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Orthographic input and second language phonology

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1. Introduction

For many instructed second language learners, much second language input is not spoken, but written input. Unlike children acquiring their first language, L2 learners are often exposed to L2 written input from the early stages of the learning process, and written input can constitute a large part of their overall L2 input. Second Language Acquisition (SLA) researchers have mostly shown little interest in the differences between spoken and written input. While spoken and written language differ in terms of structures and vocabulary (see Halliday, 1990), more interestingly for this chapter, written representations provide a visual analysis of language. For instance, the English writing system represents phonemes as individual letters and words as strings of letters separated by spaces, although neither phonemes nor words are isolated units in the spoken language. Different writing systems represent different units of language: while alphabetic writing systems (such as Italian) represent phonemes, consonantal writing systems (such as Arabic) represent consonants, syllabic writing systems (such as Japanese kana) represent syllables, and morphemic writing systems (such as Chinese) represent morphemes. Writing systems also vary along a continuum of *phonological transparency*, with some writing systems showing a highly regular correspondence between the written symbols and the sounds of the language, and other writing systems having much less regular correspondences between orthography and phonology. For instance, the Italian writing system is much more phonologically transparent than the English one, because in Italian each letter or letter cluster corresponds to one phoneme; among morphemic writing systems, Chinese hanzi (Chinese characters) are more phonologically transparent than Japanese kanji (Japanese characters), because most Chinese hanzi have only one reading whereas most Japanese kanji have different readings depending on the context. In general, no writing system represents the spoken language with a complete one-to-one correspondence between symbols and sounds like the one found in phonetic transcriptions (Cook & Bassetti, 2005). Even highly transparent writing systems such as Italian are not fully transparent, often because they represent the morphology as well as the phonology of the language. For instance, Italian represents the syllable /a/ as <a> when it means ‘at’ and as <ha> when it means ‘has’ (the symbols ‘<’ and ‘>’ denote orthographic forms), and Japanese kana has two different symbols for the sound /o/, one used when it is an object marker and one used in all other instances. Writing systems were not created to provide an analysis of language. Orthographic representations of the spoken language are not neutral, and could therefore interact with the spoken language input.

This chapter will focus on the effects of the orthographic representation of the second language on learners’ L2 phonology. Many language teachers are aware of the effects of L2 orthography on L2 pronunciation. However, what exactly are these effects has not been studied much. This chapter argues that the L2 orthographic input interacts with the acoustic input, thus affecting L2 learners’ mental representations of L2 phonology. Learners’ non-targetlike phonological representations in turn result in non-targetlike realizations of phonemes, syllables and words. Such orthography-induced pronunciations do not exist in the native speakers’ speech L2

learners are exposed to, and cannot be attributed to the influence of learners' L1 phonology or to universals of phonological acquisition. L1 phonology and orthography interact with L2 acoustic and orthographic input, to affect L2 learners' phonological representations, which are then reflected in L2 production (pronunciation and spelling) and in phonological awareness tasks. In order to underscore the importance of the orthographic representation of spoken language, this chapter will avoid the generic terms 'written input' and 'spoken input', and will instead talk about *orthographic input* (see Young-Scholten, 2002) and *acoustic input*. The following section will review findings about the effects of L2 orthographic input on L2 pronunciation.

2. Evidence of effects of L2 orthographic input on L2 pronunciation

2.1 Positive effects of L2 orthographic input

There is evidence that the orthographic representation of the second language helps L2 learners perceive and realize target phonemes, syllables and words. For instance, it is well-known that Japanese learners and users of English as a Second Language (ESL) generally cannot perceive the difference between English /l/ and /r/, because these two L2 phonemes are phonetic realizations of the same L1 Japanese phoneme. Unless specifically trained (Flege et al., 1995), Japanese ESL learners cannot distinguish for instance 'lip' from 'rip', or 'clown' from 'crown'. Still, it has been argued that if Japanese ESL learners are able to articulate [l] and [r], they just need to know whether an L2 word is spelled with an <l> or an <r> and they will be able to pronounce it (Brown, 1998; Eckman, 2004). The positive effects of L2 orthographic input can be seen in a study which found that Chinese-speaking beginner learners of French are more accurate in realizing a uvular fricative /ʁ/ in a consonant cluster (e.g., *traîneau*) when they hear the target French word while seeing its written form, compared to when they only hear the word (Steele, 2005). Steele claims that, in the absence of orthographic information, Chinese learners of French perceive (and therefore pronounce) the cluster as a consonant followed by aspiration, for instance perceiving and pronouncing the target /t ʁ/ as the L1 phone [t^h]. Instead, the orthographic representation shows that the spoken word contains two consonants, which L2 learners therefore pronounce in their output. Another study (Erdener & Burnham, 2005) looked at monolingual adult speakers' ability to perceive and repeat words in an unknown language. English and Turkish speakers listened to and repeated a series of words in Irish and Spanish. Under some conditions, participants only heard the L2 words, under other conditions they heard the words while seeing their written form. Results showed that participants were more accurate in repeating L2 words they had seen written, compared with words they had only heard.

