Vowel duration and aspiration effects in Icelandic

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Chapter 1

Introduction

Chapter 2

Literature review

2.1 Laryngeal

2.2 The effect of aspiration on vowel duration

Vowel duration has been reported in the literature to correlate with the presence vs. absence of aspiration in the following consonant. In particular, Maddieson and Gandour (1976) and Durvasula and Luo (2012) found that vowels followed by aspirated consonants in Hindi are longer than vowels followed by non-aspirated consonants. In the following paragraphs, I will briefly introduce the system of laryngeal oppositions of Hindi. I will then review some of the findings concerning the aspiration effect and the major theories regarding the cause of this phenomenon.

The consonantal system of Hindi is based on a four-way opposition of laryngeal contrasts. For each place of articulation, there are a voiceless unaspirated, a voiced unaspirated, a voiceless aspirated and (breathy) voiced aspirated stop: for example, [t], [d], [t^{h}], [$d^{ɦ}$]. The voiceless aspirated stops (like [t^{h}]) are similar to the aspirated stops of English: a relatively long VOT follows the release of the occlusion. The voiced counterpart (like [$d^{ɦ}$]) is normally voiced throughout the closure and the aspiration is characterised by breathy voicing. Maddieson and Gandour (1976) found that vowels followed by voiced and voiceless aspirated stops (like in [kaːd] ‘embroider’ and [kaːt^{h}] ‘wood’) were of equal length but longer than vowels followed by voiceless stops (like in [kaːt] ‘cut’). Moreover, vowels followed by voiced aspirated stops (like in [saː$d^{ɦ}$] ‘balance’) were even longer than voiced and voiceless aspirated stops. Table 2.1 shows the mean duration of vowels before the four alveolar stops as reported by Maddieson and Gandour (1976, 47).

Table 2.1: Mean duration of vowels in Hindi before stops.

consonant	vowel duration (msec)
/t/	160
/d/	184.5
/t^h/	184.75
/d^h/	196

Chapter 3

Methodology

3.1 Participants

For this study, I recruited six Icelandic speakers who were living in York (UK) when the recordings were made. Recruitment was done through University channels, the Icelandic Embassy in London and the York Anglo Scandinavian Society. All the participants were native speakers of Icelandic, above 18 years old and claimed to have normal hearing and speech abilities. The information on each participant is given in Table 3.1. Participant JR had to be excluded from the analysis since he misunderstood the task, while part of participant SHG's task was lost due to a technical fault in the recording equipment.

3.2 Materials

The material used in the task consisted of a list of Icelandic words (the "target words") with the following forms: (C)VCC (monosyllabic) and (C)VCCV (bisyllabic). The list of target words is given in Appendix A. The target words were selected so as to control for as many of the following aspects as possible: phonation, manner and place of articulation of consonants following the target vowel; height and frontness of the target vowel; phonation, manner and place of articulation of consonants preceding the target vowel; and height and frontness of the eventual word-final vowel.

Table 3.1: Information on participants

id	sex	age	born	city	languages	abroad
TT	female	24	Reykjavik	Reykjavik	English, Danish, German	Yes
BRS	female	25	Hofn	Hofn	Danish, English, Spanish	Yes
BTE	female	27	Reykjavik	Reykjavik	English, Danish	Yes
JJ	female	46	Reykjavik	Kopavogur	English, Danish	Yes
SHG	male	25	Selfoss	Selfoss	English	No
JR	male	66	Reykjavik	York	English	Yes

Control over these parameters was prioritised according to the order in which they were presented here. Unfortunately, obtaining a well controlled word list proved to be extremely difficult and several compromises have been made.

3.3 Procedure

The target words were embedded in the frame sentence *Segðu __ aftur*, 'Say __ again.' This sentence was chosen with the aid of one of the participants so as to control for naturalness, number of syllables and phonetic contexts preceding and following the target word, and phrase stress. The participants were asked to read aloud the sentences with the target words shown on a computer screen. They were advised to speak as naturally as possible, while keeping the same volume and pace. They did not familiarised themselves with the word list before starting the task. The decision of not showing the words beforehand was made to reduce the speakers' control over their speech. The task was presented through the software PyschoPy (Peirce, 2009), on a Apple MacBook Pro (mid 2014 model). Each sentences was shown three times consecutively and the order of appearance was randomised across subjects. The reading task was self-paced; the participant read a sentence shown on the screen and moved to the next sentence when ready by pressing the space bar.

The informants were recorded using a high-fidelity headset microphone plugged into a Zoom H4n Handy Recorder. The audio files were encoded using the `.wav` format at a sampling rate of 44 kHz (16-bit). Four speakers were recorded in a meeting room at a travel agency, while one was recorded at the University of York and the last in his living room, at his house in York. Even if the recording conditions differed between participants, the quality of the audio is comparable across files.

3.4 Measurements

The analysis of the audio file consisted of three phases: (1) conversion from stereo to mono, (2) annotation, and (3) extraction of measurements. I first converted the audio files from stereo to mono, but I did not apply any filter. During the second phase, I annotated the files in PRAAT (Boersma and Weenink, 2015) using TextGrid files. The annotation files will had four tiers. The tiers contain, respectively: (1) the graphemic transcriptions of the target words, (2) the intervals within the words where there is voicing, (3) the intervals within the words where laryngeal spread, nasality, laterality or rhoticity is present, and (4) the release of stops. Figure 3.1 shows an example of the TextGrid set-up.

