Teaching characters effectively within a mandarin curriculum
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Introduction

Learning to write the Chinese script is generally experienced as challenging by Chinese as a second language (L2) learners (Knell and West 2017: 519). As I am myself a learner of Chinese as a second language, with Dutch as my native language, I have experienced that it is very much a challenge to start learning Chinese. It was especially hard to learn how to write and remember characters, because it is so very different from an alphabetic script. When I was learning Chinese, I spent hours and hours practising, handwriting and remembering characters. I used my laptop and used a website that showed the characters and their translation, which in turn I could write down on a paper to practise them and to remember them. This took up a lot of my time every week.

During my studies and after, I experienced that I was no longer able to write some characters that I was able to write before. However, I did not know there was a specific term to describe this. When I was doing research for my thesis and searching for articles that addressed learning to write characters, I came across the term 'character amnesia'. One experiences this when one is not able to recall the written form of a part of, or a whole character that one was able to handwrite at a time. According to Almog (2019), the term character amnesia was used for the first time in 2010 on a language blog named 'Language Log' (Almog 2019: 693). In that post, some English articles are mentioned that are written about native speakers of Chinese that have difficulty in their ability to write characters by hand due to using digital devices like mobile phones and computers (Almog 2017: 693).

According to Almog (2019), increasingly more speakers of Chinese 'have been reporting that their ability to handwrite Chinese characters has been steadily diminishing, a phenomenon which is most likely a result of the growing reliance upon digital technologies' (Almog 2019: 524). This phenomenon of character amnesia can also be called the 'it's on the tip of my pen' state, which is a form of a phenomenon many people might know as 'it's on the tip of my tongue' (Almog 2019: 691). In Chinese media, certain words are used when writing or talking about character amnesia, for example the word 提笔忘字 *tí bǐ wàng zì* that means

'pick up the brush and forget character' and 电脑失写症 *Diànnǎo shī xiě zhèng* which means 'computer agraphia' (Almog 2019: 696).

According to Almog (2019), the discourse in media around the phenomenon character amnesia, with newspaper articles including studies about this, reached a peak in 2013 and in China overall is seen as an 'alarming' phenomenon (Almog 2019: 693-694). In recent years, from 2020 until 2023, studies have been done into the phenomenon of character amnesia that native Chinese people can experience. As I experienced the phenomenon of character amnesia myself, I think this phenomenon does not only occur for natives, but also occurs for Chinese as a second language learners.

This phenomenon, forgetting how to write characters, brings up many interesting questions: Should one spend time on learning characters at all? If yes, how much time should one spend on learning to handwrite characters? And if one does decide to teach or learn characters, what is the best moment to start learning them? What factors influence remembering or forgetting characters? What is the best and most effective method to learn characters? Is that handwriting characters or typing them on digital devices?

During recent years of digitalization worldwide, the use of digital devices as laptops, tablets and mobile phones has increased, and the need for handwriting in general has become smaller and smaller. As I am born in 1997, I have grown up during the development of digitalization. During primary school, we used P.C's to practice math on a weekly basis, when I was around 13 years old, I had my first smartphone with touchscreen and finally, during my time at university my laptop and mobile phone were with me everyday. The fact that digital devices have become such an important part of daily life raises the question what impact the use of digital devices and typing, in contrast to writing, have on the process of learning characters. It brings up the question if handwriting characters is necessary at all. If typing the characters appears to be useful, how could typing characters be integrated within a Mandarin curriculum effectively?

As a Chinese language and culture teacher in middle school, I see that students struggle while trying to learn how to handwrite and remember characters. Also, there is relatively little time for Chinese in the curriculum which makes it important to look at how much time to put into teaching characters and how to effectively teach them.

To summarize, my own experience of learning Chinese, my experience with character amnesia, digitalization and my practical experience of teaching Mandarin has made me want to look into the factors that influence the phenomenon of character amnesia, the process of learning characters and to connect the different perspectives on these matters to find out how to effectively teach and learn the writing and remembering of characters. The questions will be addressed by looking into and combining several research articles about these topics. Lastly, the conclusion will summarize the findings of the articles and give advice on how to teach characters effectively.

1. Characters

The Chinese script is different from the Latin script. The Latin script is an alphabet, the Chinese script, however, is not. Letters from an alphabet represent individual sounds. One can read a letter like the 'S' and one can know how to pronounce it. Furthermore, an individual letter has no meaning. The word 'I', of course, can have the meaning of 'me, myself', but when reading the letter in different words, the letter has no meaning itself. A Chinese character, however, does not directly indicate what the pronunciation should be. A character represents a morpheme, which is a unit of language with meaning that cannot be further divided (Wiedenhof, 2015: 372). An example of a morpheme is *un-*, as in *undesirable*, which means *not*. Sometimes, a morpheme is a word by itself, like *not*. In other cases, a word consists of several morphemes, like *seawater* consisting of *sea* and *water*. An example of a Chinese morpheme is 现 *xiàn*, which means 'present' and is used in combination with other morphemes to form words, like the word 现在 *xiànzài* which means 'now'. Most words in Chinese consist of two morphemes. However, there are also words that consist of one morpheme, like 树 *shù* 'tree'. A difference to be aware of, is that a word is a unit of language, a character is a unit of script.

A Chinese character contains one component or is a composition of more components, which in turn are composed of strokes. The components are combined to fit into a rectangle which then form a character. In Figure 1 a character built of two components is illustrated, component 十 *shí* 'ten' and 口 *kǒu* 'mouth', combined to be 古 *gǔ* 'ancient, old'.
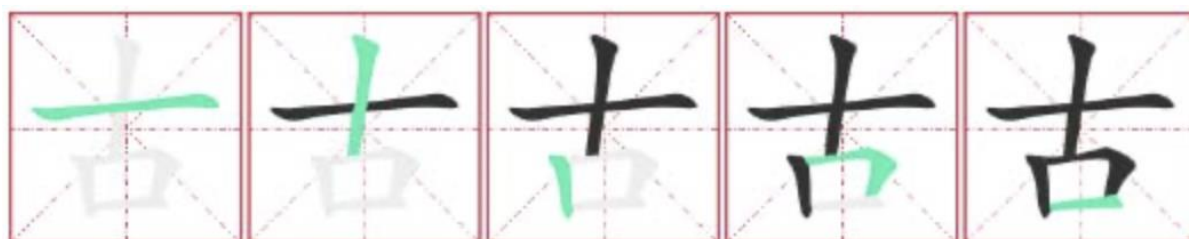

Figure 1, (China educenter: 2024).

Another example is illustrated in Figure 2. We see several strokes that form two components, component 女 *nǚ* 'woman' and 子 *zǐ* 'child' combined to form the character 好 *hǎo* 'good'. Components are often referred to as radicals.

Figure 2, (China educenter: 2024).

A component of a character can indicate either the meaning of the word, also referred to as the semantics, or the sound, also referred to as the phonetics. If a character is composed of two different components, then, in most cases, one of them gives an indication of the semantics and the other one of the phonetics. Most of the time the orthography of a character does not clearly indicate the sound or the meaning. Furthermore, different morphemes with the same sound can have different orthography (Huang et al 2021: 1498). For example, 是 *shì* 'to be' and 事 *shì* 'matter, affair'. Also, one character can have multiple pronunciations. An example is 长 which can be read as *cháng* 'long' or *zhǎng* 'to grow'.

