Supplementary Material

Table S1. *Word list in pretest*

Pinyin	cān tīng	dì tiě	fāng biàn	gào sù	gōng kè	hán jià	hé shì
Word	餐厅	地铁	方便	告诉	功课	寒假	合适
Meaning	Restaurant	Subway	Convenient	Tell	Homework	Winter vacation	Suitable
Pinyin	jiào shì	jiè shào	jǐn zhāng	kǎo shì	lù yīn	má fán	nián jí
Word	教室	介绍	紧张	考试	录音	麻烦	年级
Meaning	Classroom	Introduce	Nervous	Test	To record	Trouble	Grade
Pinyin	xǐ huān	xīng qī	yī fu	yīn yuè	yán sè	zhī dào	zhǔn bèi
Word	喜欢	星期	衣服	音乐	颜色	知道	准备
Meaning	Like	Week	Cloth	Music	Color	Know	Prepare
Pinyin	péng yǒu	pián yi	shí jiān	sù shè	suǒ yǐ	tè bié	wèn tí
Word	朋友	便宜	时间	宿舍	所以	特别	问题
Meaning	Friend	Cheap	Time	Dormitory	So	Special	Question

Table S2. *Learning words*

Pinyin	wán qiáng	gū dú	shōu huò	dào qiè	cái pàn	hū xī	bēi shāng	guī fàn
Word	顽强	孤独	收获	盗窃	裁判	呼吸	悲伤	规范
Meaning	Indomitable	Lonely	Gain	Steal	Referee	Breathe	Sad	Norm
Pinyin	qiān xū	jù liè	tiáo pí	hài chóng	wéi jīn	ruò xiàng	shì bīng	gé mìng
Word	谦虚	剧烈	调皮	害虫	围巾	弱项	士兵	革命
Meaning	Humble	Fierce	Naughty	Pest	Scarf	Disadvantage	Soldier	Revolution

Table S3. *Words in test of pronunciation transfer*

Pinyin	shāng hài	fàn wéi	xū ruò	liè shì	pí gé
Word	伤害	范围	虚弱	烈士	皮革
Meaning	Hurt	Range	Weak	Martyr	Leather

Table S4. Learning cycles in two instructions

	Task	Word-focus group			Dual-focus group		
Cycle 1	**3 presentations** with auditory pronunciation (10s total)	1st (3s) péngyǒu 朋友 friend	2nd (4s) péngyǒu 朋友 friend	3rd (3s) péngyǒu 朋友 friend	1st (3s) péng yǒu 朋 友 friend	2nd (2s+2s) sequentially péng 朋 friend yǒu 友 friend	3rd (3s) péng yǒu 朋 友 friend
	Recall: Type Pinyin and meaning (10s each)	朋友 (type Pinyin for the word) (10s)		朋友 (type word meaning) (10s)	朋 友 (type Pinyin for each character) (10s)		朋 友 (type word meaning) (10s)
	Feedback with auditory pronunciation (3s)	péngyǒu 朋友 friend (3s)			péng yǒu 朋 友 friend (3s)		
	Multiple choice (after every two learning words, 5s) with feedback ("correct-wrong", 1s)	朋友: A. péngyǒu B. fēijī (5s) 飞机: A. péngyǒu B. fēijī (5s) (*飞机 is also a learning word)			朋: A. péng B.yǒu C. fēi D. jī (5s) 友: A. péng B.yǒu C. fēi D. jī (5s) 飞: A. péng B.yǒu C. fēi D. jī (5s) 机: A. péng B.yǒu C. fēi D. jī (5s)		
Cycle 2	**3 presentations** as in Cycle 1 (10s)	Same as Cycle 1 (10s)			Same as Cycle 1 (10s)		
	Recall: Type Pinyin and meaning (6s each)	Type word Pinyin (6s)		Type word meaning (6s)	朋 (type Pinyin for character 1) (6s)	朋 友 (type word meaning) (6s)	友 (type Pinyin for character 2) (6s)
	Feedback (3s)	Same as Cycle 1 (3s)			Same as Cycle 1 (3s)		
	Multiple choice (5s)	Same as Cycle 1 (5s)			Same as Cycle 1 (5s)		
Cycle 3	Replication of Cycle 2	Same as Cycle 2			Same as Cycle 2		
Cycle 4	**Recall**: Type Pinyin and meaning	Type word Pinyin (12s)		Type word meaning (12s)	Type Pinyin for character 1 (6s)	Type Pinyin for character 2 (6s)	Type word meaning (6s)
	Feedback (3s)	Same as Cycle 1 (3s)			Same as Cycle 1 (3s)		
Cycle 5	**Recall**: Type Pinyin and meaning	Type word Pinyin (12s)		Type word meaning (12s)	Type Pinyin for each character (7s) with feedback for each character (2s)		
	Feedback (3s)	Same as Cycle 1 (3s)			Same as Cycle 1 (3s, after all characters)		
Cycle 6	**2 presentations** (7s)	1st (3s) péngyǒu 朋友 friend	2nd (4s) péngyǒu 朋友 friend		1st (3s) péng yǒu 朋 友 friend	2nd (2s+2s, sequentially) péng 朋 friend	yǒu 友 friend