The studies reported above show that orthographic input may facilitate L2 production in certain respects, and that this may happen at various stages of L2 acquisition, from first exposure to beginner and higher levels of proficiency. Orthographic input therefore might be seen to lead to a qualitative difference between preliterate children's phonological acquisition and literate adults' L2 phonological acquisition. Preliterate children acquiring an L1 or L2 phonology must be able to make a phonemic contrast before they can produce it. For literate L2 learners, the orthographic input provides a visual and permanent analysis of the acoustic input, which may complement a defective perception and thus enable learners to produce phonemes they have difficulty perceiving.

2.2 Negative effects of L2 orthographic input

While orthographic input can help L2 learners produce target L2 pronunciations, it can also lead to some non-targetlike pronunciations which would probably never occur if learners were only exposed to acoustic input. Some of the various non-targetlike pronunciations L2 learners produce, including some phone additions, omissions and substitutions, may be caused by the orthographic representation of L2 phonology.

L2 learners sometimes realize phonemes for which there is no evidence in the acoustic input they are exposed to (*phone additions*). For instance, Spanish learners of English can add a vowel before 'Spain', pronouncing it as *'Espain'; this is due to their L1 syllable structure, which does not

allow the sequence /sp/ in word-initial position (asterisks denote non-targetlike pronunciations). However, there are cases of additions that can only be explained by orthographic input, as L2 learners realize phonemes that do not exist in native speakers' speech, but correspond to 'silent letters' in the orthographic input. These *spelling pronunciations*, whereby learners pronounce silent letters (for instance pronouncing a /b/ in 'debt' or 'climb'), are probably the most obvious example of orthography-induced non-targetlike pronunciations. Indeed, the Longman Pronunciation Dictionary (Wells, 2000), which targets advanced and upper intermediate learners of English, warns learners against such errors pronunciations. That learners do so is shown in a study of 13 Italian children (Browning, 2004), which found that all children pronounced the L2 English word <walk> with an /l/. Another example of orthography-induced phone addition is the use of epenthetic vowels in adults who were learning a set of words in Polish (Young-Scholten 1998; Young-Scholten et al., 1999). The use of *epenthetic vowels*, as the 'e' in 'espain' mentioned above, is a frequently studied aspect of L2 phonology acquisition, and it is often due to learners' L1 phonology. Young-Scholten (1998; Young-Scholten et al., 1999) found that their test subjects added epenthetic vowels when faced with complex consonant clusters they found hard to pronounce. Research shows that in general children acquiring languages with complex consonant clusters tend to solve the problem by omitting consonants (Weinberger, 1987). Young-Scholten argued that adults prefer epenthesis over omission because they want to retain all the consonants they see in the orthographic input (Young-Scholten, 1998); rather than omitting consonants, learners then add vowels. This is in line with the predictions of Weinberger's 'recoverability', according to which L2 learners who cannot yet pronounce consonant clusters will add vowels rather than omit consonants, because adding vowels allows them to retain all consonants in their underlying representations. Interestingly, Young-Scholten also found that adults use epenthesis when they learn a word by both hearing it and seeing its orthographic form. When only acoustic input is provided, L2 learners primarily simplify consonant clusters by omitting consonants, as native-speaking children do (Young-Scholten et al., 1999). This again reinforces the possibility that this case of epenthetic vowel addition may be due to orthographic input.

