

## Chapter 7

# Summary, synthesis and prospect

This thesis investigated the asymmetry in mutual intelligibility between spoken Danish and Swedish. It has been reported consistently in previous research that speakers of Danish decode more spoken Swedish than vice versa. Previous investigations, however, have focused on extra-linguistic factors such as the amount of language contact across the border and different attitudes held towards the neighbouring language, but could not always confirm convincing links between intelligibility and these factors. Furthermore, the causal relationship between these extra-linguistic factors and intelligibility is still unclear.

This thesis aimed at reinvestigating some of the previously suggested factors such as language attitudes and language-specific knowledge of the orthographic system. It also investigated linguistic factors that have not been studied empirically before, such as speech rate, reduction processes in spoken language, and language-specific orthographic knowledge. In this chapter, the results from the five experiments reported in chapters 2 to 6 are summarised and evaluated. Following this, in a synthesis of the results from the previous chapters, all factors' interrelationships are analysed and their impact for formal as well as informal communication across language borders in Scandinavia are highlighted.

### **7.1. Summary**

The thesis started off with the hypothesis that previous research aiming at explaining the asymmetry in mutual intelligibility of spoken Danish and Swedish has focused too much on extra-linguistic factors and largely ignored the influence that linguistic features might have. This hypothesis was based on the fact that most of the suggested factors in previous studies either did not correlate significantly or could only explain a small amount of variation (cf. the correlation coefficients' significance values in Delsing & Lundin Åkesson 2005). To test this hypothesis, we conducted an intelligibility experiment with Danish and Swedish illiterate pre-schoolers from outside the border regions (namely from *Odense kommune* in Denmark and from *Växjö kommun* in Sweden), in which extra-linguistic factors such as the amount of

contact and language attitudes were kept constant across the two groups of participants (Danish and Swedish). At the same time, linguistic factors such as the distributions of the Swedish tonemes and the Danish stød, differences in word length and differences in duration in the material were kept similar to Gooskens & Kürschner's (2010) study in which a significant asymmetry in intelligibility scores was reported. We expected that the various relevant linguistic differences such as word length, the number of phonetic neighbours, speaking tempo or the supra-segmental features stød and the tonal accents would cause asymmetric intelligibility results in our participants. However, this turned out not to be the case. Danish and Swedish pre-schoolers performed equally well on a picture-pointing word-recognition task with 50 auditorily presented cognate words in their neighbouring language. Contrary to our initial hypothesis, we had to conclude that the asymmetry in mutual intelligibility is caused by extra-linguistic factors after all, as the exclusion of them led to symmetric intelligibility. This experiment and its conclusions are reported in chapter 2.

Subsequently, the role of language attitudes was investigated more closely. In the paper reported in chapter 3, the data from the picture-pointing word-recognition task reported in chapter 2 was extended with data from adult participants. After the word-recognition experiment, the participants were asked how they thought the neighbouring language sounded compared to their native language. Reaction times to correctly identified stimuli were analysed and correlated with self-reported language attitudes held towards the neighbouring language (Danish for Swedish participants and vice versa). It turned out that attitudes held by children generally were more positive than the attitudes held by adults, a tendency which was particularly pronounced in the Swedish participants. Swedish adults held a significantly more negative attitude towards Danish when asked overtly how they liked the language they heard in the experiment. However, contrary to our reformulated hypothesis, there was no significant correlation between intelligibility score and attitude towards the neighbouring language when the age factor was controlled for. From this experiment, we could not confirm that language attitudes play a role for intelligibility. Based on this data, language attitudes do not explain the asymmetry in mutual intelligibility between spoken Danish and Swedish.