The first tier was segmented by target words. The left boundary of the word was considered to be the off-set of voicing of the final vowel of *segðu*, which preceded the target word. The right boundary differed between consonant-final and vowel-final words. In consonant-final words, the right boundary coincided with the end of the friction following the burst of the release, as visible in the waveform and spectrogram. In vowel-final words, the right boundary was placed at the mid-point of the transition between the final vowel and the initial vowel of the following word (*aftur*). The boundaries of the intervals in the second tier were placed at the on-set and off-set of voicing within the word. If the word started with one or more voiced continuant consonants, the portion of

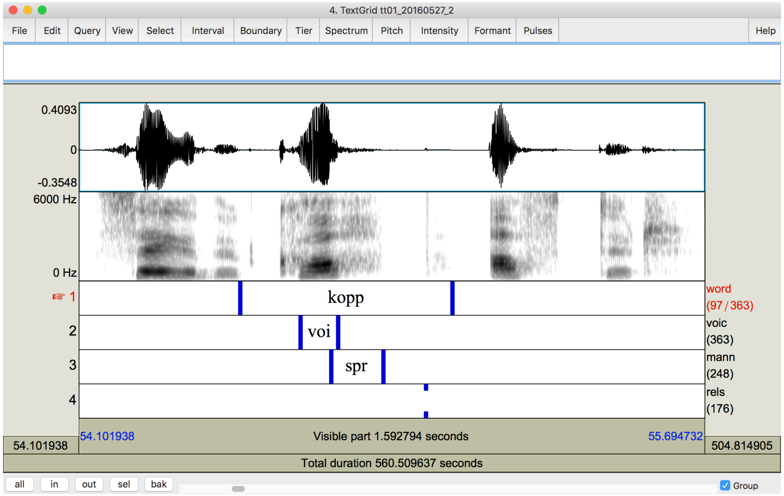

Figure 3.1: TextGrid.

voicing of those consonants was excluded from the interval and the left boundary was placed at the beginning of the following vowel.

The third tier was used for annotating glottal spread, nasal airflow, laterality and rhoticity. Marking the beginning of glottal spread proved to be particularly difficult. As in Khan (2012), I expected breathy voice to produce more round-shaped periodic waves. I took the onset of such more sinusoidal waves to coincide with glottal spread and I marked it as the left boundary of spreading. The right boundary was assumed to match the end of visible frication noise. Following standard practice, I marked the beginning of nasality where a change in the shape of the wave and the amplitude in the spectrogram were visible. I applied the same principle to laterals and rhotics. I placed the right boundary of these intervals (nasal, lateral, rhotic) depending on the nature of the segment. The voiceless nasal, lateral and trill consonants terminate with voiceless friction (nareal, lateral or central, respectively). The end of friction in these consonants was used as the end of the interval. In the voiced counterparts of these, the end of voicing coincided with the right boundary.

In the third phase, I extracted the durational properties of the annotated intervals through an automated routine. The routine was run with a PRAAT script, specifically written for this study. The script with its documentation can be found in Appendix B. The output is a `.csv` file with the relevant measurements. After running the script, I performed the statistical analysis using the R programming language (R Core Team, 2015) in RStudio (RStudio Team, 2015).

Chapter 4

Results

Chapter 5

Discussion

Chapter 6

Conclusion

Appendix A

Word list

Table A.1: List of target words

word	IPA	word	IPA
kokk	kʰoʰk	kembt	kem̥t
gogg	kokk	kembdi	kemtɪ
dökk	tœʰk	kampa	kʰam̥pa
dögg	tœkk	kamba	kʰampa
kopp	kʰoʰp	kempa	kʰem̥pa
kubb	kʰʏpp	kemba	kʰempa
vítt	viʰt	punta	pʰʏn̥ta
vídd	vitt	punda	pʰʏnta
þítt	θiʰt	vanta	van̥ta
þíddi	θittɪ	vanda	vanta
fætt	faiʰt	fínn	fitn̥
fæddi	faittɪ	kinn	kʰɪnn
ýtt	iʰt	duld	tʏlt
ydd	ɪtt	dult	tʏl̥t
ótt	ouʰt	gelta	kel̥ta
odd	ott	gelda	kelta
sets	sess	orka	or̥ka
sett	seʰt	orga	orka
feits	feiss	mjólka	mjoul̥ka
feitt	feiʰt	ólga	oulka
vots	voss	hefna	hepna
vott	voʰt	vopna	voʰpna
takka	tʰaʰka	nafla	napla
kagga	kʰakka	japla	jaʰpla
detta	teʰta	kafli	kaplɪ
gedda	ketta	kapli	kaʰplɪ
kamp	kʰam̥p	tefla	tepla
kamb	kʰamp	tipla	tɪʰpla
punt	pʰʏn̥t		
pund	pʰʏnt		

Appendix B

PRAAT script

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