Second language learners not only add phones, they also omit phones that are present in the L2 acoustic input (*phone omissions*). For instance, L2 learners can omit one consonant from consonant clusters, pronouncing 'hold' as *'hol'. Omissions may be due to universal patterns of phonological acquisition, which also appear in the early phonologies of native speakers as well as in all L2 learners regardless of the characteristics of their L1 phonology (Tarone, 1987). However, there are omissions that are better explained as a consequence of orthographic input, as L2 learners omit phones that are not represented in the orthographic input. Bassetti (forthcoming) looked at the pronunciation of specific Chinese diphthongs and triphthongs by Italian final-year (third-year) university students of Chinese. These students are exposed to much orthographic input written in *pinyin* (i.e., Chinese written using the roman alphabet). Pinyin represents the diphthongs and triphthongs under analysis in two ways: in syllables with no initial consonant it represents all vowels, but in syllables with an initial consonant it omits one vowel. For instance, /iou/ is spelled with the three letters <you> in syllables with no initial consonant, and with the two letters <iu> after a consonant (e.g., /liou/ is spelled <liu>). Bassetti compared L2 learners' pronunciations of the same diphthongs and triphthongs in syllables spelled with all vowels and syllables spelled without one vowel. Results showed that learners often omitted the vowel that was omitted in the orthographic representation. For instance, learners pronounced [iou] correctly in the syllable /iou/ (spelled as <you>), but pronounced it as *[iu] in /liou/ (spelled as <liu>). No omissions took place in diphthongs and triphthongs that are always spelled consistently, such as /iɑu/ (which is always spelled with three letters). Another possible case of omission due to orthographic input was found in a study of Korean ESL users (Lee, 2004). In Korean, the glide /w/ is sometimes omitted in speech. Lee found that Korean ESL learners reading an English text aloud sometimes omitted /w/ when preceded by a consonant and followed by a vowel. This omission only occurred when /w/ was spelled as <u>, but almost never when it was spelled as <w>; for instance, learners omitted /w/ in

45% of occurrences of 'quickly' but in only 5% of occurrences of 'twin', where learners instead added an epenthetic vowel in order to retain the /w/. Lee claims that this difference is due to orthography, as Korean ESL learners perceive /w/ as the consonantal onset of a syllable when it is spelled with <w> but not when it is spelled with <u> because of characteristics of the Korean romanization system. It appears that at least some cases of phone omission may be due to L2 orthographic input.

Second language learners can also replace a phone with another one (*phone substitutions*). For instance, Italian learners of English can pronounce 'thin' as 'tin', because the phoneme / θ / does not exist in Italian phonology and is therefore realized as the phone [t]. There is anecdotal evidence that some substitutions are caused by the L2 orthographic representation, because learners incorrectly assimilate an L2 phoneme with an L1 phoneme when they are represented by the same *grapheme* (i.e. letter or letter combination). For instance, Italian ESL learners can pronounce 'special' (/speʃəl/) as *[spetʃəl], substituting [tʃ] to /ʃ/, because in their L1 orthography the grapheme <ci> represents the phoneme /tʃ/ (D'Eugenio, 1985; Kenworthy, 1987), although /ʃ/ exists in their L1 phonology; while in the opposite direction French learners of Italian can substitute [s] to /tʃ/ and pronounce the L2 word *centro* ([tʃentro]) as *[sɛntro] (Costamagna, 2000) because of the French pronunciation of the grapheme <c> (as in <celle>, pronounced [sɛl]). Similarly, Spanish learners of English sometimes realize /j/ as an affricate similar to /dʒ/ in words spelled with word-initial <y> (e.g. <you> pronounced as *[dʒuː]), presumably because in L1 Spanish a word-initial letter <y> represents a voiced affricate (Speck, 2001), although the target /j/ exists in their L1 phonology.

The possibility that orthography leads L2 learners to equate L2 and L1 sounds was suggested by Pennington (1996) who noted that misleading associations of L1 and L2 sounds could be caused by the written language. Some systematic evidence comes from a study by Zampini (1994). In this study English learners of Spanish pronounced various Spanish words with a [v] instead of a /b/, even though the Spanish language does not have the phoneme /v/. While the phoneme /v/ was not present in the acoustic input, or indeed in the phonological repertoire of the target language, the letter <v> was present in the orthographic input (where it is pronounced [b]). Interestingly, these substitutions occurred not only in reading, but also in conversation (albeit less frequently). Furthemore, these substitutions were more frequent in students who had four semesters of L2 learning, compared with students who had two semesters. While this did not support Zampini's expectation that more proficient learners should be less affected by orthography, she pointed out that the more advanced students had been exposed to more orthographic input. Another example of orthography-induced phone substitution can be found in a paper by Piske and colleagues (Piske et al., 2002), who found effects of orthographic representations on the pronunciation of English vowels in Italian-English bilinguals. A group of Italians who had moved to an English-speaking country in childhood pronounced a series of English words which they heard and saw as a written list, followed by a series of pseudowords. Words and pseudowords contained target vowels which were later rated by native speakers for accuracy of pronunciation. Results showed that those Italian-English bilinguals who were frequent users of L1 Italian pronounced non-targetlike English vowels in pseudowords, because they pronounced these English vowels according to the Italian pronunciation of their vowel letter. For example, when bilinguals were asked to produce a nonword containing the same vowel as <red>, <dead> and <bed>, they pronounced [e] instead of [ɛ], because all these words are spelled with <e>, which in Italian is generally pronounced [e].

