who in society experiences it most often and why. Answering these questions would give governmental and academic departments, educators, parents, and all custodians and users of the Chinese script better information

[9] Min Xu, "Character Amnesia", in: *Encyclopedia of Chinese Language and Linguistics*, General Editor Rint Sybesma, accessed on May 19, 2023, http://dx.doi.org.offcampus.lib.washington.edu/10.1163/2210-7363_ecll_COM_000225.

for how to adapt (to) the language as they deem best. This study aims to look at key demographic variables to discover which prove to be the strongest predictors of character amnesia. Preceding a description of the study and the results will be an introduction of character amnesia as a phenomenon and a brief presentation of its background within academia.

In 1925, 11-year-old Frank Neuhauser of Louisville, KY became the inaugural champion of the American National Spelling Bee by correctly spelling the word *gladiolus*. He won $500, a gold medal, and the opportunity to shake hands with then-president Calvin Coolidge. Every spring since Frank's victory (with the exception of a three-year hiatus during World War II and again in 2020 due to COVID-19), young regional champion spellers from across America have gathered in Washington D.C. to engage in an orthographic tussle resulting in one of them becoming the year's national best speller.[10] For the competition, the contestants must prepare to be quizzed on any given word drawn from the official lexical source of the Bee: Webster's Unabridged English Dictionary — a volume containing over 476,000 words. The pursuit for this particular conquest has not waned over the past 20 years, even with the advent of the digital age. On the contrary, it has ballooned in popularity with 9.2 million viewers tuning in to ION's broadcast of the contest this year (a 22 percent increase from 2022's viewership).[11] What might seem most remarkable is, despite all the technology now available such as spellcheck, predictive text, and voice dictation on which we now all

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[10] James Maguire, *American Bee: the National Spelling Bee and the Culture of Word Nerds: the Lives of Five Top Spellers as They Compete for Glory and Fame, (*Emmaus, PA: Rodale, 2006), 8.

[11] The E.W. Scripps Company, "2023 Scripps National Spelling Bee seen by 9.2 million viewers, up 22% vs. 2022," *PR Newswire,* June 12, 2023, https://www.prnewswire.com/news-releases/2023-scripps-national-spelling-bee-seen-by-9-2-million-viewers-up-22-vs-2022--301848388.html.

rely, Spelling Bee contestants persist in the challenge to claim a victory that necessitates countless hours of memorizing the definitions, etymologies, and orthographies of tens of thousands of words in the English language. In the age when nearly every person in the US doesn't need to know how to spell, the Bee appears to be America's sole vestige of pride and interest in English orthography on a national stage.

The Scripps National Spelling Bee, an American invention, inspired Guān Zhèngwén 关正文 to create his own version of the Bee, a televised contest in China called *Chinese Characters Dictation Competition* (CCDC) 中国汉字听写大会 zhōngguó hànzì tīngxiě dàhuì.[12] The format of Guān's show has similarities to the American Bee, but the most stark difference between the two tournaments is the method by which the contestants exhibit their knowledge of the words in question, namely: the English words are *spelled* orally into a microphone whereas the Chinese words are *written down* on a digital interface which is then projected on a screen for the judges to evaluate. On the "History of the Bee" page of the Scripps National Spelling Bee website, it boasts the phrase, "promoting literacy since 1925."[13] Guan and the producers of CCDC have openly said they aim for a similar goal of widespread literacy not only for Chinese youth but any viewers watching from home. In fact, viewers tuning in from home are encouraged to have a scratch piece of paper and pencil with them while they watch so that they can participate with the televised contestants. The people behind CCDC hold a sincere concern for the longevity and survival of the Chinese script. Even the Ministry of

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[12] Isabella Steger, "Chinese TV's Latest Hit Features a Character-Driven Plot --- Show Aimed at Reviving the Country's Written Language Explodes," *Wall Street Journal,* October 19, 2013, https://www.wsj.com/articles/SB10001424052702304410204579141422985199050.

[13] "History of the Bee," About, The E.W. Scripps Company, accessed June 21, 2023, https://spellingbee.com/about.

Education in China now is promulgating new initiatives across the country, like CCDC, to at least delay and at most stamp out a decline in *hànzì* 汉字 (Chinese character) handwriting literacy.[14] Literacy is a fairly broad term that constitutes a set of multiple cognitive skills or practices in language processing such as reading, writing, speaking, and listening, which are all influenced by one's sociocultural context.[15] In many usages, *literacy* simply indicates one's ability to read and write. The Bee's use of the word "literacy" as mentioned above is likely a more narrow definition that deals mostly with spelling (i.e. orthographic knowledge), etymology, and use of certain words embedded within and limited to a few sentences. *Handwriting literacy* with Chinese characters, simply stated, is the ability to read (recognize) and write (recall) characters. As character amnesia has emerged more prominently as a perceived existential threat in the past 2 decades, many in China point to technological devices replacing ink and brush as a salient cause in the decline in handwriting literacy of Chinese characters. This claim isn't new, however efforts to empirically answer the claim have only recently been conducted and more testing is needed.

In fact, for more than 20 years linguistic purists and traditonalists in China have felt trepidation about a decline in handwriting literacy with the concurrent and prevalent rise in and embrace of technology across the globe.[16] In 2022, the number of

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[14] "Jiàoyù bù guānyú yìnfā 'zhōng xiǎoxué shūfǎ jiàoyù zhǐdǎo gāngyào' de tōngzhī" 教育部关于印发《中小学书法教育指导纲要》的通知 [The instruction outline for calligraphic education in primary and secondary schools], Ministry of Education of China, accessed April 25th, 2023, http://www.moe.gov.cn/srcsite/A26/s8001/201301/t20130125_147389.html.

[15] Katherine K. Frankel, Bryce L. C. Becker, Marjorie W. Rowe, and P. David Pearson, "From 'What is Reading?' To What is Literacy?," *Journal of Education*, 196, *no. 3* (2016): 7, 14, https://journals-sagepub-com.offcampus.lib.washington.edu/doi/epdf/10.1177/002205741619600303

[16] Xu Ming, "Is Penmanship a Dying Art," *Global Times*, July 31, 2012, https://www.globaltimes.cn/content/724421.shtml.

smartphone users in China amounted to almost 1.04 billion, and this number is expected to increase in the coming years. China presently accounts for over 15 percent of the total 6.6 billion people who use smartphones around the world.[17] The current relationship between smart phones and the Chinese writing system is only the latest iteration between technology and the fate of Chinese characters. Technology and its societal acceptance have played a key role in the debate of the Chinese script's survival over the past 100 years. For example, when the typewriter was first taking the world by storm, the Chinese (and many Western innovators hoping to be the first to solve the lucrative puzzle) were eager to find a solution for how their script containing thousands of unique and intricate characters could be compatible with a device designed with roughly 45 keys — consciously fashioned for alphabetic scripts. During the early 20th century amidst the fall of the Chinese dynastic era culminating in political revolution, many Chinese intellectuals and students were demanding another revolution — one on the Chinese language itself.[18] Several Chinese intellectuals and linguists at the time were making recommendations to abandon the complicated character system altogether and replace it with a Latinized script lest they be perpetually frozen in a pre-industrialized world ever lagging behind their global rivals.[19] From the viewpoint of these intellectuals, the complexity of the writing system had become an obstruction in the way of progress, development, and any hope of equal footing with the West, again the typewriter being a

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[17] "Number of smartphone users in China 2018-2027," Statista, accessed May 19, 2023, https://www.statista.com/statistics/467160/forecast-of-smartphone-users-in-china/.

[18] For more information on this period, one can refer to: DeFrancis, John, *Nationalism and Language Reform in China,* New York: Octagon Books, 1972.

[19] For a thorough overview, refer to Mullaney, Thomas S. *The Chinese Typewriter: a History*. Cambridge, Massachusetts: The MIT Press, 2017.

prime example. One of the many outcomes of the New Culture Movement (1916) was the invention of various different phonetic systems with the intention to fully or partially replace the millennia-old character system.[20] Decades later in the 1950s, during the infancy of the People's Republic of China, the Chinese Communist Party (CCP) developed and implemented the phonetic system called hànyǔ pīnyīn 汉语拼音 to help increase literacy and modernize the nation. While Máo Zédōng 毛泽东 was ready to throw out the character system altogether, scholars and party members around him strongly advised against it. After one phase of language reform that took traditional Chinese characters and simplified them by reducing the number of strokes (dramatically in some cases), pinyin was officially adopted as the romanization system to transliterate the Chinese script making the acquisition of characters easier for the common people (老百姓 *lǎobǎixìng*).[21] For some purists today, pīnyīn could be the wolf clothed in sheep's wool. On one hand, it began as a buttress for Chinese pedagogy lifting millions out of the darkness of illiteracy (before 1949, the literacy rate in China was around 20 percent. Today, it sits around 97 percent).[22] On the other hand, in the internet age, some could regard pīnyīn as having slowly sabotaged the culturally important script that has endured throughout the ages and represents the root system of Chinese civilization for many.[23] A recent study revealed a negative correlation between high-frequency use of

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[20] David Moser, *A Billion Voices: China's Search for a Common Language*, (Melbourne: Penguin Group, 2016), 50.

[21] Ibid., 72-73.

[22] Ted Plafker, "China's Long — but uneven — March to Literacy," *New York Times*, February 12, 2001, https://www.nytimes.com/2001/02/12/news/chinas-long-but-uneven-march-to-literacy.html.

