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Navigating the Tides of Change: Pinyin's Historical Impact and Contemporary Challenges in the Evolution of Chinese Characters, Language and Culture

Nian, Liu
University of Oklahoma

Abstract

This study explores the intricate roles of Pinyin, the official romanization system for standard Mandarin Chinese, and Chinese characters, or Hanzi, in the historical progression and contemporary dynamics of the Chinese language and culture, particularly in the context of the digital era. Pinyin, a valuable tool since its inception, has been pivotal in standardizing pronunciation, fostering communication, improving literacy rates, and serving as a global bridge by providing an intuitive learning tool for Chinese learners abroad. Nevertheless, its impact on character learning raises concerns about the potential erosion of the rich cultural heritage embedded in Chinese characters, which carry the weight of China's extensive history.

Furthermore, this paper highlights recent cognitive linguistics research that scrutinizes how Pinyin's role in digital communication may jeopardize the effective acquisition of written Chinese by both native and second-language learners. As China navigates the challenges and opportunities presented by the digital age, there is a pressing need to closely examine the complex interplay between Pinyin, Chinese characters, and the preservation of cultural traditions. The study emphasizes the necessity of paying more attention to this

intricate relationship to ensure a balanced adaptation to the transformative forces of the digital era.

Keywords: Pinyin, Chinese characters, digital era, language acquisition, culture preservation

1. Introduction

Writing is probably the most important invention of mankind. From ancient times to today, human beings have made countless inventions and creations. If a survey were conducted, and individuals were asked to select the most important invention or creation, a significant number would likely choose the invention of writing. Only after the invention of writing can there be subsequent accumulation of knowledge, history and culture, the dissemination of ideas, the development of education, the progress of science and technology, and the improvement of living standards, thus human society has entered a period of civilization with rapid development from the primitive and barbaric era. Without writing, human life would probably not be much better than it was five or six thousand years ago.

According to Ethnologue (26th edition), out of the currently listed 7,168 living languages, a little bit more than half of them have a developed writing system. which can be grouped into three categorizations. The first writing system among human languages is the alphabet, in which each writing symbol stands for a sound. Languages utilizing an alphabetic writing includes Latin and English. Take English for example, its letter “m” symbolizing the consonant /m/, and “a” a vowel such as /a/ or its variation depending on the phonological context and dialectal difference. But the bottom line here is, each writing symbol theoretically corresponds to one sound. The second category is syllabary. It is a writing system where each symbol represents a syllable, typically consisting of a consonant and a vowel. One example of a language that uses a syllabary is Japanese, specifically the two syllabaries called Hiragana and Katakana. For example, the Hiragana ま (ma) represents the syllable /ma/, in which two writing symbols are required in the alphabetic English spelling. Other representative languages utilizing syllabic writing include Cuneiform[1] and Cherokee. While both Alphabet and Syllabary are sound-based, the third category, namely the logograph, is not directly related to pronunciation; instead, each logographic script conveys meaning directly. In logographic writing, each script represents a word or a morpheme (a meaningful unit of language) rather than a specific sound. Chinese

[1] Cuneiform (for Akkadian): Used for Akkadian, a Semitic language, in ancient Mesopotamia.

is a notable example of a logographic writing system, where characters represent words or ideas, and each character can have its own distinct meaning.

Among the three writing systems, alphabetic systems are quite prevalent and are used by a significant portion of the world's population. In fact, it is safe to say that more than 70% of the world's languages employ an alphabetic script in some form[2]. Syllabic systems are used in several languages, particularly in Asia. Examples include the scripts used for Japanese (Hiragana and Katakana) and certain Indian scripts (like Devanagari for Hindi). The percentage is lower compared to alphabetic systems but still significant. Logographic systems are less common. Some ancient civilizations chose logographic writing systems, such as Hieroglyph in ancient Egypt[3], have all disappeared. Chinese characters, or Hanzi, are the most well-known logographic script and mostly likely the only widely used one of this kind in today's world. The Chinese writing system, historically served as a *lingua franca* in East Asia. Adopted by neighboring cultures such as Japan, Korea, and Vietnam, Chinese characters facilitated communication, cultural exchange, and education across linguistic boundaries. While each region adapted the characters to its linguistic and cultural context, the utilization of Chinese characters created a common script that contributed to a shared intellectual heritage in East Asia.

The perspective of Chinese characters breaking through the Asian cultural sphere and entering the world began in the 17th century when Jesuit missionaries arrived in China to spread religious teachings and Western culture. The complexity of Chinese characters posed unprecedented challenges to missionary work and communication, and thus hindered communication between the East and the West. Because of this, Thomas Francis Wade, a

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[2] Vaughan, Don. "The World's 5 Most Commonly Used Writing Systems". Encyclopedia Britannica, 11/23/2020. Retrieved January 3, 2024, from https://www.britannica.com/list/the-worlds-5-most-commonly-used-writing-systems.

[3] The term "hieroglyph" is derived from the Greek words "hieros" (ιερός), meaning sacred, and "glyphein" (γλύφειν), meaning to carve. Hieroglyphs were commonly used in ancient civilizations, including ancient Egypt, where they were carved or inscribed on various surfaces such as stone, wood, or papyrus. Each hieroglyphic symbol often had a specific meaning and could represent objects, actions, or abstract concepts.

British diplomat and sinologist, initially designed the earliest romanization system in the mid-19th century. The system was later finalized by another British diplomat and sinologist Herbert A. Giles in his Chinese–English Dictionary in 1892 (Camus, 2007). This Wade-Giles romanization system, named after the two inventors, facilitated China's exposure to the rest of the world by opening the Chinese language.

Later in 1943, George Kennedy, a sinologist at Yale, developed another romanization system originated for a course aimed at teaching Chinese to American soldiers during World War II. Its popularity grew through the ongoing refinement of the course at Yale. This romanization method employs English spelling conventions to approximate Chinese sounds, facilitating a faster and more accurate acquisition of pronunciation for English speakers.

These two romanization systems were predecessors of modern Pinyin, which was later developed by the Chinese government in the mid 1900's. Pinyin, literally "spelled sounds," is the official romanization system for standard Mandarin Chinese. Since the 1980s, Pinyin has become the most commonly used phonetic guide for second-language Chinese learners worldwide. It is a phonologically transparent orthography, where one phoneme corresponds to one grapheme and one grapheme corresponds to one phoneme. Table 1 illustrates the three romanization systems with a few examples. This table also incorporates Zhuyin, also known as Bopomofo, an additional phonetic script utilized for instructing Chinese pronunciation, particularly in Taiwan. Zhuyin was developed in the early 20th century in China to enhance literacy and language learning. In contrast to Pinyin, Zhuyin symbols are primarily derived from forms of regulated/simplified Chinese characters rather than the Latin alphabet.