More evidence of orthography-induced phone substitution can be found in learners of Chinese. In Chinese there is no contrast between voiced and voiceless plosive consonants: these are always voiceless, and the contrast is between aspirated (where the closure is followed by a burst of air, as the /p/ in English 'pot') and unaspirated (as the /p/ in English 'spot'). In some Chinese romanization systems, this contrast is represented by adding a superscript <^{h}>, as in <pa> and <p^{h}a>.

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However, almost all L2 learners are taught using *pinyin*, a romanization system that represents the voiceless unaspirated plosives /p/, /t/ and /k/ with the letters <b>, <d> and <g>. This causes difficulty to those learners of Chinese whose L1 writing system uses the letters <b>, <d> and <g> to represent voiced consonants. One study found that Italian learners of Chinese often identify L2 Chinese /p/ with L1 Italian /b/, rather than Italian /p/, and pronounce it as a voiced consonant (Bassetti, 2006b). In this study, 11 intermediate-level Italian learners of Chinese pronounced a series of L2 syllables containing a voiceless unaspirated plosive (/p/, /t/ or /k/) followed by the same vowel. Participants pronounced the same list of syllables twice, first by reading a series of hanzi (i.e. without an alphabetic representation of phonemes), then by reading pinyin transcriptions (i.e. an alphabetic representation). Results showed that 9 out of 11 learners produced at least one voiceless plosive as voiced. Out of 12 target consonants, learners produced on average 3 voiced consonants when reading hanzi and 4 when reading pinyin. Although learners produced more voiced consonants when they read the pinyin transcription than when they pronounced hanzi, the difference approached but did not reach statistical significance. A previous study of early beginners (Meng, 1998) had found stronger effects of orthography during pinyin reading than hanzi reading. The fact that learners are more affected by orthography while they are reading an alphabetic representation than when no alphabetic representation is provided again supports the possibility that these non-targetlike pronunciations are due to orthographic input.

L2 orthographic input can also lead learners to produce contrasts that do not exist in the L2 acoustic input. In German, word-final obstruents are always devoiced. Although L2 acoustic input contains no voiced obstruents in word-final position, English learners of German pronounce some word-final obstruents as voiced, presumably because they are spelled as voiced obstruents, for instance pronouncing [d] instead of [t] in <Bund> (Young-Scholten, 2002). Another example can be found in consonant length. In some languages consonant length is contrastive; for instance, in Italian /kɔpia/ and /kɔpːia/ mean 'copy' and 'couple' respectively (the symbol < ː > means that the preceding phoneme is long); in Japanese /kite/ and /kitːe/ have different meanings ('coming' and 'stamp' respectively). In the Italian orthography, these geminates are represented by double consonant letters, e.g. <p> vs. <pp> in <copia> and <coppia>. In English phonology there is no contrast between short and long consonants, but English orthographic words can contain double consonant letters. There is evidence that Italian ESL learners pronounce long consonants in English words that are spelled with double consonant letters. For instance, all the Italian children in Browning's study (Browning, 2004) pronounced the [p] in 'apple' with a closure that was 50% longer than the average closure in /p/. In an ongoing study, the present author is looking at the effects of orthography on the pronunciation of English consonants in Italian ESL learners. Italian learners produced a series of English words pairs, in which both words contained the same plosive consonant in the same intervocalic context, but one word was spelled with one consonant letter and the other word with two, e.g. 'happily' and 'rapidly', which both contain the consonant /p/ between /æ/ and /ɪ/. Participants heard an English sentence which contained one of these words, then heard the same sentence without the target word and produced the missing word in a carrier phrase. Preliminary results show that some Italian ESL learners pronounce longer consonants in English words spelled with double consonant letters in line with Browning's findings with children (Browning, 2004).

