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Effects of hanyu pinyin on pronunciation in learners of Chinese as a Foreign Language

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Abstract

This paper provides evidence that the hanyu pinyin representation of the phonology of Chinese affects the production of Chinese phonology in instructed learners of Chinese as a Foreign Language. Pinyin generally has a one-to-one correspondence between graphemes and phonemes, but its transcription of some Chinese rimes does not represent the main vowel. As a consequence, learners of Chinese as a Foreign Language have non-target-like phonological representations of Chinese rimes, which in turn lead to non-target-like pronunciations.

A hanzi reading-aloud task was used to elicit syllables containing the three rimes /iou/, /uei/ and /uən/ from final-year CFL students. Results show that learners often delete the vowels that are not represented in the pinyin transcription, but they produce the same vowels in the same rimes when the pinyin transcription represents them.

It is concluded that the pinyin orthographic input interacts with the phonological input in shaping the phonological representations and pronunciation of Chinese syllables in intermediate as well as beginner CFL learners. Language teachers should therefore be aware of the effects of the pinyin orthography.

摘要

本篇论文论证了汉语拼音对外国学习者的汉语发音产生影响的问题。汉语拼音通常是字母与音位一一对应的，但有一些汉语韵尾的主要元音在汉语拼音中没有得到准确的表示，因此，学习汉语的外国学习者接触到的是不准确表示汉语发音的书写形式，这些书写形式会导致他们出现非目标的发音。本研究要求学习汉语的中级阶段的外国学生大声朗读包含/iou/, /uei/ 或 /uən/ 韵尾的汉字。结果显示，在汉语拼音中得不到表示的元音经常被学生遗漏，反之，在汉语拼音中得到表示的元音，学生的发音就会出现此元音。本研究的结论是，在中级、初级学习者掌握汉语音节的书写形式和发音的过程中，汉语拼音的输入会影响发音。因此汉语教师应当对汉语拼音的这一作用有所认识。

1. Introduction

When western learners start learning Chinese, the majority of them do not begin with hanzi, but begin with pinyin, which represents Chinese using the letters of the Roman alphabet. Pinyin is currently the most widely used romanization system for Chinese, both in China and in the west. On the one hand, it provides a very useful tool for teaching Chinese phonology and vocabulary, and for allowing beginner learners to read. On the other hand, it can have negative effects on learners' pronunciation. This is a widespread idea among language teachers, but it has not been adequately investigated. The present paper concentrates on the effects of pinyin on learners' pronunciation of three Chinese rimes, showing the negative effects of pinyin on the pronunciation of intermediate learners, and it tries to explain the causes of these effects.

The introduction describes the phonology of the three rimes under investigation (1.1) and their acquisition in Chinese children (1.2). It then discusses the pinyin representation of these rimes (1.3), and it reviews previous research showing that pinyin affects learners' pronunciation (1.5).

1.1 The Chinese rimes /iou/, /uei/ and /uən/ : phonology, first language acquisition and pinyin representation

Putonghua (or Standard Chinese, from now on 'Chinese') has a simple syllable structure: $C_{(0-1)}V N_{(0-1)}$. The onset (consonant or consonant cluster at the beginning of a syllable) can consist of only one consonant, which is optional. The rime (part of the syllable that follows the onset) consists of an obligatory nucleus and an optional coda. The nucleus consists of a simple vowel (or 'monophthong'), a diphthong (a vowel with two targets) or a triphthong (a vowel with three targets); the coda (consonant or consonant cluster at the end of a syllable) can consist of one of two nasals (either /n/ or /ŋ/). Apart from 7 simple vowels, there are 9 diphthongs (/ae, ao, ei, oʊ, ia, iɛ, ua, uo, yɛ/) and 4 triphthongs (/iau, ioʊ, uae, uei/). Chinese diphthongs and triphthongs are composed of a main vowel (/a/, /o/, /e/, /ɛ/), preceded and/or followed by a high vowel (/i/, /u/, /y/[1]). In diphthongs, the main vowel can be the second one ('ongliding diphthongs', e.g. /ua/) or the first one ('offgliding diphthongs', e.g. /au/); in triphthongs it is always the central one. The main vowel has the most intensity and is the longest, with length ratios of 6:4 for offgliding diphthongs, 4:6 for ongliding ones and 4:4:2 for triphthongs (Cao and Yang, 1984). A high vowel cannot be the main vowel in diphthongs and triphthongs.

The present paper focusses on three rimes: /iou/ /uei/ and /uən/. Syllables containing these rimes are relatively frequent. In an analysis of a corpus of elementary reading materials for Chinese children (Suen, 1979), syllables containing an onset followed by /uei/, /iou/ and /uən/ constituted 4.89% of the corpus (syllables consisting of these rimes with zero onset constituted another 2.67% of the corpus). Of the most frequent 500 characters in Suen's corpus, 11 contained one of these rimes.

