PHARYNGEAL /h/ IN JAPANESE

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1. INTRODUCTION

Glottal fricatives are generally assumed to be "placeless" (Steriade (1987), Keating (1988), Stemberger (1993)). The widely-held view about Japanese is that /h/ is placeless, based on the observation that, synchronically, /h/ becomes a palatal fricative before /i/, and a bilabial fricative before /u/, suggesting that /h/ has no independent constriction location. We interpret this as an argument for the idea that Japanese /h/ is pharyngeal rather than placeless.

In our view, Japanese /h/ assimilates in these high vowel environments due to articulatory conflict (Meechan (1992), Archangeli & Pulleyblank (1994), Gick & Wilson (2006)) at the tongue root. Gick & Wilson argue that conflicting tongue root targets beget crosslinguistically diverse repair strategies. Furthermore, in many languages that have a pharyngeal /h/, a sequence of /h/ and a high vowel (*hi, *hu) is banned. In languages with sequences of this kind, vowel lowering or laxing may occur (e.g., /hilt/ > [helt] 'many' in Gitksan (Rigsby (1986: 205)), see Shahin & Blake (2004) for a vowel lowering effect in Salish, and Shaw (1991) for both pharyngeal and placeless glottals within Nisgha).

A lingual ultrasound study was conducted to test whether Japanese /h/ shows evidence of an independent pharyngeal place of articulation.

2. METHODS

2.1 Participants

Seven native speakers of standard Japanese (5 females and 2 males, ranging from early 20s to early 40s) participated in the experiment. The purpose of this experiment was not told. One participant's data was omitted, as her speech was affected by previous temporomandibular joint surgery.

2.2 Materials

All stimuli were pseudo words, phonologically and morphologically controlled. Target word was *ahha*, and dummy words were *ihhi, ihha, ahhi, ahhe, ihhe, uhhe, ahho, ihho, uhho*. Geminated *hh* rather than a singleton *h* was selected so that the lingual movement would be slower and more visible to us. The word list consists of 14 blocks. Each block contains target and dummy words that were randomized in ordering. The first and the last token of each block and all words in the first and last blocks were not used for the measurements. The list was printed and presented in katakana orthography as in アッハ, with HGP Mincho E Font of 12 point, in white letter size papers.

2.3 Procedure

Recording was conducted in the Interdisciplinary Speech Research Laboratory at the University of British Columbia. Participants were trained to read all tokens with initial-accent at a natural rate.

An Aloka SSD-5000 ultrasound machine was used with a UST-9118 and 180° electronic convex EV probe. Movie clips were recorded into iMovie, and converted to DV files. Still images were extracted at midpoints of consonants and vowels, using Final Cut Express ver. 1.01. Midsagittal tongue contours were produced and measured using EdgeTrak software (Stone (2005), among others).

2.4 Design

/h/ and flanking /a/ vowels were compared, and presented in the form of i) SSANOVAs (cf. Davidson (2006)) to **show overall tongue configuration**, and ii) boxplots of y-axis (constriction degree) to show **peak tongue height**, and x-axis (constriction location) to show **peak tongue backness**). It is predicted that pharyngeal /h/ should be significantly different from flanking /a/ vowels.

3. RESULTS

Results show that some speakers have a distinct pharyngeal constriction for /h/, but there seems to be inter-speaker variation in the details.

3.1 TT: Pharyngeal Constriction

Figure 1 gives sample graphics of SSANOVA, from one subject (TT), who has significant tongue root retraction.

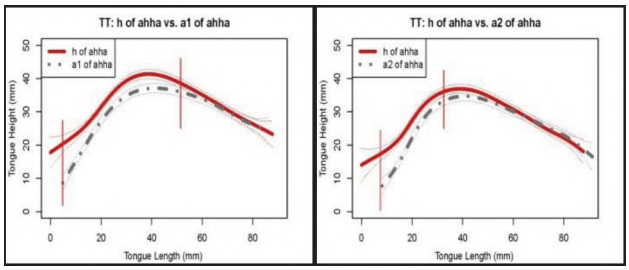

Figure 1. Tongue root retraction in SSANOVA

In each graph, the left hand side is tongue root, and the right hand side is tongue tip. A pair of vertical lines over tongue

surfaces indicate the area that has a significant difference (>.05) in tongue configurations between /h/ and /a/.