[23] Almog, "Getting Out of Hand?" 695.

pīnyīn input on a device and reading comprehension of Chinese characters.[24] Pīnyīn is the main input method editor (IME) for characters on smartphones and computers, accounting for 97 percent of users in mainland China.[25] This means that nearly every person when using their phone or computer to write isn't actually "writing" characters but typing a Chinese character's phonetic representation using roman characters (letters) on a standard QWERTY keyboard and then selecting the target character from a line-up (see Figure 1). Simultaneously contributing to this issue is the universality of the decline in handwriting with pen and paper everywhere.[26] It appears that Professor F.W. Lancaster's 1978 prediction of an American "paperless society" in the 21st century is not only accurate, but true on a global scale.[27] Evidence of this issue of orthographic "amnesia" is not unique to China and efforts to slow down or reverse it, like the Scripps Bee, can be found elsewhere. In fact, a massive dictation event was just held earlier this summer (June 4, 2023) in Paris's iconic Champs-Élysées where nearly 5,000 applicants between the ages of 10 - 90 sat together attempting to accurately transcribe excerpts of French text to raise awareness of literacy rates across France with the hope to improve them.[28] Low frequency handwriting combined with high frequency keyboarding seems

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[24] Li Hai Tan, Min Xu, Chun Qi Chang, and Wai Ting Siok, "China's Language Input System in the Digital Age Affects Children's Reading Development," *Proceedings of the National Academy of Sciences,* 110, No. 3 (2012): 1119-1123, https://doi.org/10.1073/pnas.1213586110.

[25] Jennifer 8. Lee, "In China, Computer Use Erodes Traditional Handwriting, Stirring a Cultural Debate," *New York Times*, February 1, 2001. https://www.nytimes.com/2001/02/01/technology/in-china-computer-use-erodes-traditional-handwriting-stirring-a.html.

[26] Heidi H. Harralson and Larry Miller, *Developments in Handwriting and Signature Identification in the Digital Age,* London: Taylor & Francis Group, 2012, 12.

[27] A.P. Young, "Aftermath of a Prediction: F. W. Lancaster and the Paperless Society," *Library Trends 56, no. 4* (Spring 2008): 843, https://muse.jhu.edu/article/246679.

[28] Joe Hernandez, "A massive dictation event takes over the iconic Champs-Élysées in Paris," *NPR*, June 6, 2023, https://www.npr.org/2023/06/05/1180134832/champs-elysees-paris-giant-dictation.

to be influencing handwriting literacy (specifically one's knowledge of orthography) around the world. For the Chinese, pīnyīn input on a device may be provoking the decline of handwriting literacy of hànzì and responsible for Chinese natives' occasional recall failure when writing common characters.[29] It's this lapse in orthographic muscle memory that has come to be known as the phenomenon *tíbǐwàngzì* 提笔忘字 — literally meaning "to lift the pen and forget the character." *Tíbǐwàngzì* was first translated as "character amnesia" in 2010 by Professor Victor Mair of the University of Pennsylvania. Many questions arise from this topic. What exactly is character amnesia? Why is it happening? How is it happening? Who is affected most by it? What are the most significant predictors of character amnesia? While character amnesia has been covered extensively in journalism and some academic discourse in the past decade,[30] groups of scholars have only just begun to seriously study this topic through empirical research (Wang et al 2020; Huang et al 2021a; Huang, et al 2021b).

Literature Review

As Mair's translation implies, character amnesia takes place when someone can't recall parts or the entirety of the written form of a particular word while handwriting, rendering them unable to produce the character they were once able to write.[31] Some scholarly articles have drawn comparisons between character amnesia and tip-of-the-pen (TOP) phenomenon. Huang et al., 2021b includes TOP as a facet of character

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[29] Shuting Huang, Yacong Zhou, Menglin Du, Ruiming Wang, Zhenguang Cai, "Character amnesia in Chinese Handwriting: A Mega-study Analysis," *Language Sciences* 85, (2021), https://doi.org/10.1016/j.langsci.2021.101383.

[30] Refer to Almog

[31] Min Xu, "Character Amnesia."

amnesia defining a TOP state as "knowing a character but failing to fully handwrite it and character amnesia [as] a general inability to handwrite a character despite being able to recognize it."[32] Thus, Huang categorizes a TOP (a failure in retrieval of the correct orthographic components) as merely one of the manifestations of character amnesia. Other forms of character amnesia include a "complete lack of access to the character's orthography or incorrect representations."[33] Tip-of-the-tongue (TOT) phenomenon, which is the oral counterpart of a TOP, happens when someone's mind goes blank and can't produce the word they intend and usually know how to say. "If you are unable to think of the word but feel sure that you know it and that it is on the verge of coming back to you then you are in a TOT state."[34] TOPs occur in a similar fashion when writing. In most cases, these fleetingly forgotten words are not technical, rare, or archaic but fairly common ones. This does not mean the person experiencing character amnesia has entirely forgotten the character, in fact, it's possible they could remember the character just moments later. Someone experiencing character amnesia could likely and without failure recognize the target character they are trying to think of if shown to them.[35] Therefore, the TOP state of character amnesia is a temporary shortcoming in one's recall or retrieval of a word not one's recognition of it. While TOTs can happen to anyone across various languages, TOPs in Chinese are fairly unique when compared to

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[32] Shuting Huang, "On the tip of the pen: Effects of character-level lexical variables and handwriter-level individual differences on orthographic retrieval difficulties in Chinese handwriting," *Quarterly Journal of Experimental Psychology, 74, no.* 9, (2021): 1497–1511, https://doi-org.offcampus.lib.washington.edu/10.1177/17470218211004385.

[33] Huang, "On the tip of the pen," 1498.

[34] Alan S. Brown, *The Tip of the Tongue State*, Florence: Taylor & Francis Group, 2012, https://doi.org/10.4324/9780203582961.

[35] Huang, "On the tip of the pen," 1498.

languages with more transparent orthographies (i.e., a high degree of sound-spelling correspondence). Chinese, on the other hand, has a less transparent orthography (i.e., a low degree of sound-spelling correspondence).[36] This low orthographic transparency plays a salient role in why learners of Chinese are susceptible to character amnesia.[37]

How Does Character Amnesia Occur?

What does a low-transparency orthography look like? Not all Chinese characters are the same in regard to their composition. Xǔ Shèn 许慎 (58 CE – 148 CE), the compiler of the *Shuōwén jiězì* 说文解字 — the earliest dictionary and systematic analysis of the Chinese script from the Han dynasty (206 BCE - 220 CE) — divided characters into two main categories, *wén* 文 and *zì* 字, and a further six sub-categories. Out of those six, there are four types of characters, two from wén (*zhǐshì* 指示 and *xiàngxíng* 象形) and two from zì, (*xíngshēng* 形声 and *huìyì* 会意).[38] In their basic form of categorization, zhǐshì and xiàngxíng characters are mostly pictographic and attempt to visually represent the thing or concept ascribed to them while having no particular phonetic clues for pronunciation. Examples for zhǐshì and xiàngxíng characters are 'above' shàng 上, 'fire' huó 火, and 'mountain' shān 山. Xíngshēng and huìyì make up the large majority of characters. Xíngshēng characters have some combination of a semantic and phonetic component embedded within them, while huìyì are characters made up of two semantic graphs "whose meanings taken together suggest another word."[39]

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[36] Huang, "On the tip of the pen," 1498.

[37] Xu, "Character Amnesia."

[38] Norman, *Chinese*, 68.

[39] Norman, *Chinese*, 68.

Pronunciation of characters, which with a history of over 2,000 years has seen dramatic evolution, is generally included in the character by the addition of a well-known component with a similar pronunciation. For example, the character 青 qīng, meaning green or blue, is used to reflect pronunciation in the semantic-phonetic compound characters 请 *qǐng* (request, ask, invite), 清 *qīng* (clear, pure, distinct, Qing dynasty), 情 *qíng* (feeling, emotion), and 精 *jīng* (essence, vitality, sperm). Characters are made up of components,[40] which can hold semantic or phonetic value in semantic-phonetic compound characters. Most of the wén characters' pronunciation aren't obvious and require rote memorization[41] over a long period of time.[42] As mentioned above, the low-transparency nature of Chinese characters doesn't produce a strong correspondence between phonology and orthography.

> Thus, it is possible, for instance, that a Chinese speaker have full access to a character's phonology but only partial or no access to its orthography, resulting in a TOP state that does not reflect a TOT state. For example, a Chinese speaker may be able to name a pepper in speaking (*la4jiao1*) but not able to handwrite the character corresponding to the first syllable of the spoken name (i.e., 辣), though he or she has a strong feeling of knowing it and may be able to retrieve some of its orthographic components. In this case, we say that the speaker has a TOP state for the character 辣.[43]

Pīnyīn, then, provides an alternative system to ascertain a character's phonology, but learners must still eventually memorize the correspondence between the pīnyīn and a

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[40] These components are sometimes referred to as radicals.

[41] W. T. Siok, & P. Fletcher, "The Role of Phonological Awareness and Visual-Orthographic Skills in Chinese Reading Acquisition," *Developmental Psychology, 37, no.* 6, (2001): 887, https://doi-org.offcampus.lib.washington.edu/10.1037/0012-1649.37.6.886

[42] Hui Li, Nirmala Rao and Shek Kam Tse, "Adapting Western Pedagogies for Chinese Literacy Instruction: Case Studies of Hong Kong, Shenzhen, and Singapore Preschools," *Early Education and Development,* 23, no. 4, (2012): 615, https://www.tandfonline.com/doi/abs/10.1080/10409289.2010.536441.

[43] Huang, "On the tip of the pen," 1498.

character's orthographic composition. Establishing the link between orthography, phonology, and meaning is critical to building and maintaining literacy.[44] Typing pīnyīn involves the use of alphabetic letters which doesn't include writing any of the core components of characters and has been found to negatively impact one's character-reading ability.[45] One's ability to recall any orthographic composition of the character is also negatively impacted. Thus, Huang strongly believes that when someone decreases their frequency of handwriting and increases their frequency of keyboarding (in lieu of handwriting), susceptibility to character amnesia is more likely.[46]

Exactly when character amnesia began affecting speakers of Chinese is an interesting question. Is it only a recent phenomenon brought on by the phoneticization and later digitization of characters impacting people's behavior and subsequently their ability to produce orthographic data from memory or is it a phenomenon as old as Chinese culture itself, inherent to the script and stifling learners throughout the millennia? Ichisada Miyazaki estimates that young boys between the ages of 8 and 15 during the Qing dynasty (1644-1911 CE) had to memorize the *Lunyu* 论语, *Mengzi* 孟子, *Yijing* 易经, *Shujing* 书经, *Shijing* 诗经, *Liji* 礼记, and the *Zuozhuan* 左传 — a corpus totaling over 400,000 Chinese characters that were required to be memorized (equal to 6 years of memorizing passages of text made up of approximately 200 characters per day). Memorizing this vast amount of text was for preparation purposes in taking the civil service examinations, a required exam to be passed by any candidate prior to

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[44] Tan et al., "China's Language Input System," 1119.