Finally, the effects of orthographic representations are evident not only in speech production, but also in orthographic production (i.e. spelling). For instance, Japanese learners of English use the L1 romanization system *romaji* to represent L2 English. While only very few English words are spelled with final <u>, romaji spellings of English words represent word-final consonants as syllables ending in <u> or <o>, for instance spelling England as <ingurando>. This leads to non-targetlike ESL spellings that are specific to Japanese learners, such as spelling <dress> as *<doresu> (Okada, 2005). While other factors cannot be ruled out, Okada claims that the main cause of these spellings is the influence of romaji on Japanese learners of English.

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In conclusion, there seems to be evidence that L2 orthographic input affects L2 production (both spoken and written), and leads to some non-targetlike pronunciations that would not occur if learners were only exposed to acoustic input.

3. Characteristics of orthography-induced non-targetlike pronunciations

All the studies reported in the previous section show that L2 orthographic input affects L2 pronunciation, leading non-targetlike realizations of phonemes, syllables and words. These pronunciations can show one or more of the following properties (illustrated with examples from Bassetti, forthcoming):

1) Pronunciations which do not exist in the L2 acoustic input. For instance, Italian learners of Chinese never hear diphthongs such as */iu/ or */ui/ in Chinese speakers' speech, as these sequences are not permitted in Chinese. In fact, the vowels L2 learners omit have the greatest intensity and length in the syllable, and are therefore the most salient ones in the acoustic input. Such vowels would be the least likely candidates for omission if learners were only exposed to acoustic input.

2) Pronunciations which cannot be attributed to the influence of L1 phonology. For instance, Italian learners of Chinese pronounce [uei] in syllables without an initial consonant, and only reduce it to *[ui] when it is preceded by a consonant. If this reduction was due to the influence of L1 phonology, it should occur consistently, in all contexts. Equally, since Italian has voiceless plosives, Italian learners of Chinese should have no problems assimilating Chinese /p/, /t/ and /k/ to their L1 voiceless plosives. L1 phonology cannot explain why Italians should pronounce these consonants as voiced, something which can easily be explained as a consequence of the pinyin orthographic representation of these consonants as <b>, <d> and <g>.

3) Pronunciations which do not occur in the early phonologies of native-speaking children. For instance, although diphthong and triphthong reductions are attested in first language acquisition as well, Chinese children never omit the main vowel (Zhu, 2002); they can omit /u/ or /i/ from /uei/, but never /e/ as L2 learners do. Also, Chinese children's omissions occur in all contexts, whereas L2 learners only omit vowels in post-consonantal contexts. Chinese children and L2 learners reduce different rimes: Chinese children reduce /iɑu/ the most, as it is the most difficult to articulate, whereas L2 learners never omit vowels from this triphthong, because it is always spelled with three letters. And finally, the order of acquisition is different: whereas Chinese children realize /iou/ correctly earlier than /iɑu/, intermediate L2 learners tend to realize /iɑu/ correctly and reduce /iou/ (all data about Chinese children is taken from Zhu, 2002).

4) Pronunciations which are not traceable to universals of phonological acquisition. For instance, some features are *marked*, that is to say less common and less basic than others; such marked features are universally acquired later than unmarked ones (for a review of markedness, see Eckman, 2004). Since voiced consonants are more marked than voiceless ones, it is difficult to explain why Italian learners of Chinese should replace (less marked) voiceless consonants with (more marked) voiced ones, unless this is due to the influence of orthographic input.

5) Pronunciations which reflect L1 grapheme-phoneme conversion rules (the rules that determine the pronunciation of graphemes). For instance, for Chinese speakers the spelling <ui> represents /uei/, but Italian learners reinterpret it as /ui/ because this is how it would be pronounced in L1 Italian (e.g., <sui> represents /suei/ in Chinese and /sui/ in Italian). Similarly, for Chinese readers the letter <b> represents the phoneme /p/, but L2 learners of Chinese recode this letter as /b/ following L1 grapheme-phoneme conversion rules. Such non-targetlike pronunciations would not occur if L2 learners were not already literate in their first language.

4. How L2 orthographic input affects L2 pronunciation

The literature shows that L2 orthography affects L2 phonology not only while L2 learners are being exposed to the L2 orthographic representation, but also in the absence of orthographic representations of phonology; orthography-induced non-targetlike pronunciations occur not only

when learners are reading, but also when they are repeating spoken words in a task or reading hanzi (which do not contain phonological information). The orthographic input has somehow moved from the page to the mind of the learner.