Figure 2 shows the distributions of the height (on the left hand side) and backness (on the right hand side) of the highest point of the tongue. Table 1 presents t-test results.

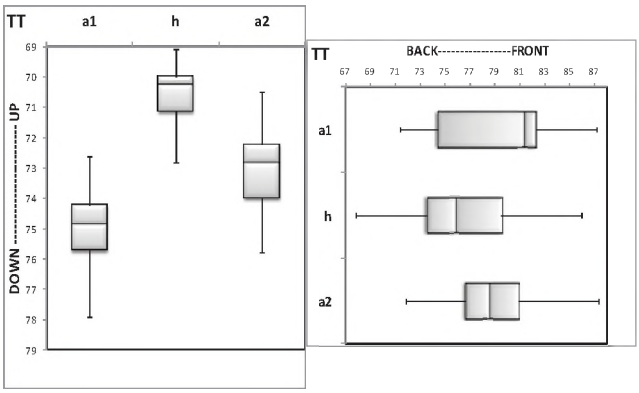

Figure 2. Peak tongue: Height and Backness

Table 1. Dorsum peak comparison of TT

t-test	a1 vs. h	h vs. a2	a1 vs. a2
Tongue Height	***<.0001	***<.001	**<.01
Tongue Backness	0.25	0.32	0.8

The results for /h/ vs. a1 or a2 indicate that the highest tongue point for /h/ is significantly raised, but not significantly backed or fronted.

3.2 All: Inter-speakers Variation

The results of six subjects are given in Table 2.

Table 2. Combined Results of R and Boxplots

	SSANOVAs	y-axis (height)	x-axis (backness)
AM	≠a1 only		
HS	***≠a1&a2***	***≠a1&a2***	≠a2 only
TT	***≠a1&a2***	***≠a1&a2***	
YS	≠a1 only	≠a2 only	≠a1 only
KK		≠a1 only	
MK	***≠a1&a2***	≠a1 only	≠a2 only

(Shadowed boxes show no significant difference between /h/ and a1, and /h/ and a2. '≠' indicates significant difference from /h/.)

The overall results consist of three groups: (i) HS, TT and MK have a significantly different retraction and/or raising around uvular/pharyngeal area for /h/, relative to /a/ on both sides, (ii) KK has no significant difference, and (iii) AM and YS show a significant difference between /h/ and a1 only.

4. DISCUSSION AND CONCLUSIONS

Based on the hypothesis of Generative Phonetics (Pierrehumbert (1980), Keating (1988), Cohn (1990)) that phonetic implementations reflect phonological feature specifications at the output of phonology, features should be specified differently for each of those three ways of implementations: (i) **α-β-α**, where the intervocalic /h/ is different from vowels, or (ii) **α-0-α**, where /h/ is unspecified for place so that it can be interpolated, and (iii) **α-β**, where β is linked to both /h/ and a2. Since β shows retraction or raising around uvular/pharyngeal area, the feature could be [pharyngeal] (McCarthy (1991)) or Tongue Root (Cole (1987)), which should be distinguished from vowel place α.

The possibility of multiple possible feature specifications as above may come from the phonetic ambiguity of /h/: it is classically dubbed as 'fricative', implying it behaves like **consonants**, but could be 'glide' (Chomsky & Halle (1968)) or 'approximant' (Keating (1988)) implying it behaves more like **vowels** or expects interpolation. Such highly variable characteristics of /h/ may allow speakers to access different resolutions to the potential ambiguity. Interestingly, although the multiple resolutions are available, the individual choice is found to be discrete and categorical.

Based on this observation, the audibly unclear covert contrast between [pharyngeal] and placelessness may be suggested as being active in Japanese phonology, and speaks in favor of the emergentist position of distinctive features (Pulleyblank (2003), Mielke (2008), Kim & Pulleyblank (2009), Mielke, Baker & Archangeli (2010)).

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