Table 1 The four phonetic scripts transcribing Chinese characters

Chinese Characters	Wade-Giles	Yale	Pinyin	Zhuyin
北京	Pei-ching	Běijīng	Běijīng	ㄅㄟˇ ㄐㄧㄥ
臺北	T'ai-pei	Táiběi	Táiběi	ㄊㄞˊ ㄅㄟˇ
華盛頓	Hua-sheng-tun	Wàh-sìhng-deun	Huáshèngdùn	ㄏㄨㄚˊ ㄕㄥˋ ㄉㄨㄣˋ

2. The historical impact of Pinyin

Because the Chinese script embodies meaning instead of phonology, Pinyin provides both native and second language learners an alternative shortcut to allow for communication without laboriously handwriting and memorizing thousands of characters. Therefore, the romanization of the Chinese written language through Pinyin has several benefits both in China and among second-language learners.

Following its initial adoption by the government in 1958, Pinyin played a crucial role domestically in standardizing Chinese pronunciation and enhancing literacy. The vast and significant dialectal differences, particularly among the most heterogeneous southern dialectal groups, posed serious communication challenges within China. Pinyin addressed this issue by offering dialectal speakers standardized pronunciation, promoting smoother communication. Moreover, literacy campaigns for adults leveraged Pinyin to teach reading, enabling individuals to study characters independently using books featuring Pinyin alongside the words (Peterson, 1997). The widespread promotion of Pinyin significantly contributed to increasing the literacy rate in China from 20% in 1950s to 85-90% in 1980s (Bhola, 1984). While some debate exists over whether Pinyin alone directly improved adult literacy rates, its undeniable role in globalizing the Chinese language is well-established.

Pinyin also served as a global bridge, connecting China to the world, as emphasized by Youguang Zhou, the father of Pinyin (Simon, 2009). For second-language Chinese learners, Pinyin became an indispensable tool in classrooms worldwide. The necessity of learning Chinese with Pinyin becomes apparent when considering the challenges associated with learning without it. Firstly, speakers of alphabetic languages must adjust to a script independent of its spoken aspect, grappling with the less logical connection

between the writing system and Chinese speech sounds. In contrast, Pinyin offers a more intuitive link between spelling and pronunciation. Secondly, for non-native Chinese speakers, learning without Pinyin complicates matters due to homographs (多音字 duōyīnzì), where characters share the same pronunciation but may have different meanings, such as 少 (shǎo/shào), and 長 (cháng/zhǎng), as the learners are less sensitive to linguistic contexts. Thirdly, semantic-phonetic characters, which incorporate phonetic components, often provide limited assistance in pronunciation due to their unpredictability, offering inaccurate and less useful information about the character's pronunciation (Wan, 2012). The supposed connection between the sound part and the character is often unclear due to sound changes in language evolution, rendering the sound parts less helpful in deciphering the character's pronunciation.

Learning Chinese without Pinyin would pose a significant challenge, discouraging many from undertaking the task. Therefore, many educational institutions in the United States employ the pedagogical approach known as 先語後文 (xiān yǔ hòu wén), emphasizing learning to speak Chinese first using Pinyin, and subsequently learning to write Chinese characters (Zhang, 2021). Rather than bombarding learners with hundreds of complicated logographs, Pinyin eases them into the learning process by first developing their speaking and pronunciation skills through Pinyin, and then later supplementing their knowledge with handwritten characters.

Crucially, Pinyin has played a pivotal role in facilitating the integration of the Chinese language into the digital era. The preference for using Pinyin to input characters on various screens, as opposed to traditional handwriting methods, is rooted in its capacity to streamline the user experience. Unlike the conventional method of handwriting, where users need to produce the written character, Pinyin allows users to recognize and select familiar characters from a dropdown menu based on their general structures, thereby reducing cognitive load during typing (Wan, 2012). This shift not only enhances user convenience but also significantly impacts productivity and economic efficiency by minimizing the effort required for written work (Zhang, 2021). Furthermore, ongoing advancements in voice recognition technologies aim to further boost productivity, potentially eliminating the need for even basic Pinyin input. Kaifu Lee, a prominent

developer in this field, has taken an assertive stance, suggesting that written Chinese poses a barrier to productivity, requiring twice as much effort to generate intellectual capital compared to many other regions globally (Wheelwright, 2001).

In summary, the development and adoption of Pinyin play a pivotal role in standardizing Chinese pronunciation, enhancing literacy in China, serving as a global learning tool, and facilitating the transition of the Chinese language into the digital age. Particularly in the Information Era, Pinyin stands out as the sole Romanized and cross-platform Chinese input method adhering to international standards, making use of the standard computer keyboard with Roman letters. While other popular keyboard input systems like Cangjie (structure-based), Wubi (strokes-based and form-based), and Zhuyin (sound-based with a unique set of phonetic symbols) exist, these non-Romanized methods were primarily designed for proficient Chinese speakers with a solid grasp of Chinese characters. Additionally, mastering those methods entails undergoing some training to become familiar with their intricate coding systems.

3. Drawbacks of utilizing Pinyin

3.1. Disadvantages of using Pinyin among second language learners

Nevertheless, the utilization of Pinyin is not without its drawbacks. In the realm of overseas Chinese education, adopting a "Pinyin first and characters second" approach may yield unfavorable outcomes. Many second-language learners of Chinese might overly rely on the romanization system, treating Pinyin as a crutch and consequently facing challenges when transitioning to reading characters (Zhao, 2011). In this context, Pinyin can impede learners from fully acquiring proficiency in both the spoken and written aspects of the Chinese language, as they may lack a thorough understanding of the genuine writing system, preventing true mastery.

A more critical concern lies in the potential adverse interaction between Pinyin and a learner's accurate pronunciation of Chinese, attributed to its spelling rules. While Pinyin generally maintains a one-to-one correspondence between graphemes and phonemes,

specific spelling rules within the system have the potential to cause confusion among English-speaking Chinese learners.

To begin, challenges faced by English learners of Chinese arise from certain aspects of the Pinyin romanization system, particularly in the representation of distinct vowels exhibiting free variation in Chinese through the use of single letters. While it is widely acknowledged that English spelling, compared to other Indo-European languages, is irregular, and the Latin alphabet's letters do not consistently reflect English pronunciation, the similar issues with Pinyin are often overlooked. For instance, the letter "i" in Pinyin can represent various vowel qualities with distinct acoustic characteristics, even though they may not be phonemically contrastive in Chinese. Specifically, the vowels in "弟 (dì)," "絲 (sī)," and "吃 (chī)" are all written with the /i/ grapheme in Pinyin, yet their actual pronunciations exhibit acoustically significant differences. This discrepancy can be opaque or counterintuitive for native Chinese speakers, as the logographic nature of Chinese does not encourage breaking down syllables into consonants and vowels. The traditional Fanqie[4] method, however, proves useful in addressing this issue by assisting native speakers in isolating and using Pinyin finals (韻母 yùnmǔ) and initial consonants (聲母 shēngmǔ) independently. Through this method, Chinese speakers can discern the distinct /i/ sounds and recognize their varied values—where the first "i" is a canonical [i], the second is a back tense vowel, and the third is a retroflex one. Nonetheless, most native speakers only grasp these differences with explicit instruction due to their exposure to Chinese phonology before learning Pinyin in school. Consequently, the mismatch between Pinyin spelling and actual vowel pronunciation does not adversely affect native speakers' pronunciation, as they were already familiar with correct sounds before encountering Pinyin.