An example of a character with two components is 妈 *mā* 'mother' which is built of the semantic component 女 *nǚ* 'female' and the phonetic component 马 *mǎ* 'horse'. In addition to 妈 *mā*, Chen and Feng (2020) mention the characters 姐 *jiě* 'elder sister', and 妹 *mèi* 'younger sister' that have the same radical 女 *nǚ* 'female' and their meaning is connected to the meaning of 'female' (Chen and Feng 2020: 1). Another example is 江 *jiāng* 'river'. This character is built of the semantic component 氵 *shuǐ* 'water' and rivers fall into this category. And it is built of the phonetic component 工 *gōng* 'labor' (Wiedenhof, 2015: 379). In 江 *jiāng*

'river' the phonetic component is not obvious for the modern ear.

Most characters are composed of a phonetic and a semantic indicator, however, not all characters can be analyzed this way. Chen and Feng (2020) point to the fact that radicals do not always provide predictable information about the meaning of a character (Chen and Feng 2020: 1). Radicals can be unrelated to or indirectly related to the meaning because the meanings of characters have changed over the centuries (Chen and Feng 2020: 1). Chen and Feng (2020) refer to characters that contain radicals that are unrelated or indirectly related to the meaning of the character as nontransparent characters. Chen and Feng (2020) studied the relationship between the radical-awareness, character knowledge and the meaning retention for nontransparent characters of second language learners.

An example of a nontransparent character is 淑 *shū* 'kind and gentle' with radical 氵 *shuǐ* 'water' (Chen 2020: 2). The meaning is not directly related to water. Transparent characters, however, have a direct link between the radical and the meaning of the character. Chen (2020) mentions that the radical 女 nǚ 'female' is transparent in "妈" mā 'mother' and nontransparent in 婿 xù 'the daughters' husband' (Chen and Feng 2020: 2). In addition, it is not possible to know in advance if a component is a semantic indicator or phonetic indicator (Wiedenhof 2015: 374). However, there are characters that look like the meaning of the character. For example, 火 *huǒ* 'fire'.

Besides characters, the Chinese language can also be written with Latin letters. The most commonly used system to write the pronunciation of Mandarin with the Latin script is called pinyin. Pinyin is useful for learning the pronunciation of the characters to foreign Mandarin language learners (Lee et al 2011: 1104).

Now that it is clear what characters are built of, we will use the next section to look into the writing of characters by hand, and whether it is necessary. If it is, when would be the best moment to start learning them, which characters should be learned and what is the most effective method to learn characters?

H2. Learning and writing characters: if, when, how and which to learn?

2.1 Necessity of characters

2.1.1 Is it necessary to continue to use characters and to write characters by hand?

When discussing the necessity of writing characters by hand when writing Chinese, one can look at how people feel about characters. Chinese sources about character amnesia can be a point to see what the general attitude is in China towards characters.

According to Huang et al (2021), digitalization and typing on digital devices as a form of communication is seen as the biggest factor of influence on character amnesia because typing replaced a major part of writing by hand (Huang 2021: 2). Overall, character amnesia is seen as a negative phenomenon by Chinese sources. According to Almog (2018), it is seen as a cause of a so-called 'Chinese character crisis' and as a danger to Chinese culture (Almog 2018: 695). In China, it is often referred to as a 'problem', 'embarrassment' or even an 'illness that one might contract' (Almog 2018: 695). So, according to Almog (2018), in many sources character amnesia is viewed as a crisis to deal with (Almog 2018: 698).

According to this Chinese perspective on character amnesia, one could say that it is felt to be necessary and important to learn how to write characters by hand, how to read characters and for them to be preserved. However, on what research and arguments are these feelings and perspectives based? Are these arguments relevant when deciding whether or not to maintain Chinese characters and if writing the characters by hand is necessary?

Almog (2019) suggests that a lot of research on character amnesia claims that people are not able to write common words and Almog points out that this is not always based on reliable and valid empirical data (Almog 2019: 526). According to Almog (2019), a problem with findings of certain studies is, for example, that these studies test the ability to handwrite uncommon characters instead of common characters (Almog 2019: 526). So, character amnesia might not be as big a problem as it is portrayed to be. In Almog (2018), several arguments for the negative portrayal of character amnesia as a crisis are named and

evaluated to see if character amnesia is as big a problem as it looks and to see if digitalization indeed has a bad influence on literacy.

One example presented in Almog (2018) is the often used historical-cultural continuity argument (Almog 2018: 701). This is used to reason that character amnesia disrupts an age-old practice of writing characters and that the ancient script should be preserved as an important part of Chinese culture (Almog 2018: 701,702). Although many people strongly agree with this, according to Almog it is not a very strong argument. He points out that 'the fact that something is, and has been done for a long time, does not necessarily mean that it should or should not continue to be done' (Almog 2018: 703). He also adds that Chinese characters have not been as continuous as one might think because characters and their shapes, sounds and meanings have transformed over the years (Almog 2018: 703).

Besides countering this historical-cultural continuity argument, he raises the fact that in China literacy rates have highly increased over the past decades and people are writing and reading more than they have ever done (Almog 2018: 705). Although digitalization and typing characters in recent years have been blamed for decreased literacy, he brings up that characters too have been blamed for the high illiteracy rates in China (Almog 2018:706). He elaborates on this by stating that by using computers, people use more characters instead of fewer (Almog 2018: 705). He points out that the government of China in 2013 increased the number of characters in the 'list of Standard Chinese Characters for common use' from 7000 to 8105 characters (Almog 2018: 706). So, according to Almog (2019), digitalization and typing of characters has had no negative impact on literacy in China.

Furthermore, Almog (2019) writes that there have been discussions during reform in China about replacing the characters by a phonetic script (Almog 2018: 707). However, one could argue that many words in Mandarin are pronunced the same but have a different meaning, for example 叫 *jiào* 'name, call' and 较 *jiào* 'to teach', which can make using only a phonetic script like pinyin quite difficult. The characters can be more easily distinguished

than written phonetics.

To summarize, based on articles about character amnesia, maintaining the use of characters and writing characters by hand is felt to be necessary in China. Digitalization and typing is felt to have a negative impact on this. However, based on Almog (2019) one could argue that writing fewer characters by hand and instead typing them on digital devices, might not be as bad of a development as it might feel for certain people. According to Almog (2019), digitalization has not had a negative influence on literacy rates in China. In chapter 5 we will look further into the effects of writing by hand and typing on the learning process. Now that we have looked at the necessity of writing characters by hand for natives in China, we will look at whether or not it is necessary to teach characters to L2 learners of Mandarin.

2.1.2 Is it necessary to learn to read and write characters when learning it as a second language?

When learning Mandarin as a second language, one could ask oneself if it is necessary to learn characters at all. As mentioned in section 2.1.1, one can argue that it is necessary to learn to read characters because reading a phonetic script like pinyin can be difficult because several characters in Mandarin share the same pronunciation. Furthermore, one can argue that in China characters are used in daily life, on buses and buildings, on the news and on menus in restaurants. So, learning to read characters has a practical advantage when visiting China. In addition, Chinese documents written by Chinese people are also written in characters and not pinyin for example. So, when one would learn Chinese to read Chinese documents for work, one would also need to read characters. So, it would be very impractical to not be able to read characters and thus necessary to read them.

Writing characters by hand, however, can be argued to be not as necessary as reading characters. Firstly, because of digitalization one can argue that one does not need to be able to write characters by hand because one can type characters on digital devices. Secondly, when one has a job for which one reads articles or documents in Chinese, it would

not be necessary to write them by hand for the job. Also, when being in China, it can be handy to write characters by hand, but it is not necessary because one can use digital devices and translation apps that show a character or that show how a character can be written, when needed. However, according to Almog (2019), overall in China the decrease of writing characters by hand is regarded as a 'crisis' and a 'danger to Chinese culture'. Learning how to write characters can be a way of showing respect for Chinese culture and tradition.