[45] Ibid., 1120.

[46] Huang, "On the tip of the pen," 1500.

applying to a government position during much of China's dynastic ages. The exam taxed many young men to their mental and physical limits and was ultimately discontinued at the end of the 19th century in part for its draconian requirements upon exhausted young scholars.[47] Research on historical versions of character amnesia would be a fascinating study and help give linguists and historians an ability to compare this most recent version of tíbǐwàngzì with previous ones. This paper will solely and briefly deal with the scope of tíbǐwàngzì as a modern phenomenon from the turn of the 21st century to the present.

One of the earliest written mentions of the actual four-character phrase, "tíbǐwàngzì," came in a 1957 article by Chinese author Yán Wénjǐng 严文井 (1915 - 2005), who penned several children's books and was once the Deputy Director of the CCP's Arts Department. In the article entitled, "Yīgè wàiháng de yìjiàn"《一个外行的意见》[An Amateur's Opinion], Yan writes about the need for language reform, citing the problem as the exorbitant amount of characters one has to remember. Despite his career as an author frequently writing essays and stories, he states he often experiences tíbǐwàngzì when putting his pen to paper.[48] In terms of the modern technological influence on tíbǐwàngzì, most agree the earliest mention came in an article by Jennifer 8. Lee published in 2000 entitled, "In China, Computer Use Erodes Traditional Handwriting, Stirring a Cultural Debate." In the article, Lee introduces the concept of character amnesia, albeit by a different name and makes a key statement pinpointing

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[47] Ichisada Miyazaki, *China's Examination Hell: the Civil Service Examinations of Imperial China,* New Haven: Yale University Press, 1981, 24.

[48] Wenjing Yan, "Yīgè wàiháng de yìjiàn"《一个外行的意见》[An Amateur Opinion], *Yǔwén Jiànshè*, no. 8 (1957): 10–11.

pīnyīn input's main negative influence upon handwriting when she elucidates that, "Chinese typing requires users only to recognize characters and not construct them from scratch."[49] Victor Mair, an American Sinologist and professor at the University of Pennsylvania, has been interested in character amnesia for years and has made it the subject of a blog to which he often contributes, *Language Log,* several times.[50] According to Mair himself, he has been discussing tíbǐwàngzì since the early nineties, and as stated earlier in this paper, Mair is credited with coining the English phrase, "character amnesia." Mair's interaction with the topic and the examples he shares of his experience of tíbǐwàngzì are merely anecdotal. For example, he once posted a picture of a grocery list belonging to a man in China who, upon forgetting the characters for some of the items on his grocery list, replaced the characters with pīnyīn, creating an authentic example of digraphia. In contrast to Mair's academic amusement with the topic, Guy Almog, a Ph.D. graduate from the University of Haifa in Israel, wrote his dissertation (of which the first two chapters were published into two different articles by Cambridge University Press) on the scholarly and journalistic discourse concerning character amnesia. He also ran many empirical surveys himself in Hong Kong and mainland China to witness firsthand the phenomenon of tíbǐwàngzì. According to Almog, a common thread throughout almost every discussion on character amnesia is the threat it poses to Chinese culture, which is one of the reasons why some find it such a significant topic.

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[49] Lee, "In China, Computer Use Erodes Traditional Handwriting."

[50] Victor Mair, "Character Amnesia," *Language Log,* July 22, 2010, https://languagelog.ldc.upenn.edu/nll/?p=2473.

This study is building on previous studies that have looked into the different possible reasons causing character amnesia. In English language scholarship, there have been three recent empirical studies, Wang et al., 2019 with their study, "Chinese Character Handwriting: A Large-scale Behavioral Study and Database," Huang et al., 2021a, with their study, "Character Amnesia in Chinese Handwriting: a Mega-study Analysis," and Huang et al., 2021b with their study, "On the Tip of the Pen: Effects of Character-level Lexical Variables and Handwriter-level Individual Differences on Orthographic Retrieval Difficulties in Chinese Handwriting." These studies were all done by one or more of the same researchers, and each one investigates character amnesia on the lexical level. For example, one study looks at variables such as character composition, imaginability, phonogram, sound-radical-order, spelling regularity, number of strokes, number of radicals, homophone density, age of acquisition, character frequency, meanings, concreteness, and familiarity.[51] The study, "Character Amnesia in Chinese Handwriting: a Mega-study Analysis," found that "university students suffer from character amnesia on average 5.6% of the time when asked to write down a character."[52] They also found a character amnesia rate of 42 percent in a selection of 1,600 common characters used in their survey. They note at the end of their study that it was a first-of-its-kind mega analysis and that further research is needed, particularly when it comes to the demographic and sociolinguistic factors of the participants. Several journalistic surveys have also been conducted over the years, particularly in the peak years of interest (2010 - 2013). For example, the *Chongching*

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[51] For definitions and criteria of terms, see Huang et al., "Character Amnesia in Chinese Handwriting: a Mega-Study Analysis." *Language Sciences (Oxford)* 85 (2021): 1-9, Table 1. doi:10.1016/j.langsci.2021.101383.

[52] Huang et al., "Character Amnesia," 4.

Ribao conducted a survey in 2013 and showed that less than 5 people out of the 50 participants (between the ages of 20-40) were able to correctly write all the target characters in the survey. Guy Almog criticizes this survey by saying the surveyor, Lán Shìqiū 兰世秋, selected uncommon characters for this survey. Thus it's likely the uncommon characters that explain the "character amnesia rate" among the participants, which renders these results with a validity problem.[53] Also in 2013, China Youth Daily conducted a survey where they found that 98.8 percent of the participants (N=2,517) reported experiencing character amnesia on some level. The participants were grouped by age corresponding to the decade in which they were born (e.g., 48.5 percent born in the 1980s). Again, Almog criticizes the methodology here, specifically that this test isn't repeatable since the information about the participants is so vague.

Nearly all previous academic studies analyzing character amnesia have been conducted in China with university students, and besides their age and gender, not much else is made conspicuous about the participants. Additionally, many of the independent variables of other studies deal with lexical variables (stroke order, age of acquisition, homophone density, character composition, character frequency, etc…) Only a few look at background or demographic information about the participants.

Preliminary Study Discussion of Significant Variables

Thus, fueled by curiosity about causal relationships between behaviors (digital use vs. handwriting) and demographics (education background, age, gender, native dialect, length of residency in the US, etc…) this study aims to investigate character amnesia as expressed in a variety of native Chinese speakers when tested on their ability

[53] Guy Almog, "Reassessing the Evidence of 'Character Amnesia'," *The China Quarterly, 238, (2019): 526-527, doi:10.1017/S0305741018001418*

to produce a random assortment of common characters during a voluntary dictation quiz. Primary research was conducted through survey with native Chinese participants all living within the Pacific Northwestern United States. This investigation aimed to gather numerous amounts more background information about the participants than previous studies, such as reading habits, native dialect spoken at home, and frequency of handwriting versus keyboarding on a device so as to quantify any significant effects of these variables on their rate of character amnesia. Age was a particularly important factor to be included in order to test the following hypothesis: high frequency digital input and low frequency handwriting will increase the amount of character amnesia in L1 native Chinese speakers. In other words, could it be that those who engage with digital devices less often (generally older people)[54] show a similar degree of character amnesia with those whose digital engagement is nearly constant (generally younger people)? With this hypothesis in mind, recruiting older participants to join the study was critical. Because the participants of this study were L1 Chinese speakers living in Oregon and Washington, length of residency in the United States (LOR) was also an important variable to observe in their test results.

Age

Research has shown that TOTs increase with age (Brown 1991).[55] It has also been suggested that "age-related atrophy in neural regions important for phonological

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[54] Michelle Faverio, "Share of those 65 and older who are tech users has grown in the past decade," *Pew Research Center,* January 13, 2022, https://pewrsr.ch/3HZd2ao.

[55] Alan S. Brown, "A Review of the Tip-of-the-Tongue Experience," *Psychological Bulletin*, 109, no. 2, (1991): 204-223.

production may contribute to age-related word production failures."[56] Likewise, retrieval of orthographic information has been shown to exhibit age-linked declines. In MacKay and Abrams (1998), participants divided into three different age groups ("young" 17-23, "older" 60-71, and "very old adults" 73-88) were asked to write down irregularly-spelled English words in a dictation test. The words were spoken in a slow and clear manner and repeated several times. The participants were tasked to correctly spell the target word on a sheet of paper at their own pace. "Despite having more education and higher vocabulary scores, the oldest adults correctly spelled high-frequency words less often than did the young adults."[57] On one hand, the current study anticipated to observe a similar outcome assuming the older participants would show a greater degree (a higher rate) of character amnesia even with higher frequency words. On the other hand, contrary to this basic assumption, it was hypothesized that the high-frequency keyboarding engaged in by younger participants might decrease the delta between the respective younger and older participants' character amnesia rates. Age and keyboarding frequency were strongly correlated, and the relationship was statistically significant, $r(82) = -.704$, $p = < .001$. Further results of this hypothesis can be found below in the results section.

Gender

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[56] Meredith A. Shafto, Deborah M. Burke, Emmanuel A. Stamatakis, Phyllis P. Tam, Lorraine K. Tyler, "On the Tip-of-the-Tongue: Neural Correlates of Increased Word-finding Failures in Normal Aging," *Journal of Cognitive Neuroscience,* 19, no.12 (2007): 2060, https://doi-org.offcampus.lib.washington.edu/10.1162/jocn.2007.19.12.2060.

