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The Effect of Mixed-sensory Mode Presentation on Retaining Graphic Features of Chinese Characters

Yongan Wu


From the earliest stages to the most advanced levels, teaching a foreign language usually comprises the task of vocabulary instruction to allow the comprehension or construction of meaning in a new semiotic code (Shu & Richard, 1999; Wang et al., 2003). The traditional method of presenting Chinese characters to Chinese as a foreign language (CFL) learners is essentially textual and flattened (Chung, 2003). Three values of a character, its meaning, writing and pronunciation, are simultaneously presented in the text form. In the context of teaching CFL in the US, characters are typically accompanied by their English equivalents and Hanyu Pinyin, a widely used Romanized system serving as a phonetic alphabet for Chinese characters (see, for example, Liu & Yao, 2008; Wu, 2007).

This method, however, has been criticized for its ineffectiveness in classroom teaching for the following reasons: (1) the interference of orthographic features of Pinyin and the learner’s primary language (Bassetti, 2006); (2) ignorance of the relationship between a character and its components in order to help retain and infer meaning (Shen & Ke, 2007; Taft & Chung, 1999); and (3) the split of attention and overload on working memory as learners search and match characters with corresponding meanings and pronunciations (Chung, 2007).

Thus far, several studies have explored using the mixed-sensory mode (MSM) presentation to deliver the values of characters through more than one sensory channel. Researchers believe this method can considerably reduce the cognitive load of processing all values of a character at once (e.g. Chuang & Ku, 2011; Chung, 2007; Jin, 2006). The results of these studies demonstrate that, when characters are presented visually as symbols and acoustically as sounds, learners are better able to retain the meaning and
pronunciation, as well as better able to distinguish the target character from its distracters.

Similarly, this chapter intends to further study the issue by examining the effect of the MSM presentation on retaining the graphic features of characters with a consideration of two factors: (1) character density, i.e. characters with a low number of strokes versus a high number of strokes; and (2) the effect of time, i.e. a participant’s performance differs between immediate and delayed posttests. The study reported herein also examines how the MSM presentation may influence a learner's frequency of using phonological retrieval cues to recall characters. In an age where technology is increasingly available in the classroom, the potential and practicality of using multimedia to facilitate CFL vocabulary instruction is unquestionably a promising method which should receive further attention in its development (Xie & Yao, 2009; Yao, 2009).

Background

The distance between Chinese and English has a considerable impact on the nature and process of how characters can be presented, making the issue a persistent focus of research for many decades (Chu, 1974; DeFrancis, 1968; Li & Lee, 2006; Wang, 1989). For CFL learners whose knowledge of the Chinese language is in its developing stage, a character appears to be either an amalgam of different distinct graphic units or a visualization of a single, solitary, graphic concept (Li & Lee, 2006). Unlike alphabets, these graphic units exist in a large quantity, yet cannot be easily associated with a given sound or meaning (Shen & Ke, 2007). It then becomes a particularly challenging task for CFL learners to squeeze an extensive knowledge map that arbitrarily connects the graphic features and semantic values of numerous characters into their working memory. To help remember and transcribe the sounds of characters, learners often rely heavily on the Pinyin script, which adds another layer of information to process and retain (Bassetti, 2007; Ke, 1998).

In order to lower the load on a learner's working memory (see also Chapter 6, this volume), scholars have been actively searching for effective methods through which faster cognition and longer retention of information can be achieved in the task of learning novel characters. One noticeable line of research stems from the theory that the human mind processes and stores information above two independent slave cognitive systems, namely, the verbal system for words and the visual system for images and analog representations (Baddeley & Hitch, 1974; Paivio, 1986).

