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Initial plosive consonants of the Low Saxon dialect of Raalte

Abstract. A contrast between voiceless aspirated and voiced unaspirated plosives is seen as typologically unusual since it is not in accordance with the Size Principle and Optimal Dispersion Theory. Even though, this contrast was found in Central Standard Swedish by Helgason and Ringen (2008). It has been known that in Dutch Low Saxon dialects plosives are aspirated and data from the Morphological and Phonological Atlas of Dutch Dialects (Meertens Institute), suggest indirectly that the Low Saxon dialect spoken in Raalte (OV) also uses the contrast observed by Helgason and Ringen. This research investigates whether this contrast indeed is detectable in the dialect spoken in Raalte, by comparing the five initial consonants /p/, /t/, /k/, /b/ and /d/ with the Dutch spoken in Noord-Holland. Although the means observed do plead for a typologically unusual contrast, a significant difference between the two groups was not found.

1. Introduction

In 1964 Lisker & Abramson introduced the Voice Onset Time (VOT). They suggested three categories, which they found in the eleven languages they measured: negative VOT (prevoicing), short-lag VOT and long-lag VOT (aspiration). This suggests that there is one single feature that accounts for laryngeal contrasts of languages with a binary contrast; [±voice]. In this paper we stick with this Single Feature Hypothesis with the binary feature [±voice] (Steriade 1995, Wetzels & Mascaró 2001) instead of the monovalent feature [voice] suggested and used by Mester & Ito (1989), Cho (1990), Lombardi (1995, 1996).

In the languages studied Lisker & Abramson found that the most common contrast was one between voiced unaspirated and voiceless unaspirated stops, thus a contrast in [±voice]. Several years later Keating, Linker & Huffman (1983) also stated that this contrast is the most common one based on a survey of 51 languages.

Although most Germanic languages such as Danish and English in initial position show a contrast between voiceless unaspirated and voiceless aspirated plosives, thus of [±aspiration], (Keating 1984, Lisker & Abramson 1964) Dutch, another Germanic language, deviates from these languages and follows the majority with a contrast that is often described as a prevoiced unaspirated – voiceless unaspirated contrast in initial position (van Alphen & Smits, 2004).

Ringen & Helgason (2008) found that in Central Standard Swedish the initial contrast between plosives was made by using voiceless aspirated and prevoiced unaspirated plosives, which means there is a maximal contrast consisting of two features: [±voice] and [±aspiration]. This is seen as typologically unusual, since it does not comply with the 'Size Principle' (Lindblom & Maddieson, 1988). This Size Principle states that one tends to avoid phonetically complex, but very distinctive segments in small inventories. Maddieson states that Swedish has a moderately small inventory with 18 consonants (WALS 1, I. Maddieson). According to Lindblom (1990) the Size Principle occurs because of an urge to establish a balance between intelligibility and effort, which results in phonemic contrasts that differ sufficiently instead of maximally. This aforementioned is also in accordance with the Optimal Dispersion Theory, which states that languages develop in a way where they maximize contrasts and auditory distinctiveness and minimize articulatory ease (Flemming 1995, 1996, 2001, Boersma 1997, Harris & Lindsey 2001).

Ringen and Helgason (p. 624) claimed that, if research were conducted with more detail than usual, more typologically unusual contrasts, such as the one found in Central Standard Swedish, could be found.

One region where such a contrast might be found is the northeastern part of the Netherlands since in this region Dutch Low Saxon is spoken, of which is known that in some of its dialects, aspiration occurs. This research focuses on the dialect spoken in Raalte, Overijssel, which also knows aspirated voiceless plosives at initial position according to the transcriptions of the Morphological and Phonological Atlas of Dutch Dialects (MAND) of the Meertens Institute (1980-1995).

While Dutch is classified as a Low Franconian language, in the northeastern parts of the Netherlands, where Raalte is located, the languages are classified as being part of Low German (Niederdeutsch, Nederduits). Dutch Low Saxon is divided in multiple forms of which one is Gelders-Oaveriessels, which is further subdivided into Achterhoeks, Urkers and Sallands.

The latter is called after the region it is spoken in; Salland. Raalte [ʀa:ltə] is located in the middle of Salland, and had approximately 18.000 inhabitants at the first of January 2014 (Gemeente Raalte, 2014). The language spoken in Salland, and thus also Raalte, is called Sallands and is recognized as a language by Ethnologue (ISO 639-3 sdz).

Does this dialect show the same initial contrast that Ringen and Helgason found in Central Standard Swedish, which confirms their statement about needing more detail in research, or does this dialect show a typologically more usual contrast?

