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Orthographic effects on the perception and production of L2 mandarin tones☆

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ABSTRACT

Recent studies on orthographic effects on L2 phonology have typically investigated alphabetic writing systems and segmental contrasts with novice learners. The current study extends such investigation to compare orthographic effects of an opaque logographic system (Chinese characters) and a transparent schematic system (*pinyin*) on a suprasegmental feature (lexical tones) with experienced learners. A perception experiment of Mandarin tones by Cantonese L2 learners shows that *pinyin* was more beneficial for tone perception in monosyllabic words, while tones were better perceived in characters for disyllabic words. A production experiment reveals a similar pattern. Additionally, low performance learners were affected by orthographic differences more than high performance learners. The findings suggest that orthographic effects are not limited to alphabetic systems, and are dependent on task nature and learner proficiency. A transparent system may not always be easier than an opaque system.

1. Effects of orthography on L2 phonology

Studies on the acquisition of L2 phonology abound, but very few have emphasized the effects of orthography because of the primacy of spoken input in acquisition research. Nevertheless, as rightly pointed out by Bassetti (2008), L2 learners are often simultaneously exposed to written and spoken input from the beginning of L2 learning. This stands in stark contrast to child first language acquisition in which input is solely spoken in nature. Children only start to learn the writing system after they have acquired the phonology of their first language. The question of how orthography affects L2 phonological acquisition is a valid, and yet underexplored, one. Researchers have started to investigate the roles of orthographic input on L2 phonological acquisition in the past two decades. Mixed results are reported among these studies covering different languages.

Some studies have demonstrated a positive effect of orthography in helping learners to discriminate L2 phonological contrasts that are otherwise difficult to distinguish. For example, Dutch learners of English often find the /æ/ and /ɛ/ contrast difficult. Using an eye-tracking paradigm, Escudero et al. (2008) showed that Dutch learners could differentiate the confusable English /æ/ and /ɛ/ contrast in non-words if they were exposed to both the auditory and the spelled forms of the words during training, as opposed to those only exposed to auditory forms. Erdener and Burnham (2005) tested the effects of orthographic depth on non-native speech production. They mentioned that orthographic depth can be defined as the degree to which an alphabetic system deviates from simple one-to-one grapheme-to-phoneme correspondences. Writing systems vary along a continuum of orthographic depth, some having very regular and unambiguous grapheme-phoneme correspondence (transparent) while others do not (opaque). Erdener and Burnham (2005) compared the production of non-words in Spanish (transparent) and Irish (opaque) by Australian English and Turkish speakers with and without audiovisual cues. English has an opaque orthography while Turkish has a transparent orthography. They found that the presence of transparent orthography enhanced production accuracy in general, and that orthographic information, when provided, even overrode the general facilitative effect of visual information. Furthermore, orthography was beneficial for transparent Turkish speakers on transparent Spanish but not on opaque Irish, while there was little difference for opaque Australian English speakers on Spanish and Irish. The results of Escudero et al. (2008) and Erdener and Burnham (2005) demonstrate that orthographic input can facilitate both the perception and the production of non-native speech.

Other studies found that orthographic input can induce non-target-like errors which cannot be explained by the spoken input. For instance, beginning learners of Chinese are often taught the official Chinese

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Romanization system of *pinyin*. For some triphthongal rimes, the main vowels are omitted in *pinyin* spelling. Using a phoneme counting task and a phoneme segmentation task, Bassetti (2006) found that English learners of Chinese would omit the main vowel when it is not represented in *pinyin* (e.g. the same /iou/ sound was counted as two phonemes when spelled as *-iu* but counted as three when spelled as *you*). In addition, two studies on English learners of German also demonstrated that orthography could hinder the learning of L2 phonology. Word-final obstruents in German are devoiced, but they are represented using letters for voiced sounds in spelling, e.g. ⟨bund⟩ for [bʊnt]. Young-Scholten (2002) found that the amount of exposure to orthographic input was inversely related to the rate of final devoicing in the production of English learners of German. Young-Scholten and Langer (2015) reported another interesting case. The German ⟨s⟩ is pronounced as [z] word-initially. Three English teenagers who were exchange students in Germany for one year learning German in an immersion environment, despite having ample correct auditory input from native speakers, pronounced ⟨s⟩ as [s] throughout their exchange period. These results showed that orthographic representation could interfere with the mental representations of L2 phonology even with correct auditory inputs.