There are three major forms of representations from which information can be ingested: (1) symbolic representation as text; (2) auditory representation as sound; and (3) analog representation as image. The first two are considered closely entwined because they both involve ‘similar cognitive
processes of text comprehension’ (Chun & Plass, 1997: 65). This feasibility of dividing the verbal form into two modes, i.e. written words (text) and auditory signals (vocalization of text), provides the key rationale for employing more than one presentation mode as an instructional means to enhance the velocity and reliability of the entire encoding process in case a singular mode will lead to detrimental overflows in the cognitive system (Andres & Petersen, 2002; Tabbers et al., 2004).

The proliferation of multimedia learning environments has provided incentives for scholars to transfer the MSM from psychology labs into general classrooms (Mayer, 2001). During the last decade, a few studies have been conducted to adapt the modality effect to the domain of CFL. By presenting characters visually on screen and their pronunciation and meaning aurally through headphones, researchers can successfully isolate, compare and confirm the superiority of the modality effect on character learning. Jin (2006) administrated a tutorial to university-level CFL students from different orthographic backgrounds, presenting 36 characters in three modes to the treatment groups via multimedia technology in computer labs, each of which highlighted one aspect of character instruction: (1) the meaning and formation of sub-character components (in textual form); (2) the sequence of strokes (with animation); and (3) the pronunciation (delivered through headphones). The control group received printouts composed in the traditional format in which a character was presented next to its English meaning and Pinyin script.

The results suggested the pronunciation mode was better than the traditional method in terms of producing a significantly higher correct rate in tasks involving distinguishing semantic, orthographic and phonological distractors, regardless of the participants’ language backgrounds. The study conducted by Chung (2008) compared the effect of the MSM presentation in character instruction among beginning- and intermediate-level CFL learners. In his first experiment, Chung presented 20 characters in random order and their prompts (pronunciations and meanings in English) to a group of beginning CFL learners who were then asked to pronounce these characters and translate them into English at the end of the presentation. Two weeks later, in a surprise, delayed test, learners were asked to perform the same task so Chung could measure their long-term memory. Compared to the control group that received prompts only in visual forms such as Pinyin scripts or texts, the treatment group who heard pronunciations and the accompanying English meanings through headphones scored higher in meaning recall tests in both rounds.

Chung duplicated his research method on the same group of students two years later and again found the superiority of the MSM presentation on meaning recall among intermediate-level CFL learners. Chuang and Ku (2011) examined beginning-level CFL learners’ ability to retain Chinese characters’ graphic features under two conditions: a text group, which saw the
character and read an introduction in English about the character’s etymological formation, and a narration group, which saw the character and heard the same introduction in English delivered as an auditory input. An immediate and a delayed posttest were given to measure how well students distinguished and recognized the writing of target characters among graphic distractors. There was not a significant difference between the text group and narration group, but all participants tested higher in the immediate posttest than in the delayed test.

In order to better evaluate the significance of the MSM presentation, one aspect that deserves particular attention from the positive results in the studies reviewed above is the number of strokes, or the density of target characters. Sergent and Everson (1992) discovered that CFL learners, regardless of their proficiency levels, felt increasingly challenged to accurately and promptly recognize characters that have a large number of strokes. Ke (1996) confirmed the common speculation that characters, in general, are easier to recognize than to produce. Those with low density are less challenging to produce than those with high density. Yet Ke’s study disagreed with that of Sergent and Everson in character recognition, suggesting that the factor of density did not play a role in character recognition. Ke’s study also confirmed a correlation that character recognition and character production decreased in the delayed test, indicating that the retention of detailed graphic features weakens at a different rate from that of general features. These findings were replicated and further refined by later studies (Ping, 2006; Xiao, 2002). Although at present there is no consensus mandating a definite stroke number as the dividing line between low- and high-density characters, CFL learners’ ability to retain graphic features of characters varies considerably at different density levels (Liu, 2008). Therefore, the advantage of the MSM presentation cannot be generalized without weighing this factor.