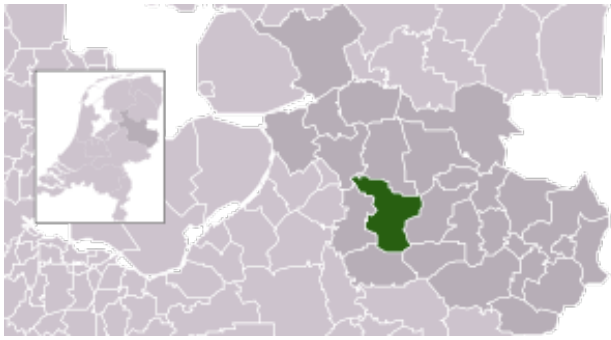


Figure 1: Community of Raalte in the northeastern part of the Netherlands.

This research looks at the initial contrast between the bilabial /p/ and /b/ and the alveolar /t/ and /d/. Since in Dutch and the dialect spoken in Raalte the velar voiced plosive only occurs in loan words, merely the realization of the voiceless velar /k/ is taken into account.

2. Method

Twelve participants were recorded while reading a list of words. Six of them were speakers of Raaltes, three females of 56, 60 and 77, and three males of 67, 72 and 80. All six had been born and raised in Raalte and only one claimed to speak German, French and English besides Dutch and Raaltes.

The other six were non-dialect speakers of Dutch, from the province of Noord-Holland; three females of 59, 62 and 74, and three males of 56, 64 and 84 years old. All claimed to speak English and German besides Dutch, and four out of six also spoke French. Only one also speaks Italian. Three out of six had been born and raised in Limmen, the other three had been born in Bussum, Bakkum and Alkmaar, and had also lived in Muiden, Heerhugowaard and Medemblik (figure 2 and table 1).

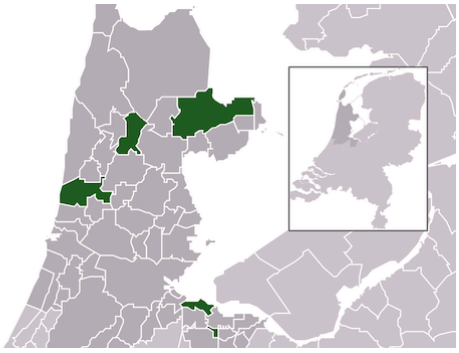


Figure 2: Communities in which the participants of Noord-Holland lived at some point in their life.

Table 1: Overview of the participants in the order in which they were recorded.

PP	Group	Gender	Age	POB	Also lived in	Languages
RV01	Raalte	Female	77	Raalte	-	-
RM02	Raalte	Male	80	Raalte	-	English, German, French
RM03	Raalte	Male	67	Raalte	-	-
RV06	Raalte	Female	56	Raalte	-	-
RV05	Raalte	Female	60	Raalte	-	-
RM04	Raalte	Male	72	Raalte	-	-
NV07	NH	Female	74	Bussum	Muiden, Heerhugowaard	English, German, French
NV08	NH	Female	59	Limmen	-	English, German
NV11	NH	Female	62	Bakkum	Limmen	English, German
NM09	NH	Male	56	Alkmaar	Medemblik, Limmen	English, German, French, Italian
NM10	NH	Male	84	Limmen	-	English, German, French
NM12	NH	Male	64	Limmen	-	English, German

The group in Raalte read a randomized list of 139 dialectal words, which consisted of three times 25 target words beginning with /b/, /p/, /t/, /d/ or /k/, and 64 fillers beginning with other consonants. The group in Noord-Holland read a randomized list of 119 Dutch words, which consisted of three times 24 target words beginning with /b/, /p/, /t/, /d/ or /k/, and 47 fillers beginning with other consonants.

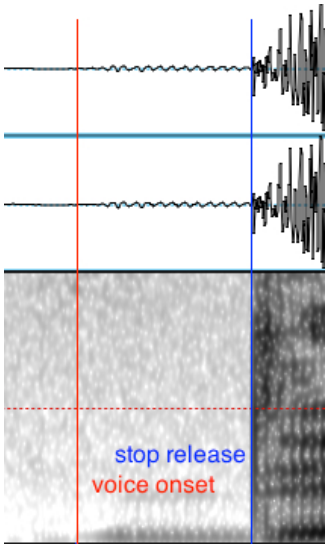
Since the aim of this research is to analyze the post-pausal plosives, the words were not implemented in carrier sentences, and the participants were asked to pause between the words. All words contained one or two syllables and did not begin with consonant clusters. Recording was done at their homes, by a EDIROL 24 bit Digital WAVE/Mp3 Recorder in combination with headphones containing a microphone.

First, the participants read the words for familiarization, after which they read them aloud. The participants were not paid but did receive a small token of appreciation afterwards.

All recordings were analyzed as wideband spectrograms of which VOT's were measured by marking the time of stop release and the time of voice onset. The time of stop release was determined by a sudden change in the spectrum which is also visible in the sound wave, while the voice onset time was determined by marking the first regular vertical striation in the spectrum, indicating vibration of the vocal folds, and the first regular pulse in the sound wave.