It is possible that the link between orthographic input and L2 pronunciations may be non-targetlike mental representations of L2 phonology influenced by orthographic representations. Many researchers have noted the relationship between literacy and phonological awareness in native speaking children, and have argued that the onset of literacy seems to coincide with a quantitative or qualitative change in phonological awareness, or that preliterate children and illiterate adults cannot perform some metalinguistic tasks (for overviews, see Castro-Caldas and Reis, 2003; Cook and Bassetti, 2005; Tarone and Bigelow, 2005). When native speakers perform metalinguistic awareness tasks in their first language, their analyses of the spoken language can be affected by orthographic representations; for instance, after the onset of literacy children start counting more phonemes and more syllables in words spelled with more letters (<interesting> segmented as 'in-ter-es-ting' rather than 'in-tres-ting') (Ehri & Wilce, 1980). With regards to L2 phonological acquisition, Flege (1996) notes that the onset of literacy appears to be related to an increase in phonemic awareness, which could relate to an increase in L2 learners' tendency to equate L1 and L2 sounds around that age. According to Young-Scholten, it may not be a coincidence that for some researchers (e.g., Long, 1990) the critical period for phonological acquisition ends at age six, which is the age of literacy onset (Young-Scholten, 2002); literacy acquisition may be one of many factors affecting phonological development. Burnham also noted that the ability to distinguish contrasts in an unknown language is at its lowest at age six, when children start learning to read (Burnham, 2003). He claimed that when children learn to read they have to classify all phones as belonging to phonemic categories which are represented by different letters, and this is why on the one hand English children's ability to distinguish /b/ from /p/ peaks with the onset of literacy, while on the other hand children lose the ability to identify the phonological categories of another language. While the latter position is too extreme, as categorical perception is established well before the onset of literacy, it is indeed possible that literacy results in a reanalysis of the spoken language in terms of its orthographic representation.

The missing link between orthographic input and non-targetlike pronunciations could then be L2 phonological representations. There are indeed interesting parallels in the way orthography affects L2 learners' pronunciations on the one hand and native speakers' performance in phonological awareness tasks on the other hand. Some orthography-induced additions and omissions in L2 learners seem to parallel native speakers' performance in phoneme counting or segmentation tasks. For instance, literate English speakers count one more phoneme in words spelled with an extra letter, e.g. counting one more phoneme in 'pitch' than in 'rich' (Derwing, 1992); this is similar to L2 learners who pronounce <walk> as *[wɔlk] rather than /wɔːk/. Indeed, second language learners' performance in phonological awareness tasks shows effects of L2 orthography in line with their non-targetlike pronunciations. Bassetti (2006a) tested the phonological awareness of English beginner learners of Chinese using a phoneme counting task. Participants counted the number of phonemes in a list of Chinese syllables (presented as hanzi) whose pinyin spelling represents all the vowels (e.g. /uei/ spelled as <wei>) and in syllables whose spelling omits one vowel (e.g., /tuei/ spelled as <dui>). In syllables whose pinyin spelling omits one vowel, most learners counted one vowel less. To confirm that the omitted vowel was indeed the one omitted in the orthographic representation, another small group of learners performed a phoneme segmentation task: they read aloud the same list of hanzi and pronounced all the phones in each syllable one by one. Results showed that learners omit in phoneme awareness tasks the same vowels they omit in speech production.

It appears that orthographic representations affect phonological representations in both L2 learners and native speakers. Still, there are two main differences:

1) in native speakers orthography only affects phonological awareness tasks, whereas in L2 learners it may also affect pronunciation. This may happen because L2 learners do not master the

target phonology before being exposed to orthographic input (although of course native speakers can also produce spelling pronunciations);

2) native speakers are only affected by orthography-internal factors, whereas L2 learners are affected by the interaction between their L1 orthography and their L2 orthography. For instance, L1 Grapheme-Phoneme Correspondence rules can affect the reading of L2 graphemes, so that learners recode L2 Spanish <v> as /v/ (as in L1 English) rather than /b/ (as Spanish readers do), or recode Chinese <ui> as /ui/ (as in L1 Italian) rather than /uei/ (as Chinese readers do). Therefore, on the one hand orthography-internal factors can lead for instance to adding the phone [l] in 'walk', and this can happen both in native speakers' phonological awareness tasks and in L2 learners' phonological awareness tasks and actual pronunciations. On the other hand, a native speaker of Spanish could never substitute a [v] to a /b/; this is due to the presence of two writing systems in the mind of the L2 learner/user.