Studies have shown, under the MSM condition, that CFL learners could retain more information about a character for a longer period of time and demonstrated an enhanced ability to distinguish target characters from their distractors, yet the relationship between retrieving graphic features and using phonological cues was left unexplored. According to Chun and Plass (1996), even when English native speakers learned words in German, both of which are alphabet languages, the percentage using phonological retrieval cues to correctly recall the English meaning of a German word was quite low and therefore ‘sound has very limited importance as a retrieval cue for the words learned’ (Chun & Plass, 1996: 190).

For novice CFL learners it would be more unlikely to choose sound as the retrieval cue because, by nature, Chinese phonology is disconnected from its graphic features. As a result, when CFL learners try to connect their mental lexicon to the prompts of the given task, either to recognize or produce characters, the only feasible option they have is to rely on remnants of graphic units in their long-term memory. This leads to a reasonable extrapolation
that auditory input may not enhance the retention of graphic features, per se. Instead, it allows CFL learners to allocate more time and attention to look at a character so they can achieve better memorization by removing the burden of scanning its Pinyin and English, and by improving the overall quality of the encoding process. If the former mechanism plays a role, then extending the exposure time to characters should be able to achieve a similar result; otherwise the latter mechanism must be true and recognized as a contributing factor as well.

Previous studies have proven the effectiveness of using the MSM presentation to facilitate character acquisition. The role of character density in recognizing and producing characters has also been studied. These combined studies indicate that the next step would focus on the issue of using the MSM presentation to enhance graphic features retention under different character densities, a factor that has not yet been identified for measurement. Such a lack of differentiation raises questions concerning a possible variation of CFL learners' performance between low-density and high-density character tasks.

Also, the issue of how the MSM presentation enhances character learning needs to be further explained by examining retrieval cues used by CFL learners when recalling characters. Intrigued by these uncertainties, this study intends to examine beginning-level CFL learners' ability to retain graphic features of characters with different densities and the impact of auditory input on the retrieval cues learners used. The issues examined concern: (1) the direction of performance differences, if any, between low- and high-density characters in recognition; (2) the direction of performance differences, if any, between low- and high-density characters in production; and (3) the effects of the MSM presentation on the frequency of using phonological retrieval cues to recognize and produce characters.

Method

Participants

A total of 104 students participated in this study. They were either native English speakers who had no previous knowledge of Chinese or came from a Chinese or East Asian background. The latter group was allowed to participate, but their test results were removed in data analysis, thereby allowing the study results to better reflect the situation experienced by CFL learners. This adjustment lowered the total to 86 (50 males and 36 females, mean age = 21.2 years). At the beginning of this study, participants had learned approximately 450 characters in six months, eight strokes per character on average, using the same textbook as the curriculum. They were familiar with Hanyu Pinyin and followed the traditional stroke-order method when learning how to write characters.
Instruments

Two instruments, a character recognition task and a character production task, were prepared to measure the retention of graphic features of low- and high-density characters. In the character recognition task, participants first saw English annotations and were asked to distinguish the corresponding characters from their orthographic distractors, characters that resemble target characters in structure and appearance. Questions from both groups were mixed up in random order to avoid a possible impact made by the sequence of questions received. Every target character was accompanied by three distractors.

In the character production task, participants needed to produce characters by looking at the English equivalent. The target characters were chosen from the character list of the HSK (Hanyu Shuiping Kaoshi); a well-developed Chinese proficiency test that identified approximately 2900 commonly used characters. The researcher only selected characters that were not found in the participants’ textbook or used in class to avoid incidental study effects. Based on the findings and research designs of relevant studies done in the past (cf. Jin, 2006; Ke, 1996; Ping, 2006; Xiao, 2002), the threshold of the character density in this study was set at 11 strokes. The low-density group consisted of characters with 6–7 strokes; the high-density group had 13–14 strokes. A total number of 60 characters were selected, 30 low-density and 30 high-density, 6.6 and 13.5 strokes on average, respectively. Characters in each density group were randomly assigned to either a recognition or production task. This arrangement resulted in 15 low- and 15 high-density characters per recognition and production task (see Appendix A and Appendix B for the list of target characters and their distractors).

