Swedish Diphthongs

A study on the occurrence of diphthongisation in three varieties of Swedish

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Abstract

The following study focuses on diphthongisation in the Swedish varieties of Lund, Linköping and Stockholm, as most knowledge on diphthongisation in Swedish is restricted to standard Swedish (Elert 1966, Bleckert 1987). It provides an analysis of a sentence reading task performed by 24 native Swedish speakers (eight from each city) and shows the results through separate vowel charts for the respective cities. High vowels /i:/, /y:/, /ʉ:/ and /u:/ seem to only marginally glide, if at all. For /e:/, clear diphthongisation of centralising nature is visible in all three varieties. For /o:/ in Stockholm Swedish, a similar centralisation is found, though none is found in Linköping and the reverse is found in Lund Swedish. /ɛ:/, /ø:/ and /ɑ:/ do not diphthongise, but /ɛ:/ and /ø:/ are realised strikingly low in all three varieties. This was the incentive for the proposal of a new vowel chart for Swedish, where /ɛ:/, /ø:/ are significantly lower and transribed as /æ:/ and /œ:/ instead. Phonological context appears to have only little or no influence on the diphthongisation process. Additionally, the study further elaborates on the idea that vowel quality in Swedish has become an increasingly important factor in determining the meaning of a word (Elert 1966), as the contrast between long and short consonants in many Swedish dialects is merely marginal (Schaeffler 2005). Low consonant ratios and relatively low vowel ratios were also found for the three varieties included in this study, and these ratios are thus seen as a possible explanation for diphthongisation in Swedish.

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III. THE RESULTS & CONCLUSIONS

1. Introduction

When opening an overview of the Swedish vowel system, such as the fairly recent work by Riad (2013), you will be presented nine long and eight short vowels, all of which are assumed to be monophthongs. Even though it is not often challenged that this is indeed true for the underlying, phonological form, questions have been raised about the true realisation of these vowels, especially the nine long vowels. This issue has been addressed a number of times, but is nowadays often left to a small paragraph, complementing a larger study focusing on a different aspect of the Swedish vowel system, of which Kuronen (2000) and Eklund & Traunmüller (1996) are some examples. Bleckert (1987) devoted his dissertation to the topic, but did not stretch beyond the varieties of Södermanland, which are believed to be closest to standard Swedish (Swedish: *rikssvenska*).

In this study I will attempt to broaden the language sample and focus on three different Swedish varieties, which are all known for their specific features. These are the varieties from Stockholm, Linköping and Lund. The pivot of this paper will be the phonetic analysis of the long vowels and the following consonants in these three varieties. This I will use to first describe the nature of the long vowels in the different varieties, as it is necessary to fundamentally establish whether the varieties indeed show their long vowels to be realised as diphthongs, and if so, in what manner. Based on previous literature by Bruce (1970, 2010), I expect to conclude that all three varieties show diphthongisation, though possibly in different fashions, demonstrating that diphthongisation is not restricted to Södermanland and standard Swedish.

Subsequently I will attempt to find an explanation for the occurrence of these diphthongs, searching elsewhere than the previous attempts relying on prosody and stress (e.g. Bleckert 1987). For this I also include the analysis of the consonant following the vowel. The contrast in length in Swedish is important for both vowels and consonants, as these are crucial in conveying the right meaning of the word. For example, *glas* /glɑːs/ (’glass’) means something entirely different than *glass* /glasː/ (’ice cream’), and could lead to amusing situations when talking about *glasögon* (’spectacles’, litt: ’glass eyes’). This is true for all varieties of Swedish. The reason for the occurrence of these diphthongs could possibly lie in just these contrasts. Schaeffler (2005) discusses consonant and vowel length in a number of different Swedish varieties, and distills these to four clusters, showing that especially varieties in the middle of Sweden show shortening of the long consonants. With the distinction between long and short consonants disappearing, the contrast in vowel length becomes increasingly important. Diphthongisation of the long vowels might thus be a new way of enhancing this distinction.

First, this paper will give the theoretical context needed to further comprehend the phenomenon of diphthongisation and how this is a well-known occurrence in the Germanic languages, followed by an introduction of the three varieties researched. Second, I will explain the conduct of the experiment. The last part of this thesis will present the results and draw a conclusion, followed by a discussion.

2. Motivation & relevance

The subject of diphthongisation in Swedish first came to mind about half a year after I had begun following courses in Swedish language acquisition. Simultaneously, I was taught about phonetics and phonology, which sparked my interest and caused me to apply it to the language I had newly acquired. Most stood out the realisation of /e:/ and /o:/, which I did not perceive to be completely monophthongal. When looking this up, I came across a number of studies showing that my perception had likely been right. However, most studies were limited to standard Swedish (Bleckert 1987), with the exception of a number of studies on Swedish spoken in Finland (Kuronen 2000) and Scanian varieties (Bruce 1970), showing very different patterns. I believed that diphthongisation was not limited to the very area just south of Stockholm, but instead was widespread across the country. This idea was reinforced during my term in Lund, in the south of Sweden, when even there I came across locals seemingly diphthongising their /e:/s and /o:/s in a similar fashion to standard Swedish.

This study bears relevance as it further broadens the knowledge on the phenomenon of diphthongisation in the Swedish language, expanding its dataset beyond the central areas of Sweden to the capital of Stockholm, East Götaland and Scania. Thus it will hopefully reinforce the notion that diphthongisation is something inherent to most Swedish varieties and not merely restricted to the standard variety.

PART I: THE THEORY

3. Diphthongs & varieties

Before preceeding to the discription and analysis of the vowels of the three different Swedish varieties, it is necessary to clarify a number of terms and present some background information, starting with *diphthongs* and the Swedish phoneme inventory (§3.1), and the terms and occurrence of diphthongisation and centralisation (§3.2). Afterward, in §3.3, we will take a closer look at the varieties of Stockholm, Linköping and Lund in particular. It will be explained why just these varieties were chosen, what makes them unique and where they stand in the landscape of the Swedish language. Afterward, §3.3 will further discuss Schaeffler's (2005) writings on consonant and vowel length in Swedish, as well as investigate other possible explanations to the occurrence of diphthongisation of long Swedish vowels.

3.1. Diphthongs and the Swedish phoneme inventory

The term diphthong describes the fluent combination of two vowels. This entails that the diphthong starts out sounding as one vowel and fluently transfers into the other (Baker, Don & Hengeveld 2013), thus shifting from a simple nucleus to a complex nucleus. For a number of languages, these diphthongs are an important part of the phoneme inventory. Diphthongs are very prevalent in the Germanic languages. Dutch, for example, has the three diphthongs /ɛi/, /œy/ and /ɑu/ (excluding glides) (Booij 1995: 18-19), which can all be essential in distinguishing the meaning of one word from the other. Both the British and American English phoneme inventories, too, contain a number of diphthongs, including amongst others sounds such as /aʊ/ and /eɪ/ (Ladefoged 2001: 28-30). As a matter of fact, Swedish seems to be one of the odd ones out when it comes to the Germanic languages, as it is the only bigger Germanic language, together with Danish, that does not seem to have any diphthongs in its phoneme inventory (Basbøll 2005). Even its direct neighbour, Norwegian, and its further relatives Icelandic and Faroese all contain a number of diphthongs (Kristoffersen 2000; Árnason 2011).

The Swedish language, however, is said to have lost its diphthongs at an earlier stage, during the development from Old Norse to Early Modern Norse in a period which is also called the syncope period (Schulte 2005: 1082; Riad 1992: 151). Instead of featuring a number of diphthongs, the Swedish language favours differences in vowel duration. There are, however, some disagreements on the correct representation of the Swedish vowel system. One system favours the approach of a phoneme inventory containing just nine vowels, assuming a variety of absolute neutralisation (Riad 2013: 31ff.; Hellberg 1971; Linell 1973). These nine vowels (/i/, /y/, /ʉ/, /u/, /e/, /o/, /ɛ/, /ø/ and /ɑ/) are then said to have long and short allophones, which occur based on their phonological environment, and stress. If, for example, the vowel is followed by a short consonant, the lengthened allophone of the vowel will appear and vice versa. Although this is a good explanation for the occurrence of certain different, more deviating allophones triggered by consonants such as /r/ or a retroflex, this explanation does not seem to cover as to why the vowel allophone is dependent on the consonant and the stress, and not the other way around.

This paper will however not further discuss the correctness of this theory on the Swedish vowel system, but for the sake of simplicity, will keep to Engstrand's (1999: 140-142) model of the Swedish vowel system. He proposes a model in which the Swedish vowel system contains seventeen vowels, of which nine are long and eight are short. These long and short vowels are often seen as pairs, which could possibly be one of the reasons that the earlier theory proposes them to be allophones. The reason for the presence of only eight short vowels in contrast to nine long vowels, can be found in that the short counterpart of both /e:/ and /ɛ:/ is /ɛ/. Historically, /e:/ and /ɛ:/ both had their own, different short counterpart, but the two have become the same over time. Even though this system might seem to be more complex, it actually provides a clearer overview, as the allophones of the short vowels and long vowels are now separated. This creates a system where a phone phoneme usually has a maximum of two allophones, whereas for Riad's (2013) theory, a phoneme can have as many as four allophones. The standard Swedish vowel system according to Engstrand is shown below in figure 3.1.

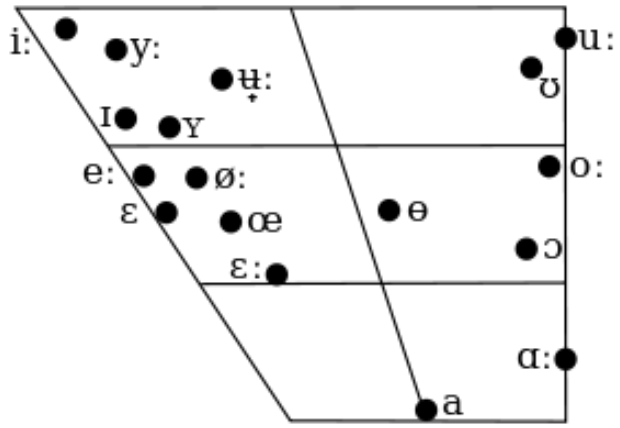

Figure 3.1. Standard Swedish vowel phoneme system, Engstrand (1999: 140).