In addition, many studies using a word learning paradigm also demonstrated the effects of orthography. Hayes-Harb et al. (2010) manipulated the congruency of orthography on word learning. Three English participant groups in their study received the same auditory input and pictures, but they differed in the written input received during training. One group saw spelling consistent with English conventions (congruent, e.g. ⟨kamad⟩ for [kɑməd]); another group saw wrong spelling inconsistent with English conventions (incongruent, e.g. ⟨kamand⟩ for [kɑməd]), and the auditory-only group saw only ⟨XXXX⟩. Their results showed that the group seeing inconsistent spelling performed the least accurately overall due to the wrong letter spelling. Similarly, the effects of congruent versus incongruent spellings were borne out in Hayes-Harb and Cheng (2016). They asked native English speakers to learn novel Mandarin words of some real object drawings. The speakers were assigned to two types of orthographic input: *pinyin* (Romanized spellings) and *zhuyin* (a semi-syllabary system not using Roman letters). Some Mandarin words have *pinyin* forms congruent with English spelling, e.g. ⟨nai⟩ for [nai], while others have incongruent forms with English spelling, e.g. ⟨xiu⟩ for [ɕiou] (the corresponding English pronunciation for ⟨x⟩ would be [z] or [ks]). They found that the *zhuyin* group outperformed the *pinyin* group on incongruent items due to the poorer performance of the *pinyin* group on such items, while both groups did not differ in their ability to distinguish the relevant sounds auditorily. They argued that despite the familiarity with *pinyin* (Roman letters), native English speakers had to suppress the grapheme-phoneme conversion in their L1 for the incongruent items, which led to poorer performance than those who had to learn an entirely new writing system (*zhuyin*).

A number of studies showed that orthography might have no or only limited influence on L2 phonology. Simon et al. (2010) tested whether English speakers' discrimination of the French /y/ and /u/ contrast would be enhanced by the presence of orthographic representations, but found no difference with and without orthographic input. Showalter and Hayes-Harb (2015) found that English speakers could not benefit from an unfamiliar script when learning a novel and difficult uvular-velar contrast (/q k/) in Arabic. Escudero et al. (2014) working with Spanish listeners of Dutch and Escudero (2015) working with Spanish and English listeners of Dutch both found that orthographic input was beneficial only when orthography is congruent between L1 and L2, or only for easy contrasts.

Many of the previous studies on orthographic effects used a word learning or recognition paradigm testing listeners' perceptual performance on foreign contrasts. Erdener and Burnham (2005) mentioned above illustrated that orthographic effects can be found on learners' production as well. Recently, Hayes-Harb et al. (2017) tested naive English speakers' production of final devoicing in German using a word learning paradigm. Participants who were exposed to the written forms during the learning phase were more likely to produce final voiced obstruents. An explicit instruction about the misleading nature of the orthographic input had no effect on participants' production of final voiced obstruents. This indicates the powerful influence of orthographic input, echoing the findings of Young-Scholten (2002) and Young-Scholten and Langer (2015) also on the production of German final devoicing discussed earlier.

Despite the fact that various results have been observed, one general conclusion that can be drawn from the above studies is that, transparency and congruence are important factors modulating the effects of orthographic input (if any) on L2 phonological acquisition: transparent and congruent orthographic forms can be positive while opaque and incongruent forms can be negative.

Most of the previous studies on orthographic influence were understandably on segmental contrasts, as these contrasts can be clearly captured by different spellings. However, the conclusion based on studies examining segmental contrasts can be extended to suprasegmental contrasts as well.

Two suprasegmental aspects have been examined: lexical stress and lexical tone, but the findings were mixed. Both inexperienced and experienced English learners of Russian did not benefit from the provision of stress marks, or from the use of Latin or Cyrillic script in the acquisition of Russian lexical stress contrasts (Hayes-Harb and Hacking, 2015). In contrast, Showalter and Hayes-Harb (2013) tested naive English speakers' learning of Mandarin tones with and without tone marks. One group was given *pinyin* together with tone marks as diacritics (e.g. < gí >) while the other group was only given *pinyin* with no tone mark (e.g. < gi >). The tone marks are schematic representations of the pitch contours of the four Mandarin tones: level tone [55] (ū), rising tone [35] (ú), dipping tone [214] (ǔ) and falling [51] tone (ù), where the numbers in [] are tone values on a 1–5 scale, with 1 corresponding to the lowest pitch level of a speaker's normal pitch range and vice versa (Chao, 1930). The tone marks are novel symbols to English speakers while *pinyin* resembles English spelling otherwise. The tone-mark group outperformed the non-tone-mark group across tones and across experiments in Showalter and Hayes-Harb's (2013) study. Their findings suggest that orthographic effects in L2 phonology are not limited to segmental contrasts only. Nevertheless, given the contrary findings and very few studies on suprasegmental contrasts, more investigation is needed for a comprehensive understanding of the effects of orthographic inputs.

2. Chinese characters and phonology

Most of the studies reviewed above dealt with alphabetic writing systems. They typically showed that an opaque orthography was a hindrance to L2 phonology. It follows that an opaque logographic writing system like Chinese characters, which does not have regular grapheme-to-phoneme correspondence or indicate lexical tones, will pose difficulties to L2 learners of Mandarin, compared to the alphabetic system of *pinyin*. This may be the case for genuine beginning learners of Mandarin, although Hayes-Harb and Cheng (2016) showed that naive English speakers being trained with the *zhuyin* system (with symbols resembling parts of a Chinese character) outperformed those being trained with *pinyin* for incongruent items. A complete understanding of orthographic effects on L2 phonology requires looking beyond alphabetic writing systems, but the challenges of doing experiments using logographic Chinese characters with beginning learners cannot be underestimated. A possible alternative to this problem is to approach the research question from a different perspective: using learners who are already familiar with Chinese characters and *pinyin*. There are many L2 learners of Mandarin whose first language is a Chinese dialect (e.g. Cantonese) which is quite different from Mandarin. Cantonese and Mandarin are mutually unintelligible, but share the same writing