[57] Donald G. MacKay, Lise Abrams, and Manissa J. Pedroza, "Aging on the Input Versus Output Side: Theoretical Implications of Age-Linked Asymmetries Between Detecting Versus Retrieving Orthographic Information," Psychology and Aging, 14, No. 1 (1999): 4.

Observation and study of differences in academic achievement between males and females has been extensively researched, and the under-achievement of young males, relative to their female counterparts, in the area of literacy is a prevailing phenomenon.[58] In their study, Gambell and Hunter (1999) elucidated that gender is a prominent predictor in literacy rates in Canada. "Literary assessments in Canada and other parts of the world reveal differential patterns in males' and females' achievement in reading and writing. Females outperform males in all areas of reading and writing at the elementary, middle, and secondary levels, and this literacy gap does not narrow or close with age."[59] Gender, while recorded and coded for this study, was not a main focus in this research nor was it an anticipated significant predictor, but in the end, it resulted in one of the four variables showing strong significance in predicting character amnesia. In China (and likely all countries around the globe), gender as a variable in literacy studies shouldn't be studied in a vacuum, as other influences beyond gender likely play a role in significant results such as this study shows. For example, Lee (2011) found that the 1979 one-child policy had an inadvertent affect on educational gender equality in China, showing that single children, whether boy or girl, have greater improved opportunities for education than their counterparts who have siblings.[60] In other words, if the results from a data set reveal one gender over the other as having a higher significance in statistical testing, more probing is required in order to find out what is

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[58] Susan Rvachew, Dahlia Thompson & Rajib Dey, "Can technology help close the gender gap in literacy achievement? Evidence from boys and girls sharing eBooks," *International Journal of Speech-Language Pathology*, 22, no. 3 (2020): 290-301, DOI: 10.1080/17549507.2019.1692905

[59] Trevor J. Gambell and Darryl M. Hunter, "Rethinking Gender Differences in Literacy," *Canadian Journal of Education / Revue Canadienne de l'éducation* 24, no. 1 (1999): 1. https://doi.org/10.2307/1585767.

[60] Ming-Hsuan Lee, "The One-Child Policy and Gender Equality in Education in China: Evidence from Household Data," *Journal of Family Economic Issues* 33 (2012): 41–52, https://doi.org/10.1007/s10834-011-9277-9

contributing to that significant result. The current study did not account for gender at any further detailed level.

Length of Residency in the US

Length of residency outside of an L1 speaker's native context has been shown to result in some amount of attrition of their mother tongue over time.[61] The predictors for such attrition will be multi-pronged and display differing degrees from one L1 speaker to the next.[62] Miller and Rothman (2019) performed a study on 30 L1 Spanish - L2 English speakers living in the United Kingdom. Among their findings, they concluded that:

> While length of residence and age of arrival may affect the depth of attrition, how often one is exposed to her native language, how often she uses it and for how long each day, who her friends are, and to which types of input she is regularly exposed, seemingly aid in the maintenance or loss of linguistic knowledge.[63]

The current study also showed length of residence as a predictor for character amnesia supporting Miller and Rothman's conclusions. Dr. Monika Schmid also speaks to the complexities of the attrition process and that looking at groups proves difficult in making findings for emigrants in general.

> The assumption would then be that a migrant who has a strong motivation to integrate into the host society will experience more attrition than someone who is comfortable with remaining a foreigner and somewhat of an outsider – all other things being equal. All other things, however, are seldom equal: Both in language acquisition and in

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[61] David Miller & Jason Rothman, "You win some, you lose some: Comprehension and event-related potential evidence for L1 attrition," *Bilingualism: Language and Cognition, 23, no.* 4 (2020): 869-883. doi:10.1017/S1366728919000737

[62] Ibid., 869-883.

[63] Ibid., 869.

language attrition, attitudes can interact with other factors in ways which are complex and difficult to predict.[64]

In regard to character amnesia, because a large-scale academic study has yet to empirically test participants living outside China, there is currently no literature (except for the current study) on length of residency in a foreign country and its effect on character amnesia. Additionally, no studies have ever classified character amnesia as a type of attrition, which would make it a claim that requires further investigation.

Input Method Editor (IME) Choice

Chen et al., 2020 found that instant messaging (IM) activity of Chinese teenagers directly predicts the performance of handwriting characters negatively. However, the same study found that IM activity "indirectly predicts handwriting performance positively" when pīnyīn input is used as the IME .[65] This suggests that while the overall use of IM activity negatively impacts handwriting characters, proficiency in the pīnyīn IME "compensates the negative effects of IM on handwriting."[66] While Qian and Feng (2004) and Zhu et al., (2009) showed in their studies that pīnyīn input had a positive effect on both orthographic and phonologic processes, Zhang and Li (2010) showed that prolonged usage of certain input methods may affect the structure of users' mental lexicon. People who often or exclusively use wǔbǐ input method showed stronger links between the orthography and meaning of words, and people accustomed to pīnyīn input

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[64] Monika S. Schmid, "Defining Language Attrition," *Babylonia* 2, no. 08 (2008): 12, https://www.researchgate.net/publication/282851959_Defining_language_attrition

[65] Jingjun Chen, Yuan Xia, Liyan Wan, Rong Luo, "The Effect of Instant Message on Chinese Character Handwriting Among Teens: Pinyin Input Experience as a Compensating Role," *Asia-Pacific Education Researcher*, 30, no.2 (2021): 177, https://link.springer.com/article/10.1007/s40299-020-00524-y.

[66] Ibid., 177.

method showed stronger links between the phonology and meaning of words.[67] This could explain why users engaged in high-frequency keyboarding using pīnyīn may be more susceptible to forgetting orthographic information of characters compared to their wǔbǐ-using counterparts. The current study revealed IME choice being a slight predictor for character amnesia, which would be supported by Chen et al. (2020) and Zhang and Li (2010). Results can be found below.

Handwriting Frequency vs. Keyboarding Frequency

Research into the differences between handwriting and keyboarding has become an important field of study especially since computers and devices have encompassed so many areas of people's daily lives over the past 30 years. One study looking into the differences (Sülzenbrück et al., 2011) measured fine motor skills between two groups, one group consisted of participants who self-identified as spending a majority of hours per week typing on a keyboard and the other group consisted of participants who self-identified as spending a majority of hours per week handwriting. "Individuals who primarily used keyboards and computers to produce written texts exhibited slower performance in a task measuring the precision of continuous arm-hand movements than people who regularly practiced the skill of handwriting" suggesting that frequent use of technology, especially cognitive tools like a computer, "may lead to fundamental changes in basic psychomotor and cognitive skills."[68] In another study by the same researchers performed in 2010, they assumed frequent computer use as being

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[67] Jijia Zhang and Mao Li, "The effects of Chinese input methods on the links among the orthography, phonology and meaning of Chinese characters (in Chinese)." *Psychological Science,* 33, no. 4 (2010): 835–838, http://www.cnki.net/kcms/doi/10.16719/j.cnki.1671-6981.2010.04.062.html.

[68] Sandra Sülzenbrück, Mathias Hegele, Gerhard Rinkenauer, and Herbert Heuer, "The Death of Handwriting: Secondary Effects of Frequent Computer Use on Basic Motor Skills," *Journal of Motor Behavior*, 43, no. 3 (2011): 250, https://doi-org.offcampus.lib.washington.edu/10.1080/00222895.2011.571727.

associated with a decreased use of handwriting in everyday life, and unexpectedly found that older participants (self-identified non-computer users) performed significantly faster than their younger counterparts (self-identified computer users) in a line tracing test evaluating fine motor skills.[69] The current study asked participants to indicate how often they type and handwrite using a Likert scale response form. Contrary to assumptions, hypotheses, and other studies, neither typing nor handwriting showed to be significant when regressed against the character amnesia rate of the participants in this study. More will be considered in the results and discussion sections.

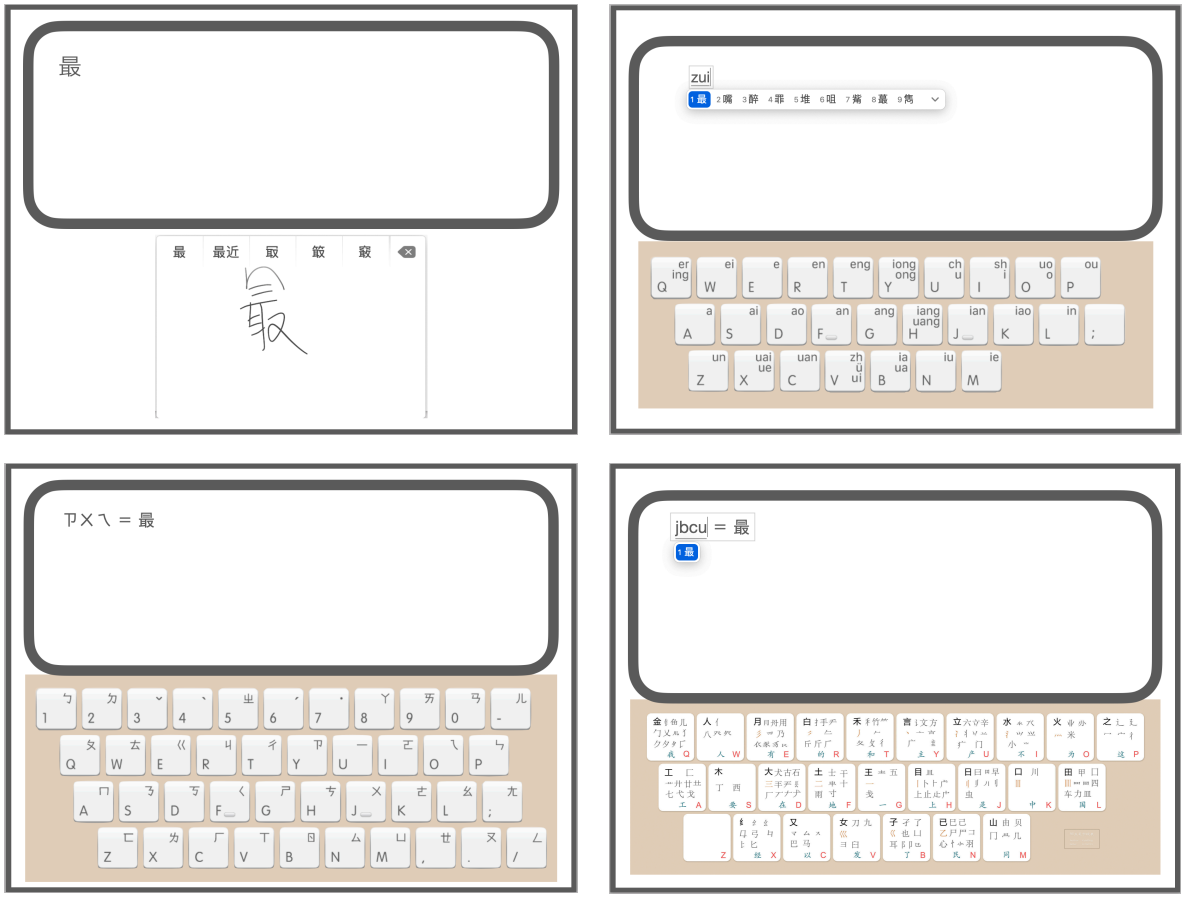
Method

Participants:

