Code-switching cost in word recognition

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Abstract

There is still no consensus on the source of code-switching costs. This study focuses on whether the CS cost comes from language processing, especially the word recognition procedure. 37 Chinese-English bilinguals have taken lexicon decision tasks. The results show that orthography does not affect the switching costs, which means there may be no cost in the early stage of mental lexicon processing. The choice of linguistic nodes (L1/L2) affects the switching costs, which means that the code cost may come from the later stage of mental lexicon processing. Our results support that Chinese Hanzi, pinyin, and English store in the same mental lexicon.

Keywords: code-switching, cost, word recognition, orthography, language node

Introduction

Code-switching refers to the alternating use of two languages in a single utterance, a sentence, or other language components. It is one of the salient features of bilingualism. The significant cost (the CS cost means switching languages relative to staying in the same language) and asymmetrical costs (the CS cost between the first language to the second language and L2 to L1 are asymmetrical) are two common phenomena in code-switching.

The source of code-switching costs is one of the core issues in code-switching from a psycholinguistic perspective, but there is still no consensus. Some studies believe that code-switching cost is from language processing, especially from the mental lexicon (Grainger & Beauvillain, 1987). The other view is that the CS cost comes from task switching or factors other than language (Thomas & Allport, 2000). The Bilingual Interactive Activation Plus Model (BIA+, Dijkstra & van Heuven, 2002), combining the two viewpoints, believes that both mental lexicon and tasks could be the sources of code-switching costs.

This study focuses on whether the CS cost comes from language processing, especially the word recognition procedure. To study the cost source in word recognition, we choose orthography (Chinese dual scripts, Hanzi and Pinyin[1]) and language nodes (L1 or L2) recognition process to test the CS costs. The former represents the early stage of mental lexicon processing, while the latter represents the late stage.

Method

Participants and materials

37 Chinese adult learners of English have participated in this experiment. Their English is fluent with a TOEFL score over 80 or equivalent.

180 simple Chinese words from HSK levels (standard Chinese level test with 6 levels in total) 1 to 4 will be used, including 90 nouns and 90 verbs. The words are translated into Pinyin and English directly. The lists are divided into three groups: Hanzi group, Pinyin group, and English group (see Table 1). We confirm that each group includes 30 nouns and 30 verbs, and the levels of words are arranged randomly. We balanced the frequency and concreteness of the words. We also balanced the length and the number of syllables between the English and Pinyin groups.

Table 1. examples of stimulus.

	Hanzi	Pinyin	English
Noun	衣服	fēngjǐng	apple
Verb	毕业	zhǔnbèi	invite

All the materials compose three groups. The first group is the Pinyin-Hanzi group with 60 words in Pinyin and 60 words in Hanzi. The order of stimulus is fixed: Hanzi-Hanzi-Pinyin-Pinyin-Pinyin-Hanzi (the data of the underlined parts will collect) to make the repetition trials coming from a pure repetition trial and exclude delaying influences of switching trials (Mosca & de Bot 2017). The second group is the Hanzi-English group, and the third group the English-Pinyin group. Each participant has a different order, sequenced in a Latin Square design. And they finish all the groups twice, 6 blocks in total.

Procedure

This experiment was conducted with OpenSesame. Participants' task is to decide whether a word is a noun or a verb. Before the online section, they read all the words in a paper version to review whether they are nouns or verbs. Then they practice reading by switching between Hanzi and Pinyin.

During the experimental session, participants judge whether a word is a verb or a noun by pressing a button. The reaction time and error rate are recorded. After the online test, the proficiencies and vocabulary of participants' English and Chinese are tested.

Results and discussion

Orthography influence on code-switching

As it is difficult to measure the proficiency differences between Hanzi and Pinyin, we controlled pre-word proficiency and selected the Chinese (the

second words in English-Hanzi/ English-Pinyin groups) to investigate the influence of orthography on the cost (the general results show in Figure 1).