Different Swedish varieties, however, do contain diphthongs. Elfdalian, for example, has two secondary diphthongs /aj:/ and /aw:/ (Sapir 2006). The phoneme inventory of the varieties of Linköping, Lund and Stockholm will be further dicussed in §3.3.

Lastly, I am aware of the fact that a small number of words in the standard Swedish vocabulary do contain diphthongs. These are, however, irrelevant to this paper, as all of them occur almost exclusively in loanwords (e.g. *paus, reuma*), have very marginal distribution, and are not consistently realised as diphthongs (Riad 2013: 39)[1].

3.2. Diphthongisation and centralisation in Swedish

Diphthongisation, in contrast to the term diphthong, is used to describe the process of a monophthong, a simple syllabic nucleus, changing into a diphthong, a complex syllabic nucleus (Trask 1996: 114). This process is also referred to as vowel breaking, which is a

[1] There is no consensus on the pronunciation of the written diphthongs <au>, <eu> and <ou> and dictionaries too give different possible pronunciations, making their status withing the Swedish phoneme vowel system very unclear.

[2] Even though the Scandinavian languages were also subject to a great vowel shift similar to that in Old-English (Riad 2013), this did not result in diphthongs.

broader term that also includes the possible change to a triphthong. The context triggering diphthongisation can vary strongly from assimilation to following sounds, to it being the result of a greater vowel shift, such as the case of Old-English (Howell 1991)[2]. It can manifest itself in different ways, including centralisation and glides.

The idea of diphthongisation and/or centralisation in Swedish is not new. In as early as 1869, Upmark noted what he called an *efterslag* or, roughly translated, 'after stop' or 'after hit'. This he used to describe the schwa-like sound he claimed to hear after all long vowels in Swedish. He, however, did not have the equipment to solidify his claim and his work did not expand any further than observations. In the early nineteen-hundreds, Ericsson (1914) and Gjerdman (1918) continued research on the topic. Ericsson challenged the notion that all long vowels diphthongised, and claimed this was predominantly restricted to /eː/, /oː/, /ɛː/ and /øː/, paving the way for the idea that the mid and mid-high vowel diphthongisation was of a centralising nature, and that the high vowel diphthongisation resulted in glides. Gjerdman, too found the vowels /eː/, /oː/, /ɛː/ and /øː/ to be most diphthongised and, interestingly, noted that younger participants tend to diphthongise more severely than older participants.

Elert (1966) attempts to simplify the model of Swedish diphthongisation by stating that all mid and mid-high vowels head into the direction of [ə], indicating that these vowels centralise. For the closed high vowels /iː/, /yː/, /ʉː/ and /uː/, he adopts the transcriptions [iːjᵊ], [yːɥᵊ], [ʉːβᵊ] and [uːβᵊ] respectively. /ɑː/ and /æː/[3] he says are the only long vowels which are not diphthongised.

When it comes to the qualitative formant changes in the long vowels, Bleckert found /iː/, /eː/, /oː/, /uː/ and /ɛː/ to be most diphthongised (1987: 170-174), though only in certain towns and cities in central Sweden. Considering the earlier division made by Gjerdman, which was also supported by Bleckert in the theoretical framework of his study (p. 12-22), it is interesting that precisely these vowels seem to diphthongise. Most striking is the exclusion of the vowel /øː/, which was not included since it appeared to be quite monophthongal in almost all varieties. /uː/ appeared to have gliding qualities towards the end.

In later works, diphthongisation is often addressed in paragraphs which are a part of a bigger study (e.g. Kuronen 2000; Riad 2013). Eklund & Traunmüller's findings (1996: 11) contradict Bleckert's earlier study, in the idea that it was in particular /eː/, /oː/ and /øː/ that showed pronounced movement of the first formant (F_1) and the second formant (F_2), in this case excluding /ɛː/. They too mention that the high vowels, especially /ʉː/ and /uː/, are diphthongised, although not in the same style. Whilst discussing their findings, they disagree with Elert (1966), arguing that the idea of all mid and mid-high vowels shifting towards [ə] is an over-simplification. Instead, they find the mid and mid-high vowels to change into the direction of much more open quality.

Summarising this brief history of findings, we can say that there seem to be three categories of diphthongisation present in Swedish: (1) high vowels /iː/, /yː/, /ʉː/ and /uː/ seem to move in the direction of a glide, (2) mid-high and mid vowels /eː/, /oː/ /ɛː/ and /øː/ seem to either centralise or head towards a more open quality, though it is unsure as to what extent this applies to /ɛː/ and /øː/, and (3) low vowels /ɑː/ and /æː/ seem to always be monophthongs.

[2] Even though the Scandinavian languages were also subject to a great vowel shift similar to that in Old-English (Riad 2013), this did not result in diphthongs.

[3] /æː/ only occurs as an allophone of /ɛː/ before /r/. This wil be addressed in more detail in §3.3.3 and §4.2.

However, since we are including a south Swedish variety in our sample, it is necessary to add another dimension to the varieties of diphthongisation. Bruce (1970) presents the distinction between (1) diphthongs that start with the diphthongal element, and (2) diphthongs that end in the diphthongal element. This diphthongal element can take many forms, for example [ə] or a glide. The first type is present in many south Swedish varieties, such as the Malmö variety. The latter occurs in most central and north Swedish varieties, including the varieties of Stockholm and Linköping. Kuronen (2000: 36) adds to this idea with a figure displaying the realisation of /e:/ for a speaker of a middle Swedish varieties and /u:/ for a speaker of a south-Swedish varieties. The figure shows the F_1 and F_2 at 50ms, 100ms and 200ms after the vowel's onset. For /e:/ in Nyköping Swedish the diphthongal element finds itself at the end of the vowel in the from of [ə]. For /u:/ in Kristianstad Swedish it is the first part of the vowel that starts out as [ə], then shifting to [u].

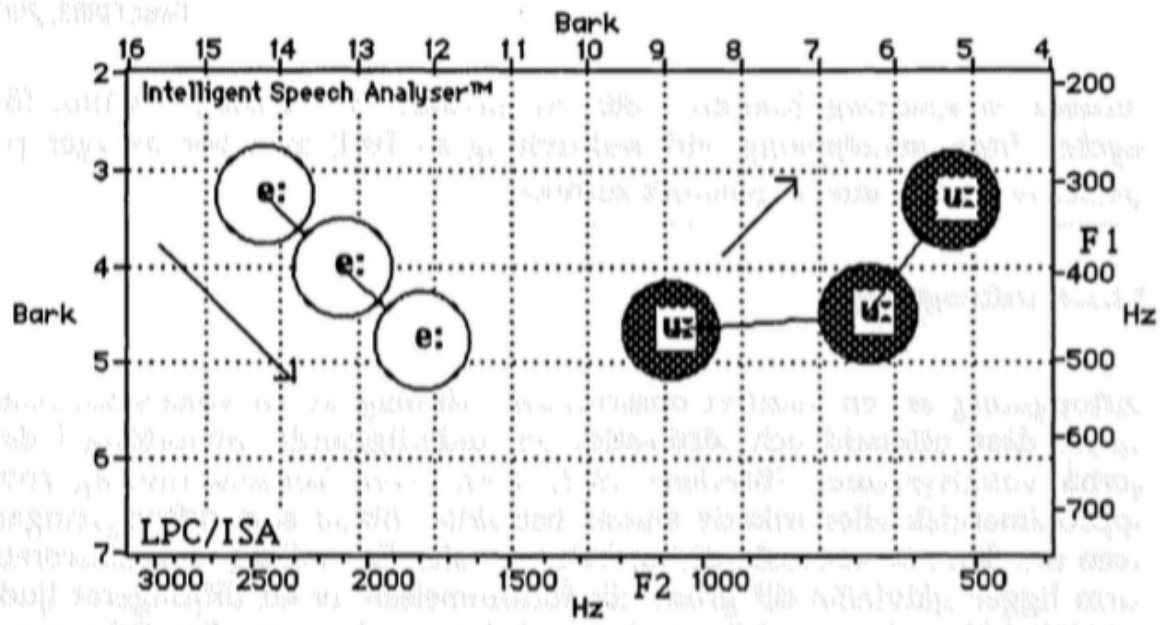

Figure 3.2. Middle-Swedish /ke:lar/ and south-Swedish /bu:/ by a speaker from Nyköping and Kristianstad respectively, Kuronen (2000: 36).

3.3. The varieties of Lund, Linköping & Stockholm

All three varieties included in the experiment will now be discussed briefly. Since the participants in this study were on avarage 24.08 (*SD*: 2.59) years old (further specifics can be found in §6.1), the following paragraph will focus on the dialectal characteristics associated with or originating from the younger generation where possible. Also, the focus will lie on charactaristics that are relevant to this study, not including irrelevant facts.

3.3.1. Lund

Diphthongisation is a general characteristic for most of the Scanian varieties, but is especially present in the varieties of south and west Scania (Bruce 2010: 121-124). All vowels seem to show some form of diphtongisation, though certain vowels more than others. For a description of the manner of diphthongisation in Scanian, we have to go back to the two types of diphthongisation introduced at the end of §3.2 by Bruce (1970). The diphthongs in the south and west Scanian varieties work according to type (1), meaning that the first part of the vowel becomes diphtongised, in this case being a schwa-like sound. However, Bruce notes that the first part of the diphthong is not usually realised as [ə], but as a sound slightly closer in characteristics to the following. For example, /i:/ becomes [e͡i] and /y:/ becomes [ø͡y]. However, back vowels /u:/, /o:/ and /ɑ:/, start remarkably far to the front of the mouth, making this one of the most distinctive aspects of the south and west Scanian varieties. The following figure 3.3 shows a complete overview of the Scanian diphthongs.