Using voluntary response sampling, participants from Seattle, Washington and Portland, Oregon were recruited through various means of online and offline channels including posted fliers around university campuses, WeChat, Instagram, email, and word of mouth. The main inclusion criteria were minimum age (participants needed to be at least 18 years old) and mother tongue (participants needed to be native speakers of Chinese and understand spoken Mandarin). The age range for qualified participants (N=84) spanned between 18 - 90 years old. The gender breakdown among participants were as follows: female, N=57; male, N=27; and other, N=0. Among the group, native dialects (see Table 1) were reported as follows: 1 percent Wú (吴语), 1 percent Hakka (客家), 70 percent Mandarin (普通话), 2 percent Xiāng (湘语), 11 percent Yuè/Cantonese (粤语), 1 percent Gàn (赣语), and 7 percent Mǐn (闽语). For highest level of education, 5

[69] Sandra Sülzenbrück, Mathias Hegele, Gerhard Rinkenauer, and Herbert Heuer, "Generalized slowing is not that general in older adults: Evidence from a tracing task," *Occupational Ergonomics* , 9, no. 2 (2010): 111 -117.

Figure 2: Examples of different Chinese IME for producing the character ‘zuì’ 最. Upper left: handwriting (手写); upper right: pīnyīn (拼音); lower right: wǔbǐ (五笔); lower left: zhùyīn (注音)



percent reported middle school, 6 percent reported high school, 56 percent reported undergraduate studies, 24 percent reported graduate studies with a master’s degree, 10 percent reported graduate studies with a doctoral degree. For length of residency in the United States (LOR), 32 percent reported 2 years or less, 17 percent reported 2 - 5 years, 19 percent reported 5 - 10 years, 10 percent reported 10 - 15 years, 4 percent reported 15 - 20 years, and 19 percent reported having lived in the United States over 20 years. 85 percent reported using simplified characters in their daily life, the remaining 15 percent indicated traditional characters. As for IME choice, 77 percent recorded using pīnyīn input, 5 percent reported *zhùyīn* 注音, 15 percent reported the handwriting function

Table 1: Percentage of Native Dialects Among Participants

Native dialect	Percentage (N=84)
Wú (吴语)	7%
Hakka (客家)	1%
Mandarin (普通话),	70%
Xiāng (湘语)	2%
Yuè/Cantonese (粤语)	11%
Gàn (赣语)	1%
Mǐn (闽语)	7%

shǒuxiě 手写 (see Figure 2 for examples). When reading, 69 percent recorded reading in Chinese 50 percent of the time or greater. With regard to familiarity in pīnyīn, 12 percent said they are not familiar, 12 percent said they are somewhat familiar, while 74 percent said they are very familiar. 94 percent stated they had experienced character amnesia at some point. As for how often character amnesia occurs, 5 percent reported it constantly happening, 20 percent reported it occurring often, 49 percent reported it sometimes happening, 19 percent felt it seldom occurred, while 1 percent stated that it never happens to them.

Materials:

The character list selected for this experiment was compiled from two main sources. The first is a frequency list created by Professor Jun Da of Middle Tennessee State University.[70] The list draws from a corpus comprised of literature, television series, and more. An initial group of 1,500 characters (characters #2,000 - #3,500) were selected

[70] Jun Da, "Modern Chinese character frequency," Jun Da's WebCentral, last modified December 21, 2005, http://lingua.mtsu.edu/chinese-computing/statistics/char/list.php?Which=MO.

out of 9,933. This range of characters was selected in anticipation that this group of characters would be neither too frequent nor too uncommon, for if the characters were too frequent, they would be less likely to be forgettable in any case. Likewise, if the characters were too uncommon, they may be forgettable but not necessarily for any reason to do with character amnesia. This list was then randomized and the first 200 characters were selected from the group of 1,500. The 200 characters were then compared with China's Ministry of Education's (MOE) "List of Common Standard Characters" 通用规范汉字表 tōngyòng guīfàn hànzìbiǎo (LCSC). The LCSC contains 8,105 characters divided into three lists. The first list has 3,500 common characters on it that the MOE would expect most literate, educated Chinese to be familiar with. The second list is made up of 3,000 less common characters that would be secondary in usage compared to characters from the first list. The third list is comprised of archaic words as well as technical words and specific terminology. Any of the 200 characters from Jun Da's list that were found on the LCSC's 2nd or 3rd list were discarded as the purpose of this experiment was to test people's ability to recall common words, and to avoid the same mistake that Lan Shiqiu's study made. The remaining characters were then randomized again and the top 106 characters were selected to make up the list for the survey (it was calculated that, including the survey questions, around 100 characters could be answered within an hour in a dictation test format). Designing the test to be completed within a reasonable timeframe was important when considering subjects' willingness to participate. With the characters selected, the next step was to choose common words within which the target characters appeared (e.g., 浸泡的浸, meaning "*jìn* as in *jìnpào* 'to soak'"). Based off these words, example sentences were then sourced

from the online Hanbook[71] and Pleco[72] dictionaries. Additionally, slides were created showing the example sentences with a blank space where the target character should be. Sentences were presented in both simplified and traditional characters and were projected on a screen providing syntactic context of the target characters for the participants. In addition to visual aid, a native of Tiānjīn 天津 was recorded speaking the example sentences and phrases containing the target characters in standard Mandarin pronunciation. These recordings were then played in tandem with the slides giving the participants audio and visual context of each target character. Before the character dictation test portion, participants via survey were asked to supply demographic information relating to their age, native dialect, education background, length of residence in the US, their habits in regard to time spent reading, writing, and keyboarding, and more. (Please refer to the appendix for the survey in its entirety.) The survey utilized Likert scale and open-ended type questions.

Procedure:

To test participants' ability to correctly write Chinese characters without the aid of technology or otherwise, a test was produced consisting of 106 characters for younger participants (18-40, N=54) and 24 characters for older participants (40-90, N=30). While the older participants' intrigue on the subject of character amnesia was equal, if not more so, than their younger counterparts, their stamina to sit for a long period in deep concentration was presumed to be less. For this reason, their test was designed with far fewer characters. This test was then administered in various locations in Seattle,

[71] "Hanbook Dictionary," Hanbook Language International HK Limited, https://www.hanbook.com/chinese-dictionary/.

[72] Pleco Chinese Dictionary for iOS, Version 3.2.71.

Washington and Portland, Oregon and on various dates during the period of late April and early May 2023. Due to scheduling and location constraints, this dictation test was conducted and repeated several times with the 84 various participants, each time reproducing the model as closely to the prior tests as possible. At the beginning of the test, participants were encouraged to relax, do their best, and to refrain from chatting and using their phone until after the exam. The participants were then given about 10 minutes to complete the questionnaire section of the survey. After everyone had completed the first section, the dictation portion began. During the dictation portion, the audio of the target character followed by its use in an example sentence was played while a slide projected the example sentence on a screen for visual aid. A time allotment of 20 seconds was provided for participants to think of the correct character, write it down, and then indicate their response from one of the four options: 1.) I know the character, and I believe that I wrote it correctly, 2.) I think I know this character but can't think how specifically to write it, 3.) I thought I knew this character, but as I go to write, I forget it, or 4.) I always have problems writing this character as I've never learned it well. It was clearly explained to participants that choice 3 was to be selected if they felt they were experiencing a moment of character amnesia, while choice 2 was to be selected if they weren't certain enough to select option 1, but couldn't say their uncertainty was due to character amnesia either. Options 1 and 4 were more straightforward. Participants were also discouraged to go back and change their answers after they had already written down a response and indicated one of the four options.

Variables:

The goal outcome for this study was to identify the most salient predictors for character amnesia, thus the participants' character amnesia rate was selected as the dependent variable. The character amnesia rate was calculated for each individual participant by first removing the results from any characters for which the participant recorded they didn't know, where they reported uncertainty but wrote the character correctly, or where they indicated confidence in accuracy but actually wrote the character incorrectly. After these were removed, two categories remained: self-reported confidence and correctly written and self-reported character amnesia with the addition of any incomplete characters or blank character boxes. The rate of character amnesia for each participant was then calculated by taking the sum of the correctly written characters and the amnesia characters and dividing the number of amnesia responses by the total. For example, if one participant's score was 55 correctly written characters with 14 character amnesia instances, their character amnesia rate would be 20% (55 + 14 = 69, 14/69 = 20) The character amnesia rate was then regressed against the independent variables. The independent variables chosen were: age, gender, education background, length of residence in the US, writing frequency, keyboarding frequency, reading frequency, familiarity with pīnyīn, and IME choice.