So, we can argue that, when learning Mandarin as a second language, it is more practical to focus on reading characters than on writing them. Writing characters, however, seems to be felt as an important part of Chinese culture to Chinese people, so from a cultural perspective one can argue that writing characters can be a nice addition to one's skillset when learning Chinese as a second language. Now we have determined that characters have a place in the Chinese as a second language curriculum, although practically seen not an important place. In the next section we will look at when to introduce the characters in the learning process.

2.2 When should one introduce characters in the curriculum?

When one teaches Mandarin, one can ask oneself when to start introducing characters. Over the years there has been discussion about whether or not to delay character instruction. The few different studies that have been done, came to different conclusions but also had different participants and procedures (Cameron 2019: 3). There are two didactical approaches, one that delays instruction of characters (DCI/DI) and one that immediately introduces character instruction (ICI/EI).

In Ye (2013) it is stated that DCI is based on the 'primacy of speech theory' that supports the idea that in any language a child that grows up learns to write after it learns to speak (Ye 2013: 611). Ye (2013) also states that 'a solid foundation in speaking is the best insurance that students will make steady progress in reading' (Ye 2013: 611). The research in the article supports this and found that students of Chinese as a second language 'who

were in control of spoken language patterns were able to move ahead in vocabulary expansion and reading competence more rapidly and easily than those who did not have a good foundation in the patterns of the language' (Ye 2013: 611). In this article experimental studies are included that indicate that students benefit from DCI by using pinyin as a substitute for characters in the meantime. It is hypothesized that this could be due to the alphabetic system the foreign students rely on. Ye (2013) states that in the beginning of learning Chinese, pinyin can facilitate reading comprehension (Ye 2013: 612). So, Ye (2013) recommends spending more time on speaking and listening in the beginning to create a solid foundation in these skills, which in turn can have a positive effect on making progress in reading competence.

In addition, Ye (2013) mentions an article of Swihart (2004) that suggests creating a strong foundation in listening and speaking before starting to read and write characters (Ye 2013: 611). Also, according to Ye (2013), Dew (2005) states that it is important to gain a strong foundation in the language before focusing on recognizing characters (Ye 2013: 611). Dew argues that Chinese children first learn to listen and speak for 5 or 6 years before they learn to write characters at school. Also, Dew states that 'CFL learners would learn the sound system, grammar, and vocabulary better if these tasks were separated from the task of reading and writing characters' (Ye 2013: 611). Lastly, Dew found that 'students who had gained firm control of spoken language patterns were able to move ahead in vocabulary expansion and reading competence more rapidly and easily than those who did not have a good foundation in the patterns of the language".

Furthermore, Ye (2013) states that several researchers agree that the perception of a student of the difficulty of learning a language has an impact on 'attitude, motivation and behavior which can hinder or facilitate the learning process' (Ye 2013: 612). Writing Chinese characters is relatively difficult for L2 learners in comparison to writing words on the basis of the alphabet (Cameron 2019: 1). This can create feelings of frustration and feelings of being overwhelmed. Ye as well as Knell and West indicate that these feelings of frustration can be an obstacle in learning Chinese as a second language because it can decrease motivation

(Ye 2013:613, Knell and West 2017: 520).

A study from Packard (1990) is included in Knell's article about the effect of DCI on student progression in learning Mandarin and confirms outcomes of Ye (2013). One group started learning characters right away (the ICI group) and the other group started learning characters after three weeks, while the oral instruction was the same for both groups (Knell and West 2017: 521). In these three weeks the ICI group was taught 75 characters, however, the DCI group caught up on these characters at a faster speed later in the semester (Knell and West 2017: 521). It was concluded that delayed instruction had a positive effect on the oral language fluency of the students, whereas there was no negative effect on their reading and writing of characters (Knell and West 2017: 521). However, one can also argue that three weeks of time is not a very long time to take as delay in learning characters and that the effect might not be of much influence on the learning process. In contrast, Knell and West (2017) did their own research similar to that of Packard which came to different conclusions than Ye (2013). Their study was focused on middle school students with no prior knowledge of the Chinese language and the period of delayed character instruction was three-and-a-half months. During that time, all the students that participated covered the same content, exercises and learning procedures during the character instruction. The early instruction group, however, learned to read and write more or less 65 characters and had more time of character instruction (Knell and West 2017: 523). The early group had 30 hours of instruction, whereas the delayed group had about 20 hours of instruction (Krashen 2017: 829). After the three-and-a-half months, the delayed instruction group started to learn characters at a somewhat accelerated rate. In the end of the school year, the EI group had learned 131 characters and the DI group had learned 100 characters.

Knell and West (2017) compared the two groups on oral fluency, character recognition, reading comprehension and character writing. There was found no significant difference between the EI and DI groups on oral fluency (Knell and West 2017: 526). Knell and West (2017) indicate that the learning of written characters had not disadvantaged the oral speech of the EI group (Knell and West 2017: 528). With regard to character

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recognition, no significant differences were found between the two groups. However, it was found that the EI group scored better on reading comprehension than the DI group. In addition to this, outcomes of a writing test suggests that the EI group, in contrast to the DI group, was better at writing characters and sentences accurately (Knell and West 2017: 528). Knell and West (2017: 528) suggest that this could be due to the additional time the students had to practice the orthography of the characters.   They conclude by suggesting that oral as well as written Chinese can be 'mutually reinforcing' when integrating speaking, listening, writing and reading, stating that 'orthographic form should always be explicitly linked to meaning and pronunciation' (Knell and West 2017: 529). Knell and West suggest that characters are taught best when there is time to learn a small number of characters, for example two to four characters each lesson, a scaffolded approach, on the tempo that fits the students (Knell and West 2017: 530).

So, according to this study, DI has no significant positive influence on learning Chinese whereas EI has a positive impact on reading and writing while it had no negative effect on oral fluency and character recognition. However, Krashen (2017) notes that the advantage of the early group might be due to the total of instructional hours that was more than the delayed group (Krashen 2017: 830). Krashen (2017) suggests that the delayed group was as efficient as the early group with fewer hours of instruction and that one could do a study where the delayed group has one semester without character instruction and three semesters with 20 hours of instruction to see if the effect of delayed instruction with the same total of hours of instruction (Krashen 2017: 830).

In addition, Osborne et al (2018) report on a study into several teaching methods for introducing characters in learning Chinese as a second language, from which one was DCI. The delayed group started learning characters after 4 weeks. DCI did not show a significant positive effect on character learning. It was found that after introducing the characters, accuracy of pinyin knowledge decreased significantly (Osborne 2018: 292).

To conclude, on the basis of the studies reviewed in this section, one can argue that delayed character instruction has not been proven to be effective, and that several studies disagree about whether or not to delay character instruction. There are studies that argue in favor of building a strong foundation in listening and speaking before starting to learn reading and writing and studies that show delayed instruction to not be effective. According to Knell and West, DCI is not more effective than EI. According to them, it is effective to start teaching characters right away and they suggest teaching a small amount of characters per lesson in a 'slow and highly scaffolded manner' in addition to integrating speaking, listening, reading and writing. Also, some argue that delaying character instruction is important for student motivation and the learning process to try to take away frustration about learning to write and remember characters in the first part of their language learning journey. So, the answer to the question, to delay or not delay character instruction, remains unclear.

2.3 How should one teach how to write and remember characters?

In the previous section we had a look at when to introduce character instruction. It was mentioned that it is useful for student motivation and their learning process to take away frustration about learning to write and remember characters. In this section we will look at how to do this and we will look into effective ways to instruct characters by creating radical-awareness.