I assigned zero-time to the point of release, which results in negative figures when the release follows the voice onset (prevoicing), and positive figures when the release precedes the voice onset (aspiration).

Figure 3 shows an example of how the points were determined for prevoicing, where you can see a clear band of voicing and a regular pulsation. Figure 4 shows an example of how the points were determined for aspiration, where we can see an irregular sound wave after a sudden release of energy.



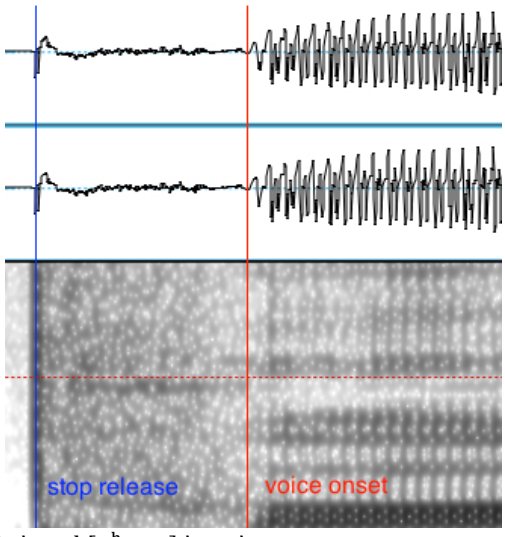


Figure 3 and 4: Points of stop release and voice onset at [dɪkə] 'fat' and [pʰoəɹt] 'gate'.

3. Results

Table 2 shows the mean VOT values of the five consonants in Noord-Holland and in Raalte. Appendices A and B also show the mean VOT values of every word per participant and every consonant per participant. The boxplots of all consonants in each group are shown in figure 5.

Table 2: Mean VOT values in milliseconds of Raalte and Noord-Holland.

Consonant	VOT.Noord-Holland	VOT.Raalte
/b/	-101.86	-95.76
/d/	-107.74	-89.40
/p/	14.88	22.63
/t/	27.25	48.98
/k/	36.90	43.60

These mean VOT values indicate that the /b/ and /d/ in Noord-Holland and Raalte are not exactly the same, in that they are slightly longer prevoiced in Noord-Holland than in Raalte. We also see that the voiceless plosives in Raalte have larger VOT values. These numbers suggest that Raalte indeed has aspirated voiceless stops and that the /b/ and /d/ are not the same as in Dutch. The values also show that the contrast is not extremely larger than in Dutch, since the voiced plosives have less negative VOT values than in Dutch, where the voiceless plosives have larger VOT values than in Dutch.

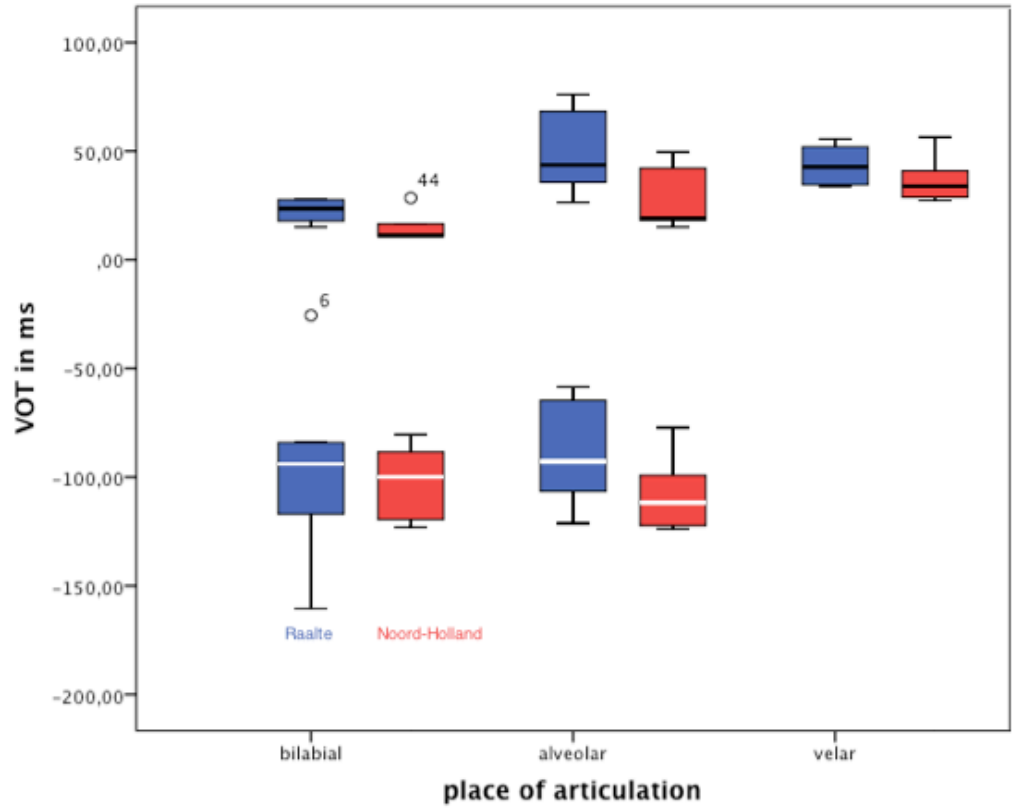


Figure 5: Boxplots of both groups per place of articulation.