Results

Using IBM's SPSS software to analyze the data from the survey, the results from several variables were inputted and coded in order to observe the most significant for predicting character amnesia. An experimental design was addressed using hierarchical regression, ANOVA, and Pearson correlation to seek statistical significance. Please note

that the character amnesia rate includes cases where participants exhibited no access at all to a character's orthography in addition to cases where participants showed partial access. Out of the total participants, there was an average character amnesia rate of 29

Table 2. Results of regression on character amnesia rate

	β	***t***	***p***
(Intercept)		3.860	<.001
Age	-0.506	-2.586	0.012
Gender	-0.306	-3.021	0.003
Length of Residence	0.583	3.474	<.001
IME Choice	0.354	2.200	0.031
Education Background	-0.191	-1.596	0.115
Writing Frequency	-0.108	-0.950	0.345
Typing Frequency	0.085	0.534	0.595
Reading Frequency	-0.126	-1.140	0.258
Familiarity of pīnyīn	-0.035	-0.235	0.815
Character Type	-0.221	-1.549	0.126

percent. Table 2 presents the results of the hierarchical regression model (adjusted R^2= 0.225; $F(10,82) = 3.41$, p=.001) with all variables included. These results indicate that when looking at character amnesia with sociolinguistic factors, the most salient variables in predicting character amnesia are age, gender, length of residency, and IME choice. Frequency of writing and keyboarding, unexpectedly, did not yield any significant results.

Discussion:

The current study presents the results from one of the first methodical and empirical investigations into character amnesia in native Chinese speakers living outside China, with differing ages, education backgrounds, native dialects, habits around device use, and degrees of familiarity with IMEs. The results of the dictation test showed a median character amnesia rate of 26 percent among the participants and out of the 106 characters surveyed, only 2 had no cases of character amnesia associated with them (*xiù* 绣 and *jiǎn* 剪). However, all participants tested were susceptible to character amnesia (albeit to varying degrees). Furthermore, the study revealed that the most influential predictors of character amnesia are gender, age, length of residency, and IME choice. Education background and character type (simplified vs. traditional) showed only a slight significance in the model.

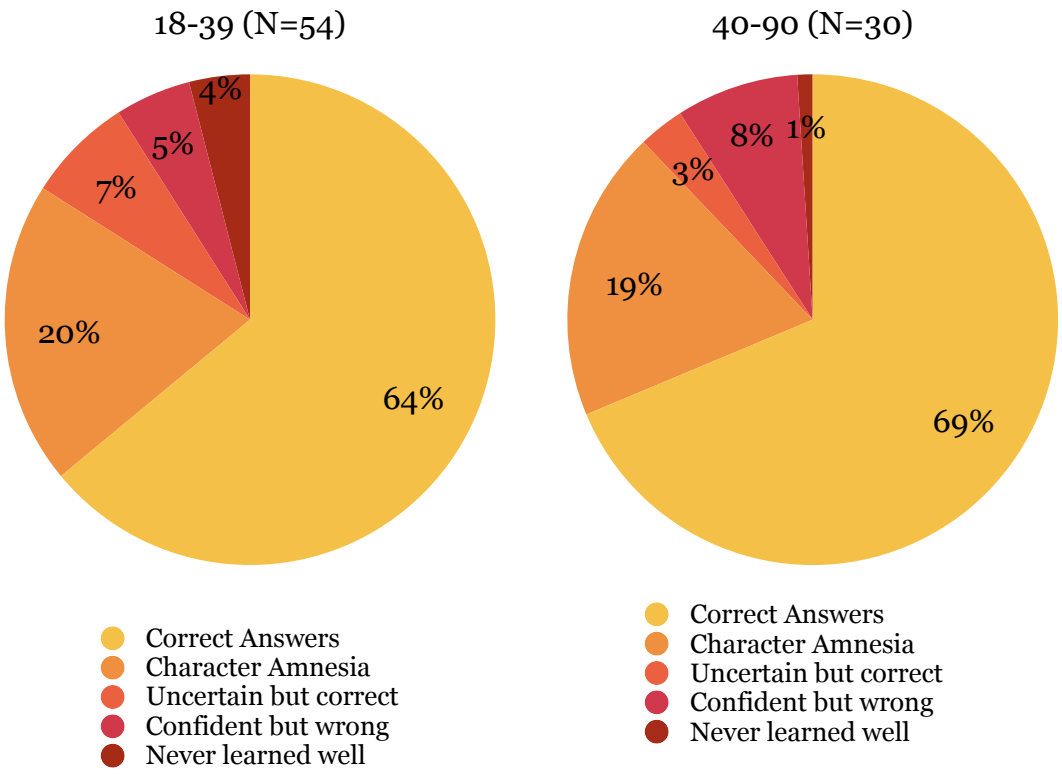
Effect of Age: As stated earlier in this paper, one hypothesis this study aimed to test was: despite the impact of a natural decline in the aging memory of the older participants, because they had spent a majority of their formative lives handwriting, and assuming they type on a keyboard infrequently in their day-to-day lives, the results might not show a strong correlation between age and character amnesia. When performing hierarchical regression, the coefficient *p=value* for age when grouped with gender, length of residence, education background, and IME choice was p=.012. However, when run in SPSS as the only independent variable with character amnesia rate as the dependent, the results for age were not significant (adjusted R^2= .003; $F(1,82) = .23$, p=.632). According to these results, the null hypothesis should be rejected which would mean that age *isn't* a significant predictor of character amnesia, opening

the door for the hypothesis that character amnesia isn't strongly correlated to age to have some validity. This can be further observed in the pie charts (Table 3) where the participants have been divided into two groups by age, a younger group (ages 18-39) and an older group (ages 40-90). The pie charts have nearly identical results, with the older participants scoring slightly higher in accuracy and slightly lower in character amnesia. Age alone, as a variable, is perhaps not enough to make any sweeping claims about character amnesia, which is likely why the regression results appear the way they do, but these results confirm that age should be an independent variable further investigated combined with other sociolinguistic variables like rural vs. urban residency, education level, and behaviors associated with computer use and handwriting. Huang et al. 2021a and Wang et al. 2020 both admitted that the homogeneity of age in their studies was a drawback. This study has made a small contribution to the study of character amnesia by expanding the range of ages surveyed.

Effect of Gender: As reviewed earlier, the literature has shown over and over that females outperform their male counterparts in reading, writing, speaking, and overall cognitive linguistic ability particularly in early development.[73] The average character amnesia rate among the female participants was 25 percent while the average among the males was 37 percent. Studies on the gender gap in adolescent academic achievement abound, and while character amnesia is a part of literacy — which has been extensively studied — it is a unique phenomenon that will require deeper exploration, particularly how gender influences and is influenced by the other demographic variables among the

[73] Torberg Falch and Linn Renée Naper, "Educational evaluation schemes and gender gaps in student achievement," *Economics of Education Review,* 36, (2013): 12-25, https://doi.org/10.1016/j.econedurev.2013.05.002.

Table 3. Pie Charts showing character amnesia rate between two age groups 18-39 and 40-90



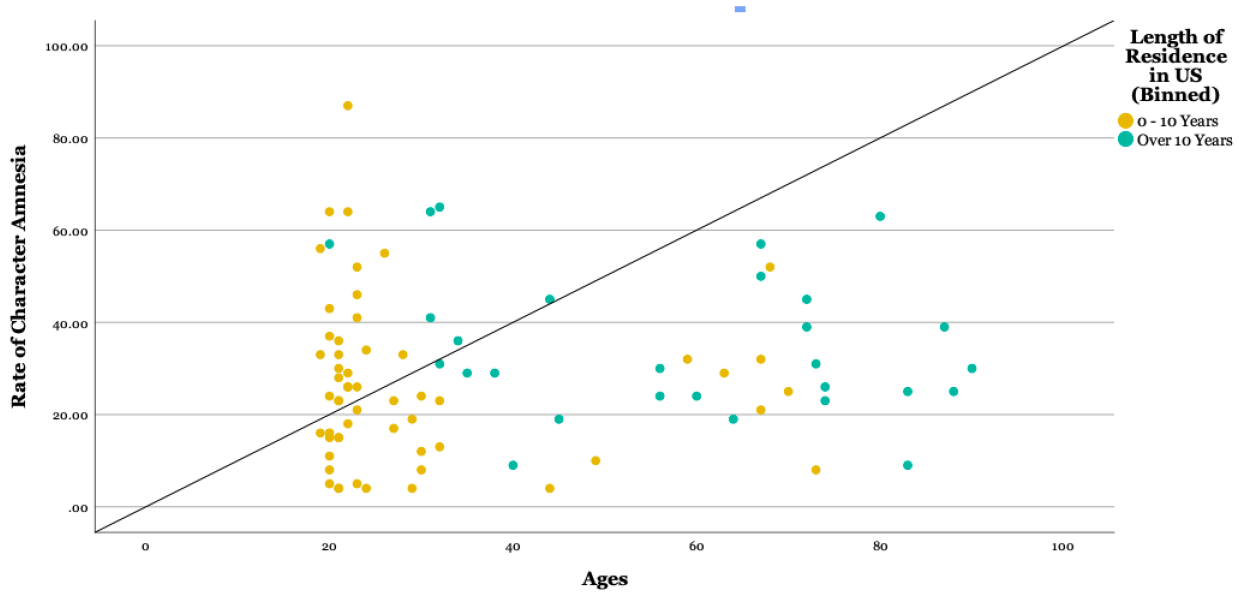
participants such as Lee's study (2011) which shows the relationship between gender, education, and policy having a combined effect on a distinctive outcome.[74]

Effect of Length of Residence (LOR): LOR was observed to be the most important predictor in the model for character amnesia, $p = <.001$. It's an interesting variable to investigate in regard to character amnesia because the literature on it is basically zero. In fact, this paper may be one of the first to report on the connection to character amnesia and length of residency. Compared to the other studies on character amnesia, the LOR variable is unique due to previous surveys being conducted solely in China. The question that arises now for L1 Chinese living in the United States or some other L2 environment is can character amnesia be considered a type of native language attrition

[74] Lee, "The One-Child Policy and Gender," 41–52.

similarly observed in other contexts involving L1 speakers whose corresponding written script is alphabetic? During the testing phase, one phrase heard over and over again from participants as they couldn't help but release some nervous laughter intermingled with a scoff was, "Oh gosh…It's been so long…[since I've written this character]." This utterance mostly came out of the mouths of younger participants who had only been in