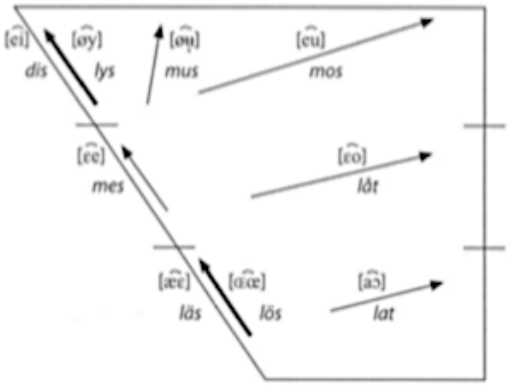

Figure 3.3. Diphthongs in south and west Scanian varieties. Bruce (2010: 122)

Even though Scanian seems less affected by the influence of standard Swedish, younger generations do tend to shift their speech more towards standard Swedish (Bruce 2000: 2013). It will be interesting to see if for example /o:/ diphthongises in Lund Swedish, and whether it manifests itself as a diphthong from front to back, or centralising as seen in standard Swedish.

3.3.2. Linköping

In the study by Bleckert (1987) that was discussed earlier, the author presents a map of central Sweden on which Linköping is included (p. 147). For this map, Bleckert has created a scale with three levels: (1) places where diphthongisation is frequent, (2) places where diphthongisation is less frequent and (3) places where the long vowels are essentially monophthongal. On his scale, Linköping is classified as a variety on level 3.

Bruce (2010: 194) argues differently, stating that the varieties of East Götaland are characterised by glides for the high, closed vowels and a shift from closed to open for /e:/ and /o:/. /ø/ seems to be open, but not diphthongised.

Even more than the Scanian varieties of Swedish, the varieties of East Götaland are both heavily influenced by and under pressure of the standard variety of Swedish, thus it would be no surprise to find diphthongisation patterns similar to those in standard Swedish.

3.3.3. Stockholm

The Stockholm variety belongs to the group of varieties that is said to be closest to what is perceived as standard-Swedish (Bruce 2010: 198). However, even within this cluster of varieties that are often referred to as *Sveamål*, the Stockholm accent has its own distinctive features.

For many Swedes, the Stockholm accent is characterised by the realisation of /ɛ:/ as [e:] in words such as *äta* ('to eat') and *väg* ('way') (Bruce 2010: 201). However, this accent, which has often been attributed to the former working class, has started disappearing over the years and has mostly restricted itself to speakers over fourty years of age. The speech of the youngsters in Stockholm is defined by quite the opposite array of sounds. Instead of raising the realisation of /ɛ:/ to [e:], it is lowered to [æ:] (Kotsinas 2004). Even though this also occurs in standard Swedish and varieties in the middle and north of the country before /r/, it is characteristic for the younger Stockholm variety to lower /ɛ:/ and /ø:/ in all phonological contexts[4]. If results would later show that /ø:/ is centralised, then one would expect to find a fall in the F1 instead of a rise, considering that /ø:/ is realised as [œ:] in Stockholm Swedish. Additionally, /ɑ:/ is often rounded, pushing its realisation close to [ɒ:] (Bruce 2010: 200).

Another relatively recent phenomenon is the so-called *Lidingö-i*, named after the island of Lidingö where it presumably got popularised by the elite youth[5]. This Lidingö-i entails a buzz to the front vowels /i:/ and /y:/, causing them to sound more like [i:^{z}] and [y:^{z}] respectively (Riad 2013: 7). Björsten & Engstrand (1999: 1957) noted that the realisation of /i:/ and /y:/ is much more centralised and even showed that there was little or no difference between the realisations of /i:/ and /y:/. Over the last years, the Lidingö-i has spread through Stockholm and recently even beyond the city's borders, losing its social charge. There seems to be no data on whether the Lidingö-i is subject to diphthongisation.

Stockholm, too, was included in the map by Bleckert (1987: 147). In similar fashion to Linköping, the variety was said to have predominantly monophthongal long vowels. This, however, is a questionable statement, since both Kuronen (2000) and Riad (2013) argued that centralisation was spread widely amongst the central Swedish varieties and Bruce (2010: 201) describes centralisation as a phenomenon which is 'not seldom' present in the Stockholm variety of Swedish.

[4] Even though /ɛ:/ and /ø:/ are consistently realised lower in Stockholm Swedish, it is argued that there remains a difference between /ɛ:/ and /ø:/ before /r/ and /ɛ:/ and /ø:/ in other phonological contexts. When appearing before /r/, /ɛ:/ and /ø:/ could be realised as low as [a:] and [œ:] respectively (Riad 2013).

[5] Lidingö is not the only place in Sweden where this dental [i:] seems to surface. It is also often referred to as the *Viby-i*, after the small town of Viby in the province of Närke. The buzzing /y:/ sound is subsequently referred to as *Viby-y*. A recent theory addressing as to why this phenomenon also appeared on Lidingö in Stockholm, reasons that, since Lidingö was known to be home to the Swedish upper class, its residents would frequently vacation close to the seaside town of Viby. The buzzing pronunciation of [i:] and [y:] would thus have become their status marker, showing that they can afford a regular holiday to the coast (Lindström 2014).

3.4. The reason for the diphthongisation of long Swedish vowels

3.4.1. Earlier explanations

Gjerdman (1918) attempted to find his explanation for diphthongisation in Swedish in the earlier stages of the language and reverted back to Old Norse. He examined the long vowels that had replaced earlier /ɛi/, /øy/ and /au/ and compared them to others to uncover whether it was precisely these long vowels that diphthongised most. He found diphthongisation in the realisation of Swedish *ben* which comes from Old-Norse *bein* (both mean 'leg'), confirming that long /e:/ which had previously been /ɛi/, indeed diphthongised. However, when examining the Swedish word *medveten* ('aware'), it showed that both /e:/s here diphthongised, too, whilst only the latter had been a diphthong in a previous stage. Also, the diphthongs /øy/ and /au/ which had both become /ø:/ did not seem to diphthongise to a similar extent. Thus, Gjerdman realised that diphthongisation in modern Swedish was much more widespread and not restricted or speficically connected to the three long vowels that had replaced /ɛi/, /øy/ and /au/.

It was not before 1970 that Bleckert published a more elaborate study on his ideas about the nature of Swedish diphthongisation, presenting it in the light of a sentence-phonetic problem. His attempt to describe dipthongisation in both the domains of the phrase/sentence and the vowel/syllable results in a theory based on the functional stress gesture and hyperarticulation. In combination with the falling curve in energy in declarative sentences in Swedish, this functional stress gesture would cause a short moment of relaxation after greater effort at the beginning of the vowel, which, according to Bleckert, is what causes the diphthongisation. To that should be added that the more stressed a vowel is, the earlier it diphthongises.

3.4.2. The importance of the vowel

Schaeffler (2005) makes a very interesting point regarding the duration of vowels in the different varieties of Swedish. As mentioned in the introduction, the nucleus and coda of Swedish can usually only follow two structures, namely V:/C or V/C:, which is crucial in determining the word's meaning. The analysis of 86 Swedish varieties brought him to the construction of a map, showing four different regional clusters spread over the Swedish sprachraum based on these durations of vowels and consonants. One regional cluster lies in Finland, characterised by extremely high vowel and consonant ratios of almost 2.0, meaning that the long vowel or consonant is nearly twice as long as its short counterpart. Another regional cluster lies in the north of Sweden and is also characterised by long consonant ratios, though not nearly as long as for the varieties in Finland. The third and fourth regional clusters are especially interesting to this study, as they include all three varieties in the sample. The two remaining clusters – cluster one and two in Schaeffler's paper – are located in the middle and south of Sweden and are charactarised by a very low consonant ratio, meaning that the long and short consonants often have the same duration.

What this tells us, is that the vowel is becoming an increasingly important factor in the process of determining the meaning of word. In this scenario, either one of the following could be a plausible consequence to this merge of the long and short consonants: (1) the contrast in duration for vowels becomes more extreme, creating a situation where the meaning

of the word can still easily be deduced from the duration of the vowel, or (2) the quality of the vowels changes in such a manner that the long vowels are more clearly distinguished from their shorter counterparts. However, a number of notes have to be added to both situations.

Although lengthening of the long vowel and thus creating a higher long-to-short vowel ratio could indeed be a way to distinguish the long from the short vowels, there is no reason to believe this is happening yet. What actually seems to be happening is that for the regional clusters that have a low consonant ratio (clusters 1&2), the vowel ratio also seems to be relatively low. This indicates that the lack in contrast between long and short consonants is not resolved by a larger contrast in long and short vowels. Figure 3.3 presents the vowel and consonant ratios for the four regional clusters according to Schaeffler (2005).

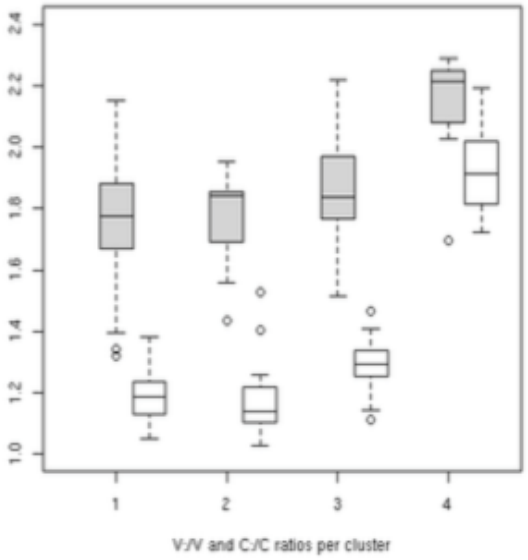

Figure 3.3. V:/V and C:/C ratios per regional cluster.
Grey: vowel ratios, white: consonant ratios. Schaeffler (2005:3).