1.2 Chinese children's acquisition of /iou/, /uei/ and /uən/

A few studies have investigated the acquisition of Chinese phonology in children, starting with the early work of Zhao Yuanren (Chao, 1951/1971). With regards to the acquisition of diphthongs and triphthongs, the first language acquisition literature shows that Chinese young children often reduce triphthongs to diphthongs, and diphthongs to monophthongs; for instance, they pronounce /au/ as /a/, or /uei/ as /ei/. At age 2, children reduce 67% of triphthongs and diphthongs; at age 3, they reduce 38% of diphthongs and 48% of triphthongs, at age 4 they reduce 19% of diphthongs and 23% of triphthongs (Li et al., 2000); children aged 5 to 6 still do not have stable triphthongs (Hsu, 1987, quoted in Zhu, 2002). There seems to be a hierarchy of difficulty, so that /iau/ is reduced the most, with /uei/ being the second most often reduced triphthong. In Zhu and Dodd's (Zhu and Dodd, 2000) study, 37% of all children reduced /iau/, and 10% reduced /uei/. There seems also to be a developmental order of acquisition, with some diphthongs and triphthongs emerging (i.e. being produced correctly for the first time) earlier than others. In a longitudinal study, 3 children out of 4 produced /ei/ as their first diphthong (between age 1;2 and 1;7) and /uo/ as the last one (between age 1;7 and 1;9). Among triphthongs, all children produced /iou/ first (age 1;3-1;5) and 3 out of 5 produced /uai/ last (age 1;6-1;9) (Zhu, 2002). This is most likely due to difficulty in articulating three vowel targets in a syllable, which requires rapid movement towards two or three target vowels.

A typical finding is that, in reducing diphthongs and triphthongs, Chinese children never delete the main vowel. They delete the the first vowel in ongliding diphthongs (e.g., /ua/ pronounced as /a/), and the last one in offgliding diphthongs (e.g., /au/ pronounced as /a/). In

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[1] These are sometimes considered semi-vowels, but here they will be represented as vowels for clarity.

triphthongs children delete the first or last vowel but never the middle vowel. For instance, among the 37% of children in Zhu's (2002) study who reduced /iau/, 29% reduced it to /ia/ and 8% to /au/; the /a/ was never deleted. This is probably due to the fact that the middle vowel is longer and louder than the preceding or following high vowels. For this reason, the main vowel is noticed in the input, and as a consequence it is present in the output as well (Li et al., 2000) (Zhu, 2002).

1.3 The representation of /iou/, /uei/ and /uən/ in hanyu pinyin

Hanyu pinyin uses the letters of the Roman alphabet to represent the sounds of Standard Chinese (*putonghua*). Each phoneme is represented by a grapheme, i.e. a letter or letter combination (e.g. /t/ is written as *d*, /i/ as *i*, /ʃ/ as *sh*, etc.). Tones are represented with a diacritic placed above the main vowel (e.g. *má, mà*). Pinyin is a phonologically transparent orthography, where one phoneme corresponds to one grapheme and one grapheme corresponds to one phoneme. For instance, the pinyin *a* represents the phoneme /a/, *ma* represents /ma/, *mang* represents /maŋ/, and conversely /a/ is spelled as *a*, /ʃa/ as *sha* and /ʃaŋ/ as *shang*. Although pinyin was created to be a phonemic transcription system and to represent the correct pronunciation of putonghua, at the time when it was designed it was also meant to be a fully working writing system which could eventually replace hanzi (Chen, 1999). For this reason, phonemic accuray was sometimes sacrified to make pinyin easier to read or write. For instance, /i/ is normally spelled *i*, but in syllable-initial position it is spelled *y*. This orthographic convention facilitates reading, as readers can quickly distinguish *fanian* /fa niɛn/ from *fanyan* /fan iɛn/. Without this convention, both /fa niɛn/ and /fan iɛn/ would be spelled as *fanian*, or an apostrophe would be needed to distinguish *fanian* from *fan'ian* (as happens with syllable-initial *a*, as in *fang'an*). Since the use of the apostrophe requires one more stroke on the keyboard, it is easier to use different letters to represent syllable-initial vowels when such letters are available (but no letter is available as an alternative to *a*). In the same vein, the desire to avoid diacritics led to representing /y/ with *u* rather than *ü* in contexts where this could not lead to confusion, as in *qu* and *xu* (Chinese does not have */tɕʰu/ or */ɕu/); but *ü* is used in *lü* and *nü* in order to avoid confusion with *lu* and *nu*.

Another orthographic convention which was meant to facilitate reading applies to the representation of three Chinese rimes: /uei/, /iou/ and /uən/. When there is no consonantal onset, these syllables are spelled as *wei*, *you* and *wen*. But when these rimes are preceded by a consonant, the main vowel is not represented: /uei/ is spelled as *ui* (e.g. *sui*), /iou/ is spelled as *iu* (e.g., *liu*), /uən/ is spelled as *un* (e.g. *cun*). Since the main vowel, which normally bears the tone, is not represented, the tone marker is instead placed on the last vowel, as in *duì* (normally the tone is placed on the *e*, as in *wèi*). These orthographic conventions affect 12 /uei/ syllables (chui, cui, dui, gui, hui, kui, rui, shui, sui, tui, zhui, zui), 7 /iou/ syllables (diu, jiu, liu, miu, niu, qiu, xiu) and 13 /uən/ syllables (chun, cun, dun, gun, hun, kun, lun, run, shun, sun, tun, zhun, zun).