On the contrary, for English learners of Chinese, the Pinyin spelling can pose challenges as they lack the inherent phonological knowledge that native speakers possess. The pronunciation of Chinese in Pinyin may seem unnatural in words like 弟 and 吃,

[4] Fanqie (反切) is a traditional Chinese phonological annotation system used in dictionaries to indicate the pronunciation of characters. It involves using two other characters, one representing the initial sound and the other representing the final sound, to phonetically convey the pronunciation of the target character. This method is commonly employed in classical Chinese lexicography.

both containing the lexeme "i." When English learners start learning Chinese pronunciation with Pinyin, the fact that different rimes are transcribed the same can cause confusion and hinder accurate memorization and pronunciation. This highly likely results in non-target-like phonological representations of Chinese rimes, leading to non-target-like pronunciations. English learners must navigate phonological distinctions not supported by the Pinyin system, as the same Pinyin letter "i" is permitted to mark three different pronunciations. Simply put, there are more vowel distinctions in Chinese than reflected in the Pinyin finals, posing difficulties for English learners using Pinyin to master Chinese pronunciations.

Another common issue among second language Chinese learners due to Pinyin is vowel deletion. For instance, the Pinyin "liù" for 六 [liou] lacks the intermediate transition vowel. In a study by Bassetti (2007), native English speakers were found to apply English spelling rules to Chinese Pinyin. A reading-aloud task using Chinese characters revealed vowel deletion in three rimes (/iou/, /uei/, and /uən/), represented as [iu], [ui], and [en] in Pinyin. Results indicated that second language speakers dropped the glide, producing [iu], [ui], and [ən], as suggested by the spelling system. Despite hearing the correct pronunciation in recordings, English learners of Chinese are often influenced by spelling and struggled to pronounce or perceive the vowel phoneme not represented in Pinyin, leading to the mistaken pronunciation as [liu]. Furthermore, it was mistakenly thought that the word had only three phonemes instead of four. Unlike Chinese native speakers, who associate "iu" with /iou/, "ui" with /uei/, and "un" with /uən/, second-language Chinese learners may be misled if relying solely on Pinyin spelling. This aligns with previous findings that second-language Chinese learners' mental representations of these rimes often lack the main vowel. In general, learners often delete the vowels that are not represented in the Pinyin transcription, but they produce the same vowels in the same rimes when the Pinyin transcription represents them.

The vowel deletion found in Bassetti’s research is consistent with the general pattern in foreign language learning—the writing systems associated with second languages have a great influence on the learning of their speech sounds. Studies have shown that at the beginning of learning the second language speech, using a writing system that looks similar

to the reading and writing rules of the first language (such as native English speakers learning Chinese using Pinyin) may be faster at first because the learner does not need to be familiar with another writing system (such as Chinese characters). However, the negative effects of this learning method are also prominent: Hayes-Harb and colleagues found in their 2010 study (Hayes-Harb et al., 2010) that when language learners hear words that are inconsistent with the spelling habits of their mother tongue, learners will be more inclined to remember the pronunciation implied by the spelling rules of the mother tongue than the actual pronunciation, which leads to errors. For example, the word [fɑʃə] in Dutch is spelled as "faza." Even if the native English speaker hears the correct pronunciation, because of English spelling rules, it is still easy to mistakenly pronounce it in the process of learning Dutch as [fazə]. We can conclude that the Pinyin orthographic input interacts with the phonological input in shaping the phonological representations and pronunciation of Chinese syllables in English Chinese language learners. As a result, Chinese language teachers should therefore be aware of the negative effects of the Pinyin orthography.

People may wonder if the vowel deletion observed is genuinely a result of Pinyin spelling. It's worth noting that young Chinese-speaking children often simplify triphthongs to diphthongs and diphthongs to monophthongs, such as pronouncing /uei/ as [ei] or /au/ as [a] (Li et al., 2000; Zhu & Dodd, 2000; Zhu, 2002). However, it is crucial to highlight that native Chinese-speaking children never omit the main vowels in a syllable. Interestingly, triphthongs like /iou/ discussed earlier are among the first acquired (age 1;3-1;5) and show fewer errors. As a result, the phenomenon of vowel deletion in native Chinese-speaking children is likely attributed to the challenge of articulating three vowel targets in a syllable, requiring rapid movement towards two or three target vowels. This stands in sharp contrast to second-language Chinese learners who consistently omit main vowels that are not explicitly spelled out in Pinyin. Consequently, we can affirm that the mentioned vowel deletion issue is a specific phenomenon associated with learning Chinese through Pinyin and does not reflect a universal occurrence in language acquisition.

Hence, despite Pinyin's use of the same letters as English, starting Chinese learning with Pinyin's spelling system can lead to a negative transfer of native language spelling. This, in turn, complicates the ability of English-speaking Chinese learners to discern

differences between the two pronunciation systems due to entrenched patterns. Consequently, while it may appear counterintuitive, learning Chinese pronunciation exclusively through the romanization system like Pinyin may be infeasible but potentially less reliable. Starting Chinese learning with characters can avoid issues related to first language transfer, presenting acoustic information as chunked for each character/syllable, eliminating unnecessary spelling transfer or mismatches between Pinyin spelling and actual speech sounds.

One potential solution to mitigate confusion among native English learners of Chinese is to adopt Zhuyin, a phonetic system that employs symbols derived from Chinese characters instead of Latin alphabets, as proposed by Hayes-Harb & Cheng (2016). Their investigation into the impact of orthography on second language (L2) word form learning in Chinese compared two key factors: the shared writing system between the native language and L2, and, if shared, whether relevant grapheme-phoneme correspondences were also shared. The study's results indicated that, despite the familiarity of Pinyin to native English speakers, the Zhuyin group surpassed the Pinyin group in auditory and written forms matching tests. This superiority was attributed to the Pinyin group's challenges with "incongruent" items, where Pinyin forms involve a familiar grapheme representing a novel phoneme (e.g., "xiu" for [ɕiou]). The findings suggest that, when acquiring new words in L2 Chinese, the necessity to suppress native language grapheme-phoneme correspondences in favor of new ones may result in less target-like knowledge, especially with familiar graphemes like Pinyin. Conversely, employing Zhuyin with novel graphemes appears to alleviate this negative native-language transferring effect.