A restriction in this experiment was the fact that we did not control for individual speech properties in our two speakers such as the liveliness of the intonation, the general pitch employed, or speaking tempo etc. It is likely that the elicited attitudes are partly influenced by speaker-specific speech features and therefore are not fully comparable. To investigate the link between language attitudes and intelligibility more accurately, and to avoid the shortcomings from the experiment reported in chapter 3, we conducted a matched-guise experiment, which is reported in chapter 4. Seven- to sixteen-year-old subjects hailing from similar geographical areas as the subjects who participated in the experiments reported in chapters 2 and 3 participated in the same word recognition experiment. However, this time, we elicited their subconsciously held attitudes towards the neighbouring

language before their word recognition was tested. This was done by presenting them with the same text recorded in six different languages (Danish, Swedish, Norwegian, Dutch, Frisian and Indonesian) and instructing them to indicate on a five-point scale how normal, modern, beautiful, kind, smart and rich they thought the speaker was. Importantly, the Danish and the Swedish recordings were produced by the same speaker, a Danish-Swedish bilingual. It was ensured that the participants did not discover this. In this experiment, we took care not to ask the participants' attitude towards the language in question in an open manner, but to let the participants judge personality traits of all five speakers instead. As they judged the bilingual speaker twice, we could draw conclusions as to their attitudes regarding the neighbouring language. We found a significant but low correlation between intelligibility and language attitudes, which explained merely 3.6% of their word recognition variance. Interestingly, the Danish participants clearly outperformed the Swedish participants in the intelligibility experiment once again, thereby confirming results from Maurud (1976), Bø (1978), Delsing & Lundin Åkesson (2005), and our results reported in chapter 3. Again, we had to modify our hypothesis about which factors play an important role for the asymmetry in mutual intelligibility between spoken Danish and Swedish and had to conclude that language attitudes are of no major importance for intelligibility and, hence, cannot explain the asymmetry in mutual intelligibility.

In the work reported in chapter 5, we turned to the investigation of two linguistic factors, namely articulation rate and the degree of reduction in spoken language. Having observed that all Danish stimuli in our previous experiments tended to have a shorter duration than the Swedish stimuli, although the number of canonical syllables generally seemed similar across the languages, we hypothesised that Danes generally communicate more quickly than Swedes do. If this turned out to be the case, it is likely to impair the intelligibility of spoken Danish compared to spoken Swedish. We tested this hypothesis by measuring the number of canonical syllables and the number of phonetically realised syllables in two corpora, namely in radio news broadcasts and in recordings of semantically unpredictable sentences made in a highly controlled setting. In this experiment, we also included Norwegian, although this is not the focus of this thesis. We found that speakers in our Danish corpora generally produced more canonical syllables per time unit than the speakers in the Swedish and Norwegian corpora did. At the same time, they did not produce significantly more phonetic syllables, which were defined as intensity peaks in voiced sounds. This means that Danes generally manage to transfer a specific message faster than Swedes do, without increasing their speaking rate. We assumed that this can only be done if some information is deleted or reduced, e.g. by assimilating sounds towards the surrounding phonetic segments, by leniting consonants to approximants or by deleting certain segments completely. By subtracting the number of phonetic syllables produced per time unit from the number of canonical syllables produced per time unit, we calculated a reduction ratio for all three languages. It turned out that the reduction ratio is significantly higher in Danish speakers than in Norwegian and Swedish speakers. That means that spoken Danish in our corpora was significantly

more reduced than Swedish and Norwegian, which is likely to have a detrimental effect on the intelligibility of spoken Danish. These findings thus could be part of the explanation why mutual intelligibility between Danish and Swedish adults is typically reported to be asymmetric. However, it is not clear why Danish and Swedish preschoolers' intelligibility of the neighbouring language was found to be symmetrical. This question was addressed in the following paper.