This orthographic conventions is not adopted in all romanization systems. Both the phonetic transcription systems used in Taiwan (*tongyong pinyin* and *zhuyin fuhao*) represent /iou/ and /uei/ with the same number of graphemes regardless of the environment, although tongyong pinyin adopted the convention of representing syllable-initial /i/ and /u/ as *y* and *w* (e.g., /uei/ is represented as ㄨㄟ in zhuyin fuhao, and as *wei* and *uei* in tongyong pinyin). Wade-Giles represents all vowels in /uei/ but omits one in /iou/ and /uən/.

1.4 The effects of pinyin on the phonetic analysis of /iou/, /uei/ and /uən/

Research has repeatedly shown that the orthographic representation of the sounds of a language affects the mental representations of these sounds. For instance, native speakers of English count one more sound in *debt* than in *dot* because *debt* contains one more letters (but not one more phoneme) (Derwing, 1992; Perin, 1983). If this is so, then native speakers of Chinese may perceive one more sound in *you* or *wei* than in the rimes of *liu* or *shui*, because the rimes in the latter two are spelled with two letters rather than three (as in *liou* or *shuei*).

Some researchers hold it that the pinyin representation negatively affects the phonetic analysis of Chinese. (Canepari, 2005) criticizes a phonetic tradition strongly influenced by pinyin, which 'even has a "zero (graphic) vowel", when pinyin "smartly" economized on vowels, by writing *un* for /wɤn/ /wɜn/, and *iu* for /jou/ [...], *ui* for /wei/ /wəi/, where a vowel is definitely present, phonically! (p. 345).

According to some scholars, the phonetic realization of the main vowel in the rimes /iou/, /uei/ and /uən/ changes depending on the tone: it has more intensity and length in the third and fourth tones than in the first and second tones (Norman, 1988). Some researchers therefore transcribe these syllables without a main vowel in the first and second tone: *you* and *qiu* are transcribed as /ju/ and /tɕʻiu/ in the first and second tone, and as /jou/ and /liou/ in the third and fourth tone (see Li and Shi, 1986). The most likely explanation for the effects of tone is that the third tone makes syllables longer in the citation form and therefore makes the main vowel more salient; on the other side, in connected speech syllables in the third tone are actually shorter, so that the effects of the third tone are not consistent (Yi Xu, personal communication). Still, if the phonetic realization of such vowels indeed is affected by tones, this happens both when the syllable contains a consonantal onset and when it has zero onset. In pinyin, on the other side, the vowel is only omitted in post-consonantal position. As Canepari quite rightly argued, this does not mean that such vowels do not exist.

Canepari suggests that pinyin should not have introduced such orthographic conventions: '[n]o doubt, *uen, iou, uei* would have been much better' (ibidem). Whether such orthographic conventions are useful or not is debatable. Still, nowadays pinyin is the most widely used transcription system in the teaching of Chinese as a Foreign Language. If orthographic representations affect L2 learners' pronunciation, then CFL learners should be affected by the orthographic conventions described above.

1.5 Previous research on the effects of pinyin on L2 phonology

Research shows that the pronunciation of second language learners can be affected by orthographic representations. Young-Scholten found effects of orthographic representations on the pronunciation of consonants in English learners of German (Young-Scholten, 2002) and on the pronunciation of consonant clusters in L2 learners of Polish (Young-Scholten, 1998; Young-Scholten et al., 1999). Since the L2 orthographic input affects pronunciation, it is possible that the pinyin input affects CFL learners' pronunciation. This has been shown in a couple of previous studies.

One study (Meng, 1998) found that CFL learners' pronunciation of Chinese voiceless consonants is less target-like when they are shown the pinyin transcription together with the hanzi. The researcher tested 25 learners of Chinese as a Foreign Language from various L1 backgrounds reading 4 words: 半年, 但是, 高兴, 再见. In all these words, the first consonant is spelled with a letter that represents a voiced consonant in the learners' first language orthographies. Learners read each word three times. First, they read the hanzi with their pinyin transcription. Then the researcher explained the differences between the sounds represented by the letters *b, d, g* and *z* in pinyin and the sounds represented by the same letters in the learners' L1 orthographies. Learners practiced the correct pronunciation using the International Phonetic Alphabet (IPA) symbols /p/, /t/, /k/, /ts/, then read the words a second time. Finally, learners

read again the words which were shown together with the pinyin transcription. The percentage of correct pronunciations for the 4 phonemes under analysis was 16% for the first reading with pinyin, 81% for the IPA reading, and 16% for the second reading with pinyin. It appears that the pinyin transcription leads learners to make errors in pronunciation.