Furthermore, research by Siok & Liu (2018) delves into the impact of various typewriting methods on the literacy abilities of fluent Chinese-English bilingual readers. Their findings demonstrate positive correlations between orthographic-based typewriting measures and Chinese reading abilities. College students who opted for orthographic-based typewriting, such as Cangjie, exhibited higher scores in Chinese reading and dictation when controlling for age, typewriting skills, and pre-university language ability. In contrast, pronunciation-based typewriting measures, such as Pinyin, did not exhibit a similar correlation with Chinese reading but showed positive correlations with English reading and

spelling performance. The results suggest that typewriting methods aligned with the learning principles of a writing system should be prioritized in the digital era. The key takeaway is that if digital typing is unavoidable, selecting typewriting methods that align with the learning principles of a writing system could better preserve and enhance literacy skills in the digital age if feasible.

3.2. Disadvantages of using Pinyin among native speakers

3.2.1. Chinese character amnesia

Pinyin digital input methods can contribute to language attrition in adults, a phenomenon commonly known as "character amnesia" or 提筆忘字 (tí bǐ wàng zì) in Chinese, literally translating to "pick up pen, forget character." This term underscores the challenge of remembering how to handwrite characters, given the reliance on Pinyin digital input systems. According to a *China Youth Daily* poll conducted in 2010, 83% of 2,072 participants acknowledged difficulties in writing characters[5]. Chinese youth, particularly those extensively using Pinyin digital input systems, face situations where they struggle to recall how to write characters, even fundamental ones like 箱 (xiāng), used in the word for "mailbox" (Demick, 2010; Li & Li, 2013). In a television program centered on Chinese characters knowledge, the accuracy of an adult group is only 8%. In real life, news stories such as “a university student handwriting a 400-character resume with 24 misspellings” has prompted many people to recall their embarrassing experiences of forgetting characters when wielding a pen. This character amnesia phenomenon is closely associated with the digitalization of Chinese, especially in work settings emphasizing the efficiency of Pinyin digital input systems for enhanced productivity. In the digital age, people heavily rely on keyboards for typing, seldom finding the occasion to manually write Chinese characters stroke by stroke. Over the years, discussions on the "Hanzi (Chinese characters) crisis" and the widespread occurrence of "character-writing disorder" among the population have been recurrent. Many Chinese people, working in increasingly paperless offices, find their

[5] China Youth Daily 2010-04-16, Retrieved 1/6/2024 from https://zqb.cyol.com/content/2010-04/16/content_3185826.htm

opportunities to handwrite characters diminishing due to the speed and convenience offered by Pinyin digital input systems. To recollect character strokes, they often resort to online dictionaries on his phone or computer, the process that involves the use of Pinyin. The act of forgetting characters while writing and frequent spelling mistakes has evolved into a concerning cultural phenomenon.

This character amnesia that results from the use of Pinyin can be compared to a similar phenomenon in the decline of English speakers' spelling ability resulting from the use of spell check in English typing. In a study investigating common American students' grammar errors in 1988 and 2008, misspelling was not in the list of top twenty errors in 1988, while it jumped to number five in 2008 (La Force, 2009). This is likely due to the prevalence of smart spell-check systems which, like Pinyin, have become a crutch and reduce the need for thorough language learning. In contrast to spell-check, however, Pinyin is a fundamental, not supplemental, tool for basic digital input and is thus more damaging in Chinese character learning than spell-check is to English.

3.2.2. Literacy ability associated with handwriting

It is natural for people to wonder whether there are potential ramifications on the literacy skills consequent to the transition from traditional handwriting to digital writing in the contemporary era characterized by escalating technological integration. In recent years, a considerable body of scholarly research has delved into this topic by testing both juvenile and adult populations.

Most studies are focused on preliterate children. A study conducted by James & Engelhardt (2012) investigates the impact of handwriting, typing, and tracing on brain activation during letter perception in five-year-old children. Using fMRI, they found that the previously documented "reading circuit" is activated exclusively after handwriting and not after typing or tracing. More specifically, significantly more neural activation was found after handwriting than typing in the left Inferior frontal gyrus, a.k.a the language-related Broca area, and the left anterior cingulate cortex. The results suggest that

handwriting plays a crucial role in the early recruitment of brain regions essential for successful reading, particularly in young children.

Another study in 2015 (Kiefer et al., 2015) contributed to the debate surrounding the ease of typing. The study aimed at investigating the impact of handwriting versus typing on reading and writing performance in preschool children. Their results did not indicate superiority in typing training over handwriting in various tasks, including letter recognition and naming. Handwriting training demonstrated superiority, especially in word writing, supporting theories that emphasize the facilitatory influence of sensory-motor representations established during handwriting on reading and writing.

James (2017) further explored why handwriting has this facilitative effect reported on the ability of young children to recognize letters. She examined the impact of handwriting experience on young children's letter recognition abilities through behavioral measures and functional neuroimaging. The findings revealed that early handwriting practice positively influences visual symbol recognition by producing variable visual forms that enhance symbol understanding. The results suggest that the communication between visual and motor systems in the brain, facilitated by handwriting, plays a crucial role in improving subsequent letter recognition skills.

A more recent study done by Mayer et al. (2020) compared the impact on letter and word level literacy acquisition when kindergarten children typed on a virtual keyboard versus handwriting with a pencil or a stylus on a tablet. The results indicate that handwriting with a pencil led to superior performance in letter recognition and enhanced visuospatial skills compared to keyboard training, while stylus training did not significantly differ from either method. Although keyboard training showed better results in word writing and reading compared to stylus training, it did not outperform handwriting with a pencil.

These behavioral and neuroimaging studies can be interpreted in the larger context of the facilitatory effect that learning through action has on perceptual capabilities, or what in Chinese can be expressed as 知行合一 (zhī xíng hé yī). It is obvious that children’s letter

recognition and literacy ability can be negatively affected by digital typing when it substitutes handwriting.

The above-mentioned research gathered data from children who spoke English and German. In alphabetic writing systems like English and German, where each letter generally corresponds to a phoneme, it is expected that typing and handwriting would exhibit no fundamental differences in recognition and cognitive abilities. The distinctions between different input modes (digital or manual) are likely confined to fine motor movements and perception. However, the impact on cognitive processes may be more pronounced in Chinese characters, given that their strokes are unrelated to pronunciation. Questions arise regarding the impact of typewriting experience on literacy development in the logographic Chinese system, which is fundamentally different from alphabetic systems. How does the shift from handwriting to digital typing influence reading abilities and beyond?

Tan et al. (2005) discovered that reading Chinese, unlike reading English, necessitates intensive visual-spatial analysis. They explored the impact of the Chinese writing system on children's language development, specifically focusing on reading and writing abilities. While previous research has emphasized the strong association between reading and phonological awareness in alphabetic languages, this study challenges that view in the context of the logographic Chinese language based on meaning rather than phonology. The findings reveal a strong relationship between Chinese reading and a child's writing skills, suggesting that logograph writing plays a crucial role in reading development. The study proposes two interacting mechanisms—orthographic awareness and motor programs—as key contributors to this relationship, providing unique insights into the cognitive systems involved in reading development and challenging prevailing views on the centrality of phonological awareness.