One method to learn characters is by focusing on radicals. Radicals are the components in a character, as was discussed in chapter 2. Knell and West (2017) mention several articles that suggest that identifying radicals supports character learning (Knell and West 2017: 528). Zhang et al. (2016) indicate that there are around 200 semantic radicals and 800 phonetic radicals (Zhang et al. 2016: 523). As discussed in chapter 2, characters with the same semantic radical can, broadly speaking, fall within one and the same semantic category. It can be useful to be aware of characters that fall within the same category. With regard to this, Chen et al mention the term 'radical awareness', which is when a student understands the role of semantic radicals and is able to identify them in a character (Chen et

al 2020: 1).

Chen et al. mention that several studies support the idea that radicals and radical awareness can support character learning for Chinese as a second language learners with regard to recognition and retention (Chen et al 2020: 1,2). Chen et al (2020) studied the relationship between the radical-awareness, character knowledge and the meaning retention for nontransparent characters of L2 learners (see chapter 2). Furthermore, Chen et al. (2020) state that 'there are around 58% of transparent characters and 42% of nontransparent characters among 2,570 Chinese characters explicitly taught in Chinese elementary schools' (Chen et al 2020: 2).

With regard to the learning process, Chen et al. (2020) indicate that L2 learners cannot memorize a character by linking it to the meaning of the radical (Chen et al 2020: 7). It is stated that their radical awareness has no direct influence on the meaning retention for nontransparent characters because the meanings of the radicals are not directly related to the meaning of the character (Chen et al 2020: 7). Also, the article suggests it can be more effective to memorize a nontransparent character as one unit (Chen et al. 2020: 9). The article gives the following concrete example of how to do this. When learning 妈 *mā* 'mother', 姐 *jiě* 'elder sister' and 妹 *mèi* 'younger sister', students can train segmenting and analyzing new characters that share the same radical, like the transparent character 姨 *yí* 'aunt' and the nontransparent character 婿 *xù* 'son-in-law' (Chen et al 2020: 8).

In addition, Xu et al (2014) also give concrete examples on how to instruct characters. The article proposes that when one teaches a character, one can refer to characters that share radicals in previous and upcoming lessons (Xu et al. 2014: 789). Xu et al (2014) give the example of teaching the character 时 *shí* 'time' and connect characters that share the radical and meaning of 日 *rì* 'sun, day' in the same position in the character. A teacher can review and preview characters like 晚 *wǎn* 'evening, late', 昨 *zuó* 'yesterday' and 明 *míng* 'tomorrow' and add a character like 星 *xīng* 'star' with the radical in a different position (Xu et al. 2014: 789). The article notes that often textbook lessons are based on

themes so it can be a challenge for the teacher to present the characters that share radicals together in class (Xu et al. 2014: 789). Moreover, it is pointed out that one can develop knowledge about character orthography through context, like through reading a short text that contains a group of characters that share a radical (Xu et al. 2014: 789). These texts can be used as supplementary text to the textbook. Lastly, this research supports the positive effect of textbook exercises that let students 'recycle learned characters by grouping them based on shared radicals or by making radical-based meaning inferences in unfamiliar characters' (Xu et al. 2014: 789).

Furthermore, Nguyen et al (2017) did a study into the effect of radical instruction on character recognition. Two groups of students received one 90-minute radical instruction about twelve radicals and the function of radicals, the control group did not receive this lesson (Nguyen et al 2017: 7). There was found a positive effect of radical instruction on finding the meaning of unfamiliar characters when reading a text (Nguyen et al 2017: 9). Lastly, Knell and West (2017: 529) mention the positive impact of multi-sensory learning on memorization. This means using more than one sense when learning, for example seeing, hearing, touching. An example of this is 'visual haptic training', mentioned by Huang et al (2021). Huang et al (2021) indicate that people benefit from visual haptic training during language learning. This is a way of teaching where one is taught to run the finger along the outline of the shape of a letter in a fixed order that corresponds to the way the letter should be written (Huang et al 2021: 1498). This is different from writing with a pen in the way that one does not make a fine movement with the tip of the fingers while holding a pen, but one makes a bigger movement with the arm and hand to follow the outline of the character. This could be a way to teach the writing of radicals and characters when teaching people Chinese as a second language.

To summarize these articles, it is indicated that radical awareness has a positive influence on the learning of transparent characters and that nontransparent characters can be effectively memorized as one unit. So, one can argue that it is efficient for students to separate transparent and nontransparent characters for memorizing characters during the

learning process. Also, it is advised to give direct instruction and exercises to students in segmentation of characters to understand the relation between radicals and transparent characters as well as nontransparent characters (Chen et al 2020: 9). There are several ways to use radical awareness, radical-based instruction and multi-sensory learning when teaching students about writing, reading and remembering characters and according to the studies discussed here, it has been found to be an effective way of teaching characters. Now that we have looked at several methods to teach characters, in the next section we will look at how to know which characters to teach in a curriculum.

2.4 Which characters should be taught?

When teaching characters, one must know which characters one should be familiar with to be able to read present-day publications. To know this, one can look at what characters are most commonly used. There are several ways to find out which words are common or uncommon and various ways are mentioned in Almog (2019).

One list that is mentioned in Almog's article that one could use is the "List of Standard Chinese Characters for Common Use" *Tōngyòng guīfàn hànzì biǎo* 通用规范汉 字表 (SCCCU). This list was provided by the People's Republic of China (PRC) State Council in 2013 and it includes 8105 characters. These characters are split into three levels that consist of 3500, 3000 and 1605 characters. Almog (2019) indicates that the larger part of native Chinese speakers does not have the ability to read the majority of the characters from the second level and that the third level contains 1605 rare characters (Almog 2019: 526). Almog states that for functional literacy one needs to be familiar with roughly 2000 to 3500 characters (Almog 2019: 526, 527). However, Almog also mentions that some statistics estimated that to understand approximately 80% of the characters in present-day publications, one should master the most common 500–600 characters (Almog 2019: 526, 527). Almog states that being familiar with around 2000 characters should cover more than 95% and familiarity with about 3000 characters should be enough to be able to read 99% of contemporary publications (Almog 2019: 527). These numbers can be useful to decide how

many and which characters are necessary to be taught in a Chinese language curriculum.

Besides the SCCCU, Almog presents another way to find out which characters are common in the PRC. One can look at words that are part of the 'HSK' *Hànyǔ shuǐpíng kǎoshì* 汉语水平考试, which is the standardized proficiency test for non-native learners of Chinese, developed and administered by the Ministry of Education. One can check if a character is part of the required 2663 characters that one should master for the highest level, level six, of the HSK (Almog 2019: 527). As Almog states, 'the Chinese government itself expects even the most proficient foreign learners of Chinese to master about 2660 characters' (Almog 2019: 527).

Furthermore, Almog refers to several unofficial lists with the frequency of common and uncommon characters composed by individuals. One of them is the "Modern Chinese character frequency list" *Xiàndài hànyǔ dānzì pínlǜ lièbiǎo* '现代汉语单 字频率列表', composed by 笪骏 *Dá Jùn* in 2004 (Almog 2019: 527). The data was acquired from many electronic texts that were published between 1997 and 2003, including news articles, informative materials and academic texts as well as imaginative materials, for example fiction or prose (Almog 2019: 527).

To summarize this section, there are several ways to get insight in which characters are necessary to master to understand present-day publications and looking at these lists can be useful when compiling the character lists for a Mandarin curriculum.
To conclude this chapter, practically seen it is not very necessary to learn to write characters and more necessary to learn to read them. When to introduce characters in the curriculum is a matter that several studies disagree on. However, it has been argued that radical awareness, multi-sensory learning and radical-based instruction can be effective as a method to teach characters. To know which characters to teach, one can look at several lists that show which characters are most commonly used. To understand around 80% of modern publications one should master the most common 500-600 characters and around 2000 characters to understand 95% of them.