Meng also found effects of pinyin on the pronunciation of the triphthong /uən/. A group of Japanese CFL learners read the hanzi 棍, 困 and 婚 twice. The first time they saw the hanzi together with their pinyin transcriptions *gun*, *kun* and *hun*; the second time the transcriptions included the main vowel: *guen*, *kuen*, *huen*. Results show a dramatic difference in accuracy: 81% of the students pronounced the syllables correctly when they were spelled with the main vowel, but only 20% of them pronounced correctly when they saw the pinyin spellings. Both these studies show that learners are led astray by the pinyin transcription, making more pronunciation errors in reading the same hanzi when they are shown the pinyin spelling, at least at the beginner level.

Effects of pinyin on CFL learners' pronunciation were also found by (Ye et al., 1997). In this study, CFL learners read aloud 100 hanzi. Their pronunciation of each syllable was rated for three characteristics:

1) accuracy. Five Chinese researchers with experience in phonetics and Chinese language teaching listed all the pronunciation errors made by learners in each syllable.

2) similarity to the target form. Ten Chinese native speakers rated each syllable as 'similar to the target', 'slightly different from the target' or 'very different from the target'.

3) understandability. Twenty Chinese native speakers transcribed each syllable in pinyin.

Among these syllables, a few contained the rimes of interest for the present study: /uei/ (对, 睡, 喂), /uən/ (村, 春), /iou/ (九, 有). The analysis of English CFL learners' pronunciations shows that all these syllables were recognized by native speakers in the 'understandability' task, showing that pronunciation errors at least do not disrupt communication. Results of the 'accuracy' task show that the /uən/ rime was the most problematic, as the /ə/ was too short; also, the /u/ in /uei/ was sometimes omitted. Ye et al. blame the pinyin orthography for the deletion of vowels from Chinese rimes, and suggest ways to teach Chinese pronunciation that could eliminate the effects of pinyin.

It has been argued that the reason of the non-target-like pronunciations found by Meng and Ye et al. is the interference between the orthographic input and the phonological input. Bassetti (forthcoming) tested the phonological awareness of English CFL learners using a phoneme counting task. Participants were shown a series of hanzi and counted the number of phonemes in each syllables. The same rime was presented in syllables whose pinyin spelling does not represent the main vowel (e.g., *dui*) and in syllables whose pinyin spelling represents the main vowel (e.g., *wei*). English beginner CFL learners mostly counted one less vowel in syllables whose pinyin spelling does not represent the main vowel. To confirm that the omitted vowel was indeed the vowel not represented in the pinyin transcription, a small group of learners were asked to perform a phoneme segmentation task: they read the same hanzi list and pronounced all the phonemes in each syllable one by one. Results show that learners do not pronounce the main vowel as a separate phoneme in syllables whose spelling does not include it, confirming that the vowel omitted in the phoneme counting task was indeed the main vowel. The researcher argues that the pinyin input interferes with the spoken input, leading to incorrect mental representations of these rimes. CFL learners hear /liou/ but read and spell *iu*, and both these forms of input affect their mental representation of Chinese rimes, at least in beginner learners. When pinyin spellings do not represent the main vowel in the three rimes under analysis, Chinese language learners count one less vowel in the rime than they count when the pinyin spelling represents the main vowel as well. The researcher claimed that the absence of these vowels from learners' mental representations could be the reason why learners do not pronounce them.

The previous studies all showed that pinyin affects the CFL learners' pronunciation. But the effects of pinyin on the pronunciation of Chinese rimes have not been analysed systematically.

2. The study

The purpose of the present study was to evaluate in a systematic way the impact of pinyin orthography on the pronunciation of learners of Chinese as a Foreign Language (CFL). It was predicted that pinyin orthographic conventions (whereby the main vowel is not represented in certain rimes) would result in learners simplifying such syllables, as they would delete (not pronounce) the main vowel in those rimes whose pinyin transcription does not represent such vowel. Learners with three years' exposure to Chinese were chosen in order to verify whether the effects of pinyin on pronunciation are long-lasting or are limited to beginners such as the participants in Meng's (1998) study.

First, a simple articulatory explanation was ruled out by testing whether learners omitted the main vowel from other rimes. If the omission of the main vowel from /iou/, /uei/ and /uən/ is due to the difficulty in articulating three target vowels in a syllable, then learners should also omit the main vowel in the thriphthongs /iau/, /uai/ and /uan/. If the vowel in these triphthongs is pronounced, then the absence of the main vowel in the rimes under analysis cannot be explained as a consequence of articulatory difficulties. This would also rule out he possibility that deletions are due to the presence or absence of similar di- and triphthongs in the first language phonology, because the triphthong /iau/ does not exist in the learners' first language phonology. Syllables with and without a consonantal onset were compared, to test whether participants were able to pronounce the rimes under investigation. If the deletion of the main vowel in these rimes is indeed due to the pinyin representation, then the main vowel should be deleted only in syllables with a consonantal onset but not in syllables with zero onset, because the pinyin spelling of the latter syllables represents the main vowel. It was therefore predicted that L2 learners would pronounce the main vowel in the rimes /iou/, /uei/ and /uən/ only in syllables with zero onset, as in these syllables pinyin represents all the vowels in the rime (*you, wei, wen*), but they would simplify the same rimes in syllables with consonantal onset by deleting the main vowel, as in these syllables pinyin does not represent all the vowels (*iu, ui, un*). On the basis of previous findings concerning CFL learners' phonemic awareness (Bassetti, forthcoming), it was further predicted that the pinyin orthographic conventions may affect some rimes more than others, and that syllables in the third and fourth tone may be less affected than syllables in the first and second tone.