Although these mean VOTs look revealing, statistical tests say otherwise. Independent-samples t-tests indicate that VOT values of /b/, /d/ and /k/ were not significantly different between Raalte (/b/: *M* = -95.76, *SD* = 44.15, /d/: *M* = -89.40, *SD* = 25.62, /k/: *M* = 43.59, *SD* = 9.12) and Noord-Holland (/b/: *M* = -101.86, *SD* = 16.88, /d/: *M* = -107.64, *SD* = 17.87, /k/: *M* = 36.90, *SD* = 11.07):

/b/ $t(10) = 0.316$, $p = 0.758$.
/d/ $t(10) = -1.430$, $p = 0.183$.
/k/ $t(10) = -1.143$, $p = 0.280$.

Since the data of /p/ and /t/ were not normally distributed, Mann-Whitney tests were done for these two consonants, which indicated that VOT values of /p/ and /t/ were also not significantly different between Raalte (*Mdn* /p/ = 23.64, /t/ = 43.64) and Noord-Holland (*Mdn* /p/ = 14.88, /t/ = 19.20):

/p/ U = 7.000, $p = 0.078$, $r = -0.508$.
/t/ U = 6.000, $p = 0.055$, $r = -0.555$.

Place of articulation

As we look at the place of articulation we see that in Noord-Holland the alveolars are more aspirated and more prevoiced than the labials, and the velars are also more aspirated than the alveolars. In Raaltes the

voiced labials are more prevoiced than the voiced alveolars, and the voiceless alveolars and velars are more aspirated than the bilabials, but the voiceless alveolars and velars do not differ much. As we could see, there is no significant difference between the velars in both groups. A possible reason for the latter is that in both Dutch and Raaltes no velar contrast exists.

4. Discussion

Although the means of /p/ and /t/ in Raalte differ from those in Noord-Holland, they are not significantly different. This is most probably due to the small sample size of 6 participants per group. For this research I have chosen to record two times six participants, since Helgason and Ringen (2008) also used six participants in their group of Central Standard Swedish speakers. The results found suggest however that further research should be done with a larger sample size.

Interestingly, Helgason and Ringen did not compare their findings with a control group, so it is not clear whether the contrast they found significantly differs from a language in which there is no aspiration contrast. The values of voiced plosive VOT in Raalte resemble the Central Standard Swedish values, but the voiceless VOT values are somewhat lower.

Inter-participant and inter-word differences

Another explanation for not finding significant differences between the Raalte and Noord-Holland can be that the participants were not consistent in their realization of the consonants over different words, or that one or more participants did not represent the population well.

To test whether one or more words differed significantly from the rest of the words, ten one-way analyses of variance have been done, one for each consonant of each group, with word as factor. Out of the ten tests, only one significant difference was found. This difference was found between the labial plosives in Raaltes $F(5,30) = 2.736$, $p = .038$. Post-hoc analyses using Tukey's HSD indicated that the only significant difference found, was that VOT values for [pʰɑsn] were significantly more positive than for [pʰoəɹt], meaning that the latter was more aspirated ($p = .016$). No other significant differences were found for the other words (see appendix C).

To test whether one or more participants differed significantly from the rest, another one-way analysis of variance with participant as factor showed no significant differences between the participants at voiceless ($F(11,24) = 2.086$, $p = .064$) and voiced plosives ($F(11,12) = 1.564$, $p = .227$), although again, there is almost a significant difference in the voiceless plosives per participant.

/d/

A very interesting finding was that five out of twelve participants (one from Noord-Holland and four from Raalte) multiple times, and some consistently, showed something that looked like aspirated voiced plosives at words starting with /d/ (and one time /b/). All the words in which this occurred, and their VOT values, are displayed in appendix D.

Since this research was not designed to investigate this, there is not much to say about at this moment. Further research must tell what this is and how to describe it. Figure 6 shows an example of [dɪkə], where the red lines show voicing onset and the blue line shows the stop release.

