The Influence of Japanese Phonotactics on Second Language Perception

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Does Phonotactics Influence Perception?

Phonetic and phonological differences between a speaker's native language and a target, second language systematically influence how learners perceive sounds (e.g., Best, 1995).

Most research has primarily focused on the effects of phonemic category and phonetic inventory differences but has ignored phonotactics.

Japanese provides a unique opportunity to observe the influence of phonotactics on perception due to the maintenance of co-occurrence restrictions on CV combinations (see Figure 1).

	s	ʃ	h	ç	ɸ	t	tʃ	ts
a	sa	ʃa	ha	ça		ta	tʃa	
i		ʃi		çi			tʃi	
u	su	ʃu		çu	ɸu		tʃu	tsu
e	se		he			te	tʃe	
o	so	ʃo	ho	ço		to	tʃo	

Figure 1. A selection of permissible moraic combinations in Conservative Japanese (Pintér 2015, p. 125).

The Perceptual Assimilation Model (PAM: Best 1995) non-native sound categories:

1. A phone that has a good fit to an existing native category.
2. A phone that fits somewhere between two existing native categories.
3. A phone with no perceivable resemblance to any native phoneme.

We predicted that participants would be able to:

- Accurately categorise VCV tokens according to native sequences.
- Be more accurate at discriminating between tokens that differed more greatly in terms of place and manner of articulation.
- Be more accurate in discriminating between two category contrasts.

Stimuli and Participants

Legal	Illegal
/iʃi/	/isi/
/itʃi/	/iti/
/usu/	/utu/
/uʃu/	
/utsu/	

Figure 2. Stimuli sorted by legality.

Stimuli were provided by phonetically trained native Australian English speakers and presented to participants through PsyScope X.

Ten native Japanese speaking participants were recruited for this study. All were born in and had undergone both primary and secondary education in the Yamagata prefecture of Japan.

Participants were near-monolingual females aged 27-34.

Experiments were conducted in quiet rooms in Tokyo and Murayama city.

Experiment 1: Categorisation

Experiment 1 involved participants undertaking a categorisation task and assigning goodness to fit ratings to each of the 8 VCV tokens.

Participants were asked to categorise both legal and illegal stimuli into one of four legal categories.

They were then asked to assign a rating to indicate how well each token 'fit' to allocated categories on a scale from 1(bad) to 7 (excellent).

Participants each provided two hundred categorisations and goodness to fit ratings, twenty five per VCV token.

Stimuli \ Categories	/iʃi/	/itʃi/	/usu/	/utsu/
[iʃi]	100 % (5.96)			
[isi]	100% (4.23)			
[itʃi]		100% (5.95)		
[iti]		100% (2.88)		
[usu]			98% (5.59)	2%
[uʃu]			98% (2.47)	2%
[utsu]			1%	99% (5.11)
[utu]			1%	99% (2.71)

Figure 3. Experiment 1 categorisation rates with goodness-to-fit scores in parenthesis.

All tokens achieved a greater than 97% categorisation rate into expected categories.

Goodness-to-fit scores along a 7 point scale indicate that participants were in agreement with each category having a prototypical token (M = 5.65, SD = 0.47) and a non-prototypical token (M = 3.07, SD = 0.69).

Experiment 2: Discrimination

Experiment 2 involved five AXB discrimination tests, it was conducted after each participant had completed Experiment 1 and used the same tokens.

Participants each provided three hundred discrimination responses, sixty per AXB test.

Pairs Contrasts

Two Category	Category Goodness
/iʃi/ & /iti/	/itʃi/ & /iti/
/uʃu/ & /usu/	/iʃi/ & /isi/
	/utsu/ & /utu/

Figure 4. AXB tests organised into PAM categories.

An ANOVA revealed a significant difference between tests, $F(4) = 10.11$, $p = > 0.001$, partial $\eta 2 = 0.243$.

A second ANOVA measuring between the two types of pairs contrasts also revealed a significant difference, $F(4) = 30.813$, $p = > 0.001$, partial $\eta 2 = 0.391$.

A series of paired-sample t-tests found a significant difference between [uʃu/usu] results and [itʃi/iti] $t = 2.57$ $p = .03$, [iʃi/isi] $t = 3.74$ $p = .005$, and [utsu/utu] $t = 8.34$ $p = > 0.001$.