Supplementary methods of the six learning cycles:

In the first learning cycle, participants in two groups first saw a two-character word along with its pronunciation and its meaning on the computer screen. The word to be learned was in the center of the screen and its pronunciation and meaning were presented above and below it, respectively. The spoken pronunciation was played to the participant's headphones at the same time. Each word was presented three times continuously for 3 seconds, 4 seconds, and 3 seconds, respectively. In the word-focus instruction group, the two-character word was presented as a whole (e.g., 朋友), with its pronunciation (e.g., "péngyǒu"), and with its meaning (e.g., "friend") three times (See Table S4 for more details of the procedure for each cycle). In the dual-focus instruction group, the two characters in a word were presented with a space between them (e.g., 朋 友). A space was also inserted to separate their corresponding pronunciation (e.g., "péng yǒu"). This design was to draw attention to the character as an orthographic unit and its association to phonology. Further, during the second presentation for the dual-focus instruction group, the two characters in a word were presented sequentially to highlight the character-level mapping. The third presentation reverted to simultaneous display. After three presentations of each word, participants in both groups retrieved (typed) first its pronunciation and then its meaning. The word-focus group typed the word's pronunciation as a whole, while the dual-focus group typed the word's pronunciation with a space to separate the pronunciations of the two constituent characters. Participants were asked to produce the pronunciation and meaning in 10 seconds each. Then the word with its pronunciation, meaning, and the auditory pronunciation were presented again for three seconds to provide feedback to the learner. During the feedback for the dual-focus group, the space between two characters in a word and also their Pronunciation was retained to emphasize the character-level mapping. After every two words, participants in both groups had a multiple-choice test. In the word-focus group, participants were to select the correct pronunciation for each of the two words; participants in the dual-focus group made choices for the pronunciation of each constituent character.

Participants had five seconds for their response, after which two-second feedback indicated whether their response was correct or incorrect.

Learning cycles 2 and 3 were identical to cycle 1, except for an additional retrieval attempt for the dual-focus group. After typing the pronunciation for the first character of a word, participants were asked to type the word meaning and then the pronunciation of the second character. This manipulation was to emphasize the phonological mappings to each character by adding an interval of typing word meaning.

In learning cycle 4, participants were first asked to retrieve the pronunciation and meaning of each word and then received feedback. In this cycle, the word-focus group retrieved the pronunciation of the whole word while the dual-focus group sequentially retrieved the pronunciations of the two characters in a word. After the responses for each word, its pronunciation, meaning, and recorded pronunciation were presented for three seconds.

In learning cycle 5, the procedure for the word-focus group was the same as in learning cycle 4. For the dual-focus group, different from retrieving pronunciations of two constituent characters from the same word sequentially in learning cycle 4, characters in all words were tested randomly in learning cycle 5. Learners were required to type the pronunciation for each character within seven seconds. After the response for each character, the character and its correct pronunciation were presented for two seconds as feedback. Because characters were tested randomly instead of in a word, word meaning was not tested in the dual-focus group. This design was also used to balance the total learning times between the two groups. After typing pronunciations for all characters, each word was presented one by one with its pronunciation, meaning, and auditory pronunciation for three seconds.

Learning cycle 6 was dedicated to review all words. Each word was presented with its pronunciation, meaning, and recorded pronunciation twice in a row. For the dual-focus group, the first presentation displayed a word with a space between the two characters and their corresponding pronunciation. For the word-focus group, the word of two characters was presented as a whole without extra space between the two

characters. The presentation times of the first presentation were three seconds for both groups. During the second presentation, the two characters in a word were presented sequentially for the dual-focus group. The word for the word-focus group was presented as a whole as in the first presentation. The second presentation times were four seconds for both groups.

To facilitate learning and memory, the ten words in the day-one session were assigned to two learning blocks. In Block 1, participants first learned four words through learning cycle 1 to cycle 5. In Block 2, participants learned the other six words through cycle 1 to cycle 5. All ten words were reviewed together in cycle 6.