It is then possible that the L2 orthographic input, reinterpreted according to the L1 orthography-phonology conversion rules, interacts with the L2 acoustic input, also reinterpreted according to L1 phonology, leading to non-targetlike phonological representations of L2 phonemes, syllables and words. Still, it should be noted that the interaction between orthographic input and acoustic input could be more complex than it appears from the discussion above, first because orthography-induced non-targetlike pronunciations could be present in the L2 spoken input, and second because the L2 orthographic representation could affect the perception of L2 phonology. First of all, as Piske pointed out (Thorsten Piske, personal communication, 21 August 2006), orthography-induced pronunciations may be part of the acoustic input for instructed learners. When other learners produce non-targetlike pronunciations due to the L2 orthographic representation, these pronunciations become part of the acoustic input learners are exposed to in the classroom. There is also a possibility that language teachers may produce spelling pronunciations when providing the citation form of words; the present author is aware that some Italian language teachers pronounce Italian phonemes /tʃ/ and /dʒ/ as [tʃi] and [dʒi] in the classroom, for instance pronouncing <ciao> as *[tʃiao] rather than [tʃao]. These orthography-induced pronunciations may be part of instructed learners' spoken input, reinforcing their own incorrect recoding of the orthographic input. Second, learners' mental representations of L2 phonology may affect their perception, leading them to perceive sounds that do not exist in the acoustic input but are represented in the orthographic representation. It is known that L1 phonology can lead L2 learners to perceive sounds that do not exist in the L2 acoustic input, as in Japanese ESL learners who perceive non-existing vowels in English perception tasks due to the influence of their L1 phonology (Matthews & Brown, 2004). In the same way, if L2 learners' mental representations contain an extra phoneme, voicing, or consonant length as a consequence of orthographic input, learners could actually perceive in the L2 acoustic input the extra phoneme, voicing or length represented in the orthographic input. The interaction between L2 orthographic input and L2 acoustic input may be indeed rather complex.

5. Implications for research and language teaching

The review above shows that orthographic input can be an important factor in the acquisition of second language phonology. One reason why this factor has received little attention could be the view, held by some theoretical and applied linguists, that spoken language is primary while written language is secondary (for a discussion, see Coulmas, 2003; Linell, 1982).

Although it is true that in the history of humanity spoken language precedes writing, the other arguments for the primacy of the spoken language do not necessarily apply to second language learners (see also the discussion in Cook, 2005). First, spoken language emerges earlier than written language in first language acquisition (i.e. children learn to speak before they learn to read), however in instructed L2 learners spoken and written language can emerge at the same time. Second, children learn to speak spontaneously but only learn to read with instruction, however L2 learners are often not instructed in how to read and write the second language, and develop L2

literacy naturally. Third, all normal children develop spoken language but not all develop written language, however L2 learners can develop the ability to read the L2 without the ability to understand the spoken language, or can develop the ability to write the L2 without the ability to speak it.

It appears that the spoken language is not primary in second language acquisition (at least in instructed contexts) as it is in first language acquisition. Researchers and language teachers should therefore take the role of written language into account more than it has hitherto been the case. Research on L2 phonology could in particular look at more examples of effects of L2 orthography. At the same time, it could also investigate which factors might modulate such effects. Such factors may include the characteristics of the L1 and L2 writing systems, including both the type of writing system and their level of phonological transparency. While all research reported in this chapter looked only at the effects of alphabetic writing systems, syllabic or consonantal writing systems could have different effects on L2 phonology. The degree of phonological transparency of both L1 and L2 writing systems could also play an important role. It is likely that native users of phonologically transparent writing systems rely on L2 orthographic input more than native users of phonologically opaque writing systems, and that learners of second languages that have phonologically transparent writing systems rely on L2 orthographic input more than learners of languages that have an opaque writing system. For instance, Erdener and Burnham (2005) found that, while all L2 learners were better able to repeat L2 words when they saw a written representation of the words, the effect was stronger or weaker depending on the level of phonological transparency of both L1 and L2 orthographies. The Turkish and Spanish writing systems are phonologically transparent, whereas English and Irish are more opaque. Results show that, when repeating Spanish words, Turkish speakers were facilitated by the orthographic representation more than English speakers, probably because L2 learners whose L1 orthography is phonologically transparent can make better use of L2 orthographic input in processing L2 acoustic input. On the other hand, when repeating Irish words, Turkish learners were negatively affected by the orthographic representation, while English learners were not, showing that native users of transparent L1 writing systems are more negatively affected by an L2 orthographic input that does not represent the L2 phonology transparently.