2.1 Participants

Eight final-year students of Chinese as a Foreign Language (CFL) were recruited at an Italian university (all females, mean age = 22). On average they had studied Chinese for 33 months (6 students had studied it for 30 months and 2 students for 42 months), and had spent 1 month in China (minimum = 0, maximum = 2). They mostly considered a native-like pronunciation of Chinese 'very important' or 'important' (87.5%). They reported practicing reading and writing more than listening and speaking (on average 1 hour a day for reading and writing, and less than one hour for listening and speaking). Pinyin was the only transcription system they knew, and they reported using it 'very often' or 'often' (75%).

2.2 Materials and procedure

Each student read aloud a list of 60 hanzi. Each hanzi was printed on a separate line, followed by examples of Chinese words containing the hanzi and Italian translations of both hanzi and words. If students did not recognize a hanzi, they were allowed to look up the pronunciation in a separate list.

Hanzi reading was selected as the most appropriate task to elicit learners' pronunciation of the target syllables for two reasons: on the one hand, hanzi list reading could result in better pronunciation than less formal tasks, while at the same time hanzi provide no orthographic information regarding the number or type of phonemes. A pinyin reading list may result in more orthographic interference (Meng, 1998), and therefore not reflect learners' actual pronunciations; a spoken production task may result in less accurate pronunciations. In a sense, hanzi reading is similar to picture naming, since the target word is elicited without providing orthographic information.

Six target rimes were tested: /iau/, /iou/, /uai/, /uei/, /uan/ and /uən/. Each rime appeared in 6 hanzi, 4 representing a syllable with consonantal onset and 2 representing a syllable with zero onset. The 18 hanzi used to elicit /iou/, /uei/ and /uən/ are listed in Table 1. These were the same hanzi used in the previous study on CFL learners' phonological representations (Bassetti, forthcoming), with two exceptions: 伦 (lún) and 敦 (dūn) were replaced by 论 (lùn) and 村 (cūn) respectively. The hanzi used to elicit /iau/, /uai/ and /uan/ were the following: 条, 小, 叫, 跳, 药, 要, 筷, 怪, 快, 坏, 外, 关, 川, 短, 换, 完, 万. The remaining 24 hanzi were not analyzed as part of this study.

Rime	Syllable	Tone	Hanzi	Pinyin
iou	tɕʰiou	1	秋	qiū
	ɕiou	1	休	xiū
	tɕiou	3	酒	jiǔ
	liou	4	六	liù
	iou	3	有	yǒu
	iou	4	右	yòu
uei	xuei	2	回	huí
	ʂuei	3	水	shuǐ
	suei	4	岁	suì

Rime	Syllable	Tone	Hanzi	Pinyin
	tsuei	4	最	zuì
	uei	2	为	wéi
	uei	4	喂	wèi
uən	suən	1	孙	sūn
	tsʰuən	1	村	cūn
	tʂuən	3	准	zhǔn
	luən	4	伦	lùn
	uən	2	文	wén
	uən	4	问	wèn

Table 1.   The 18 target syllables arranged by type of rime.

Students were recorded in their classroom using a Shure Spotlight C606 microphone and a MacIntosh G4 laptop computer running Praat (Boersma and Weenink, 2005). After the recording, they filled in a questionnaire regarding their biographical and linguistic background. Participation was voluntary.

2.4 Results
First of all, the learners' ability to pronounce triphthongs was assessed by analysing their pronunciation of the three rimes /iau/, /uai/ and /uan/, both in syllables with consonantal onset and with zero onset. All learners pronounced the main vowel in all the three types of rimes and in both contexts. This confirmed that these learners are able to pronounce triphthongs both when preceded by a consonantal onset and in syllables with zero onset.

The pronunciation of the three target rimes /iou/, /uei/ and /uən/ was then assessed twice, once for target-likeness and once for accuracy. For each participant, each rime was rated as target-like (containing the main vowel) or non-targetlike (main vowel deleted). The rating was performed twice with an interval of six months, yielding an intra-rater agreement rate of .87 (r = .87, p < .001). To analyse the effects of pinyin on the deletion of the main vowel, the number

of target-like pronunciations of /iou/, /uei/ and /uən/ were entered into a Repeated Measures Analysis of Variance (ANOVA) with phonology-pinyin consistency as a within-subject factor with two levels: consistent (i.e. pinyin represents all vowels in the rime) or inconsistent (i.e. pinyin does not represent all vowels). There was a highly significant effect of phonology-pinyin consistency, $F(1, 7) = 20.18$, $p < .005$, $\eta^2 = .74$. Participants pronounced the main vowel more often in rimes whose pinyin representation includes the main vowel than in rimes whose pinyin representation does not include the main vowel (on average participants pronounced the main vowel in 100% of the phonology-pinyin consistent syllables and in 57% of the phonology-pinyin inconsistent syllables).