In both tasks, participants were asked to indicate how frequently they evoked sounds in the recalling process by checking one of the following options: ‘very rarely’, ‘infrequently’, ‘frequently’ and ‘always’, at the end of the task. Their answers were then coded into categories 1–4 for data analysis. By comparing this information with test scores, the researcher examined how MSM presentation affected the participants’ choice of retrieval cues in both tasks.

Scoring

In the recognition task, one point was given when participants chose the right answer to a question as they eliminated the interference of distractors. In the production task, one point was given when a character was written correctly and easily identifiable. Writings that resembled the target character, but deviated in stroke numbers and structures, regardless of the degree of resemblance, received no points. Both instruments were graded by the researcher and a native Chinese speaker. The interrater agreement was 100%.
Procedure

Participants were randomly assigned into the treatment and control groups. Both groups received characters and later took the tests in a computer lab. The order of presentation was random. The treatment group saw characters on screen and heard the corresponding pronunciation and English meaning via headphones. By clicking a link next to the character they could hear the auditory input multiple times. One character was displayed at a time for 10 seconds each and was automatically replaced by another. The control group saw the character, along with its Pinyin and English annotation on the same screen but heard no sound. The display time (per character) was twice as long (20 seconds) following the same, automatic replacement mechanism. The reason why the control group received 10 additional seconds in order to learn the characters is due to the known effects of MSM presentation, which has proven to be capable of yielding a positive impact on information processing and retention. Since no previous studies have addressed both MSM presentation and character density at the same time, it is reasonable to give the group without the advantages of MSM presentation, i.e. the control group, more time to study characters so the author can better understand the interplay between these two major variables.

Participants received the same presentation for three consecutive days, one round per day, and were told to try their best to remember all three values of the characters: the written form, the meaning and the sound. On day three, right after the presentation, both groups completed the first round of tests on character recognition and production. No feedback or results of the tests were given. Five days later the second round of tests was administered, using the same instruments, again with no prior notice. Questions remained unchanged, but were in a different order to avoid text effects. The duration of both rounds of tests was 25 minutes. Oral instructions were given during the test to avoid confusion and anxiety.

Results

What effect did the MSM presentation have on the participants' ability to recognize characters and the direction of the performance difference, if any, between recognizing low- and high-density characters?

Means and standard deviations of test scores for recognition of low-density characters in both rounds are presented in Table 6.1. A significant group difference was found, $F (1, 84) = 4.33, p < 0.05$ with a near medium effect size (partial $\eta^2 = 0.05$), indicating an advantage of MSM presentation
for recognizing low-density characters. The average score of the treatment group was significantly higher than that of the control group in the immediate posttest \((t = 3.29, p < 0.05)\) with a medium-to-large effect size \((d = 0.71)\). The difference was greatly reduced as time went by, i.e. the average score of the treatment group was 0.33 points higher than that of the control group in the delayed posttest, but insignificant \((t = 0.69, p > 0.49)\). Compared to the mean difference of 1.37 in Round 1, it was evident that the advantage of MSM for low-density characters can hardly be retained for an extended period of time without reinforcement.

For high-density characters, the data analysis revealed a different pattern of performance from that of the low-density characters. Group difference was insignificant, \(F(1, 84) = 1.51, p = 0.22\). Both groups demonstrated an equal degree of competency when recognizing high-density characters in the immediate posttest \((t = -0.05, p > 0.95)\), yet the treatment group performed significantly better in the delayed posttest \((t = 2.32, p < 0.05)\) with a medium effect size \((d = 0.50)\). This suggested that the MSM presentation, compared to the traditional method, did not enable the participants to recognize high-density characters in a short period of time. However, the general orthographic features of more complex characters could be retained longer in the treatment group.