H3. Factors that impact the possibility of character amnesia

In this section we will look at factors that influence the possibility of character amnesia and thus the factors that influence how well a character is remembered and how accurately it is produced. The study of Wang et al. (2020) analyzed the likelihood of a character being correctly written by native Chinese students. Wang et al (2020) looked at the influence of certain characteristics of characters on the latency (the time it takes to think of the character and prepare before writing), duration (the time it takes to finish writing the character) and accuracy of handwriting characters (Wang et al. 2020: 2). In addition, Huang et al (2021) looked further into the phenomenon of character amnesia on the basis of the data-base and research of Wang et al (2020) and explains it as the 'tip of the pen state (TOP)' which can be explained as the feeling to know a character but not being able to retrieve how to write it, to fail to retrieve the orthography (Huang et al. (2021): 1498). Being aware of the influence of certain characteristics on natives might also be useful when teaching characters within a Mandarin curriculum. Wang et al. found that the following factors affect the possibility of character amnesia (Wang et al. 2020: 3).

- A character's frequency and context
- Age of acquisition (AoA)
- Word context familiarity
- Semantics
- Phonology
- Orthographic complexity

A character's frequency and context. This includes two factors: count frequency and contextual frequency. Count frequency: the log of a characters count in a database of 46.8 million words and character frequencies which is based on a collection of television and film subtitles. (Cai 2010: 3, Wang et al. 2020: 3). Character amnesia occured more often for words lower in frequency. Huang et al (2021) state that a character with higher frequency

tends to be processed faster in speaking or handwriting because the connection between the meaning, sound and form strengthens which makes it more likely to not be forgotten (Huang et al. 2021: 1506). This can be relevant when deciding which characters to put emphasis on within a lesson.

Contextual frequency: This refers to the number of films a character appears in (Wang 2020: 86). This represents the number of different contexts a character appears in real life. Wang et al (2020) found that 'people spend less time writing a more frequent character, and they are also more accurate at writing it' (Wang et al 2020: 90). It can be useful to use the database when teaching Mandarin. One can argue that the more different contexts a character is used in in daily life, the more easily it is remembered and produced. Findings of Huang et al (2021) confirm these outcomes of the study of Wang et al (2020). In their analysis, participants did experience a TOP state more often if a character was less frequent (Huang et al. 2021: 1504). Furthermore, Huang et al (2021) state that several studies show that the more frequent a word is, the more likely it is that the character is retrieved from the mind with success (Huang et al. 2021: 1506). Huang et al. (2021) explain that the meaning pronunciation, and orthography of a character can become more strongly connected with higher frequency and that a character with higher frequency has the tendency to be processed faster (Huang et al. 2021: 1506).

So, count frequency and contextual frequency might be useful factors to take into account when deciding what characters should be taught. How often a character is seen and heard in the context of a movie has a positive influence on being able to remember and write it. Teachers could try to make use of this database by teaching students the characters that have a high count frequency and are important to learn, by giving students context of movies or texts with the characters they need to study.

Age of acquisition (AoA): it refers to the age of a person at the time a character was learned. In China characters are taught in school and there are textbooks that have lists of the characters that are learned in the 12 semesters of primary school and these lists were

used to measure AoA (Wang et al. 2020: 86). Children in China start going to school from age 6. In this study, a character learned in semester 1 would have an AoA of 6-6,5 and a character learned in semester 12 would have an AoA of 11,5-12. A character learned after that would have AoA 12,5. Wang et al state that later-acquired characters are more vulnerable to amnesia and earlier-acquired words often are higher in frequency (Wang 2020: 6). The study of Huang et al (2021) confirm the outcomes of the factor AoA of the study of Wang et al (2020). The participants experienced a TOP state more often if it was acquired later in life (Huang et al 2021: 1504). For Chinese as a second language learners the AoA will be higher when the students are studying in middle schools and universities. However, this factor can still be of influence. One can remember the first learned words better because one uses them during a longer time than ones learned later and often that are words like 我 wǒ 'me' 你 nǐ 'you' that one uses relatively often and are high in frequency. This can be relevant for teaching Chinese as a second language because one can focus extra on later-acquired characters to make sure these characters are well remembered.

Word context familiarity: 'This is a subjective rating of familiarity with the context word where a target character is embedded). 'For instance, in the phrase 灶台的灶 *zào tái de zào*, 灶台 *zào tái* is the context word for the target character 灶.' (Wang et al. 2020: 3). A character embedded in a more familiar word was found to have positive influence on writing latency, writing duration, and accuracy (Wang et al. 2020: 90). Also, this finding of Wang et al (2020) is consistent with the findings of Huang et al (2021). Huang et al (2021) also found that participants did experience a TOP state more often if it was embedded in a less familiar context (Huang et al. 2021: 1504). This can be relevant for teaching Chinese as a second language, because this method can be used as an effective way when introducing new words in a book or during a lesson to make sure the students remember the characters well and produce the characters more accurately.

To summarize above factors, it was found that a character had a lower handwriting accuracy and more time was needed to handwrite it if the frequency was lower, it was

learned later in life or it was seen or heard in a less-familiar word (Wang et al. 2020: 5).

These factors can be of use when teaching Chinese as a second language. There are more factors of influence on character amnesia, which will be explained as follows.

Semantics includes the following factors:

- Number of meanings

- Imageability

- Concreteness

Number of meanings refers to the number of meanings a character has according to the Xinhua Dictionary' (Wang et al. 2020: 3). Imageability is the capacity to imagine something related to the meaning of a word. 60 participants rated 400 randomly selected characters on imageability on a 7-point scale. Concreteness (Wang 2020: 3) refers to the degree of being concrete or abstract. For instance, 灶 is high in concreteness as it refers to something concrete' (Wang 2020: 3).

60 participants rated 400 randomly selected characters on imageability on a 7-point scale. This can be useful when teaching Chinese because when it appears that certain words are more difficult to produce, teachers can spend more time focusing on characters that fall within these categories. It was found that a character was produced in shorter time when it is more imaginable and more concrete instead of abstract and thus less imageable characters are more vulnerable to amnesia (Wang et al. 2020: 5). When teaching Chinese as L2, teachers can spend more time on teaching less imaginable and more abstract words to make sure these characters are to be remembered well and to be less of a risk for character amnesia for L2 learners. There was found no influence of a character's number of meanings on latency, duration and accuracy of writing characters. However, another study is mentioned (Chang et al. 2016) in which it was found that 'people are quicker at naming words or characters with more meanings' (Wang et al. 2020: 91). These outcomes do not

align. Furthermore, there are three other factors of influence on latency, duration and accuracy which will be explained next.

Phonology includes spelling regularity and homophone density. According to Wang et al (2020), this means 'the degree of resemblance in pronunciation between a character and one of its radicals. For instance, the character 灶 *zào* is lower in regularity as the character has no pronunciation- cueing radicals.' (Wang et al. 2020: 87). Wang et al state that spelling regularity influences character amnesia and it is explained as 'less regular characters being more susceptible to character amnesia' (Wang et al. 2020: 5). It was found that a character had a lower handwriting accuracy when it was lower in its spelling regularity (Wang et al. 2020: 3). To be more concrete, people were quicker at initiating to write a character if it had a more indicative sound radical (Wang et al: 92). The findings of Huang et al. (2021) are in line with these outcomes of Wang et al (2020). The TOP state was experienced more often if a character was less regular in spelling or (Huang et al. 2021: 1504). This can be useful for teachers of Chinese as L2, teachers can put extra emphasis on teaching words that are lower in spelling regularity to make sure these words are less susceptible to character amnesia. Furthermore, homophone means words with the same sound but different meaning (Wang 2020: 3). Homophone density in the study is the log of the number of homophonous characters in SUBTLEX-CH corpus, so the number of characters that sound the same as the target character. For instance, 灶 *zào* has 6 other characters in the corpus that have the same pronunciation and thus, in the study, it has a log homophone density of 0.78. It was found that 'people were slower at accessing the written form of a character when asked to write a character with more homophones' (Wang et al. 2020: 92). This is useful for teachers of Chinese as L2 to put more emphasis on these types of words in the curriculum.