To test for the effects of pinyin on the accuracy of learners' pronunciation, each rime was then rated for accuracy on a 7-point scale where 1 was 'extremely accurate' by two linguists: a Chinese native speaker and an Italian second language user of Chinese (the researcher). A mean rating was obtained for each rime for each participant. The ratings were analysed using an ANOVA with phonology-pinyin consistency as a within-participant factor. The results show that the pinyin representation significantly affects the accuracy of learners' pronunciation of /iou/, /uei/ and /uən/, $F(1, 7) = 44.65$, $p < .001$, $\eta^2 = .86$. Participants' rime pronunciations were rated as more accurate in syllables whose pinyin representation includes the main vowel than in syllables whose pinyin representation does not include all vowels (the average rating was 2.3 and 3.68 respectively).

To test whether pinyin representations affect learners' pronunciation to different extents in different rimes, the number of phonology-pinyin inconsistent syllables was analysed using an ANOVA with type of rime as a within-participant factor (with three levels: /iou/, /uei/ and /uən/). Since Mauchly's test indicated that the assumption of sphericity had been violated, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. Although participants pronounce the main vowel in 78% of /iou/ rimes, compared with 56% of /uei/ rimes and 38% of / uən/ rimes, this difference is not significant, $F(2, 14) = 4.10$, $p = $ ns.

Finally, an ANOVA was used to analyse the effects of tone (2 levels: tones 1 and 2; tones 3 and 4) on the number of rimes pronounced with the main vowel in phonology-pinyin inconsistent syllables. Learners pronounced more main vowels in syllables with the third and fourth tones (61%) than in syllables with the first and second tones (53%) but the difference was not significant, $F(1, 7) = 2.74$, $p = $ ns.

3. Discussion

The results of the present study show a strong effect of pinyin orthographic conventions on the pronunciation of learners of Chinese as a Foreign Language (CFL). Learners often deleted the main vowel in the three phonology-pinyin inconsistent rimes (*iu*, *ui*, *un*), but always pronounced the same vowel in the same rimes in the three phonology-pinyin consistent rimes (*you*, *wei*, *wen*). Vowel deletion occurred in all the three types of rime and with all the four tones. This is consistent with previous findings that CFL learners' mental representations of these rimes do not contain the main vowel (Bassetti, forthcoming). It also expands previous findings that pinyin affects the pronunciation of these rimes in beginner learners (Meng, 1998), by showing that such effects are still present in learners who have been studying the Chinese language for three years.

The non-targetlike pronunciation of the rimes under analysis is unlikely to affect communication. Communication disruptions occur when the second language learners' incorrect pronunciation is a meaningful sequence in the second language. For instance, if a learner of English pronounces *sheep* as /ʃɪp/ rather than /ʃiːp/, English speakers may hear *ship*. Since in Chinese the syllables /tun/, /tiu/ and /tui/ do not exist, Chinese speakers cannot misunderstand what CFL learners are saying. CFL learners' pronunciations may sound strange, and this will contribute to their foreign accent, but there will be no communication breakdowns. This means that Chinese speakers will never correct CFL learners' pronunciation. An English

speaker may correct a second language learner's /ʃɪp/ to /ʃiːp/, but Chinese speakers have no reason to correct /tui/ to /tuei/. In fact, native speakers will probably not even notice such pronunciations. Indeed, the pronunciations of CFL learners in the present study were mostly rated highly in terms of accuracy (on average slightly above 4 on a 7-point scale), showing that the deletion of vowels from these rimes does not result in unacceptable pronunciations. While this may be positive, on the other side, because of the lack of negative feedback and of communication disruptions, CFL learners may never 'notice the gap' between their pronunciation and Chinese native speakers' pronunciation.

3.1 Why does pinyin affect CFL learners' pronunciation?

Native speakers of Standard Chinese are exposed to Chinese phonology for years before learning pinyin in school. For them, the sequence of letters *iu* is the orthographic representation of /iou/, in the same way as the written word *yacht* represents the spoken word /jɒt/ for native speakers of English. Since in Chinese there are no /iu/, /ui/ or /un/ rimes, for a Chinese native speaker *iu* represents /iou/, *ui* represents /uei/ and *un* represents /uən/. This is not the case for CFL learners.

There are a variety of reasons why CFL learners interpret *iu* as /iu/, *ui* as /ui/ and *un* as /un/:

1) CFL learners are exposed to pinyin orthography from the beginning. When they start being exposed to the written form *iu*, they still do not know that /iu/ is not part of the phonological repertoire of Chinese.