The scores of those who received the MSM presentation were then analyzed by a Wilcoxon Signed Ranks test to compare participants’ performance under two conditions, low-density versus high-density characters. The difference was significant in Round 1 \((z = -4.33, p < 0.05)\) with a large effect size \((r = 0.66)\), but not in Round 2 \((z = -0.56, p > 0.57)\). This proved that MSM helped participants better remember details about characters that are relatively low density in short-term memory. As time went by, however, annotations of both types of characters were eventually forgotten at such a speed that the difference became insignificant in the end.

Table 6.1 Means and standard deviations and \(N\) for test scores of low- and high-density characters as a function of presentation mode and time in recognition test

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation mode</th>
<th>Density</th>
<th>(M)</th>
<th>(SD)</th>
<th>(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>Mixed</td>
<td>Low</td>
<td>9.95</td>
<td>2.00</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>8.58</td>
<td>2.18</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Traditional</td>
<td>Low</td>
<td>8.58</td>
<td>1.87</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>8.60</td>
<td>1.95</td>
<td>43</td>
</tr>
<tr>
<td>Round 2</td>
<td>Mixed</td>
<td>Low</td>
<td>6.93</td>
<td>2.07</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>7.19</td>
<td>2.40</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Traditional</td>
<td>Low</td>
<td>6.60</td>
<td>2.32</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>6.09</td>
<td>1.95</td>
<td>43</td>
</tr>
</tbody>
</table>
What effect did the MSM presentation have on the participants’ ability to produce characters and the direction of the performance difference, if any, between producing low- and high-density characters?

Table 6.2 contains means and standard deviations of test scores for participants’ production of low-density and high-density characters in both rounds. For low-density characters, a significant group difference was found since the treatment group produced more correct target characters, $F (1, 84) = 5.25, p < 0.05$ with a medium effect size ($\eta^2 = 0.06$). An insignificant group difference was found in Round 1 ($t = -0.17, p > 0.87$), but became significant in Round 2, ($t = 4.52, p < 0.05$) with a very large effect size ($d = 0.93$). This suggested the MSM presentation could not make participants remember more characters in the immediate posttest, but it did help them better remember the details of low-density characters.

The participants’ performance with high-density characters was not significant between the two groups, $F (1, 84) = 0.05, p = 0.82$, neither in the immediate ($t = 1.85, p > 0.06$) nor the delayed posttest ($t = -1.44, p > 0.15$). The main effect of time was significant, $F (1, 84) = 124.41, p < 0.05$ with a large effect size ($\eta^2 = 0.60$). Compared to the task of recognition, writing complex characters from scratch was so difficult that the MSM presentation did not produce any difference in Round 1 and the participants were unable to hold onto the comprehensive orthographic features of the various characters.

For the treatment group, the low-density characters were significantly easier to produce than the higher density characters in both Round 1 ($z = -5.65, p < 0.05$) and Round 2 ($z = -5.15, p < 0.05$); the effect sizes were 0.86 and 0.79, respectively. The large effect size not only confirmed the common experience that characters with more strokes required a longer time

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation mode</th>
<th>Density</th>
<th>M</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>Mixed</td>
<td>Low</td>
<td>9.16</td>
<td>1.72</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>5.77</td>
<td>1.39</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Traditional</td>
<td>Low</td>
<td>9.23</td>
<td>2.10</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>5.28</td>
<td>1.03</td>
<td>43</td>
</tr>
<tr>
<td>Round 2</td>
<td>Mixed</td>
<td>Low</td>
<td>6.16</td>
<td>2.01</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>3.44</td>
<td>1.18</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Traditional</td>
<td>Low</td>
<td>4.53</td>
<td>1.24</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>3.84</td>
<td>1.36</td>
<td>43</td>
</tr>
</tbody>
</table>
to learn, but also indicated the inability of the MSM presentation to lead to
the retention of minute, subtle graphic features.