Table 4: Scatterplot showing participants' character amnesia rate, age, and LOR



the United States 5 years or less. L1 attrition, however, isn't simply low-frequency use of one's native language. Rather, for it to be considered attrition, there must be an actual deficit in "aspects of performance such as speed and accuracy of production and comprehension."[75] One could argue then that character amnesia, even in China, is a kind of L1 attrition, but in this case the L2 landscape is the QWERTY keyboard. Under the concept of L1 attrition, a significant result for LOR as a predictor for character

[75] F. Gallo, Bermudez-Margaretto B, Shtyrov Y, Abutalebi J, Kreiner H, Chitaya T, Petrova A and Myachykov A, "First Language Attrition: What It Is, What It Isn't, and What It Can Be," *Frontiers in Human Neuroscience,* 15 (2021): 2, https://doi.org/10.3389/fnhum.2021.686388.

amnesia makes practical sense. Gallo et al. (2021) offers a clear definition for attrition that could be used to frame character amnesia in the attrition context. The study first quotes Köpke and Schmid (2004) saying, language attrition is "the non-pathological decrease in a language that had previously been acquired by an individual." They go on to say:

> Attrition would hence reflect a situation whereby a speaker is losing proficiency in a language he or she previously mastered, not due to any brain degeneration or an age-related cognitive impairment but as a result of "a change in linguistic behavior due to a severance of the contact with the community in which the language is spoken" (Schmid, 2008, p.10)[76]

As further research into character amnesia continues, studying Chinese L1 speakers living outside China and character amnesia as a kind of language attrition would bring value to the comprehensive study of character amnesia by adding the extra variable of living outside one's native context and measuring its overall influence on character amnesia in comparison to those living within China. In China, character amnesia is likely the cause of a change in linguistic behavior, not due to a severance from the language community, but a change from historic orthographic practices (handwriting to digital) that seem to impact Chinese differently than its alphabetic counterparts. Another limitation comes with the LOR variable. As Schmid (2008) and Miller and Rothman (2019) explain, there is an immense amount of complexity and variability with L1 subjects and L1 attrition when living outside of their home country. In regard to LOR, this study did not ask any further questions beyond simply the length of time they had

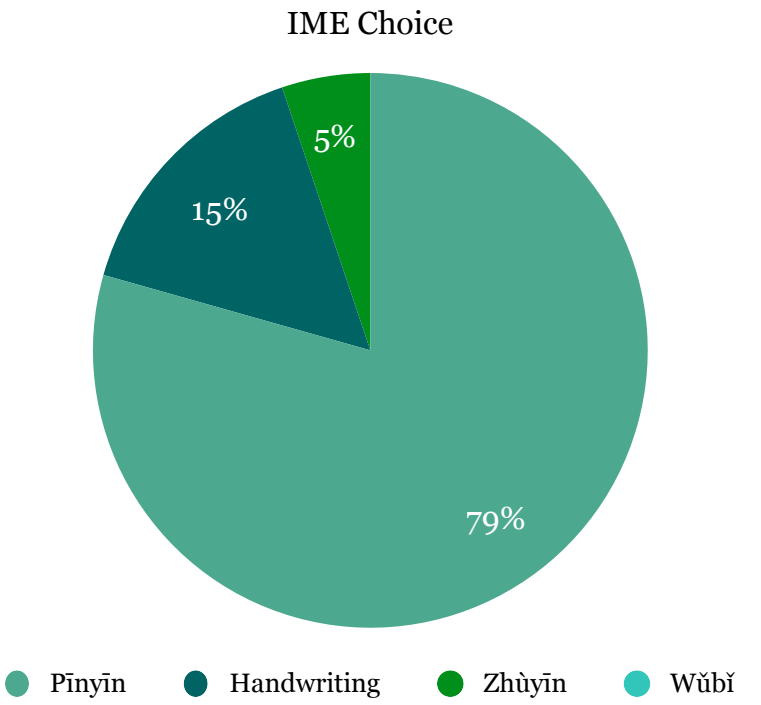
[76] Gallo, "First Language Attrition," 3.

been living in the US and habits around reading and writing in Chinese. There were no additional questions relating to lifestyle or the participant's everyday language community (i.e. on average, how much L2 English do you speak everyday and with whom?). Without additional questions such as these, the data could show a participant in their 60s having lived in the United States for 30 years but who lives within a tight-knit Chinese community which doesn't require the participant to use much English on any given day. Thus, hypothetically, this participant's reality and their LOR Likert score could be at odds. They may also be very different from a 19 year old who has only been in the United States for 8 months, but who is studying at a university and immersed in an English world 18 or more waking hours each day. Future character amnesia studies that are conducted outside China should take into account the multilayered nature of LOR.

Effect of IME Choice: When one uses their device to type Chinese, there are a menu of different character input options from which to choose, from phonetic-based to stroke-based and more. In the survey, there were four main systems from which to choose: pīnyīn, handwriting, zhùyīn, or wǔbǐ. The *p value* for IME choice as a predictor was p=.031. This again makes some practical sense as it has been shown that the majority of Chinese phone users choose pīnyīn when they type. This was the case in this current study as 79 percent of users indicated pīnyīn as their method of choice for digital input method. What this result could possibly indicate is the users who choose pīnyīn as their IME are more susceptible to character amnesia. Based on these results alone, that claim could not be asserted conclusively. Another study could firm up this claim by

doing more specific tasks related to pīnyīn, handwriting, zhùyīn, wǔbǐ (and the host of

Table 5: IME preference among participants



other IMEs) and regressing the results of those tasks against character amnesia rates.

Effect of Handwriting vs. Keyboarding Frequency: To find that neither writing nor keyboarding frequency showed any significance as a predicting variable for character amnesia was a bit surprising. These results were not expected, especially because common sense would lead one to assume there would be a significant relationship between low-frequency use and lack of recall (i.e. use it or lose it), but also due to the fact that there is a variety of other published studies that demonstrate a significant relationship between handwriting and lexical recall. For example, a study conducted in 2018 and published recently found that elderly Chinese with mild cognitive impairment improved their emotional stability, concentration, hand movement, memory and speech, and overall psychological cognition when practicing

Chinese calligraphy.[77] In Mangen et al., (2015) researchers studied the impact of writing modality (handwriting vs. keyboarding) on word recall and recognition. The results showed participants had significantly better free recall of words written in the handwriting condition compared to keyboard writing conditions. "There was no effect of writing modality in the recognition condition. This indicates that, with respect to aspects of word recall, there may be certain cognitive benefits to handwriting which may not be fully retained in keyboard writing."[78] To echo Huang et al., 2021b, keyboarding (in lieu of handwriting) doesn't seem to affect recognition but mostly recall.[79] Mangen et al. (2015) cites Longcamp et al. (2008), stating that fMRI research indicates that the "sensorimotor movements entailed in writing by hand may contribute to the subsequent memorization of the shape and/or orientation of characters," which suggests the recognition of characters would take longer to erode if built on a strong foundation of handwriting many build during the formative scholastic years.[80] Since other studies show such positive correlation between handwriting, keyboarding, and cognitive linguistic functions such as recall, and in the present case 'character amnesia,' the current study's non-significant results are perplexing. Subsequent studies are needed to research handwriting and keyboarding behavior and habits in relation to character amnesia.

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[77] Chih-Chun Hsiao, Chun-Chieh Lin, Chun-Gu Cheng, Yin-Han Chang, Hui-Chen Lin, Hsing-Chen Wu, and Chun-An Cheng, "Self-Reported Beneficial Effects of Chinese Calligraphy Handwriting Training for Individuals with Mild Cognitive Impairment: An Exploratory Study," *International Journal of Environmental Research and Public Health* 20, no. 2 (2023): 1031, https://doi.org/10.3390/ijerph20021031.

[78] Anne Mangen, Liss G. Anda, Gunn H. Oxborough, and Kolbjørn Brønnick, "Handwriting Versus Keyboarding: Effect on Word Recall," *Journal of Writing Research*, 7, no. 2 (2015): 227-247, http://dx.doi.org/10.17239/jwor-2015.07.02.1

[79] Huang, "On the tip of the pen," 1500.

[80] Mangen, "Handwriting Versus Keyboarding," 235.

Conclusion and Limitation

In the present study, the effects of different demographic and behavioral variables on character amnesia rates were investigated. It was shown that length of residency in the US, age, gender, and IME preference are among the most important predictors of character amnesia. Key behavioral variables such as handwriting frequency and keyboarding frequency showed no significance in the data set raising questions about how these variables could not have any influence on character amnesia when there is plenty of anecdotal and some empirical evidence saying otherwise. In Mangen et al., (2015), the results showing a positive correlation between handwriting and word recall were achieved through hands-on empirical experiments done with the subjects. This study simply employed two Likert scale self-assessed response questions, which may have proved too deficient for gathering the information needed. Nevertheless, this study has made some important contributions in the research of character amnesia that had not previously-been empirically tested, particularly with L1 Chinese speakers living outside China. Still, the need for deeper investigation into cognitive linguistic habits, age, gender, and character amnesia as a type of native language attrition is warranted. Further research into the different modalities of writing and typing Chinese and their relationship to character amnesia is also paramount for understanding the implications of their impact. Researchers ought to continue to utilize a variety of interdisciplinary approaches such as sociolinguistics, neurolinguistics, psycholinguistics, technolinguistics, and others to fully understand the comprehensive reasons for why this phenomenon occurs and to whom it mostly affects. The results of these studies can

then be used by the various Chinese communities, governmental and academic bodies in East Asia and around the world to decide what recourse to take, if any.

Throughout the ages, Chinese characters have been questioned, cursed, praised, and cherished. They've endured war, famine, hostile takeover, cultural flourishing, revolution, industrialization, globalization, modernization, and digitization. There have been occasions when it looked like they may be discarded for some other transcription system, but they, nevertheless, continue on as one of the most widely used and enduring writing systems in history. As a historian, Mullaney feels that the script has already entered a new epoch. No one can say for certain what the Chinese writing system's future will be, and time will tell how character amnesia will impact the script and its users, but one can look back at history and clearly see that Chinese characters won't be so easily forgotten, if ever.