Orthographic complexity includes the number of strokes, number of radicals, and character composition like built top-down or left-right. With character composition it is meant that the radicals of the character are vertically or horizontally arranged. It was found that a character had a bigger possibility of amnesia, had a lower handwriting accuracy and one

needed more time to prepare and handwrite if it had more strokes (Wang et al.2020: 3,5).

Also, Huang et al (2021) had this outcome. In Huang et al's analysis, participants did

experience a TOP state more often if a character contained more strokes (Huang et al. 2021:

1504). To further explain, Huang et al (2021) found that participants had more character

amnesia and TOP experiences and made more errors for more complex characters with

more strokes (Huang et al 2021: 1507). It can be useful for teachers of Chinese as L2 to be

aware of this when teaching to write certain characters. However, as Almog (2019) points

out, one should consider that 'it is not necessarily harder to remember how to handwrite

characters with a higher stroke count, or that such characters are necessarily more

complicated'. Almog gives the following example and argues that it is easier to remember

how to handwrite a relatively simple character like 鑫 *xīn* consisting of 24 strokes and

consists of three times the character 金 *jīn*, than to handwrite a character with fewer strokes

like 嫩 *nèn*, which has 14 strokes and three different radicals (Almog 2019: 529). In addition,

there was a finding in the study of Wang et al. (2020) that suggested that people seem to

spend longer times accessing characters that are built top-down than for characters of other

types (Wang et al. 2020: 88).

Wang et al (2020) concluded that 'the most influential predictor of character amnesia

is frequency, then familiarity with the word in which the character is embedded, then AoA,

also stroke number and imageability play a role, though a smaller role' (Wang et al: 5).

Huang et al (2021) had a different outcome. Huang et al. (2021) found that the most leading

factor on occurrence of TOP state was print exposure, then AoA, context word familiarity,

pen exposure, digital exposure, number of strokes and frequency (Huang et al. 2021: 1504).

Besides the factors that Wang looked into, Huang et al (2021) looked into the factors

print exposure, digital exposure and pen exposure and they found that participants of the

study experienced more TOP states if they had less print exposure, more digital exposure

and less pen exposure (Huang et al 2021: 1498). Print exposure refers to how much a

person regularly reads printed texts on paper. Pen exposure refers to how much a person

regularly writes by hand and digital exposure refers to digital typing instead of handwriting. The influence of digital typing on character amnesia will not be addressed in this section, but in the next section, when we look at the impact of writing and typing on the learning process.

To summarize the above, the advice on the basis of these two studies is to increase the exposure to characters that are low in frequency and acquired later. It is advised to increase reading assignments with characters in low-frequency and focus on characters that are most prone to amnesia, which can be found in the database of Wang et al (Huang et al 2021: 6). Also, one can focus on lists of words with less concrete meanings, homophone characters and characters with many strokes.

H4. The influence of writing by hand and typing on learning characters

In this section we will discuss the positive and negative impact of writing as well as typing on the process of learning characters. Firstly, there are several input method editors

(IME) which one can use to enter characters on a digital device. One can use handwriting,

wǔbǐ, *pīnyīn* and *zhùyīnfùhào*, which are shown in the image taken from the thesis of

Chesbro (2023). As illustrated in the upper left picture, one can write the strokes of a

character by hand and the device will try to recognize the character. The upper right picture

illustrates the most common input method, via pinyin: one can type pinyin, i.e. alphabetic

letters, and the device will choose the relevant character or show a (dropdown) menu with

several characters that match the pinyin representation, from which the writer can choose.

The lower left picture illustrates the method in which strokes are associated with keys on the

keyboard. By pressing the relevant keys, one assembles the character one wants to write.

Lastly, the lower right picture shows the input method zhuyinfuhao that, like pinyin, is based

on the sound of the words one wants to type. This method is not based on individual sounds

but on the traditional way in which syllables of Chinese are analyzed, as consisting of a

beginning sound and the rest of the syllable.

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)
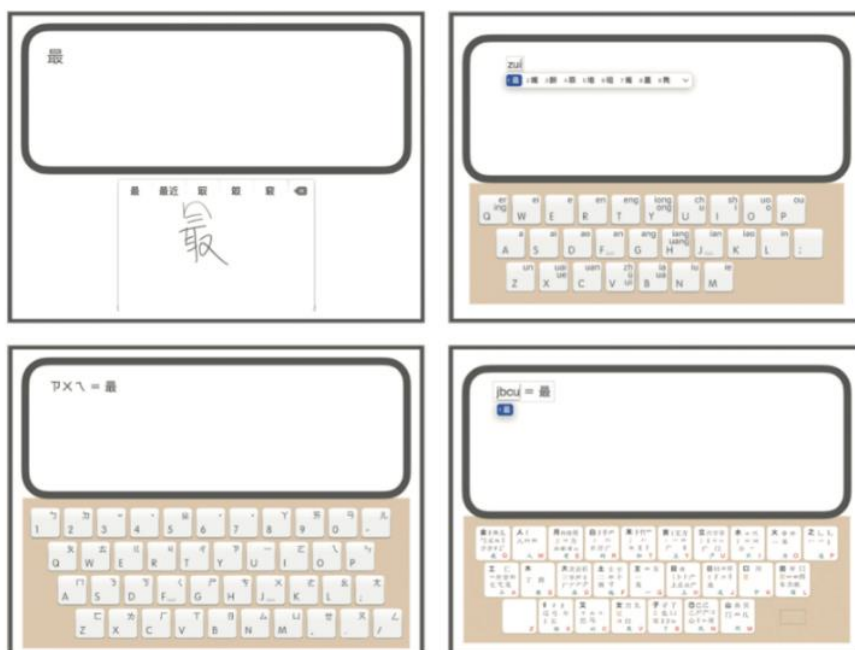
Chesbro 2023: 31

In this section, however, we will solely focus on the effect of handwriting and on the effect of typing pinyin; the other two methods are not very common inside and outside of the Chinese speaking world. According to Chesbro (2023), in mainland China pinyin as input method is used by 97% of the digital device users (Chesbro 2023: 14). How does this input method work? One uses the pinyin IME on a keyboard by typing the alphabetic transcription of the word. Then, several characters are shown that share the transcribed sound, like 好, 号, 豪, 浩, 耗, 郝 and more when one types *hao*, and one chooses the character one requires. It is also possible to type full sentences in pinyin for which the device then chooses the characters, which are often chosen correctly. In the next section we will discuss positive impact of handwriting on the learning process.

4.1 Positive impact of handwriting

It is quite well known that, in general, handwriting has a positive influence on memorization of words and sentences in the long term (Cameron 2019: 5). In this section, we will discuss studies and articles which indicate a positive impact of writing on a learning process, both productively (writing) and receptively (reading).