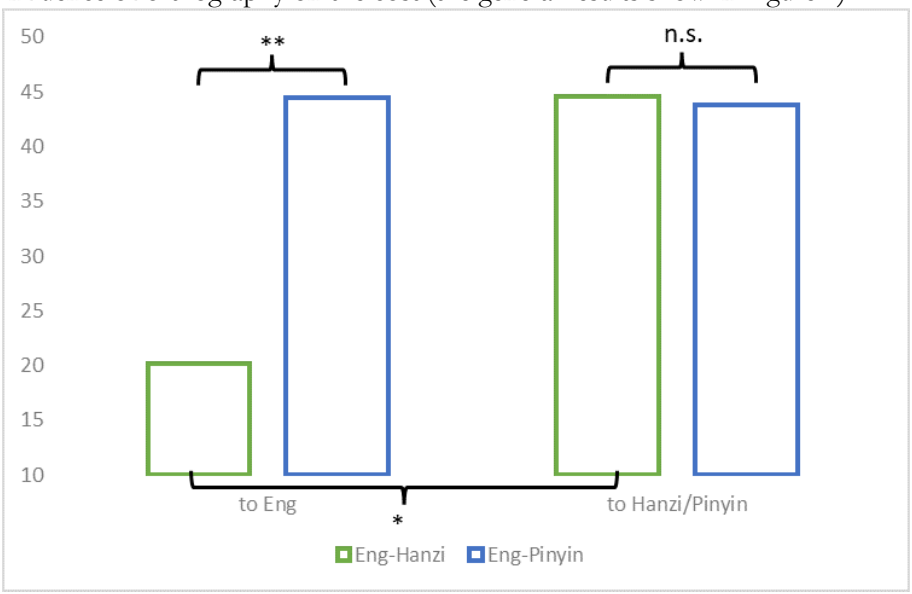

Figure 1. Switching costs among English, Hanzi and Pinyin.

By subject, the results of repeated measure ANOVA shows that the main effect of code-switching is significant, $F1(1,36)=19.361$, $p<0.05$, $\eta 2=0.350$, and the statistical power $\beta=0.990$. The main effect of different orthographies to English is significant, $F1(1,36)=248.848$, $p<0.05$, $\eta 2=0.874$, $\beta=1$; The interaction is not significant, $(1,36)=0.002$, $p>0.05$, $\eta 2=0$, $\beta=0.050$. The results from analysis by item and the mixed-effects model by R are consistent with the former analysis. The paired-samples T-test shows there is no difference between the cost from English to Hanzi (M=44.61ms, SD=68.63) and the cost from English to Pinyin (M=44.43ms, SD=41.02), $t(36)=0.043$, $p>0.05$.

The orthographic differences between Hanzi and Pinyin do not affect the switching. The result implies that the early orthographic stage of word recognition is not the place where produces cost. Therefore, the results show that the orthographies of Chinese, Pinyin, and English are in the same mental lexicon. Their orthographies activate simultaneously during word processing.

Language nodes effects on code-switching

For this question, We analyze the switching between English and Hanzi, as it is hard to measure the proficiency of Pinyin. We used language proficiency as covariance and establish a mixed effect model analysis by R. The results show that the interaction between language nodes and code-switching is significant (t=2.956, =0.018), which means that language nodes (L1/L2) significantly affected the generation of code-switching costs, consistent with the prediction

of the BIA+ model (Dijkstra & van Heuven, 2002). This model assumes that the language node activation in the late stage of word recognition is a source of the cost. Code-switching involves the process of breaking through the recognition threshold of a single language. This process requires cognitive consumption. Our results indicate that when language changes, the language judgment process of bilinguals produces costs.

Conclusion

In this study, the sources of code-switching costs were investigated during the recognition process of orthography (Hanzi/Pinyin dual system) and language nodes. The results show that: (1) There is no code-switching cost in the early orthographic processing of word recognition. At this stage, the orthographies of both languages are activated simultaneously; (2) Switching costs are generated at the late stage of word recognition, especially in the decision of language node. The results partly support the BIA+ model and indicate that Chinese Hanzi, Pinyin, and English are stored in the same mental lexicon, and the mechanism of Pinyin, Hanzi, and English are consistent.

Notes

1. Chinese has a dual-script system: the logographic script Hanzi and phonological script Pinyin. Each Chinese word can be written in the logographic script (Hanzi) and Pinyin. These two scripts have a one-to-one corresponding relationship. Hanzi is used commonly in daily life while Pinyin is a useful tool for children and second language learners.

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