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Appendix

1.) Character Dictation Test Pre-Questionnaire

Character Amnesia Study Questionnaire 提笔忘字研究的问卷调查

1.) 姓名 Name _____

2.) 出生日期（年/月）Month & Year of Birth _____年_____月

3.) 性别 Gender： 男 M 女 F 其他 O

4.) 母语和方言 Native Language and Dialect

_____

5.) 家乡(包括省和国家）Hometown (including Province & Country)

_____

6.) 职业 Occupation _____

7.) 最高教育程度 Highest Level of Education

_____

8.) 学历/学术背景 Degree/Academic Background

_____

9.) 你已在美国住了多久了？ How long have you lived in the US?

_____

10.) 在日常生活，你用简体字还是繁体字?
In daily life, do you use simplified or traditional characters?

_____

考完试以后，你想知道你的结果吗？我们可以通过邮件给你发结果。
After the test, would you like to know your results via email?

想/Yes ☐ 不想/No ☐

范围说明 | **Description of Parameters**

总是（比如，你什么都手写 ）
Always (ex. you write everything)

常常（比如，你每天手写 ）
Often (ex. you write something every day)

有的时候（比如，一周几次会手写 ）
Sometimes (ex. you write down something a couple times a week)

很少（比如， 一个月几次你可能会手写一点 ）
Seldom (ex. you may write something a few times in a month)

从不（比如，你记不住上次手写 ）
Never (ex. you can't remember the last time you wrote something by hand)

选择最佳答案 | Choose the best answer

11.) 你多长时间用笔一次写字? | How often do you handwrite ?

a.) 总是 always
b.) 常常 often
c.) 有的时候 sometimes
d.) 很少 seldom
e.) 从不 never

12.) 你手写时，哪种媒体最好举例说明你的手写的方式?
When you write, which medium best describes your style of writing?

a.) 表格 forms
b.) 日记 diary
c.) 文章 essay/article
d.) 购物清单 shopping list
e.) 待办事项列表 to-do list
f.) 课堂笔记 class notes

13.) 你多长时间用某种设备一次打字？（比如手机电脑等）
How often do you type on a device? (Such as a phone, computer, etc…)

a.) 总是 always
b.) 常常 often
c.) 有的时候 sometimes
d.) 很少 seldom
e.) 从不 never

14.) 使用手机或电脑打字时，您用哪个输入方式?
When you use a computer or phone to write Chinese, which input method do you use?

a.) 拼音 pinyin input
b.) 手写 handwriting
c.) 五笔 wubi
d.) 注音 zhuyin
e.) 其他 other

15.) 你多长时间一次阅读？ How often do you read ？

a.) 总是 always
b.) 常常 often
c.) 有的时候 sometimes
d.) 很少 seldom
e.) 从不 never

15a.) 你阅读时，你最常看哪种读物?
When you read, what kind of reading material to you most often read?

a.) 小说 novels
b.) 报纸 news
c.) 文章 essays/articles
d.) 漫画书 comic book
e.) 非虚构作品 non-fiction works

15b.) 你阅读在线上和纸质的对比是百分之几?
What's the percentage of your reading online vs. reading physical print?

_____%在线上 _____%纸质

15c.) 你目前阅读中文和英文的对比是百分之几?
Currently, what's the percentage of your reading in Chinese vs. English

_____%中文 _____%英文

16.) 你对拼音字母系统有多熟悉? How familiar are you with pinyin?

a.) 很熟悉 Very
b.) 有所熟悉 Somewhat
c.) 不太熟悉 not familiar

17.) 您拥有几个设备? How many devices do you own?
_____ 台式电脑 computer(s)
_____ 平板 tablet(s)
_____ 手提电脑 laptop(s)
_____ 手机 cellphone(s)

18.）你有过提笔忘字的经历吗? Have you ever experienced "character amnesia"?

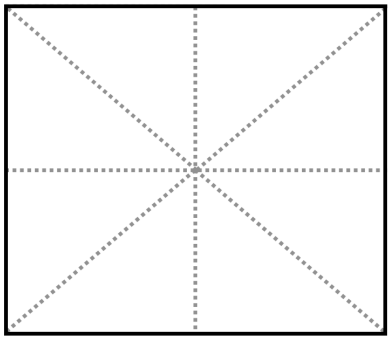
18a.) 如果"经历过"的话，发生了多久一次? If "Yes," how often does it occur?

18b.) 忘记如何写一个字时，你怎样解决这个问题呢?
How do you solve the problem when you forget how to write a character?

a.) 查看手机 check your phone
b.) 查词典 check a dictionary
c.) 问朋友 ask a friend
d.) 放弃 give up

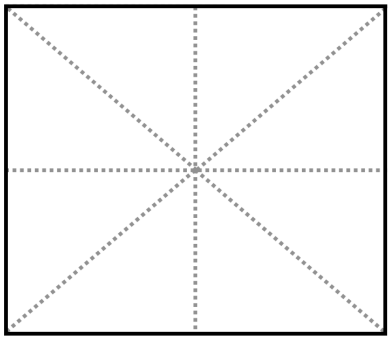
2) Character Dictation Test (sample questions 1-4)

1.)



☐ 这个字我知道， 而且我觉得我也写对了。
I know the character, and I believe that I wrote it correctly.
☐ 这个字我应该知道的，但是就是想不起来具体怎么写。
I think I know this character but can't think how specifically to write it.
☐ 这个字我以为我知道，但是下笔以后写着写着就忘了。
I thought I knew this character, but as I go to write, I forget it.
☐ 这个字我总是写不对。学的时候就没有学好。
I always have problems writing this character. I've never learned it well.

2.)



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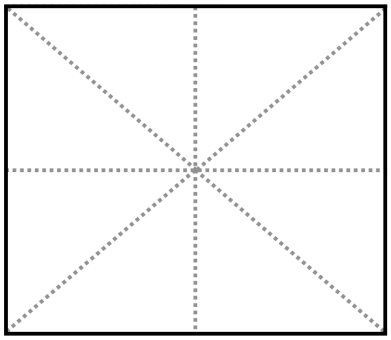
3.)



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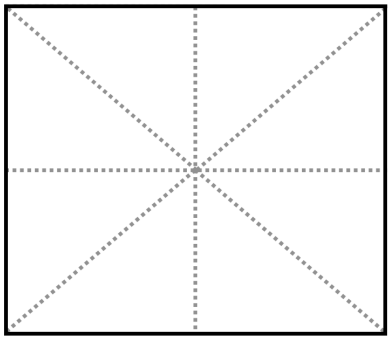

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☐ 这个字我总是写不对。学的时候就没有学好。
I always have problems writing this character. I've never learned it well.

3.) Randomized Character List with Character Amnesia Rate

Jun Da's List Rank	LCSC List Rank	Character	Character Amnesia Rate
2721	3211	蔬	12%
2217	1454	砍	4%
3481	3291	澎	34%
2165	3050	碧	19%
2774	2576	棕	2%
2208	2778	慨	19%
3188	3076	蔚	44%
2687	1817	耿	53%
2054	2065	涛	10%
2235	1797	捐	4%
2496	2929	嗓	27%
2476	2259	匙	21%
2130	2552	葡	8%
2434	2151	绣	0%
3239	662	芜	2%
2201	1780	匪	15%
2839	3442	蹦	6%
2311	381	吏	51%
2920	1047	厕	24%
3485	3197	撮	53%

2919	2223	梗	22%
2239	1445	歪	12%
2339	1016	茅	17%
2767	3102	瞅	36%
2304	2241	硕	6%
2665	1470	虐	53%
3035	2294	崭	45%
2850	3200	擒	58%
2982	3443	嚣	73%
2354	2085	浸	12%
2806	3029	寝	42%
2613	3430	燥	2%
2383	1904	哨	9%
2458	1283	帘	9%
2028	1547	秒	2%
3312	2579	椭	67%
2270	3063	摔	21%
3191	2258	眶	11%
3003	1581	徊	2%
2314	2142	恕	22%
3249	3009	滤	14%
3066	679	杠	9%
2778	2646	喧	11%

2126	2471	尉	15%
2068	2727	蛮	14%
3474	2447	悴	36%
2200	3439	藤	60%
2315	2416	渠	37%
3086	3159	煽	33%
2633	3212	蕴	32%
2484	2042	剖	37%
2227	2406	剪	0%
2499	2426	淘	2%
3049	3464	蟹	48%
2593	3106	蜡	18%
2912	551	讳	63%
2466	1115	贩	24%
2953	3149	彰	46%
2827	3271	僻	30%
2077	3486	灌	24%
2644	3080	榴	14%
2247	2292	崖	13%
2322	559	讽	17%
2488	1266	怯	34%
2064	2959	催	15%
2789	3298	澜	46%

3127	1307	屉	63%
2968	2095	悯	37%
2062	3022	滩	14%
2748	3027	窥	56%
2209	2210	菩	42%
2149	3155	歉	22%
2994	2419	淌	22%
3081	1152	侈	48%
2387	3139	裹	24%
2376	1477	昧	30%
2987	3315	撼	43%
2441	3487	譬	83%
2413	3375	糕	10%
3195	3448	瀑	24%
2647	1527	钞	20%
3068	2300	崛	38%
2969	858	汰	12%
2150	374	芝	2%
2590	1234	炒	4%
3131	2100	宵	4%
2785	2225	梢	10%
2332	500	旬	9%
3471	2178	捻	45%

2393	3039	媳	16%
2133	1892	鸭	2%
2244	2104	窄	10%
3153	3377	濒	43%
2148	2386	庸	39%
2786	629	坝	22%
2415	3364	膨	20%
2477	672	芦	13%
2237	2823	骚	39%
3285	3146	瘟	2%
2205	2504	琼	16%
3371	1459	鸥	5%
2493	2140	娱	2%
3022	2380	庵	43%
2754	1398	拯	26%
3329	3320	蕾	5%
3460	3074	蔼	33%