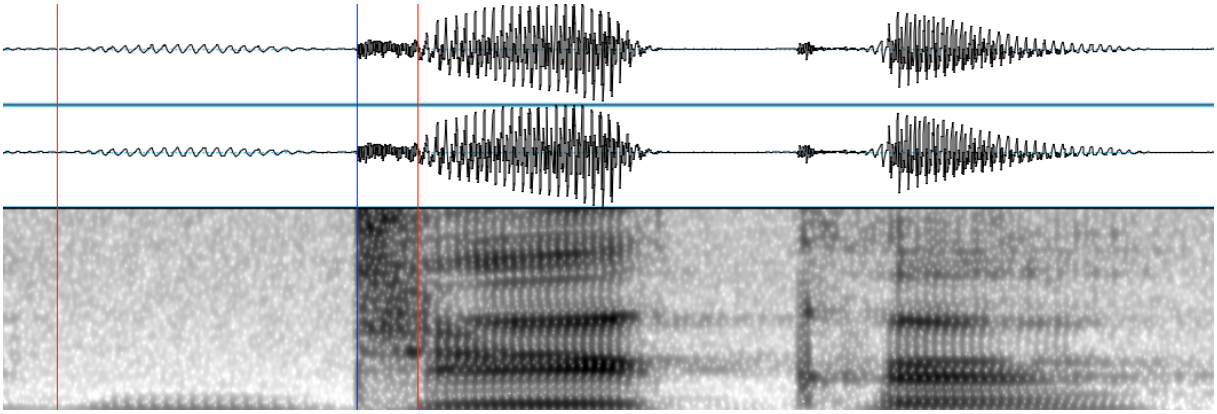


Figure 6: Example of spectogram and waveform of [dɪkə] 'fat'.

If indeed these utterances show aspirated voiced plosives, this would be extremely rare. According to Ladefoged (1971) these sounds have not yet been observed in any language, but Blust (2006) claims to have found them intervocally in Kelabit, an Austronesian language spoken on Borneo. Blust states that the segments observed in Kelabit are not clusters, but true aspirated voiced plosives. One of his reasons for this statement is that Kelabit shows a canonical form of CVCVC, which means that if the segments observed are interpreted as clusters, they would be the only clusters in the language. Typologically seen it is much more likely that these segments are aspirated voiced plosives instead of the only clusters in the language.

Pinget observed the same phenomenon during her research that included data from five different regions in the Netherlands and Flanders. She observed bilabials that started voiced but ended voiceless. At this moment she is working on a different way of measuring voicing, since she believes that VOT no longer is a reliable measure (A.C.H. Pinget, Personal communication, June 26 2014).

One should keep in mind that this research has been conducted on relatively older people, since the younger generation does not really master the dialect anymore in this region. Interesting further research would be to focus at the younger generation from these or other regions in the northeastern part of the Netherlands, where the same Dutch words would be used to analyze whether the initial plosives differ. In this case the target words would be exactly the same, and so a difference in VOT could be accredited to the existence of regional difference in realization.

5. Acknowledgements

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Appendix A: Mean VOT in milliseconds per consonant per participant.

PP	VOT./b/	VOT./d/	VOT./p/	VOT./t/	VOT./k/
1	-116.89	-121.27	26.64	76.13	52.08
2	-160.42	-106.49	15.12	36.37	46.11
3	-89.28	-64.60	17.89	26.53	34.56
4	-98.44	106.57	27.78	68.27	55.58
5	-84.00	-79.00	27.72	50.91	39.31
6	-25.54	-58.47	20.65	35.67	33.89
7	-102.60	-118.267	10.93	19.27	28.83
8	-123.10	-123.87	28.53	49.55	56.46
9	-119.47	-122.27	11.60	19.13	40.98
10	-97.20	-105.13	10.72	18.33	27.38
11	-88.40	-99.13	16.63	42.13	38.27
12	-80.40	-77.17	10.88	15.07	29.46

Appendix B: All means of words per participant.