A later more through study done by Tan and his team (Tan et al., 2012) further investigates the impact of Pinyin input methods on the reading abilities of Chinese children who traditionally learn to associate visuo-graphic properties of characters through handwriting. The shift to electronic devices using Pinyin, which associates phonemes and English letters with characters, raises concerns about potential conflicts with traditional

learning processes. The research reveals a higher incidence of severe reading difficulty than previously reported in Chinese reading. Crucially, the study finds a significant negative correlation between children's reading scores and their use of the Pinyin input method, suggesting that typing in Pinyin on electronic devices may hinder Chinese reading development. The study highlights potential challenges in adapting to digital communication while preserving proficiency in written Chinese.

The prevalence of Pinyin in digital input systems raises concerns about language attrition in adults and, more significantly, its potential to impede the language acquisition of Chinese children. The current incidence of severe reading difficulty in China is reportedly higher than previously recorded, possibly linked to the widespread use of Pinyin in Chinese digital input systems.

3.2.3 Cognitive ability associated with reading and writing Chinese characters

Beyond its impact on literacy abilities, the logographic Chinese writing system requires a distinct processing strategy. Compelling fMRI findings have demonstrated that the visual recognition of Chinese characters is marked by heightened activity in the left middle frontal regions. These cortical areas are not essential for the phonological and orthographic processing observed in native speakers of alphabetic languages (Tan, 2005). In other words, reading alphabetic words is primarily driven by phonological cognitive processes (Baddeley, 1986; Paivio, 1986), while reading logographs appears to rely to a greater extent on visual cognitive processes (Hung & Tzeng, 1981; Zhou & Marslen-Wilson, 1999). Because of the fundamental differences in recognition and processing between reading alphabetic and logographic scripts, the reduction in handwriting Chinese characters may result in the loss of some unique cognitive abilities among its speakers.

In a study conducted by Tavassoli (2002), it was found that English processing occurs linearly in working memory with a focus on phonetic processing, where visual neural and related brain regions play a minor role. However, Chinese is different, as similar-looking characters may have different pronunciations, and characters with different forms may have similar or identical pronunciations. The brain in processing Chinese characters requires

rapid spatial recognition and analysis that does not trigger sound but retrieves meaningful information, providing spatial processing advantages to Chinese speakers. In experiments involving memorizing and recalling meaningless English or Chinese words, Chinese speakers outperformed English speakers, showcasing that incidental spatial memory would be more prominent for Chinese logographs compared to alphabetic English words, hence, the cognitive advantages associated with Chinese language speakers in spatial cognition and memory (Tavassoli, 2002).

More significantly, the processing advantage associated with reading Chinese characters is acquirable. In a recent study (Lai et al., 2021), the neural mechanisms of semantic processing were investigated in advanced Mandarin Chinese learners, specifically those who are Indo-European language speakers. Using functional magnetic resonance imaging (fMRI), the study compared Chinese adult learners (L2 group) and Chinese adult native speakers (L1 group) during a semantic judgment task. The L2 group demonstrated heightened activation in bilateral occipital regions compared to the L1 group. Correlation analysis within the L2 group established a connection between increased activation in the left middle temporal gyrus/superior temporal gyrus, higher accuracy in the semantic task, and improved vocabulary test scores. The findings suggest that adult Chinese L2 learners utilize enhanced recruitment of bilateral occipital brain regions for visuospatial information processing of Chinese orthographic system. In essence, advanced L2 learners also depend on visual input from the logographic system to decipher the meanings of Chinese characters, pointing to a cognitive developmental aspect in late adult L2 learners.

Moreover, using Pinyin instead of Chinese characters may also have some impact on the Chinese character system itself. We can expect an adaptive-frequency change, which roughly means that high-frequency words are more likely to be used even more frequently, while low-frequency words may be used less and less. This reversed feedback is triggered by a tendency to choose the first appearing characters from the menu when inputting Chinese characters with Pinyin, as words appearing later require more effort to access by turning to the second or later pages. To save time and energy, many people may resort to homophones or homonymous words appearing first in the menu, acknowledging that readers will be able to understand or speculate the correct intended characters. Over time,

characters with lower frequency might be put in a vulnerable position of being replaced by more frequent homophones, creating alternative characters or pseudo-homophones, which is not an ideal outcome in the long run. With the widespread use of digital and electronic technology, writing Chinese characters is gradually becoming an unconventional and even luxurious activity required in very limited occurrences.

In summary, the reduction in handwriting leads to an increase in character amnesia, a decline in children's reading abilities, possible loss of certain cognitive advantages among Chinese native speakers and L2 learners, and even potential negative impact in the Chinese writing system itself to some degree. Despite these potential negative impact when moving away from handwriting Chinese characters, many are practical and willing to accept this the shift from handwriting to digital typing, as this idea of the exchange of cultural heritage embodied in written Chinese for competitiveness in the global arena dates back to the Nationalist movement when some of the most prominent intellectual and political figures in China in the early 1900's even wanted to abolish the Chinese script altogether.

4. Crises encountered by the Chinese writing system

4.1. The Chinese language reform in the early 20th century

The first time when Chinese writing system was severely scrutinized and criticized was during the modern Chinese language reform movement that traced back to 1892 with Zhuangzhang Lu's publication of "*Chinese Phonetic New Characters Xiamen Dialect*[6]" (Lu, 1956). Lu expressed his motivation for creating new phonetic characters, connecting national prosperity to character simplification and phonetic clarity. The proposal was supported by many scholars and peaked around the May Fourth revolution in 1919, and gradually developed into a notion of completely abolishing or Romanizing Chinese characters, although this radical language reform might sound seemingly absurd, the juxtaposition of national prosperity and language reform was widely accepted at that time.

[6] 見盧戇章《一目瞭然初階（中國切音新字廈腔）》。

It suggested that retaining Chinese characters would lead to China's demise, while abolishing them would bring about China's resurgence:

> "The origin of Chinese characters is extremely primitive, their shapes are extremely bizarre, understanding them is extremely inconvenient, and their application is extremely uneconomical. They are truly a clumsy and crude tool, a cumbersome and inconvenient instrument in the world[7]."— Sinian, Fu (Fu, 1919)

> "There is no doubt that Chinese characters are treasures passed down from ancient times, but our ancestors are even more ancient than the characters, so we are even more precious relics passed down from antiquity. Sacrifice ourselves for Chinese characters, or sacrifice Chinese characters for us? This is something that anyone who has not lost their sanity can answer immediately[8]." – Xun, Lu (Lu, 1981)

As seen in the views of these representative revolutionary figures, a new China demanded a new written language to compete not only economically, but also linguistically with prominent Western powers (Simpson, 2007: 151). The references to "uneconomical" and "inconvenient" point to the assumption that the difficulty of the Chinese written language can be a hindrance to economic growth and progress on the competitive world stage.