2) CFL learners are already literate in another orthography. In the Italian orthography, iu is pronounced /iu/, *ui* is pronounced /ui/ and *un* is pronounced /un/. If learners were only exposed to spoken and written Chinese they would not pronounce *iu* as /iu/, because *iu* is always associated with the sounds /iou/ in the classroom. Learner's incorrect reading of these rimes is therefore caused by their first language reading experience.

3) pinyin is a phonologically transparent writing system. In pinyin one grapheme (one or two letters) always corresponds to one phoneme; the only exceptions are *iu*, *ou* and *un*. Learners may therefore expect that two letters will represent two phonemes, and generalise this rule to the three inconsistent rimes.

4) pinyin uses the same letters or sequences of letters to represent different sounds. Among the rimes under analysis, this applies to *un*. In pinyin, *un* represents three phonemes in *lun* and *shun*, but it represents two phonemes in *jun*, *qun* and *xun* (/tɕyn/, /tɕʰyn/, /ɕyn/, where the vowel is not /u/ but /y/).

The last factor, which has not been discussed so far, in fact played a role in the data under analysis. The orthographic convention of representing /y/ with *u* rather than *ü* was created in order to avoid unnecessary diacritics in pinyin. Since */tɕun/, */tɕʰun/ and */ɕun/ are not part of the Chinese phonological repertoire, *ü* can be replaced with *u* without any risk of confounding the readers. While this is a logical rule for Chinese native speakers, in the present study some of the CFL learners who reduced /uən/ to /un/ in fact replaced /u/ with /y/ (/lyn/, /syn/), showing that they have overgeneralized the correspondence between *un* and /yn/ to syllables with other consonantal onsets. It is interesting to note that in Ye et al.'s study (1997) some English CFL learners pronounced an /ə/ in *qun* (p. 253), showing that they had overgeneralized the *un*-/uən/ correspondence also to syllables where *un* represents /yn/.

It appears that the effects of pinyin on CFL learners' pronunciation can be attributed both to characteristics of the pinyin system and to the previous experiences of the learners.

3.2 Could the simplification of rimes be attributed to other causes?

This paragraphs investigates the possibility that the deletion of one vowel in CFL learners' pronunciation could be due to other factors, rather than to the influence of pinyin: 1) the

influence of the first language phonology; or 2) a universal difficulty in pronouncing diphthongs and triphthongs, common to both adult CFL learners and young Chinese children.

Research on second language phonology has identified the influence of the first language phonology as one of the main factors determining how the L2 is pronounced (Eckman, 2004). It is therefore possible that the simplification of rimes in /iou/, /uei/ and /uən/ may be due to first language influence. It is worth providing a quick description of those aspects of Italian phonology and orthography that could affect Italian learners' pronunciation of the Chinese rimes described above (the following description is based upon Schmid (1999) and D'Eugenio (1982)).

Most Italian syllables are composed of a consonant and a vowel, although the onset can contain up to three consonants and the coda up to two. More than 50% of all syllables in Italian frequency lists have a CV structure. Italian has 7 monophthongs, 21 diphthongs and 4 triphthongs. Diphthongs can be ongliding /iu ie io iɛ iɔ ia ui ue uo uɛ uɔ ua/ or offgliding /ui ei oi ɛi ɔi ai eu ɛu au/. In the four triphthongs /iɛi uei uai uɔi/ the main vowel is the central one, but there are also ongliding triphthongs, where the main vowel is the last one /uiɛ/ (*quiete*). Diphthongs and triphthongs are rare in Italian, compared with monophthongs: in Italian syllable frequency counts, diphthongs occur in about 7% of syllables, and triphthongs in less than 1%.

Moving on to orthographic representations, Italian has a phonologically transparent orthography where generally each phoneme is represented by a grapheme, i.e. a letter (*a*, *b*) or a letter combination (*ci* represents /tʃ/, *ch* represents /k/). Italian diphthongs and triphthongs are therefore represented by sequences of two and three letters: ue (*questo*), uai (*guai*), uei (*quei*), iei (*miei*).

From the above short description of Italian vowels, it appears that no specific difficulty can be predicted in the pronunciation of Chinese rimes in post-consonantal contexts. On the other hand, one difficulty could be caused by the Italian orthography. Since the Italian orthography is phonologically transparent, Italians are used to relying on the written form of a word to determine its pronunciation; in fact, many Italians are native speakers of various dialects, and they use the orthographic form as a guide to the correct pronunciation of words in Standard Italian. It is therefore more likely that their non-targetlike pronunciations are due to overreliance on the pinyin orthographic representations than due to effects of the first language phonology.