Since it seems unlikely that it is indeed the first consequence that is the reaction to the low consonant ratios, we will have to further look at the second possible consequence presented. Of course, there is already a difference in quality present for most long-short vowel pairs, with the exception of /ɛ:/ and /ɛ/. However, if we revert to the vowel chart by Engstrand (1999) presented in §3.1, short /ɛ/ is actually located much closer to /e:/, meaning that we cannot really rely on the use of IPA for determining the distance between sounds in Swedish. The vowel chart also shows that long /u:/ and short /ʊ/ and long /y:/ and short /ʏ/ are very close together. For short /ɵ/ Riad (2013) even argues that it is often realised as [ʉ̟], also bringing /ɵ/ and /ʉ/ much closer together. If it is not duration that can clearly enough distinguish between the long and short vowels, quality might be the answer instead. Since many long and short vowels are relatively close to each other, diphthongisation could be an additional way to further differentiate between long and short vowels.

Elert (1964: 39-42) lightly touches this idea when considering the notations of the Swedish contrasts in duration. In his example of *vit* (’white’ UTRUM) versus *vitt* (’white’ NEUTRUM), he shows that one possible transcription would be /vijt/ versus /vit/, showing that the difference in meaning cannot be traced from the consonant or vowel duration, but instead from the

vowel quality, for which in this case the author chooses the transcription /ij/ for long /i:/. Elert sees expressing distinction by vowel quality as a very adequate possibility, and even underlines that the influence of consonant length is so marginal that one should only look at the preceding vowel. He rejects the previous notation of /vi:t/ as /vijt/ based on the idea that this would not suffice as an equal notation of all long vowels, as the diphthongisation or glide in the second half of the vowel would only occur in high or mid vowels.

Since all three varieties included in this study, according to Schaeffler (2005), should have a very low consonant ratio and a relatively low vowel ratio, one would expect the vowel quality to be of great importance, thus creating a perfect context for diphthongisation. For this reason, the vowel and consonant ratios will be measured for each of the varieties.

PART II: THE EXPERIMENT

4. The design

4.1. Sentence reading task

In order to compose an accurate representation of the realisation of the Swedish long vowels, we use a simple sentence reading task. This type of task provides much freedom to modify the phonological environment of the long vowel and thus allowes one to include possibly influencing factors. A sentence reading task was preferred over reading a word list, as it would more likely avoid the participant reading in a summarising rhythm. Since diphthongisation is thought to be more pronounced in a stressed position (Eklund & Traunmüller 1996: 16), the idea was to construct the sentences in a manner that would stress the target vowel. By using short carrier sentences with a word containing the long target vowel, at the end, the stress of the sentence could be regulated and directed to the last word. The ability to control the phonological environment of the long vowel was the reason why a sentence reading task was chosen over analysing fluent speech, as this would complicate collecting an even frequency and variety of vowels and their phonological environments. A drawback of the sentence reading task could be that it could still cause the participant to read in a repetitive, summarising rhythm, though less than when just reading words. Reading a short story including all the long vowels in different phonological contexts would avoid this, but would simultaneously attract a whole different array of intonations and stress.

4.2. Measuring duration and formants

All nine long vowels in Swedish were measured eight times per person. All eight times the long vowel found itself in a different phonological environment, since these are said to possibly influence the preceding vowel. Two factors concerning the consonant following the target vowel were included in this study.

First, the voicing of the consonant following the long vowel can influence the degree of diphthongisation. Since a vowel is usually longer when preceding a voiced consonant, it has more time to diphthongise (Lehiste & Peterson 1961). In addition to this, the transition in frequency value from the vowel to consonant is larger. This influence of voicedness on the level of diphthongisation in the preceding vowel was taken into account by counterbalancing the design in a manner that every vowel was equally often presented followed by a voiced consonant, as it was by a voiceless consonant.

Second, the place of articulation can also encourage the diphthongisation of the preceding vowel. This is particularly the case for alveolar consonants (Lehiste & Peterson 1961). This too was counterbalanced. It has to be noted, however, that the earlier mentioned consonant /r/ was excluded from the sample, since /r/ is part of the phoneme inventory of middle and northern varieties of Swedish and it is known that this consonant in particular affects the vowels /ɛ:/ and /ø:/, causing them to lower to /æ:/ and /œ:/ (Riad 2013: 10, 16). Including the phoneme /r/ in the position following the long vowel would thus skew the image we are attempting to compose.

Third, all nine long vowels in Swedish were presented in two syllabic contexts: (1) the long target vowel appears in the penultimate syllable, and (2) the long target vowel appears in the last syllable. This was designed as such since vowels tend to have a longer duration when appearing in the last syllable of a word.

In order to measure the duration of the long consonants and short vowels to later calculate the consonant and vowel ratios, words with short vowels and long consonants (V/C:) were also included.

5. Materials

5.1. Sentences, target word and target vowel

As mentioned earlier, participants were presented with a carrier sentence including a target word. The target word contained the target vowel. §4.2 presented all features that would be counterbalanced, namely (1) vowel length, (2) voicedness of the following consonant, (3) whether the following consonant was alveolar or not and (4) the position of the syllable containing the target vowel. Considering those features, a table was created for all long vowels, which was designed in such a manner that all combinations of the four features were included. The following table is the table for the vowel <a>. The abbreviations [l+/-], [v+/-] and [a+/-] stand for length, voice and alveolar respectively. The left column presents a disyllabic target word, the right a monosyllabic target word. The tables for the other vowels can be found in appendix 1.

Table 5.1. Stimuli table for vowel <a>.

<a>	**disyllabic**	**monosyllabic**
v+a+l+	bada	blad
v-a+l+	prata	lat
v+a-l+	klaga	krav
v-a-l+	baka	smak
v+a+l-	stanna	man
v-a+l-	fatta	platt
v+a-l-	damma	lamm
v-a-l-	backa	lapp

Since /e:/ and /ɛ:/ both have the short counterpart /ɛ/, only one set of eight words was contructed for /ɛ/. The choice of words with spelling <e> or <ä> for /ɛ/ was made based on the words that were deemed most fit for the carrier sentences. The short vowels were always followed only by a geminate for monosyllabic words, and a geminate + [a] for disyllabic words, as seen in table 5.1. Two short vowels, however, proved to be problematic.

First, /œ/ proved to be an issue in regard to the principle that all short vowels in the material would be followed only by a geminate or geminate + [a]. Some feature combinations made it impossible to find a word containing a short vowel followed only by a geminate that was not incredibly infrequent or plainly peculiar, meaning that for the feature combinations [v+a+l-], [v-a+l-] and [v-a-l-] the words *dölja, tröttna* and *öppna* were used respectively.

Second, /ʊ/ (grapheme <o>) brought up even more issues, as it attested to be highly infrequent. Nearly all possible target words contained a combination where /ʊ/ was followed by either /t:/ (in past participles of verbs), /d:/ (in the utrum form of supina), /r/ (often in conjugated verbs) or a retroflex (always a combination of /r/ + alveolar consonant). Since, first of all, all these consonant phonemes with the exception of /ʈ/ are voiced, all cells containing the features [v-] and [l-] except for one would be left blank. Both /r/ and the retroflexes could not be included for the influential reasons of /r/ on preceding vowels mentioned earlier in §4.2 and in addition to this, /t:/ and /d:/ are both alveolar, meaning all cells containing [a-] and [l-] would also be left empty. Since a set of three out of eight was not

deemed adequate, /ʊ/ was left out of this study. For the spelling of /ɔ/, a solution in similar fashion to that for /ɛ/ was used, as /ɔ/ can be spelt as both <o> and <å>.

For bisyllabic words, infinitives were used, as these were easy to position last in short carrier sentences. For monosyllabic words nouns or adjectives were opted for, the only exception being *föll* in the table for <ö>. Nouns and verbs stemming from the same root were avoided where possible (e.g. *prata – prat, backa, back*), in order for the participant not to notice patterns or similarities in the material presented.

The carrier sentences were short, often using an auxiliary verb and never stretching beyond five words. The sentences were constructed in such a way that possible secondary stress or contrasting stress on a different word than the target word at the end of the sentence were avoided as much as possible. To achieve this, the use of phrasal verbs was limited, as the particle in phrasal verbs in Swedish always carries secondary stress (Riad 2013). Quantifiers and personal names were avoided, too. All carrier sentences were declarative sentences followed by an exlamation mark to further direct the participants to a pronunciation emphasising the final word in the sentence. In total, the material consisted of 130 sentences.

5.2. Fillers

Essentially, the feature categories functioned as fillers for each other. As mentioned in §4.2, words with the structure C/V: were also included in order to measure the difference in duration of long and short vowels and consonants. The alternation of the C/V: and V:/C structures for all nine vowels followed by consonants conforming to different features such as alveolar and voicing was deemed as sufficient variation to avoid the participant either discovering the experiment's purpose or becoming bored.

6. Participants & procedure

6.1. Participants

24 native speakers of Swedish took part in the experiment. The total group consisted of three subgroups, eight speakers from Lund (age *M*: 23.88, *SD*: 3.57), eight from Linköping (age *M*: 24, *SD*: 2.39) and eight speakers from Stockholm (age *M*: 24.38, *SD*: 2.2). Each group of eight consisted of four men and four women who had all lived in the cities mentioned above until at least the age of twenty, with most of them currently still living there. None of the participants had been diagnosed with dyslexia or had any other reading, speaking or hearing impairments. The participants were acquired through snowball sampling at the universities of Lund, Linköping and Stockholm and pursued either an under- or postgraduate degree there.