**How did the MSM presentation affect the participants’
frequency in using phonological retrieval cues when
recognizing and producing characters?**

Since participants did not receive any type of reviews on target charac-
ters between the two rounds of testing, their memory of the sound attributes
seemed to have faded rapidly and therefore was not relevant to the scope of
this study. The data analysis of retrieval cues only focused on the result of
the first round. A chi-square test of independence was performed and found
an insignificant difference between the control and treatment groups regard-
ing their frequency of evoking sounds in the task of recognizing characters,
$\chi^2(4, N = 86) = 1.43, p > 0.69$. Within each group, $\eta$ was used to investigate
the strength of the association between the participants’ frequency of using
sounds to assist recall and the scores they received. A large effect size was
found: $\eta = 0.45$ for the treatment group and 0.50 for the control group. A
Mann–Whitney $U$-test was performed to find the significant contrast. It
revealed that in the treatment group, those who frequently recalled the
sounds scored significantly higher than those who rarely did so, $z = -2.65,$
$p < 0.05$ with a large effect size ($r = 0.49$).

The same data analysis procedure was applied to the scores of character
production. The group difference was insignificant; i.e. participants from
neither group demonstrated a higher tendency of using sounds to help their
memory, $\chi^2(4, N = 86) = 2.78, p > 0.42$. Within each group, a Kruskal–Wallis
$H$-test was conducted to examine the score difference among the partici-
pants who rarely, infrequently, frequently or always recalled sounds while
producing characters. The results were insignificant for the treatment group
as well as for the control group, $p > 0.47$ and $p > 0.44$, respectively. The lack
of performance difference revealed the MSM presentation had little impact
on character writing, in terms of influencing the participants’ ability to recall
a character and produce characters.

**Discussion**

With almost no exceptions, CFL teaching involves a challenging yet crucial
task of presenting words and characters for learners to remember. Vocabulary
learning creates considerable challenges for CFL learners in the US, by and large
due to the difficulty in retaining orthographic features of Chinese characters
and remembering their pronunciation and English annotations (Hamada &
Koda, 2008; Zhang, 2009). By taking advantage of the modality effect, which
has been proven effective in many areas (cf. Neath & Surprenant, 2003),
CFL teachers have hoped to create a multimedia environment where students would be able to allocate more time to closely observing and encoding the orthographic features of characters while receiving their pronunciation and meaning aurally.

One important finding from the present study is the positive effect of the MSM presentation for the learning of characters, both in terms of recognition and production. For example, the treatment condition promoted short-term retention of general features as well as longer term retention of specific orthographic details of low-density characters. Such effects varied considerably from one condition to another and often fell short of retention. The variable and short-term effects, to a certain extent, were manifest across density levels, and therefore deserve attention.

An in-depth examination of studies on character density reveals some, albeit partial and indirect, clues. The average number of strokes in Jin’s (2006) experiment was approximately 10. Characters associated with beginning-level participants in Chung’s (2008) study had seven strokes on average. Compared to the current study, this conspicuous difference in character density may help explain the absence of a general, dominant modality effect. According to You (2003), seven strokes constitutes a difficulty threshold for CFL learners, such that characters containing more than seven strokes are considerably more difficult to recall and produce than those containing fewer strokes.

This finding is in accordance with the results of Feng’s (2002) study, which proposed a bell-shaped learning curve that changes direction at the point of six strokes; i.e. characters containing six strokes are the easiest to recall and those with more than 14 strokes are the hardest. The difficulty imposed by the high-density characters in the current study undoubtedly overloaded the encoding process even after Pinyin and English annotation as possible interferences were removed to make room for the visual channel. The results suggest that character density is an impacting factor to the outcome of the MSM presentation and therefore must be taken into full consideration in instructional design. Without such qualified knowledge, the claimed advantage of the MSM presentation is likely to fail as a result of oversimplification in manipulating the cognitive mechanism to retain orthographic features.