word	PP	group	VOT in ms	word	PP	group	VOT in ms
[baːɬ]	7	1	-125.33	**[bɑsn]**	1	2	-92.33
[baːɬ]	8	1	-125.67	**[bɑsn]**	2	2	-230.00
[baːɬ]	9	1	-113.00	**[bɑsn]**	3	2	-50.67
[baːɬ]	10	1	-107.667	**[bɑsn]**	4	2	-122.00
[baːɬ]	11	1	-81.676	**[bɑsn]**	5	2	-60.00
[baːɬ]	12	1	-68.00	**[bɑsn]**	6	2	-11.33
[beinən]	7	1	-115.00	**[bijə]**	1	2	-146.33
[beinən]	8	1	-125.50	**[bijə]**	2	2	-169.33
[beinən]	9	1	-120.67	**[bijə]**	3	2	-143.00
[beinən]	10	1	-100.67	**[bijə]**	4	2	-133.67
[beinən]	11	1	-95.33	**[bijə]**	5	2	-80.67
[beinən]	12	1	-82.33	**[bijə]**	6	2	-6.00
[bit]	7	1	-92.00	**[boəɹt]**	1	2	-139.33
[bit]	8	1	-98.33	**[boəɹt]**	2	2	-103.00
[bit]	9	1	-110.00	**[boəɹt]**	3	2	-58.67
[bit]	10	1	-101.67	**[boəɹt]**	4	2	-159.00
[bit]	11	1	-102.67	**[boəɹt]**	5	2	-75.00
[bit]	12	1	-51.50	**[boəɹt]**	6	2	13.00
[bɪlən]	7	1	-85.33	**[bɔlə]**	1	2	-114.67
[bɪlən]	8	1	-116.00	**[bɔlə]**	2	2	-171.50
[bɪlən]	9	1	-126.33	**[bɔlə]**	3	2	-101.50
[bɪlən]	10	1	-114.33	**[bɔlə]**	4	2	-52.67
[bɪlən]	11	1	-74.67	**[bɔlə]**	5	2	-122.33
[bɪlən]	12	1	-103.67	**[bɔlə]**	6	2	-56.25
[bɔlən]	7	1	-95.33	**[buːk]**	1	2	-117.00
[bɔlən]	8	1	-150.00	**[buːk]**	2	2	-165.33
[bɔlən]	9	1	-127.33	**[buːk]**	3	2	-84.33
[bɔlən]	10	1	-61.67	**[buːk]**	4	2	-78.33
[bɔlən]	11	1	-87.67	**[buːk]**	5	2	-74.00
[bɔlən]	12	1	-96.50	**[buːk]**	6	2	-86.00
[dein]	7	1	-138.33	**[bʏlə]**	1	2	-91.67
[dein]	8	1	-140.00	**[bʏlə]**	2	2	-123.33
[dein]	9	1	-140.00	**[bʏlə]**	3	2	-97.50
[dein]	10	1	-93.00	**[bʏlə]**	4	2	-45.00
[dein]	11	1	-89.67	**[bʏlə]**	5	2	-92.00
[dein]	12	1	-109.33	**[bʏlə]**	6	2	-6.67
[dɛŋkən]	7	1	-119.67	**[dik]**	1	2	-84.67
[dɛŋkən]	8	1	-117.33	**[dik]**	2	2	-87.67
[dɛŋkən]	9	1	-124.00	**[dik]**	3	2	-71.00
[dɛŋkən]	10	1	-104.00	**[dik]**	4	2	-89.00
[dɛŋkən]	11	1	-72.67	**[dik]**	5	2	-95.00
[dɛŋkən]	12	1	-31.00	**[dik]**	6	2	-64.67
[dɪlə]	7	1	-117.33	**[dɪkə]**	1	2	-129.67
[dɪlə]	8	1	-122.67	**[dɪkə]**	2	2	-125.67

[dɪlə]	9	1	-134.67	**[dɪkə]**	3	2	-70.67
[dɪlə]	10	1	-113.67	**[dɪkə]**	4	2	-119.67
[dɪlə]	11	1	-127.00	**[dɪkə]**	5	2	-84.00
[dɪlə]	12	1	-121.50	**[dɪkə]**	6	2	-43.33
[dɔfə]	7	1	-95.67	**[dɔlə]**	1	2	-122.33
[dɔfə]	8	1	-111.67	**[dɔlə]**	2	2	-94.33
[dɔfə]	9	1	-110.00	**[dɔlə]**	3	2	-60.67
[dɔfə]	10	1	-117.33	**[dɔlə]**	4	2	-110.00
[dɔfə]	11	1	-98.00	**[dɔlə]**	5	2	-97.67
[dɔfə]	12	1	-56.33	**[dɔlə]**	6	2	11.33
[dɔp]	7	1	-120.33	**[dɔʁə]**	1	2	-142.00
[dɔp]	8	1	-127.67	**[dɔʁə]**	2	2	-141.00
[dɔp]	9	1	-102.67	**[dɔʁə]**	3	2	-53.00
[dɔp]	10	1	-97.67	**[dɔʁə]**	4	2	-127.50
[dɔp]	11	1	-108.33	**[dɔʁə]**	5	2	-41.00
[dɔp]	12	1	-67.67	**[dɔʁə]**	6	2	-90.33
[kaːs]	7	1	25.00	**[duːn]**	1	2	-127.67
[kaːs]	8	1	48.67	**[duːn]**	2	2	-83.80
[kaːs]	9	1	37.33	**[duːn]**	3	2	-67.67
[kaːs]	10	1	23.67	**[duːn]**	4	2	-86.67
[kaːs]	11	1	39.33	**[duːn]**	5	2	-77.33
[kaːs]	12	1	28.67	**[duːn]**	6	2	-105.33
[kɑstʲə]	7	1	33.33	**[kʰeːzə]**	1	2	54.00
[kɑstʲə]	8	1	55.67	**[kʰeːzə]**	2	2	49.33
[kɑstʲə]	9	1	45.33	**[kʰeːzə]**	3	2	42.67
[kɑstʲə]	10	1	26.33	**[kʰeːzə]**	4	2	60.33
[kɑstʲə]	11	1	40.00	**[kʰeːzə]**	5	2	43.00
[kɑstʲə]	12	1	28.67	**[kʰeːzə]**	6	2	47.00
[kouɣəɬ]	7	1	33.50	**[kʰikn]**	1	2	45.75
[kouɣəɬ]	8	1	58.00	**[kʰikn]**	2	2	48.00
[kouɣəɬ]	9	1	38.25	**[kʰikn]**	3	2	32.00
[kouɣəɬ]	10	1	30.00	**[kʰikn]**	4	2	53.75
[kouɣəɬ]	11	1	42.25	**[kʰikn]**	5	2	36.25
[kouɣəɬ]	12	1	24.50	**[kʰikn]**	6	2	25.33
[kɔɹt]	7	1	23.50	**[kʰykn]**	1	2	56.50
[kɔɹt]	8	1	63.50	**[kʰykn]**	2	2	41.00
[kɔɹt]	9	1	43.00	**[kʰykn]**	3	2	29.00
[kɔɹt]	10	1	29.50	**[kʰykn]**	4	2	52.67
[kɔɹt]	11	1	31.50	**[kʰykn]**	5	2	38.67
[kɔɹt]	12	1	36.00	**[kʰykn]**	6	2	29.33
[paːɬ]	7	1	11.67	**[pʰɑsn]**	1	2	9.50
[paːɬ]	8	1	17.33	**[pʰɑsn]**	2	2	11.43
[paːɬ]	9	1	14.33	**[pʰɑsn]**	3	2	9.67
[paːɬ]	10	1	10.67	**[pʰɑsn]**	4	2	23.00
[paːɬ]	11	1	17.50	**[pʰɑsn]**	5	2	12.00
[paːɬ]	12	1	13.33	**[pʰɑsn]**	6	2	13.67