6.2. Procedure

The experiments were conducted in the three cities included in the sample. In each city, the experiments took place in quiet study rooms at the university campuses, with no one but the conducter and the participant in the room. All participants received around two minutes of clarification on the test's proceedings, which emphasised (1) reading the sentence on the screen out loud as if they found themselves in a conversation in order to avoid formal pronunciation as much as possible, (2) a brief explanation of the keyboard controls and microphone, (3) taking as much time as needed, and (4) avoiding a summarising tone or rhythm when reading. The microphone was then adjusted to the speaker before allowing the speaker to start the experiment. Since the nature of the sentence reading task was quite simple, a practice round was deemed unnecessary.

All 130 sentences were randomised to avoid a sequence of sentences with the same target vowel following each other. The participants could use the right arrow key to continue to the next sentence and if one sentence was accidentally skipped, the participants could use the left arrow key to go back. The conductor of the experiment was present and able to see the screen, in order to check whether the participant had read all sentences and if this was done correctly. The test started with a screen instructing the participants to press the right arrow key to start. The participants were recorded with an Audix HT2 microphone.

There were no pauses or breaks and it generally took the participants around five to seven minutes to complete the experiment, largely depending on how quickly the participants spoke and the pauses between sentences. The quickest participant was a male from Linköping, completing the reading within three minutes and twenty-five seconds. The participant taking the most time was also a male from Linköping with a recording time of almost thirteen minutes, caused by extremely lengthy pauses between sentences.

7. Processing of the data

After all 24 participants had taken part in the experiment, the recordings were labeled separately in Praat. For every recording, two tiers were used for annotation, of which the first was to indicate the target word and the second was to mark the target vowel and the following consonant. The sound files recorded in Linköping were of lesser quality than the data gathered in Lund and Stockholm, but were deemed adequate for formant analysis and measuring of vowel and consonant duration.

By using the labels, a large table was constructed, featuring the participant's place and sex. For each new vowel, a new row was appended. The column 'vowel' would then show the target vowel, following by the columns of 'voi' and 'alv' which showed whether the following consonant was voiced and/or alveolar or not, indicated by 'yes' or 'no'. Subsequently, five columns indicated the vowel's duration, two F_1 values and two F_2 values (one 25% and one at 75% after the vowel's onset). The script responsible for this table can be found in appendix 2. The formants were measured through a short-term spectral analysis and computed using the algorithm by Burg (Childers 1978; Press et al. 1992 in Boersma & Weenink 2010). The values of F_1a, F_1b, F_2a and F_2b were then used to create the vowel charts as presented in the upcoming §8.1, the intersect of F_1a and F_2a being the starting point for the vowel and the intersect of F_1b and F_2b being the end point. A separate but similar table was made for all consonants, including the features voice, alveolar, length and duration, which can be found in appendix 3.

The first table was used to calculate the vowel ratio per city (V:/V), by dividing the mean duration of the long vowels (V:) by the mean duration of the short vowels (V). The consonant ratio was calculated in a similar manner.

The degree of diphthongisation was calculated by subtracting F_1b from F_1a and F_2b from F_2a. A linear mixed-effects model was used to calculate the influence of the phonological contexts on the degree of diphthongisation.

PART III: THE RESULTS & DISCUSSION

8. Results

8.1. Vowels

From the results the following vowel charts were constructed for Lund Swedish (figure 8.1), Linköping Swedish (figure 8.2) and Stockholm (figure 8.3). The vowel charts do not inlcude the short vowels and represent only the nine long vowels as stated by Engstrand (1999).

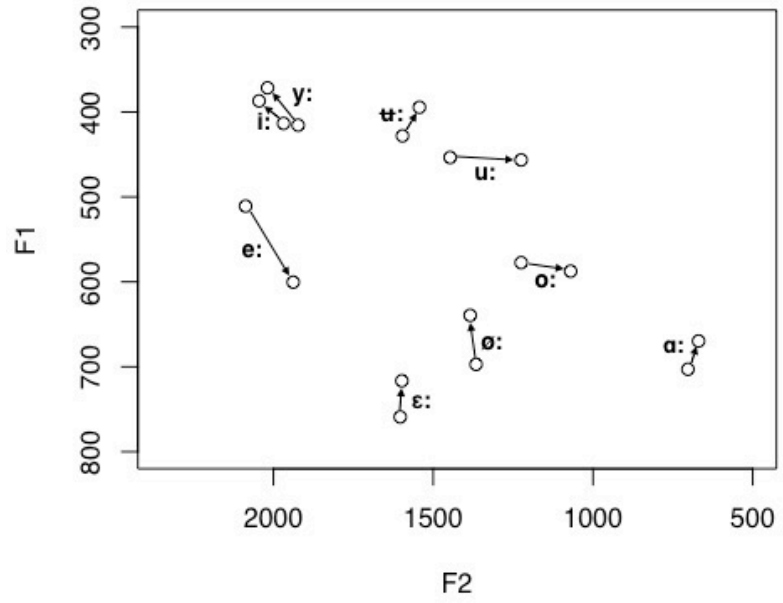

Figure 8.1. Vowel chart for Lund Swedish

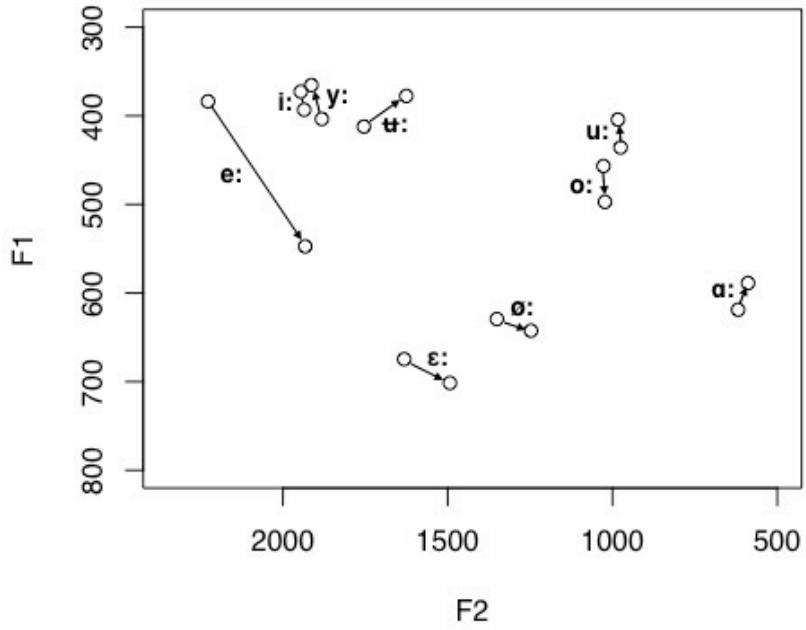

Figure 8.2. Vowel chart for Linköping Swedish

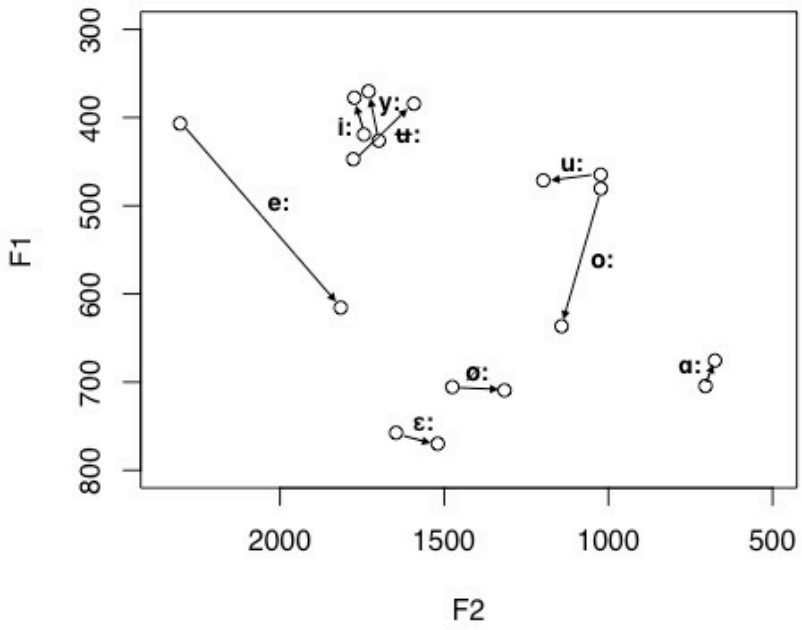

Figure 8.3. Vowel chart for Stockholm Swedish

8.1.1. High vowels

The high vowels /i:/, /y:/, /ʉ:/ and /u:/ seem to show some sense of glide in all three varieties, though not to extreme extents. Especially /i:/ and /y:/ seem to not move much in the mouth and lie remarkably close to each other, indicating that the only real difference between the two would be that /y:/ is rounded, whereas /i:/ is not. Furthermore, it is interesting to see that /i:/ and /y:/ are very much central in the Stockholm variety of Swedish, affirming Björnsten & Engstrand (1999) findings on the central nature of the Lidingö-i. Linköping serves as a middle ground in this matter, as we see that, though not as much as in Stockholm Swedish, /i:/ and /y:/ also seem quite central, creeping closer to /ʉ:/. Lund, on the other end of the spectrum, shows a much clearer division between /i:/ and /y:/ on the one hand, still very much front positioned, and /ʉ:/ on the other.

/ʉ:/ seems to diphthongise in Stockholm Swedish, but not particularly much in the other two varieties. This could possibly be to distinguish it from near /i:/ and /y:/. /u:/ seems diphthongised in Lund Swedish, which is in line with the writings of Bruce (2010), and is also much more central. The latter could be caused by the different nature of Scanian diphthongs, as /u:/ is said to be possibly realised as [e͡u]. In this case, the realisation of /u:/ seems to more resemble [ɨʊ].