Apart from characteristics of writing systems, there are other factors that may modulate the influence of orthographic input. Learner-internal factors may also play a role. For instance, it would be interesting to test whether learners rely more on orthographic representations if they have lower phonemic coding ability (i.e. lower capacity to discriminate unfamiliar sounds and to retrieve them from memory). Level of proficiency and length of study could also be important factors, and although some researchers have looked at learners with different lengths of study or lengths of stay in a target-language environment, no longitudinal studies have been done to investigate the influence of orthographic input on the development of a second phonology. There could also be effects of learning context, as instructed learners may be more affected than uninstructed learners. Also, teaching methods that involve more use of written materials may lead to stronger effects of orthographic input. Another area of interest for researchers and teachers alike could be the difference between literate and non-literate adult L2 learners. Tarone and Bigelow (2005) discussed such differences and called for researchers to investigate the effects of illiteracy on SLA, and for teachers to adapt their teaching to the specific needs of non-literate L2 learners.

With regards to the practical aspects of everyday teaching in the classroom, several proposals have been put forward to reduce the potentially negative effects of orthography. One possibility is to avoid written input at least at the early stages of second language learning, as proposed for instance by the Comprehension Approach (Winitz and Yanes, 2002). With specific reference to Chinese language teaching, Meng (1988) proposed that teachers should avoid using pinyin at the beginning (Meng, 1998). Others have proposed to provide modified orthographic input, i.e. a 'foreigner-directed orthography'. For instance, there have been proposals for teaching Chinese using a modified version of pinyin, where either all vowels are represented (e.g. spelling /uei/ as

<uei> rather than <ui>, Ye et al., 1997), or the missing vowel is added in brackets (e.g. spelling /uei/ as <u(e)i>, Luciano Canepari, personal communication, March 2006). It has also been proposed to provide orthographic instruction, i.e. a focus on orthographic forms, or to use pronunciation exercises or explicit pronunciation instruction that target the potential effects of the L2 orthographic input (Elliot, 1997, Zampini, 1994); one reviewer of this paper suggested that learners themselves could research aspects of their L1 and L2 writing systems to raise their own awareness. More research is needed to test whether these proposals are effective. For instance, in one study (Elliott, 1997) a group of English-speaking learners of Spanish learned that the Spanish grapheme <v> is pronounced [b] (rather than [v]) during a series of pronunciation instruction sessions. While pronunciation instruction significantly improved learners' realizations of various phonemes, the pronunciation of /b/ did not improve significantly. Both the experimental group and a control group who had not received pronunciation instruction made more pronunciation errors when [b] was spelled as <v> than when it was spelled as <b>. Furthermore, the experimental group mispronounced [b] when it was spelled as <v> more than when it was spelled as <b> both before and after pronunciation instruction, showing that perhaps instruction had not had a strong impact. Clearly more research is needed to evaluate the various proposals, but at least teachers should be aware of the potential effects of L2 orthographic input and make instructional decisions based on this knowledge.

6. Conclusions

Research on the role of input in second language acquisition has not seriously investigated the distinction between phonological and orthographic input. While children acquiring L1 phonology are only exposed to acoustic input, L2 learners can be exposed to large amounts of orthographic input, from the very early stages of acquisition, after having learnt to read and write another language. This chapter argues that, in the same way that L2 acoustic input is modulated by the presence of another phonological system in the learner's mind, L2 orthographic input is also modulated by the presence of another orthography. Orthographic input, sometimes reinterpreted according to L1 orthography-phonology correspondences, interacts with acoustic input in shaping learners' L2 phonological representations; these in turn lead to non-targetlike pronunciation (as well as affecting spelling, phonological awareness tasks and possibly perception). The effects of orthography are evident when the L2 pronunciations are not attested in native children's early phonology, and cannot be explained in terms of effects of L1 phonology or universals of phonological acquisition. Rather, these can be attributed to the influence of a phonological form based on a non-targetlike recoding of L2 orthographic input. Researchers and teachers with an interest in L2 phonology would do well to bear in mind that input comes not only in a spoken but also in a written modality, and that orthographic input may have a significant impact on the L2 phonological system.

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