The movement led to various proposed linguistic reforms with the aim of altering the Chinese writing system, including attempts for a "world language," "national language in Roman letters," and "Latinization." However, despite the desirability of such changes, the feasibility of the proposals was low, and no single plan gained universal acceptance among scholars. Consequently, over more than a century since the Chinese language reform

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[7] 傅斯年，〈漢語改用拼音文字的初步談〉，《新潮》（1919，1 卷 3 號）頁 391－408：「中國文字的起源是極野蠻，形狀是極奇異，認識是極不便，應用是極不經濟，真是又笨又粗、牛鬼蛇神的文字，真是天下第一不方便的器具。」

[8] 魯迅，〈漢字和拉丁化〉，《魯迅全集》，卷 5，頁 557：「不錯，漢字是古代傳下來的寶貝，但我們的祖先，比漢字還要古，所以我們更是古代傳下來的寶貝。為漢字而犧牲我們，還是為我們而犧牲漢字呢？這是只要還沒有喪心病狂的人，都能夠馬上回答的。」

movement, the fundamental logographic nature of Chinese characters has remained unchanged. While the system has welcomed a few phonetic additions such as Pinyin and undergone a series of simplification processes to reduce the complexity of some characters, the movement to abolish the characters was abandoned.

4.2. Navigating the Information Era with keyboard in the 1980s

The second time the Chinese writing system faced scrutiny was during the advent of the Information Era, marked by the invention of personal computers and the necessity of keyboard typing. In 1977, Apple, an American company, introduced Apple II, the inaugural personal computer tailored for everyday home users. Priced at $1,298 and equipped with 4KB of memory, this computer was within the financial reach of middle-class households in the United States. What distinguished the Apple II was its user-friendly interface which created no technical barriers like the first-generation home computers. It offered easy operation, making it accessible even to individuals not well-versed in engineering or technology. Consequently, the Apple II swiftly gained popularity in the United States, marking the beginning of the era of personal computers worldwide.

During the same period in China, the perceived lag in the country's computer and printing industries was often attributed to the complexity of Chinese characters. In contrast, Japanese typing, utilizing kana matched to Roman letters, was deemed convenient—typing "Japan" as "Nihon," for instance, was straightforward. However, adopting Romanized Pinyin for inputting Chinese characters posed challenges due to homophones, resulting in a high rate of duplicate codes. In fact, Yutang Lin had invented the Ming Kuai typewriter as early as 1947, inspired by Japanese kana. It used a standard typewriter keyboard arranged similarly to today's Wubi input method and could input about 7,000 Chinese characters (see Figure 1), with each character requiring only three keys and a typing speed of 50 characters per minute. However, Mr. Lin's 64-key layout and a speed of 50 characters per minute were clearly insufficient to meet the requirements of the information age. Consequently, there were widespread calls, both domestically and internationally, advocating for the "abolishment of Chinese characters" and the "adoption of

Romanization." The assertion was that unless China relinquished its square-shaped Chinese characters, it would be unable to transition into the information age. Once again as in the early 20th century, these calls were difficult to refute since, in the early days of the computer age, Chinese characters indeed faced impediments in rapid input and output.

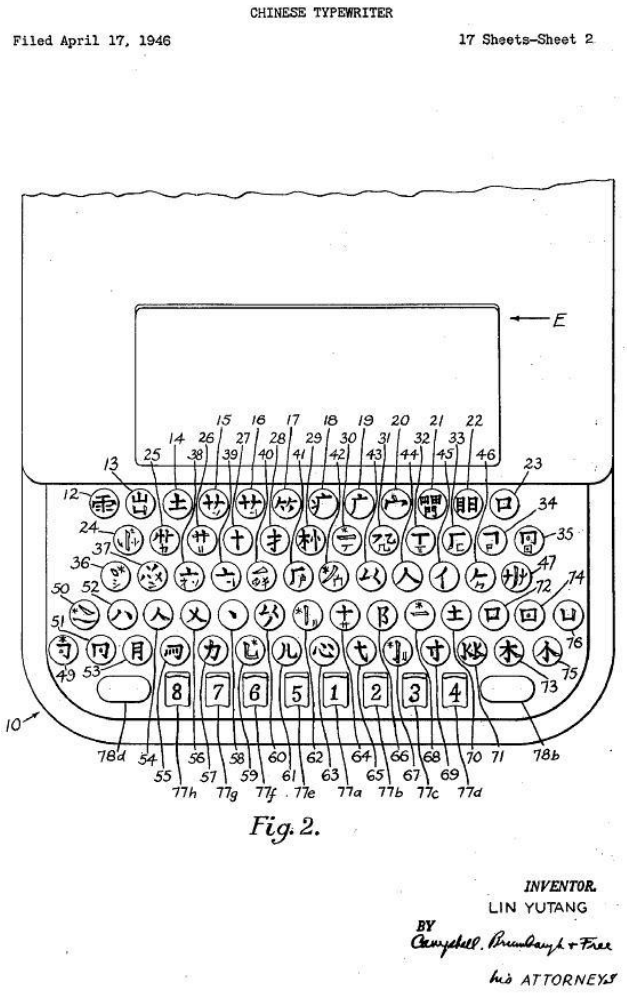

Figure 1

Ming Kuai typewriter invented with a standard typewriter 64-key layout keyboard

In 1983, Yongmin Wang, inspired by a novel Chinese character coding system devised by Yili Zheng, successfully condensed the coding of Chinese characters from 188 keys to the 25-key format of the initial version of the Wubi input method. This innovation meant that Chinese character input methods could seamlessly utilize the universally recognized QWERTY keyboard without necessitating the development of a specialized

Chinese keyboard. In 1984, during a presentation at the United Nations, the Wubi input method achieved a remarkable record of typing over 120 characters per minute, eventually setting the official record at 293 characters per minute. Consequently, China discovered the means to employ a standard keyboard for input, enabling its entry into the information age. Simultaneously, the second crisis of romanization for Chinese characters was successfully addressed.

4.3. The third wave of Chinese character crisis

It is worth noting that the first two crises, despite being prominent, were largely confined to the academic sphere, proposed and debated primarily by intellectuals and professionals. Both initiatives were driven by a sense of national shame and a demand for rapid prosperity from the elite class. The general public remained largely unaffected throughout these two “revolutions.” For example, during the May Fourth revolution, about 90% of the Chinese population was illiterate and uninterested in linguistic reforms. Similarly, in the 1980s and 1990s, computers were still a luxury beyond the reach of the common people, and there was no perceived urgency for Chinese character romanization among them.