[peinən]	7	1	8.67	**[pʰijə]**	1	2	32.33
[peinən]	8	1	31.00	**[pʰijə]**	2	2	9.67
[peinən]	9	1	11.00	**[pʰijə]**	3	2	15.00
[peinən]	10	1	9.33	**[pʰijə]**	4	2	22.33
[peinən]	11	1	13.33	**[pʰijə]**	5	2	27.67
[peinən]	12	1	11.75	**[pʰijə]**	6	2	18.75
[pit]	7	1	12.67	**[pʰoəɹt]**	1	2	27.67
[pit]	8	1	21.33	**[pʰoəɹt]**	2	2	25.00
[pit]	9	1	8.33	**[pʰoəɹt]**	3	2	21.00
[pit]	10	1	10.25	**[pʰoəɹt]**	4	2	29.00
[pit]	11	1	16.33	**[pʰoəɹt]**	5	2	60.00
[pit]	12	1	10.33	**[pʰoəɹt]**	6	2	23.80
[pɪlən]	7	1	12.00	**[pʰɔnə]**	1	2	25.00
[pɪlən]	8	1	35.00	**[pʰɔnə]**	2	2	16.50
[pɪlən]	9	1	8.67	**[pʰɔnə]**	3	2	18.00
[pɪlən]	10	1	11.00	**[pʰɔnə]**	4	2	36.33
[pɪlən]	11	1	13.33	**[pʰɔnə]**	5	2	18.67
[pɪlən]	12	1	9.00	**[pʰɔnə]**	6	2	18.67
[pɔlən]	7	1	9.67	**[pʰut]**	1	2	33.67
[pɔlən]	8	1	38.00	**[pʰut]**	2	2	11.33
[pɔlən]	9	1	15.67	**[pʰut]**	3	2	26.00
[pɔlən]	10	1	12.33	**[pʰut]**	4	2	26.67
[pɔlən]	11	1	22.67	**[pʰut]**	5	2	31.00
[pɔlən]	12	1	10.00	**[pʰut]**	6	2	29.33
[tein]	7	1	15.67	**[pʰʏtə]**	1	2	31.67
[tein]	8	1	54.00	**[pʰʏtə]**	2	2	16.80
[tein]	9	1	20.00	**[pʰʏtə]**	3	2	17.67
[tein]	10	1	21.00	**[pʰʏtə]**	4	2	29.33
[tein]	11	1	42.33	**[pʰʏtə]**	5	2	17.00
[tein]	12	1	14.00	**[pʰʏtə]**	6	2	19.67
[tɛŋkən]	7	1	7.67	**[tʰit]**	1	2	71.67
[tɛŋkən]	8	1	46.67	**[tʰit]**	2	2	37.00
[tɛŋkən]	9	1	17.00	**[tʰit]**	3	2	38.33
[tɛŋkən]	10	1	16.67	**[tʰit]**	4	2	75.33
[tɛŋkən]	11	1	31.00	**[tʰit]**	5	2	54.00
[tɛŋkən]	12	1	13.67	**[tʰit]**	6	2	42.67
[tɪlən]	7	1	22.00	**[tʰɪtə]**	1	2	74.67
[tɪlən]	8	1	64.33	**[tʰɪtə]**	2	2	31.50
[tɪlən]	9	1	23.00	**[tʰɪtə]**	3	2	31.00
[tɪlən]	10	1	24.67	**[tʰɪtə]**	4	2	77.33
[tɪlən]	11	1	44.33	**[tʰɪtə]**	5	2	58.12
[tɪlən]	12	1	20.67	**[tʰɪtə]**	6	2	40.67
[tɔfə]	7	1	26.00	**[tʰɔlə]**	1	2	76.33
[tɔfə]	8	1	40.50	**[tʰɔlə]**	2	2	36.33
[tɔfə]	9	1	19.00	**[tʰɔlə]**	3	2	19.67
[tɔfə]	10	1	17.00	**[tʰɔlə]**	4	2	69.00