In the work reported in chapter 6, we investigated the link between language-specific orthographic knowledge and intelligibility of the neighbouring language. Following up on the findings reported in chapter 5, we investigated the role of well-established reduction processes in spoken Danish, which are not reflected in the orthographic system. Danish orthography has been described as particularly conservative, both compared to its pronunciation (orthography is generally considered more conservative than the spoken form of the same language, Elbro 2006) as well as compared to its neighbouring languages (Danish orthography is more conservative than Swedish orthography is, Elbro 2006). The orthographic system represents pronunciation which was used several centuries ago, e.g. the spelling *mild* reflects pronunciation [mil], in which the word final [d] has been dropped entirely in the spoken form of the word, while it is still preserved in its written form. At the same time, spoken Danish has developed further away from its East Nordic root than spoken Swedish has (Elbro 2006), which generally makes Danish orthography deeper (i.e. less transparent) than Swedish orthography. Figure 1 shows a schematic illustration of the relationship and distances between spoken Danish and Swedish and their spelling systems.

**Figure 1.** Schematic illustration of the distances between spoken and written Danish and Swedish.

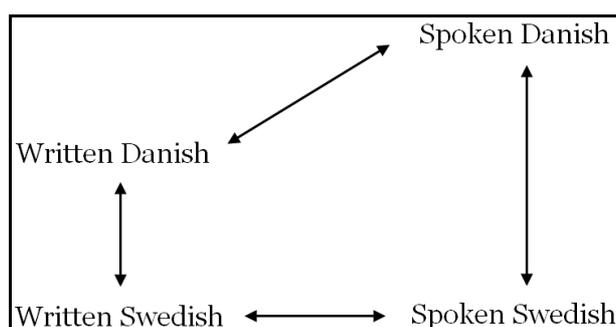
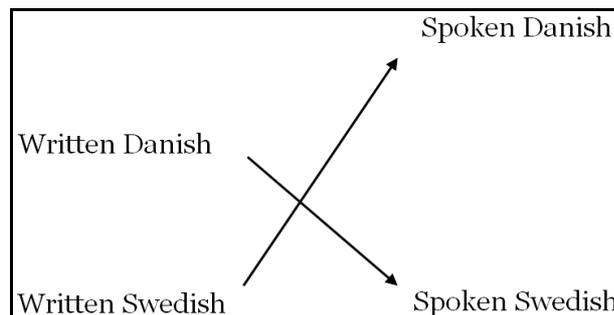


Figure 1 illustrates the fact that the distance between the two orthographic systems is smaller than between the spoken forms of the languages, which means that the same text written in Danish and Swedish generally tends to look rather similar, while the same text fragment in spoken language would sound (or look, if transcribed phonetically) much less alike. This is in line with the intelligibility results reported by Maurud (1976), Bø (1978) and Delsing & Lundin Åkesson (2005), who showed that the mutual intelligibility between written Danish and Swedish is higher than the

mutual intelligibility of spoken Danish and Swedish. In other words, literate Danes have fewer difficulties reading Swedish texts than decoding spoken Swedish, and, similarly, literate Swedes have fewer difficulties reading Danish texts than decoding spoken Danish. It is also illustrated in Figure 1 that Danish orthography is deeper (i.e. less transparent) than Swedish orthography (Elbro 2006), as the distance between spoken and written Danish is larger than the distance between spoken and written Swedish.

Finally, Doetjes & Gooskens' (2009) cross-linguistic calculations of grapheme-sound correspondences showed that the distance between spoken Danish and written Swedish is larger than the distance between spoken Swedish and written Danish. This is illustrated in Figure 2 by the two one-headed arrows crossing each other. That means that literate speakers of Danish have a larger advantage from their native orthography when confronted with spoken Swedish, than literate speakers of Swedish have when confronted with spoken Danish, if it can be proven that native orthography is activated during spoken language recognition of an unknown language at all.

**Figure 2.** Schematic illustration of the distances between spoken Danish and written Swedish as well as between spoken Swedish and written Danish.