Time is another factor which both teachers and students should pay close attention to for the purpose of achieving better and longer retention. As the present study has shown, without reinforcement between the immediate and delayed posttest, the auxiliary function of the modality effect in mnemonics quickly dissipated and lapsed into insignificance, particularly in character recognition. Studies have proven that externally supplied mnemonic aids, such as visual illustrations of characters (Kuo & Hooper, 2004) or instructor-provided explanations (Shen, 2004), do help participants score higher with a better short-term retention rate for general orthographic features and meaning, but can hardly resist the work of time.
Meanwhile, self-generated mnemonics allow participants to actively infer and construct meaning based upon their existing knowledge and personal experiences. This very act of pressing oneself to interpret and digest the new information into meaningful expressions may enable deeper processing (Phan, 2008; Wittrock, 1990). The MSM presentation appears to hold little potential to stimulate deep procession and therefore must be either integrated into broader teaching strategies or repetitively implemented throughout the entire learning process.

The findings of the present study revealed that the possible improvement of the encoding quality promised by the MSM presentation was not found in a number of situations where character density and time lapse played a substantial role. Unlike the research design of Chung (2008), under which participants in both groups were exposed to target characters for the same amount of time, this study granted longer time for the control group, which resulted in some noticeable changes. The insignificant group difference proved that simply exposing participants to target characters for a longer period of time could achieve a similar effect to that of the MSM presentation for the purpose of learning orthographic features.

Mayer (1984), in his classic study on reading aids and text comprehension, identified three types that are most relevant and valuable: (1) aids for selecting information, (2) aids for building internal connections, and (3) aids for building external connections. This concept was then adapted into the multimedia environment, where the target information can be delivered in a larger volume (cf. Chun & Plass, 1997). Following this line of thinking, researchers are looking for new methods through which the MSM presentation can be connected with all three types of aids to foster text comprehension.

Svenconis and Kerst (1995) coupled audio input with the semantic mapping technique, i.e. using illustrative maps to depict the semantic relationship between target Spanish words. Compared to the traditional word listing method, semantic mapping alone did not lead to higher scores on vocabulary tests, yet one hybrid method (semantic mapping with sound) produced the highest average scores and another (word list with sound) impeded learning. This interaction between the modality effect and other techniques was duplicated in CFL by Jin's (2006) study, in which the group that received both radical presentations with the option to hear the sound performed the best. It follows that audio annotation must be appropriately combined with other variables for optimal vocabulary learning in a hypertext environment.

In addition to the direct effect of the MSM presentation, one important aspect associated with the ramifications of this practice must not be ignored, namely the role of phonological cues in learning and reading characters. CFL learners not only use phonological information embedded in orthographic features to learn characters and make word decisions (Hue, 1992;
Shen, 2005), but also consciously add a layer of phonological prompts to assist reading comprehension (Everson & Ke, 1997; Lee-Thompson, 2008). The results of this study are in line with those findings. Three tutorials obviously were too ephemeral to impact the participants' overall character learning strategies. Not surprisingly, there was no group difference in the frequency of evoking sounds when participants performed either task. Yet, those who made use of sounds ended up scoring significantly higher than those who infrequently or rarely did so.

In conclusion, by incorporating auditory input in character instruction to stimulate the modality effect, this study examined the density factor that had been overlooked by previous studies and found the strengths as well as the weaknesses of the MSM presentation method in developing character recognition and production. The relatively small sample size and the possible homogeneity among participants from the same institute, along with other methodological inadequacies, suggests that the results of this study are tentative in nature and must be interpreted with caution. Researchers need to experiment with different ways of integrating the modality effect along with other methods in order to foster better retention of information presented.
Appendix A: List of Characters and their Distractors Used in the Recognition Task

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Notes: D, distractor; SN, stroke numbers.

Appendix B: List of Characters Used in the Production Task

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Notes: SN, stroke numbers.

References