8.1.2. Mid-high and mid vowels

For all three varieties, /e:/ appeared to be the long vowel that was most clearly diphthongised. Especially in Linköping and Stockholm, the F_1 of /e:/ rises from roughly 400Hz to 600Hz. In these two varieties, /e:/ also starts remarkably far front whilst strongly centralising towards the end of the diphthong. One could even argue that /e:/ is more realised as [iə] than [eə], as it starts both higher and more front than /i:/. The results shown above are quite similar to those found on the pronunciation of /e:/ by Bleckert (1987: 171), as the averages for F_1a and F_1b of Stockholm Swedish are very close to those of Bleckert. However, the F_2a for Stockholm

Swedish seems to be much higher, implying that Bleckert's informants did not realise /e:/ equally front.

As seen in Bruce's (2010:122) vowel chart for west and south Scanian diphthongs, one would expect /e:/ to be realised starting mid, raising to mid-high towards the end. Instead, we see a realisation similar to that in Linköping and Stockholm. Although not as extreme, it is clearly visible that the realisation of /e:/ is completely opposite to Bruce's (2010) description. This could be because of the ever-growing influence of Stockholm Swedish on the rest of the country and the pressure coming from standard Swedish that the Scanian varieties are under.

After /e:/, the other mid-high vowel /o:/ is most subject to diphthongisation. Though not very visible in the Linköping variety of Swedish, Stockholm Swedish shows a clear centralisation towards the end of the vowel. Interestingly, /o:/ too appears to start much higher than first expected, and though not crossing /u:/, it comes remarkably close. In contrast to this, Lund Swedish shows its Scanian roots, as /o:/ does not centralise but moves more from central to back in the form of [əo].

For both /ɛ:/ and /ø:/, no extreme diphthongisation was found. Whereas /ɛ:/ and /ø:/ appear to be moving towards more back and low in Linköping and Stockholm Swedish, Lund Swedish seems to yet again show the opposite. For this dialect, instead of a downward movement, the vowels seem to go up. This is indeed in line with the writing by Bruce (2000).

Apart from diphthongisation, we have to note that /ɛ:/ and /ø:/ are realised strikingly low in all three varieties. Especially comparing these vowel charts to the one by Engstand (1999), we can spot discrepancies for both /ɛ:/ and /ø:/. Whereas Engstrand (1999) claims rounded /ø:/ to be equal in height to unrounded /e:/ (mid-high), /ø/ is instead realised as [œ:], or even [œ̝] for Stockholm Swedish. Similarly, /ɛ:/, which Engstrand classifies as mid, is realised [æ:]-like in all three varieties, though with some minor differences. Most striking is that these realisations are on par with, if not lower than, the realisation of /ɑ:/, which Engstrand (1999) considers to be clearly low. Interestingly, this study did not find diphthongisation of /ɛ:/ similar to findings by Bleckert (1987), for either of the three varieties. These realisations for /ɛ:/ and /ø:/ are not quite surprising for Stockholm Swedish, as Kotsinas (2004) already noted this in their work, and neither is it that they are the lowest of the three varieties. This study, however, shows that this lower pronunciation of /ɛ:/ and /ø:/ has strongly spread across the country.

8.1.3. Low vowels

Apart from /ɑ:/ being generally slightly higher in Linköping Swedish, the realisation of /ɑ:/ does not seem to differ gravely amongst the three varieties. Similar to the works by Engstrand (1999) and Elert (1966), /ɑ:/ does not seem to diphthongise.

8.2. Phonological context

For a number of long vowels that appeared to be diphthongised, a linear mixed-effects model was used to describe the possible influence of the phonological contexts. The predictors in this model were voicing, alveolar and sex. For voicing and alveolar, a random slope was modelled per participant. For /e:/ in Stockholm Swedish, the consonant following being voiced or alveolar did not seem to have a significant effect on the degree of diphthongisation, as the *t*-values for voice and alveolar were -0.908 and 0.146 respectively. For the Stockholm Swedish long /o:/, too, neither features seemed to influence degree of diphthongisation. The *t*-

values were 0.584 for voicedness and -0.942 for alveolar and both had confidence intervals that included 0 (95% CI [-43.91, 78.30] and 95% CI [-70.46, 26.00] respectively). A similar situation was found for Linköping Swedish /e:/ with 95% CI [-60.69, 71.28] for the feature voice and 95% CI [-92.55, 88.94] for the feature alveolar, and for Lund Swedish /o:/ with 95% CI [-53.74, 41.59] for the feature voice and 95% CI [-88.91, 32.37] for the feature alveolar. Thus, the phonological enviroment seems to have only little or no influence on the degree of diphthongisation.

8.3. Consonant and vowel ratios

For the three cities included, the mean duration for the long and short vowels was calculated separately. These means were quite similar for all three places, though both short and long consonants seemed to be lower in duration in Linköping than in Stockholm and Lund. These values were then used to calculate the consonant ratios (C:/C), which were 1.297 for Linköping, 1.214 for Lund and 1.232 for Stockholm.

The vowel ratios were calculated in similar fashion and also appeared to be relatively close to each other. The V:/V ratios for Linköping, Lund and Stockholm were 1.698, 1.751 and 1.696 respectively. All consonant and vowel ratios are shown in figure 8.4.

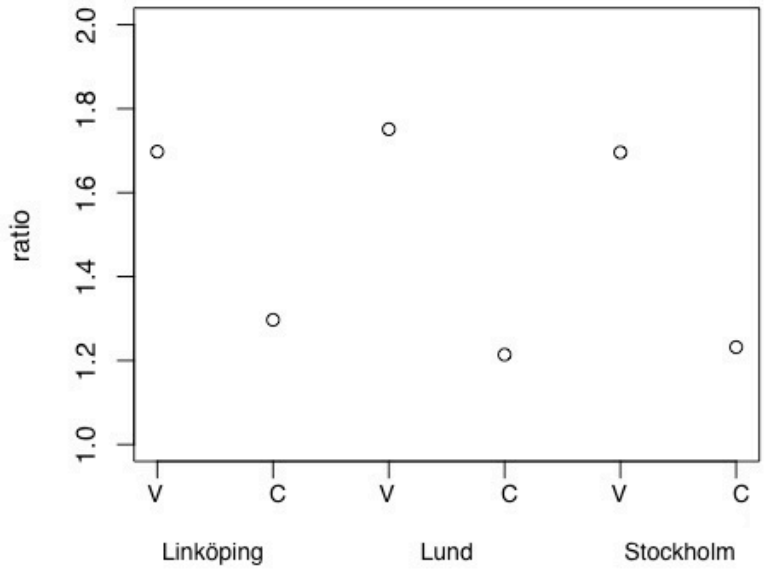

Figure 8.4. Vowel and consonant ratios for Linköping, Lund and Stockholm.

These results proved to be very similar to the earlier foundings by Schaeffler (2005), confirming that all of these three varieties of Swedish should indeed be categorised in regional clusters 1 or 2. Considering that the consonant ratio indeed was very low for these three varieties of Swedish, and the vowel ratio not remarkably high, it could be expected that vowel quality indeed is important in all three varieties.

9. Conclusion and discussion

In conclusion, high vowels seem to only marginally glide and if so, it is often /ʉ:/ and/or /u:/, which is in line with Bleckert's (1987) and Eklund & Traunmüller's (1996) findings. For the vowels /i:/ and /y:/ there is not enough reason to assume the transcriptions [i:jᵊ], [y:ɥᵊ] as proposed by Elert (1966). /ʉ:/ seems to only really diphthongise for Stockholm Swedish, possibly to distinguish itself from close /i:/ and /y:/, which are strongly central (Björsten & Engstrand 1999). For /u:/ there is no real trend to discover among the three varieties.

As for mid-high and mid vowels, /e:/ shows centralising diphthongisation in all three varieties. /o:/ shows clear diphthongisation in Stockholm Swedish and in reverse a slight shift in height in Lund Swedish, as expected based on Bruce's (2010) work. Interestingly, /o:/ does not diphthongise in Linköping Swedish, even though most literature (e.g. Eklund & Traunmüller 1996; Kuronen 2000, Bruce 2010, Riad 2013) stated that mid-high vowels tend to centralise. Bleckert (1987: 175) did consider Linköping Swedish to be a variety with predominantly monophthongal vowels, but this does not correspond with the clear diphthongisation of /e:/ found in this study. Whilst Eklund & Traunmüller (1996) on the one hand excluded /ɛ:/ from the mid vowels to diphthongise, and Bleckert (1987) excluded /ø:/ on the other, both seem to diphthongise equally little in all three varieties, though not particularly much. However, the realisation of /ɛ:/ & /ø:/ is strikingly low. /ɑ:/ does not diphthongise but is realised slightly higher than anticipated.

Based on the vowel charts of the three varieties, I would like to propose a new division of the Swedish long vowels. Throughout the paper we have kept to Engstrand's (1999) division of high, mid-high, mid and low vowels, but the current results incline us to adapt this division. Since /ɛ:/ and /ø:/ are realised so remarkably low and as said, on par with or even lower than /ɑ:/, I propose to instead group these three vowels as low. Since this will invalidate the division between mid-high and mid vowels, I suggest we group /e:/ and /o:/ under mid vowels, doing away with the category mid-high. The high vowels will then remain as how they were before. The vowel chart that would result from such a division is shown in figure 9.1, and for comparison, Engstrand's (1999) vowel chart for Swedish including only the long vowels is also added (figure 9.2).