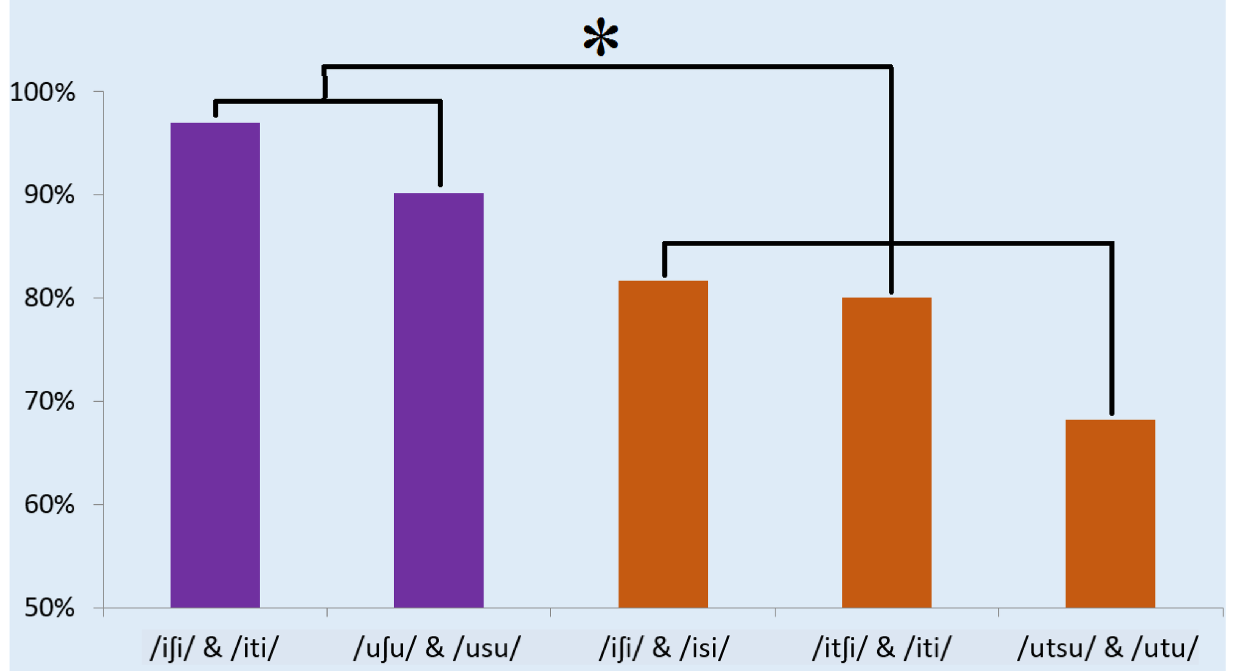

Figure 5. Experiment 2 AXB discrimination test results where 50% equals chance.

Discussion

To our knowledge, this is the first study to examine the influence of native (Japanese) co-occurrence restrictions on the perception of non-native (English) consonants.

The results provide clear evidence that Japanese phonotactic restrictions have a significant influence on second language perception.

These findings conflict with current second language perception models (PAM) which would predict that /s/ and /ʃ/ would have a high discriminability due to the fact that they constitute separate phonemes of Japanese.

Here, the significant difference between the /usu/-/uʃu/ and the /iʃi/-/isi/ tests clearly show that the discriminability of /s/ and /ʃ/ is, at least partly, influenced by the environment in which a sound is presented.

While further research is required to determine what factors are motivating variation in the results for category goodness contrasts, one possible explanation is the frequency at which illegal diphones are maintained in the production of loanwords (Itô & Mester, 1995).

This is an important finding with clear theoretical implications given that most contemporary models of non-native and cross-language speech perception, like the Perceptual Assimilation Model (PAM), predict and account for the varying degrees of success that learners have with non-native phonetic and phonological contrasts but offer no framework or predictions for the ways in which native phonotactics may play a role in non-native segmental perception.

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Ethical approval for this research granted by the Humanities and Applied Sciences Human Ethics Sub-Committee. Ethics ID: 1544315