In contrast, the present-day third crisis facing Chinese writing system is grassroots-driven, characterized by its pervasive, silent, and gradual nature, steadily spreading. What was once a political concern has now evolved into a practical challenge. A century later, the unachieved Latinization goal may gradually undermine Chinese characters in the era of digital writing/typing. With the increasing digitization of technology and diminishing reliance on handwriting, Chinese characters and the cultural nuances they carry may slowly lose relevance as more Chinese individuals and learners of the language opt for digital communication methods. While some lament the potential loss of cultural richness, many in China adopt a pragmatic stance regarding the Chinese language, prioritizing efficiency over sentimentality. Ming Zhou, a Microsoft researcher specializing in advanced digital input systems, asserts that "when culture and speed come into conflict, speed wins." He acknowledges that the advancements in his research may accelerate the process of people

forgetting how to write (Lee, 2001). This notion of sacrificing elements of cultural heritage embodied in written Chinese for enhanced global competitiveness has resurfaced, now in a broader context and garnering support from a larger segment of the population, whether consciously or inadvertently, posing the most significant challenge to Chinese writing system to date.

4.3.1. The future of Chinese characters overseas is increasingly precarious

Norman (1988) believes that Chinese characters "play such an important role in Chinese cultural identity that it would take an almost superhuman effort to dislodge them after almost 4000 years of hegemony" His claim was of course backed by linguistic research, and the resolution of the preceding two Chinese character crises lent support to Jerry Norman's rationale in this instance. However, this deduction was formulated in the 1980s, and at that point, no one could anticipate the myriad challenges that the Information Era would present to Chinese characters today, let alone make predictions about the circumstances of Chinese language education and learning abroad.

As indicated by a survey conducted by the author at her educational institution, over half of advanced Chinese language students believe that Chinese characters could potentially be supplanted by Pinyin. One student taking a Chinese linguistics class pointed out, "The slow, gradual process of 'linguistic evolution' in the competitive global arena could lead to the extinction of a written language like Chinese. Similar to Ancient Egyptian hieroglyphs, which were logographic in form, the Chinese written language might not withstand the test of time and cultural competition, eventually becoming part of ancient history. Due to the complexity of the Chinese script and the widespread use of digital input systems like Pinyin, the cherished symbol of Chinese identity may one day become a relic."

For second-language Chinese learners, their connection to Chinese characters is weaker compared to Chinese native speakers, lacking a sense of cultural identity and familiarity, which makes the substitution of characters by Pinyin more cost-effective. Stepping into the shoes of those second-language learners allows us to comprehend their diverse cultural perspectives on language and writing. In alphabetic languages like English,

writing and language are intertwined, with written language serving merely as a carrier of speech sounds. In contrast, Chinese characters consistently hold a transcendent status in Chinese, with writing enjoying a higher cultural standing than spoken language. Over millennia of Chinese language development, there has always been a prioritization of written over spoken language, creating a situation where the study of Chinese characters (漢字學) almost parallels the field of linguistics (語言學). The disparity in status between written and spoken language is also evident in the creation myths of the two cultures regarding the origin of language. While the Tower of Babel myth discusses initial human languages clearly referring to speech, the Chinese myth of Cangjie's creation of characters emphasizes writing symbols.

As a result, students whose mother tongue is alphabetic, and who did not grow up in an environment saturated with Chinese characters, tend to view characters merely as tools for recording oral language. While some advanced students may find abstract aesthetic value in learning Chinese characters, lacking a profound understanding and connection with Chinese civilization might hinder their grasp of the historical and cultural significance of Chinese characters. As a result, their perspective on Chinese characters tends to be more radical than that of native speakers. Many of them express a positive outlook on the potential replacement or extinction of Chinese characters, viewing these writing symbols as mere tools for recording language.

4.4. Are Chinese characters merely replaceable tools?

The “tool theory” of Chinese characters gained popularity among advocates of language reform as early as the 20th century. The notion of “instrumentalism” likely prevailed among language reform advocates. In 1918, Xuantong Qian, in his essay “Reply to Lügong Tao's discussion on Esperanto,” expressed the concept that writing is just like measures, calendars, currency, etc. He argued, “The more unified the symbols, the less mental effort is needed[9].” (Qian, 1999)

[9] 錢玄同，〈答陶履恭論 Esperanto〉:「玄同對於文字之觀念，以為與度量衡，紀年，貨幣等等相同，

A century later, Xiaoming Zhang, Deputy Director of the Cultural Research Center at the Chinese Academy of Social Sciences, also believes that the essential functions of writing are recording, dissemination, and communication. In his view, from the brush to the ballpoint pen, the evolution of writing tools aims to make writing more convenient and efficient, enabling more people to engage in writing and communication. In the era of keyboards, the changes take a different course, where more convenient and efficient input methods replace traditional writing means. In fact, not only in the realm of writing but also in various fields, similar changes are observed. With the development of society and technological progress, many means of livelihood for human beings have transformed into artistic pursuits for a select few. In the future, writing might become a way for self-cultivation only[10].

However, treating language and writing as equivalent to measures oversimplifies humanity's most complex communication tool. Is it possible for a nation's language to be entirely divorced from its cultural history? In terms of functionality, writing may seem like a mere carrier or tool. Nevertheless, concerning its historical background, writing reflects language and acts as a vessel for a nation’s culture and history. The connection between writing and the content it conveys is inseparable and integral. Starting from ancient times when the Chinese written language originated on tortoise shells and oracle bones, through the Spring and Autumn period reflecting societal upheavals, the standardization during the Qin dynasty for national unity, the flourishing calligraphy and poetry during the Tang dynasty, to China's recent global presence with simplification for effective communication, written Chinese has been a defining element of Chinese culture. The logographic Chinese script, carrying millennia of history, stands as a cherished aspect of Chinese identity. It serves as the cohesive force that unites the diverse regions of China, preventing the

符號愈統一，則愈可少勞腦筋也。」

[10] People.cn (October 9th, 2014): During the early years of the Republic of China, some people proposed "abolishing Chinese characters," and Sinian Fu advocated replacing them with pinyin (民國初曾有人提出「廢滅漢字」，傅斯年主張使用拼音替代). Retrieved December 20, 2023, from https://www.chinanews.com.cn/cul/2014/10-09/6659716.shtml

fragmentation of dialects into separate languages, akin to the fate of Latin and its modern European descendants (Norman, 1988). Samuel Wells Williams, a sinologist and missionary to China has also noted the importance of Chinese characters. In his book "the Middle Kingdom", which has been widely considered the start of sinology study in the US, he wrote: "… owing to the partial communication between distant parts of so great a country and mass of people (Williams, 1848). That it is evident, if this bond of union was removed by the substitution of an alphabetical language, the Chinese would soon be split into many small nations, as is the case in India." Here "this bond of union" clearly refers to the Chinese writing system, representing far more than a mere tool for the over 1.4 billion Chinese speakers worldwide today.