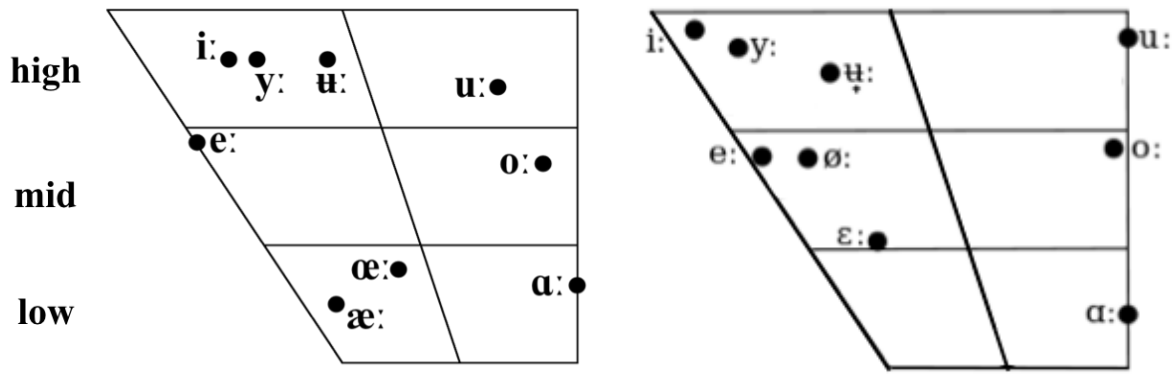

Figure 9.1 & 9.2. Proposed vowel chart for Swedish (left) in comparson to Engstrand's (1999) vowel chart (right).

As the degree of diphthongisation between varieties appears to differ, I have chosen to not include /eː/ or /oː/ as diphthongs, but I have rather chosen the approximate midpoint. Aside from merely lowering the position of /ɛː/ and /øː/, it seemed appropriate to also assume the transcriptions of /æː/ and /œː/ respectively, as these are a more accurate representation of the realisation. /uː/ and /oː/ were also moved slightly to the centre of the vowel chart, as these appeared to be less back than /ɑː/.

An interesting addition to the vowel charts would have been to include a third measuring point for the F_1 and F_2 at 50% after the vowel's onset, in order to gain further insight in the precise point of breaking. This way it would have been clearer whether the diphthongised vowels shifted gradually, or whether there was a clear breaking point.

Interestingly, neither the feature voice nor the feature alveolar influenced the degree of diphthongisation of the preceding long vowels. It has to be addressed that, even though the experiment was constructed in such a manner as to control intonation and avoid extremely formal speech, some participants still seemed subject to divergent intonation patterns and the pressure of conforming to a formal version of Swedish when reading. Though not often, sometimes the personal pronoun at the start of a sentence was stressed, causing the last word to only receive secondary stress. An example:

	Du ska öva	'you should/will practice'
General realisation	dʉː ska ˈøːva	
Realisation with secondary stress	ˈdʉː ska ˌøːva	

This, however, did not happen particularly often or specifically with one carrier sentence and was thus not analysed separately. Considering the formality of speech, three speakers were consistently very formal, pronouncing the pronoun *de* ('they') as [də] instead of the colloquial [dɔm][6], and *mycket* ('very'/'much') as [mʏkːət] instead of [mʏkːə]. The majority, however, spoke much more colloquially.

As far as further reasearch is concerned, most opportunities lie in the extent of including more varieties of Swedish and examining their consonant ratios. For this study, the consonant ratios for all three varieties lie around 1.2, meaning that the 'long' consonant is only slightly longer than the 'short' consonant. The vowel ratios for all three varieties lie around 1.7. These results are in line with earlier findings by Schaeffler (2005). However, in order to truly measure the influence of the consonant ratio on diphthongisation, a variety from either the north of Sweden or Swedish-speaking Finland with a relatively high consonant ratio should be included. As all three varieties with a low consonant ratio show signs of diphthongisation, it would be interesting to see whether diphthongisation is equally prevalent in varieties with a higher consonant ratio. Nevertheless, this study functions as a stepping stone for additional research including other varieties of Swedish to broaden the sample and further investigate the importance of consonant length in relation to diphthongisation.

[6] The pronunciation of *de* as [dɔm] is nowadays the norm across the country and considered standard-Swedish. Since the third person plural subject pronoun *dem* is also pronounced [dɔm], this often causes confusion about the spelling of the word. In informal conversations, *de* is often spelt as *dom* for both object and subject positions (e.g. Abrahamsson 2007).

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Appendices

Appendix 1: tables for all vowels and carrier sentences.

carrier sentence	vowel	length	syllabicity	voice	coronal
Solen ska skina!	i:	long	di	yes	yes
Han tycker om att rita!	i:	long	di	no	yes
I biblioteket bör man tiga!	i:	long	di	yes	no
Jag vill skrika!	i:	long	di	no	no
Vi måste vinna!	ɪ	short	di	yes	yes
Du ska gissa!	ɪ	short	di	no	yes
I Sverige får man tigga!	ɪ	short	di	yes	no
Jag tänker sticka!	ɪ	short	di	no	no
Han äger en bil!	i:	long	mono	yes	yes
Hon äter ris!	i:	long	mono	no	yes
Hon kämpar för sitt liv!	i:	long	mono	yes	no
Hon är rik!	i:	long	mono	no	no
Han mäter kjolens vidd!	ɪ	short	mono	yes	yes
Huset är vitt!	ɪ	short	mono	no	yes
Hon är pigg!	ɪ	short	mono	yes	no
Han hälsade med en nick!	ɪ	short	mono	no	no
Barn ska lyda!	y:	long	di	yes	yes
Jag ska nysa!	y:	long	di	no	yes
Planen ska flyga!	y:	long	di	yes	no
Bebisen har lärt sig krypa!	y:	long	di	no	no
Alla skulle gynnas!	ʏ	short	di	yes	yes
Jag tänker flytta!	ʏ	short	di	no	yes
Huset ska byggas!	ʏ	short	di	yes	no
Hans bok ska tryckas!	ʏ	short	di	no	no
Det är min pryl!	y:	long	mono	yes	yes
Då fick han nys!	y:	long	mono	no	yes
Han missade sitt flyg!	y:	long	mono	yes	no
Hon gav honom ett nyp!	y:	long	mono	no	no
De tvingades söka skydd!	ʏ	short	mono	yes	yes
Det är inget nytt!	ʏ	short	mono	no	yes
Han är snygg!	ʏ	short	mono	yes	no
Boken går till tryck!	ʏ	short	mono	no	no
Han ska bjuda!	ʉ:	long	di	yes	yes
Nu ska du sluta!	ʉ:	long	di	no	yes
Barnet brukar ljuga!	ʉ:	long	di	yes	no
På lördag ska vi supa!	ʉ:	long	di	no	no
Pengarna ska rulla!	ʊ	short	di	yes	yes
Barn ska pussas!	ʊ	short	di	no	yes
Hon älskar att sjunga!	ʊ	short	di	yes	no
Killen brukar bluffa!	ʊ	short	di	no	no
Hon väcktes av ett ljud!	ʉ:	long	mono	yes	yes

Vi bor i ett hus!	ʉ:	long	mono	no	yes
Han är en tjuv!	ʉ:	long	mono	yes	no
Maskinen tas i bruk!	ʉ:	long	mono	no	no
Väggen är tunn!	ɵ	short	mono	yes	yes
Han åker buss!	ɵ	short	mono	no	yes
Huset har tre rum!	ɵ	short	mono	yes	no
Hon är tuff!	ɵ	short	mono	no	no
Fåren ska klonas!	u:	long	di	yes	yes
Sjukdomen ska botas!	u:	long	di	no	yes
Du får prova!	u:	long	di	yes	no
Nu måste du boka!	u:	long	di	no	no
Jag kan kolla!	ɔ	short	di	yes	yes
Han gör det på låtsas!	ɔ	short	di	no	yes
Han ska jogga!	ɔ	short	di	yes	no
Håret ska lockas!	ɔ	short	di	no	no
Han simmar i en flod!	u:	long	mono	yes	yes
Det var ett hot!	u:	long	mono	no	yes
Hon bor i en skog!	u:	long	mono	yes	no
Jag läser en bok!	u:	long	mono	no	no
Han har koll!	ɔ	short	mono	yes	yes
Killen begick ett brott!	ɔ	short	mono	no	yes
Hon är en snobb!	ɔ	short	mono	yes	no
Han köper en rock!	ɔ	short	mono	no	no
Nu ska du spela!	e:	long	di	yes	yes
Jag vill resa!	e:	long	di	no	yes
Du ska leva!	e:	long	di	yes	no
Barnen gillar att leka!	e:	long	di	no	no
Hon kastar en sten!	e:	long	mono	yes	yes
Vi ses!	e:	long	mono	no	yes
Hon tar ett steg!	e:	long	mono	yes	no
De gör det på lek!	e:	long	mono	no	no
Han mäter bilens bredd!	ɛ	short	mono	yes	yes
Han är lätt!	ɛ	short	mono	no	yes
Jag går hem!	ɛ	short	mono	yes	no
Det blev en fläck!	ɛ	short	mono	no	no
Nu ska hon föda!	ø:	long	di	yes	yes
Problemet ska lösas!	ø:	long	di	no	yes
Du ska öva!	ø:	long	di	yes	no
Han slutade röka!	ø:	long	di	no	no
Sanningen ska döljas!	œ	short	di	yes	yes
Snart kommer barnet att tröttna!	œ	short	di	no	yes
Inget ska gömmas!	œ	short	di	yes	no
Dörren ska öppnas!	œ	short	di	no	no
Hon dricker öl!	ø:	long	mono	yes	yes
Hon äter en nöt!	ø:	long	mono	no	yes
Träden fäller sina löv!	ø:	long	mono	yes	no