Firstly, Mangen et al (2015) state that there have been several neuroscience studies with the focus on the effect of writing by hand and typing on a keyboard on cognition. The studies focus on the effect on the retention, recognition and recall of letters. The participants in a study that is mentioned, both children and adults, who wrote by hand showed better memory and visual recognition than the participants that typed on a keyboard (Mangen et al 2015: 233). This study, however, is not focused on Chinese characters and L2 learners particularly. The study is focused on L1 learners of Norwegian and 'the findings relate to memorization of single letters or characters' (Mangen et al.: 233). Mangen et al further explain that data from Longcamp et al (2008) show that handwritten and keyboard typed characters activated different areas in the brain. Mangen et al (2015: 233) explain that it was found that areas of the brain that are used for imagery, observation and execution of actions

were more activated in the participants with the handwriting condition. They also indicate that the movements of handwriting can contribute to memorizing the shape of characters (Mangen et al 2015: 233). It is concluded that results of the research show that there is a connection between writing by hand and recall of the written material compared to typing on a keyboard (Mangen et al 2015: 238). Also, the article indicates that writing by hand may improve some aspects of memory (Mangen et al 2015: 240). The findings of the mentioned study suggest that there can be certain cognitive benefits of writing by hand which may not be fully retained in keyboard writing, as we will further explore in the next section (Mangen et al 2015: 311). Also, Huang et al (2021) found that the more pen exposure a participant had, which is the amount of handwriting a person is regularly doing, the less likely they were to forget how to write a character (Huang et al. 2021: 1507). This is consistent with the findings of Mangen et al (2015). To summarize, on the basis of Mangen et al (2015) we can argue that handwriting does have a positive effect on recall of characters.

In addition to Mangen et al, Suggate et al (2023) and Guan et al (2015) indicate that several studies found that handwriting can improve recognition of letters when compared to typing (Suggate et al. 2023: 4, 5, Guan et al. 2015: 789, 2015). In section 4.2 and 4.3 we will look further into the effect of typing on the learning process. Furthermore, Knell and West (2017) state that handwriting has been shown to have a positive effect on the ability of reading characters out loud. The group of students that wrote characters by hand was significantly better in reading out loud than the group that practiced the characters by using recognition games. It seems logical that when one writes characters by hand, the positive effect of writing on memory shows its effect when reading because when one has memorized the characters well, one can more easily read them. Besides this, research reported on in Chai and Brysbaert (2021) and Guan et al (2015) shows that writing by hand contributes to the cognitive process when reading Chinese and thus that Chinese character writing proficiency has a positive effect on reading proficiency (Chai and Brysbaert 2021:15, Guan et al 2015: 792).

In short, based on the articles that are mentioned we can argue that handwriting has a positive impact on memorization, recognition as well as reading proficiency. No obvious negative effect of writing by hand on the learning process was found. We conclude that it is useful to use handwriting as a method to practise the memorization of characters. However, one could say that writing by hand takes a lot of time which takes away time that could be spent on learning vocabulary, learning about the Chinese culture or that one could spend on practising speaking proficiency.

4.2 Positive impact of typing

Now that we have looked at the positive influence of handwriting, we will also look at the possible positive influence of typing. Several articles studied the influence of typing. In Mangen et al (2015), the effect on recognizing characters was the same for writing or typing (Mangen et al 2015: 238). So, according to Mangen et al (2015), it cannot be said that typing on a keyboard has a negative effect on recognizing written material (Mangen et al 2015: 238). We can argue that typing characters has no negative influence and is enough when practicing for recognition of characters. So, this is in line with the last section and we can argue that writing as well as typing has a positive impact on recognition of characters and both are an effective method to learn characters.

Besides the positive effect of typing on recognition of characters, it has been found that, when compared to handwriting, typing can have a positive effect on phonological awareness. Lyu et al (2021) found that typing had a greater effect on phonology recognition than handwriting and that phonology recognition can be strengthened by typing in Chinese (Lyu et al. 2021: 9). So, because one types the sound of a character, one is more aware of how to pronounce it. This was also found by Zhu et al (2009). During this study they showed students low-frequency words and asked them to 'judge whether the syllable of a character includes a consonant like 'b' or vowel like 'a' and if the character contained a certain radical.

The participants that typed pinyin scored better on the two tasks. The article suggests that using pinyin as input has a positive impact on the phonologic judgement and orthographic recognition (Chen et al. 2021: 925). When one types, one sees several characters as options to choose from which can be seen as a practice in recognition.

Furthermore, this article mentions a study that asked participants to determine the phonology and orthography of two homophone characters. The results also suggest that pinyin as IME had a positive effect on the phonologic process and orthographic process (Chen et al. 2021: 925). So, this is in line with Chen et al (2021) and these findings are consistent with each other. In addition, Guan et al (2015) states that by typing pinyin phonological articulation can be improved (Guan et al. 2015: 792). However, when compared to the findings in last section, the findings of the study in the last section suggest that there are cognitive benefits of writing by hand that may not be fully retained in keyboard writing (Mangen et al 2015: 311).

So, based on these articles one can argue that typing characters can have a positive influence on phonology recognition because one types the sound, and a positive impact on orthography recognition because one does look at the forms of several characters when choosing the character one needs. However, in the last section it is stated that writing has a positive influence on recognition as well as recall and retention and that certain cognitive benefits may not be fully retained when typing, compared to writing. So, writing seems to be effective for more cognitive processes. The effect on phonological awareness might be a reason to also make typing of characters part of learning methods. Furthermore, one can argue that typing characters takes up less study time when compared to writing characters. This time could be used to focus on speaking proficiency for example. In the next section we will look into negative effects of typing on the learning process.

4.3 Negative impact of typing

Whereas a positive impact of typing was found on phonological awareness, there has been found negative impact of typing pinyin on the learning process. According to Chesbro

(2023), one can say that the fact that people are typing increasingly more, has contributed to people writing less by hand, which has led to character amnesia (Chesbro 2023: 14). Chesbro (2023) states that typing has a negative impact on the ability to recall the orthographic composition of a character (Chesbro 2023: 19). In the last section, findings showed a positive impact of typing on recognition, but not on recall. This could be because, when typing, one does not practice writing the form of the character and one does not need to recall a character actively, one only needs to recognize it. So, by typing, one does not practice actively recalling words from memory.

Furthermore, the study of Huang et al (2021) focused on the influence of typing on character amnesia. They found that people with more exposure to typing had more difficulty to access the orthography of a character (Huang et al 2021: 1507). The article mentions several studies that compare the impact of typing and handwriting and found that the influence of handwriting on letter recognition, distinguishing letters and learning to write letters, was relatively good compared to typing. This is in line with findings in the first section of this chapter that state that handwriting has positive effects on recognition and that there is a connection between handwriting and recall compared to typing on a keyboard (Mangen et al 2015: 238). The article suggests that 'while these findings are not direct evidence for detrimental effects of digital use on handwriting, the use of typing does diminish the usage of handwriting, which may then lead to a decrease in the ability to write by hand (Huang et al: 507).' In Chen et al (2020) it was interestingly stated that one of the reasons character amnesia occurs is 'a decline in writing activities' and one way to change this, is to increase the practice of writing (Chen et al 2020: 183).

So, on the basis of the articles discussed in this section, we can argue that typing characters is not very effective when focusing on recall of characters, when compared to handwriting. Increasing writing activity can be a way to make up for the increase in typing activities in daily life. In the next section we will look at how the positive effects of both writing and typing can be integrated to be effective when learning characters.

4.4 Integration of handwriting and typing pinyin

We have now looked at the positive and negative influence of writing by hand, and the positive as well as the negative influence of typing. In this section we will look at how to integrate writing and typing when learning characters.