From the discussion above, it appears that the deletion of vowels in Chinese rimes cannot be attributed to the influence of the first language phonology. Another factor that may cause the simplification of rimes is the difficulty of pronouncing diphthongs and triphthongs. Italian CFL learners could delete one vowel from such rimes due to the difficulty of articulating two or three targets in a rapid sequence. Furthermore, simplification of complex structures is a feature of both first and second language acquisition. Still, a comparison between adult Italian CFL learners and young Chinese children shows that this cannot be the reason. Just like CFL learners, young Chinese children also do not pronounce all the vowels in diphthongs and triphthongs, because they are difficult to articulate as they require rapid movement of the tongue. But the way CFL learners simplify rimes is different from the way Chinese children do it:

1) CFL learners delete the main vowel, whereas Chinese children delete one of the high vowels but never delete the main vowel, i.e. CFL learners pronounce /uei/ as /ui/, Chinese children pronounce it as /ei/;

2) CFL learners only delete vowels in post-consonantal contexts, whereas Chinese children's reductions occur in all contexts, i.e. CFL learners reduce /tiou/ to /tiu/ but not /iou/ to /iu/;

3) CFL learners do not reduce the same rimes as Chinese children: CFL learners do not reduce /iau/, which is the rime most often reduced by Chinese children (37% of children in Hua and Dodd, 2000);

4) CFL learners acquire rimes in a different order compared with Chinese children: after three years of Chinese, CFL learners produce /iau/ correctly and omit one vowel in /iou/, whereas Chinese children correctly produce /iou/ earlier than /iau/ (Hua, 2002).

The above differences between CFL learners and Chinese children show that CFL learners' rime reductions cannot be due to difficulty in articulating the target sounds. In conclusion, it appears that the only explanation for CFL learners' deletion of vowels in Chinese rimes is the effect of pinyin.

3.3 How can the influences of pinyin be dealt with?

The use of pinyin with beginner learners is of course necessary, as CFL learners take long time to learn to read Chinese hanzi, and pinyin allows them to read Chinese from the very beginning. It also gives them a sense of achievement. Learners of Japanese are so happy with romanisation they sometimes do not want to move on to Japanese kana and kanji (Miura, 1987). For these reasons, Meng's (1998) suggestion that pinyin should only be introduced after learners have established their phonological systems appears impractical.

Language teachers and researchers who discuss how to avoid these unwanted consequences of pinyin orthography generally suggest to use explicit instruction. For instance, Yin (1990) explains that in order to pronounce /iou/ the student should first form /i/ and then add the diphthong /ou/; similar explanations are provided for /uei/ and /uən/. The student is cautioned that the absence of the vowel /o/ is merely a spelling conventions. Ye and colleagues (1997), who are targetting both teachers and learners of Chinese, suggest using an amended version of pinyin for beginner learners, so that at the beginning stage learners are presented with the complete transcription of the target syllable, as in *suei* or *jiou* (rather than *sui* and *jiu*). The official pinyin form can then be introduced after learners have acquired the correct pronunciation of these rimes.

The effects of explicit pronunciation teaching in textbooks are not clear. Still, looking at the textbook used by the CFL learners in the present study provides some interesting information. The participants in the present study had used the three volumes of 汉语教程 (Yang, 1999). In this textbook, Chinese consonants and rimes are introduced in the first five lessons (corresponding, according to the author's indications, to 10 one-hour classes). The first lesson introduces 11 consonants, 6 monophthongs and 4 diphthongs. The textbook explains how to articulate the simple vowels, and then only provides the International Phonetic Alphabet transcriptions for the other rimes. The rimes under analysis are introduced in lessons 3 (/iou/) and 4 (/uei/ and /uən/). *Hanyu jiaocheng* explains the orthographic conventions that apply to /iou/ under 'Rules of writing the transcription': 'iou is written as -iu if an initial is added' (p.22). The orthographic conventions of /uei/ and /uən/ are not explained. It is therefore interesting to note that the CFL learners in the present study deleted vowels from 62% of /uən/ rimes and 44% of /uei/ rimes, but only in 22% of /iou/ rimes. It is possible that students noticed the difference between the spoken input and the pinyin transcription in /iou/ because it is introduced in their textbook, but did not notice it in those rimes whose orthographic conventions are not formally explained in their textbook.

Besides whether instruction is explicitly provided or not, another issue could be the timing of explicit instruction. Most Chinese language textbooks provide a description of Chinese consonants and vowels only in the first few lessons. It is possible that phonological instruction could be more effective if it was provided not only at the early stages of language learning, but also at later stages. In her study of tone acquisition, Sun suggested that there should be explicit instruction throughout the learning process, not only at the beginning (Sun, 1997). Perhaps textbooks should explain these orthographic conventions both when first introduced and again in the course of the second language learning process.

Whether these or other teaching methods could diminish the influence of pinyin on CFL learners' pronunciation is an open question which is worth investigating.

CONCLUSIONS

Pinyin affects the pronunciation of adult learners of Chinese as a Foreign Language. This is due to the fact that adults are exposed to pinyin from the beginning and that they are already literate in another orthography, but it is also due to characteristics of the pinyin system. The influence of pinyin results in non-target-like pronunciations that never occur either in the Chinese spoken language learners are exposed to, or in young Chinese children's pronunciation. Language teachers should bear in mind that pinyin can influence not only the pronunciation of beginner CFL learners, but also more advanced learners with a few years' exposure to the language.

Acknowledgments

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