Köket fylldes av rök!	ø:	long	mono	no	no
Han föll!	œ	short	mono	yes	yes
Hon äter kött!	œ	short	mono	no	yes
Vi dricker glögg!	œ	short	mono	yes	no
Grisen säger nöff nöff!	œ	short	mono	no	no
Jag gillar att måla!	o:	long	di	yes	yes
Han började gråta!	o:	long	di	no	yes
Jag ställde en fråga!	o:	long	di	yes	no
Hon tänker åka!	o:	long	di	no	no
Han gav mig råd!	o:	long	mono	yes	yes
De har en båt!	o:	long	mono	no	yes
Vi ska byta tåg!	o:	long	mono	yes	no
Det ligger i ett skåp!	o:	long	mono	no	no
De fortsatte gräla!	ɛ:	long	di	yes	yes
Jag älskar att läsa!	ɛ:	long	di	no	yes
Hon gillar att väva!	ɛ:	long	di	yes	no
Nu ska vi käka!	ɛ:	long	di	no	no
Tårtan ska gräddas!	ɛ	short	di	yes	yes
Jag ska tvätta!	ɛ	short	di	no	yes
Barnen ska läggas!	ɛ	short	di	yes	no
Ljuset ska släckas!	ɛ	short	di	no	no
De klättrar i träd!	ɛ:	long	mono	yes	yes
Han sköt bollen i nät!	ɛ:	long	mono	no	yes
Han skulle jaga räv!	ɛ:	long	mono	yes	no
Han slänger skräp!	ɛ:	long	mono	no	no
Jag tänker bada!	ɑ:	long	di	yes	yes
Vi måste prata!	ɑ:	long	di	no	yes
Nu ska han klaga!	ɑ:	long	di	yes	no
De tänker baka!	ɑ:	long	di	no	no
Jag tänker stanna!	a	short	di	yes	yes
Du måste fatta!	a	short	di	no	yes
Vi behöver damma!	a	short	di	yes	no
Bilen skulle backas!	a	short	di	no	no
Växter har blad!	ɑ:	long	mono	yes	yes
Hon är mycket lat!	ɑ:	long	mono	no	yes
De ställer höga krav!	ɑ:	long	mono	yes	no
Han tycker om soppans smak!	ɑ:	long	mono	no	no
Han är en man!	a	short	mono	yes	yes
Hennes hår är platt!	a	short	mono	no	yes
Får får lamm!	a	short	mono	yes	no
Hon skrev på en lapp!	a	short	mono	no	no

Appendix 2: Script for vowel table

```
# analyseerkopia.praat
# Paul Boersma & Joppe Pelzer, 2017-06-21


folder$ = "Opnames & Textgrids"
table = Create Table with column names: "table", 0, "file place speaker sex word vowel voi alv
dur length F1a F1b F2a F2b"
fileList = Create Strings as file list: "fileList", folder$ + "/*.WAV"
numberOfSoundFiles = Get number of strings
for file to numberOfSoundFiles
      selectObject: fileList
      soundFileName$ = Get string: file
      speaker$ = soundFileName$ - ".WAV"
      sex$ = right$ (speaker$, 1)
      sound = Read from file: folder$ + "/" + soundFileName$
      formant = To Formant (burg): 0.001, 5.0, if sex$ = "k" then 5500 else 5000 fi, 0.025,
50.0
      textgrid = Read from file: folder$ + "/" + speaker$ + ".TextGrid"
      numberOfIntervals2 = Get number of intervals: 2
      if numberOfIntervals2 mod 3 = 1
            numberOfVowels = numberOfIntervals2 div 3
            for vowel to numberOfVowels
                  selectObject: textgrid
                  vowel$ = Get label of interval: 2, vowel * 3 - 1
                  if vowel$ = "ɑ:"
                        tablevowel$ = "aa"
                  elsif vowel$ = "ʉ:"
                        tablevowel$ = "uu"
                  elsif vowel$ = "ɛ:"
                        tablevowel$ = "ee"
                  elsif vowel$ = "ø:"
                        tablevowel$ = "eu"
                  else
                        tablevowel$ = vowel$
                  endif
                  consonant$ = Get label of interval: 2, vowel * 3
                  if vowel$ <> "" and consonant$ <> ""
                        tmin = Get start time of interval: 2, vowel * 3 - 1
                        tmax = Get end time of interval: 2, vowel * 3 - 1
                        duration = tmax - tmin
                        beginningInterval = Get start time of interval: 2, vowel * 3 - 1
                        intervalTierOne = Get interval at time: 1, beginningInterval
                        word$ = Get label of interval: 1, intervalTierOne
                        selectObject: formant
                        f1a = Get value at time: 1, tmin + 0.25 * duration, "hertz", "linear"
                        f1b = Get value at time: 1, tmin + 0.75 * duration, "hertz", "linear"
                        f2a = Get value at time: 2, tmin + 0.25 * duration, "hertz", "linear"
                        f2b = Get value at time: 2, tmin + 0.75 * duration, "hertz", "linear"
                        if consonant$ = "b"
                              voiced$ = "yes"
                        elsif consonant$ = "b:"
                              voiced$ = "yes"
                        elsif consonant$ = "d"
                              voiced$ = "yes"
                        elsif consonant$ = "d:"
                              voiced$ = "yes"
                        elsif consonant$ = "g"
                              voiced$ = "yes"
                        elsif consonant$ = "g:"
                              voiced$ = "yes"
                        elsif consonant$ = "l"
                              voiced$ = "yes"
                        elsif consonant$ = "l:"
                              voiced$ = "yes"
                        elsif consonant$ = "n"
                              voiced$ = "yes"
                        elsif consonant$ = "n:"
                              voiced$ = "yes"
                        elsif consonant$ = "m"
                              voiced$ = "yes"
                        elsif consonant$ = "m:"
                              voiced$ = "yes"
```

```
                        elsif consonant$ = "ŋ:"
                              voiced$ = "yes"
                        elsif consonant$ = "v"
                              voiced$ = "yes"
                        else
                              voiced$ = "no"
                        endif
                        if consonant$ = "s"
                              alveolar$ = "yes"
                        elsif consonant$ = "s:"
                              alveolar$ = "yes"
                        elsif consonant$ = "t"
                              alveolar$ = "yes"
                        elsif consonant$ = "t:"
                              alveolar$ = "yes"
                        elsif consonant$ = "d"
                              alveolar$ = "yes"
                        elsif consonant$ = "d:"
                              alveolar$ = "yes"
                        elsif consonant$ = "l"
                              alveolar$ = "yes"
                        elsif consonant$ = "l:"
                              alveolar$ = "yes"
                        elsif consonant$ = "n"
                              alveolar$ = "yes"
                        elsif consonant$ = "n:"
                              alveolar$ = "yes"
                        else
                              alveolar$ = "no"
                        endif
                        if right$ (vowel$, length (vowel$) - 1) = ":"
                              length$ = "long"
                        else
                              length$ = "short"
                        endif
                        selectObject: table
                        Append row
                        row = Get number of rows
                        Set string value: row, "file", soundFileName$
                        Set string value: row, "speaker", speaker$
                        Set string value: row, "sex", right$ (speaker$, 1)
                        Set string value: row, "place", left$ (speaker$, length (speaker$)- 2)
                        Set string value: row, "vowel", tablevowel$
                        Set string value: row, "dur", fixed$ (1000 * duration, 3)
                        Set string value: row, "F1a", fixed$ (f1a, 3)
                        Set string value: row, "F1b", fixed$ (f1b, 3)
                        Set string value: row, "F2a", fixed$ (f2a, 3)
                        Set string value: row, "F2b", fixed$ (f2b, 3)
                        Set string value: row, "voi", voiced$
                        Set string value: row, "alv", alveolar$
                        Set string value: row, "word", word$
                        Set string value: row, "length", length$
                  else
                        appendInfoLine: "empty vowel or consonant in interval ", vowel * 3 -
1, " of textgrid ", speaker$
                  endif
            endfor
            removeObject: textgrid
      else
            appendInfoLine: "wrong in textgrid ", speaker$
      endif
      removeObject: sound, formant
endfor
```

Appendix 3 – Script for consonant table

```
# analyseConsonants.praat
# Joppe Pelzer, 2017-06-23

folder$ = "Opnames & Textgrids"
table = Create Table with column names: "tableConsonants", 0, "file place speaker sex word
consonant dur length"
fileList = Create Strings as file list: "fileList", folder$ + "/*.WAV"
numberOfSoundFiles = Get number of strings
for file to numberOfSoundFiles
      selectObject: fileList
      soundFileName$ = Get string: file
      speaker$ = soundFileName$ - ".WAV"
      sex$ = right$ (speaker$, 1)
      sound = Read from file: folder$ + "/" + soundFileName$
      textgrid = Read from file: folder$ + "/" + speaker$ + ".TextGrid"
      numberOfIntervals2 = Get number of intervals: 2
      if numberOfIntervals2 mod 3 = 1
            numberOfConsonants = numberOfIntervals2 div 3
            for consonant to numberOfConsonants
                  selectObject: textgrid
                  consonant$ = Get label of interval: 2, consonant * 3
                  if consonant$ <> ""
                        tmin = Get start time of interval: 2, consonant * 3
                        tmax = Get end time of interval: 2, consonant * 3
                        duration = tmax - tmin
                        beginningInterval = Get start time of interval: 2, consonant *3
                        intervalTierOne = Get interval at time: 1, beginningInterval
                        word$ = Get label of interval: 1, intervalTierOne
                        if right$ (consonant$, length (consonant$) - 1) = ":"
                              length$ = "long"
                        else
                              length$ = "short"
                        endif
                        selectObject: table
                        Append row
                        row = Get number of rows
                        Set string value: row, "file", soundFileName$
                        Set string value: row, "speaker", speaker$
                        Set string value: row, "sex", right$ (speaker$, 1)
                        Set string value: row, "place", left$ (speaker$, length (speaker$)- 2)
                        Set string value: row, "dur", fixed$ (1000 * duration, 3)
                        Set string value: row, "word", word$
                        Set string value: row, "consonant", consonant$
                        Set string value: row, "length", length$
                  else
                        appendInfoLine : "empty consonant in interval ", vowel * 3 " of
textgrid", speaker$
                  endif
            endfor
            removeObject: textgrid
      else
            appendInfoLine: "mistake in textgrid ", speaker$
      endif
      removeObject: sound
endfor
```