Firstly, according to research of Lyu et al (2021) on the influence of writing and typing on Chinese language learning, a group of participants that practiced characters by writing, performed better on word recognition and on knowing the meaning of the character. However, performance was not better when looked at the link between the character and phonology. The research advised that an integration of handwriting and pinyin typing helps to improve reading performance and phonology knowledge for Chinese when learning it as a second language (Lyu 2021: 9). This is in line with what is discussed in the previos sections. Another study, that is consistent with the findings of Lyu et al (2021), is the study of Ye et al (2022) that investigated the effectiveness of writing and typing in second language word acquisition and compared the impact on learning outcomes. Ye et al (2022) indicate that handwriting was shown to have a positive effect on memory directly after writing and a positive effect one week later. Typing was found to only have a positive effect on memorization one week later and not directly after typing. The effect of writing as well as typing on learning characters was found to be the same after one week, so writing did not have a better effect than typing on the learning outcomes one week later (Ye 2022: 5). These outcomes differ from previous sections, however the focus also differs.

So, on the basis of this research (Ye 2022), one can argue that it can be effective to use writing characters as well as typing characters because the two complement each other. In addition, Chen et al (2020) found that when Chinese teenagers use digital typing for sending messages, it has a direct negative influence on their handwriting of characters because they write less by hand and type instead. However, the same study found that using digital typing can have an indirect positive effect on handwriting of characters when pinyin is used as the input method editor (Chen 2020: 182). Because one sees several characters when choosing the target character in the IME, one can more easily memorize how to

handwrite it, so pinyin compensates for writing less by hand.

Chen (2020) suggests that although the overall use of digital typing when sending messages has a negative effect on handwriting of characters, using the pinyin IME 'compensates the negative effects of IM on handwriting.' So, on the one hand the study of Chen et al suggests that digital typing has a negative effect on handwriting, however, this negative impact can be compensated by the positive 'impact of using pinyin input (Chen et al 2020: 182). Chen et al (2020), mentions several studies that showed that using pinyin input had a positive effect on phonological as well as orthographic processes (Chen et al 2020: 182). So, also on the basis of Chen et al (2020) we can argue that using pinyin as IME next to handwriting can be integrated in a curriculum as method to learn characters. In addition, Chesbro (2023) indicates that people who often used pinyin input method showed stronger links between the phonology and meaning of words' (Chesbro 2023: 28,29).

To conclude, the article of Chen et al advises teachers to combine handwriting on paper with pinyin input when teaching Chinese (Chen et al. 2020: 183). According to Chen et al, but also according to several other studies discussed in this section, pinyin can have a positive impact on the phonological knowledge, whereas handwriting on paper can help to improve the writing and memorization of characters (Chen et al. 2020: 183). We can argue that integrating typing pinyin and handwriting can be an effective method for learning characters.

Conclusion

In this section an advice will be given on how to effectively teach characters within a Chinese curriculum, by connecting the findings of the different sections in this thesis.

Firstly, in section 2.1.2 we argued that for L2 learners of Mandarin, from a practical perspective, it is not necessary to write characters by hand. Due to digitalization, there are apps and websites on digital devices that show how a character can be written when needed. Also, reading characters and speaking Chinese seems to be more of use in practical situations on a job or in daily life than writing characters by hand. On the basis of this practical argument, the advice is to give handwriting characters a smaller place within the curriculum and to spend more time on speaking, listening and reading proficiency.

Secondly, however, there is also a different side to the question whether or not to put emphasis on handwriting characters. In section 4.1 we discussed that it was found that areas in the brain connected to imagery, observation and execution of actions show to be more active when people are handwriting (Mangen et al. 2015: 233). Also, handwriting was found to have a positive effect on memory and recalling characters (Mangen et al 2015: 238, 240). In addition, writing was found to contribute to the cognitive process of reading and thus positively influences reading proficiency (Chai and Brysbaert 2021: 15). Furthermore, it was found that handwriting improves the recognition of characters (Suggate et al. 2023: 4, 5, Guan et al. 2015: 789, 2015). Taken these findings together, we can argue that writing plays

an important role in the cognitive process of learning Chinese and thus is important within and advised to be a part of a curriculum.

Thirdly, although writing characters by hand is important for cognitive processing, it can take up quite a lot of time within the process of learning Chinese. To make sure the time of writing characters to learn them is used effectively and the characters are not all forgotten at a later time, it is advised to take the factors that play a role in character amnesia into account. Firstly, a character with higher frequency strengthens the connection between the meaning, sound and form (Huang et al. 2021: 1506). So, it is advised to let the newly learned words appear in as much context as possible, for example texts, conversations and video's. Secondly, the age and moment of learning a character influences character amnesia, the later a word is learned, the more easily it can be forgotten (Huang et al 2021: 1504). Thirdly, it was found that a character embedded in a more familiar word has a positive influence on writing latency, writing duration, and accuracy (Wang et al. 2020: 90). The advice is to explain words by, if possible, embedding it in a familiar word to make sure it is well remembered. For example: 国外的外 *guǒwàidewài,* 'foreign from the word foreign country'. Furthermore, it is advised to put more emphasis on teaching words with abstract meanings, because those are more prone to character amnesia (Wang et al. 2020: 5). Lastly, spelling regularity and homophone characters influence the chance of character amnesia (Wang et al. 2020: 5). So, it is advised to put more emphasis on teaching characters with a less indicative sound radical and the ones that have several homophones to make sure the character can be produced accurately more easily (Wang et al. 2020: 92).

Another effective way to learn and to write characters is by integrating handwriting and typing by using pinyin as input method editor. The positive cognitive impact of handwriting and the positive effects of typing pinyin can be combined to complement each other (Chen et al. 2020: 183). Using pinyin as IME can have a positive impact on phonological awareness and handwriting can have a positive effect on recall and recognition

(Chen et al. 2020: 183). So, it is advised to let students also use computers to hand in writing assignments and to encourage students to type Chinese on their phone.

The question of when to introduce characters into the learning process, has not been answered because several studies come to different conclusions. There is, however, an effective method that is advised to be used when teaching characters. In section 2.3 it is discussed that radical awareness can support students in character learning when looking at recognition and retention for transparent characters (Chen et al 2020: 1,2) and for finding the meaning of unfamiliar characters (Nguyen et al. 2017: 9). It is advised to let nontransparent characters be memorized as one unit and give exercises in segmentation of characters (Chen et al. 2020: 9). Also, it is advised to let students group characters based on shared radicals (Xu et al. 2014: 789). Lastly, multi-sensory learning has been found to be effective when teaching characters (Knell and West 2017: 529, Huang et al. 2021: 1498).

To know which characters should be part of a curriculum, it is advised to look into the following lists: "List of Standard Chinese Characters for Common Use" *Tōngyòng guīfàn hànzì biǎo* 通用规范汉 字表 (SCCCU), the list of the HSK *Hànyǔ shuǐpíng kǎoshì* 汉语水平考试, and an unofficial list "Modern Chinese character frequency list" *Xiàndài hànyǔ dānzì pínlǜ lièbiǎo* '现代汉语单 字频率列表, composed by Dá Jùn 笪骏'. Furthermore, it is advised to master the most common 500–600 characters to understand around 80% of the content in present-day publications and to master 2000 characters to understand more than 95% of contemporary publications (Almog 2019: 526, 527).

To conclude, learning Chinese as a second language can be a complex task, especially when the native language is written with an alphabet. When teaching it, it is important to use handwriting of characters as a tool to learn the language, but not necessarily as a goal to master writing all characters. Typing can complement writing as a method for learning the language and characters. Radical awareness and multi-sensory learning is advised to be used as a method. It is useful to take into account factors that influence character amnesia, like characters lower in frequency, characters with an abstract

meaning and homophone characters. It is advised to put more emphasis on those, so that one can use the time that is spent on learning characters within the curriculum effectively.

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