5. Strategies to safeguard the continuity of Chinese writing

The way in which Pinyin has affected the Chinese language is a two-edged sword. The very thing that is keeping the Chinese language as a whole alive and competitive in an increasingly globalized digital age could eventually lead to the disappearance of the age-old elegant script and the cultural treasures it contains. The same script, which is independent of sound and at one time helped to preserve the unity of China, is now at risk of disappearing in the age of Romanization and voice-activation, which deems the complicated writing system superfluous. In this day and age, economic competition and instant communication outweigh the need to preserve the beautiful Chinese script. The trend is toward the gradual loss of the Chinese written language for the sake of convenience and economic productivity.

The Chinese government has been proactive in addressing this trend, implementing measures domestically and internationally to promote the Chinese language. In 2011, the Ministry of Education mandated all primary schools to conduct a calligraphy class weekly (Zhu, 2013). Additionally, China Central Television (CCTV) introduced the Chinese Characters Dictation Competition, comparable to a spelling bee, to reignite interest in characters (Shi, 2013). Since 2004, China has established numerous Confucius Institutes globally, serving as ambassadors to advocate for Chinese language and culture in foreign

universities (Confucius Institute, 2014). However, with its recent delinking from the world and economic downturn due to COVID-19, its future global influence becomes uncertain and less apparent, which will inevitably impact the status of overseas Chinese language education and learning. According to the most recent Modern Language Association (MLA) report on foreign language enrollment in the US, Chinese Mandarin programs in the US have declined by 105 in the five years from 2016 to 2021. Moreover, its enrollment witnessed a 14.3% decrease, compared to a smaller 4.3% drop in Japanese and a notable 38% increase in Korean, the other two commonly taught Asian languages in the United States (Modern Language Association of America, 2023).

Amidst the broader decline in foreign language learning and humanity in general, there is a noticeable trend where some Chinese language educators, aiming to sustain enrollment, have eased the entry into learning Chinese by promoting keyboard Pinyin typing. Certain researchers in Chinese language studies consider Pinyin typing a "gamechanger" (for example, see Zhang, 2021), offering a fundamentally different approach to Chinese characters pedagogy for beginners of Chinese as a Foreign Language (CFL). While it's acknowledged that Pinyin input facilitates rapid acquisition of vocabulary and diverse sentence structures for novices, the importance of handwriting Chinese characters persists in the context of long-term Chinese language learning.

Concerning curriculum design, it is advisable for introductory and intermediate Chinese courses to prioritize Pinyin or Zhuyin typing, supplemented by character recognition and reading components. This approach aids in nurturing and sustaining students' interest in Chinese language acquisition. As students progress to advanced levels, incorporating courses like Chinese character studies and calligraphy becomes crucial to reinforce handwriting skills. Chinese character courses delve into etymology and the construction of characters, offering theoretical insights and a broader understanding. Additionally, calligraphy courses not only introduce the historical and aesthetic value of Chinese calligraphy but also provide advantages like slow-paced and magnified writing, contributing to enhanced muscle memory and hand-eye coordination to further fostering more profound cognitive abilities acquired by native speakers of Chinese. In the United States, where tablets and digital assignments are prevalent tools for elementary and middle

school Chinese learners, it is recommended to introduce Pinyin or Zhuyin typing as the primary teaching and learning method. Additionally, incorporating a weekly tracing exercise and calligraphy class involving handwriting can further enhance children's cognitive development related to orthographic language learning.

More significantly, in the realm of educational philosophy, it is imperative for Chinese language instructors abroad to articulate two key points. Firstly, in the Artificial Intelligence Era, with the escalating prevalence widespread adoption of swift and cost-effective machine translation, individuals possessing only rudimentary language proficiency will find diminished demand in the job market. Consequently, the ultimate goal of language education lies in fostering global citizens rather than mere basic language skills. Beyond the foundational language competencies, the cultivation of cultural awareness and adeptness in cross-cultural communication takes precedence. This integral aspect cannot be divorced from the educational focus on Chinese writing system, which embody the profound culture and history of Chinese civilization.

Furthermore, we need more empirical studies in cognitive linguistics and neuro-linguistics, utilizing refined methods like eye-tracking and fMRI, to assess the influence of electronic input compared to handwritten Chinese characters on precise literacy skills and cognitive functions. Additionally, given the contemporary trend of short videos progressively supplanting text reading, it is crucial to explore the potential consequences of the diminishing engagement in handwriting Chinese characters and in reading them on cognitive abilities.

In summary, Pinyin has proven to be a valuable tool, playing an active role since its inception. It has contributed to standardizing pronunciation, facilitating effective communication in China, boosting literacy rates, and overcoming the challenges of handwritten Chinese to maintain China's competitiveness in the digital era. However, its role in hindering comprehensive character learning poses a threat to the rich cultural heritage embedded in the characters, which encapsulate much of China's history and culture. Additionally, the Pinyin system can have adverse effects on the reading development of Chinese children, contribute to language attrition in adults, and lead to negative native language transfer in second language learners of Chinese.

While the Chinese language has successfully navigated political and technological challenges over the past century, a significant third wave of the Chinese characters crisis is unfolding. The advantages of digital communication may come at the expense of proficient learning of written Chinese, potentially leading to the demise of Chinese characters. Essential measures, including considerations for typing input choices, curriculum design, and the philosophy of Chinese language teaching, should be taken into account to preserve this millennia-old, continuously passed down, and culturally rich treasure of traditional Chinese characters.

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劉念 Nian Liu
奧克拉荷馬大學現代語言文學及語言學系
Department of Modern Languages, Literautres, and Linguistcs
University of Oklahoma
nian.liu@ou.edu
TEL: +1-405-325-6181

數位時代的變革：拼音和漢字在語言和文化演進中的歷史影響與當代挑戰

劉念

奧克拉荷馬大學

摘要

本文考察了漢語拼音自誕生一個多世紀以來，在漢字以及華語文化的發展進程中，尤其是上世紀兩次「漢字危機」所起到的作用。一方面，拼音對於規範華語發音、提高識字率、為海外華語學習者提供直觀便利的工具，並幫助華語順利進入數字時代，從而為華語走向世界架起一道橋梁。但同時，對於拼音的依賴也會造成負面影響，包括影響母語兒童的閱讀能力、造成提筆忘字的普遍現象，以及對於拼音為母語的華語學習者造成不利的母語遷移影響。此外，本文還引入最新的認知語言學研究，審視日漸普遍的拼音輸入和手寫漢字減少對語言使用者認知能力的潛在影響。隨著鍵盤時代和人工智能的到來，做為世界上唯一廣泛使用的表意文字，漢字的延續正在經歷又一次深刻而廣泛的挑戰。華語言工作者有必要重新審視對於拼音這一工具的使用，釐清語言教學的宗旨與目標，以確保文字、歷史和文化在數位時代變革中的延續和發展。

關鍵詞：拼音、漢字、數位時代、語言習得、文化保護