[tɔfə]	11	1	39.33	**[tʰɔlə]**	5	2	52.33
[tɔfə]	12	1	15.00	**[tʰɔlə]**	6	2	27.33
[tɔp]	7	1	25.00	**[tʰɔʀə]**	1	2	93.67
[tɔp]	8	1	42.25	**[tʰɔʀə]**	2	2	30.00
[tɔp]	9	1	16.67	**[tʰɔʀə]**	3	2	20.67
[tɔp]	10	1	12.33	**[tʰɔʀə]**	4	2	63.00
[tɔp]	11	1	53.67	**[tʰɔʀə]**	5	2	43.33
[tɔp]	12	1	12.00	**[tʰɔʀə]**	6	2	25.00
				[tʰuːn]	1	2	64.33
				[tʰuːn]	2	2	47.00
				[tʰuːn]	3	2	23.00
				[tʰuːn]	4	2	56.67
				[tʰuːn]	5	2	46.67
				[tʰuːn]	6	2	42.67

Appendix C: Results of Analysis of variance of the words per group:

Noord-Holland /p/: $F(4,25) = 0.325$, $p = .859$
Noord-Holland /t/: $F(4,25) = 0.391$, $p = .813$
Noord-Holland /k/: $F(3,20) = 0.198$, $p = .903$
Noord-Holland /b/: $F(4,25) = 0.321$, $p = .861$
Noord-Holland /d/: $F(4,25) = 1.594$, $p = .207$

Raalte /p/: $F(5,30) = 2.736$, $p = .038$, Tukey's HSD: [pʰoəɹt] - [pʰɑsn] $p = .016$
Raalte /t/: $F(4,25) = 0.158$, $p = .957$
Raalte /k/: $F(2,15) = 1.557$, $p = .243$
Raalte /b/: $F(5,30) = 0.335$, $p = .888$
Raalte /d/: $F(4,25) = 0.362$, $p = .833$

Appendix D: Values in milliseconds of all 'aspirated voiced plosives'.

Word	VOT1	VOT2	PP	Group
[bɪlən]	-82,0	48,0	11	Raalte
[dein]	-77,0	14,0	11	Raalte
[dein]	-102,0	25,0	11	Raalte
[dein]	-92,0	14,0	12	NH
[dein]	-114,0	16,0	12	NH
[dɛŋkən]	-114,0	7,0	8	Raalte
[dɛŋkən]	-54,0	10,0	11	Raalte
[dɛŋkən]	-60,0	27,0	11	Raalte
[dik]	-46,0	12,0	1	Raalte
[dɪkə]	-118,0	17,0	1	Raalte
[dɪkə]	-139,0	28,0	1	Raalte
[dɪkə]	-132,0	50,0	1	Raalte
[dɪkə]	-80,0	17,0	6	Raalte
[dɪlə]	-137,0	21,0	11	Raalte
[dɪlə]	-110,0	23,0	11	Raalte
[dɪlə]	-134,0	25,0	11	Raalte
[dɪlə]	-132,0	11,0	12	NH
[dɪlə]	-111,0	17,0	12	NH
[dɔfə]	-76,0	8,0	8	Raalte
[dɔfə]	-154,0	22,0	8	Raalte
[dɔfə]	-105,0	22,0	8	Raalte
[dɔfə]	-99,0	16,0	11	Raalte
[dɔfə]	-102,0	18,0	11	Raalte
[dɔfə]	-93,0	18,0	11	Raalte
[dɔfə]	-54,0	15,0	12	NH
[dɔfə]	-59,0	23,0	12	NH
[dɔlə]	-121,0	21,0	1	Raalte
[dɔp]	-91,0	17,0	8	Raalte
[dɔp]	-158,0	19,0	8	Raalte
[dɔp]	-106,0	8,0	11	Raalte
[dɔp]	-119,0	15,0	11	Raalte
[dɔp]	-100,0	24,0	11	Raalte
[dɔp]	-66,0	15,0	12	NH
[dɔʀə]	-121,0	13,0	1	Raalte
[dɔʀə]	-167,0	18,0	6	Raalte
[duːn]	-141,0	7,0	1	Raalte