Although it has been reported that native orthography is activated during *native* language spoken word recognition (Perre and Ziegler 2008, Pattamadilok et al. 2009, Perre et al. 2009) it has never been investigated whether this is also the case when listeners are confronted with a foreign language. In chapter 6, we therefore investigate whether literate speakers of Danish can use their native orthography as an additional cue when confronted with spoken Swedish. Results revealed that this is the case, as their electrophysiological responses to words where their native Danish orthography was consistent with Swedish pronunciation (such as *mild* [mild]) differed significantly from signals to words where Danish orthography and Swedish pronunciation were inconsistent (such as *gift* [gifd]). More specifically, inconsistent items elicited a broadly distributed negativity on centro-posterior and occipital electrodes in the time window 750-900 ms post-stimulus onset, which was interpreted as neural correlates of the resolution of the inconsistency between L1

orthography and L2 pronunciation, or the integration of the consistency between L1 orthography and L2 pronunciation into lexical retrieval. Furthermore, the participants' word recognition scores were higher for consistent than for inconsistent words. This provides strong evidence that Danish listeners have an advantage from their native orthography when confronted with spoken Swedish, as there are more instances when Danish spelling reflects Swedish pronunciation rather accurately, than instances when Swedish spelling reflects Danish pronunciation. As this is not the case for illiterate pre-schoolers, our data suggested that on-line activation of L1 orthography is part of the explanation of the well-documented asymmetry in mutual intelligibility between spoken Danish and Swedish.

## **7.2. Synthesis and conclusion**

The papers in this thesis indicate that extra-linguistic as well as linguistic factors are linked to the asymmetry in mutual intelligibility between spoken Danish and Swedish. If other factors are controlled for, *language attitudes* correlate weakly, yet significantly with the degree of intelligibility of Danish to Swedish-speaking listeners and of Swedish to Danish-speaking listeners. More specifically, a positive attitude goes with higher intelligibility scores. Our experiments, however, were not designed to investigate the causal relationship between these two factors. That means that it is not clear whether a positive attitude held by listeners towards the speaker increases their willingness to try to decode the language he or she hears, or whether higher intelligibility of the speaker makes the attitude held by the listeners towards speaker more positive.

Literacy is usually considered an extra-linguistic factor as it is based in the subjects and not in the material. However, it is not literacy as such which has an impact on mutual intelligibility between Danes and Swedes. Instead, it is the degree of orthographic conservatism, along with the amount of reduction in the spoken form which seems to have an effect on the degree of intelligibility of Danish and Swedish. These are clearly linguistic factors and they are likely to account for a large part of the variance in mutual intelligibility of closely related languages. More specifically, a conservative native orthography and a conservative pronunciation of a closely related language together work in favour of the listeners, while a progressive orthography which is updated regularly give listeners fewer cues when they are confronted with the spoken form of a progressive closely related language. In our case, Danish has a conservative orthography, while Danish-speaking listeners in our experiments were confronted with a rather conservative pronunciation of Swedish compared to spoken Danish. It turned out that literate Danes can use their orthographic knowledge when decoding spoken Swedish. Based on Doetjes & Gooskens' (2009) findings, the advantage that literate Danes have from their native orthography when listening to spoken Swedish can be assumed to be larger than the advantage that literate Swedes have from their native spelling system when confronted with spoken Danish. It has to be pointed out, however, that Swedish listeners are assumed to use their native

orthography as well when decoding spoken Danish. Danish words such as *gift* [gɪf̥t̚] can be considered to be consistent for Swedish-speaking listeners and therefore to be easier to decode for them than words such as *mild* [mil], where one of the phonemes have been deleted in spoken Danish. However, Doetjes & Gooskens (2009) showed that the advantage can be assumed to be smaller for Swedish-speaking listeners than for Danish-speaking listeners.

The results from the experiment reported in chapter 6 fit nicely with the results from the experiment reported in chapter 2, where we report that mutual intelligibility of spoken Danish and Swedish is symmetrical in illiterate pre-schoolers. This supports the assumption that the access to orthographic knowledge plays a major role for the intelligibility of Danish and Swedish in Scandinavian listeners by serving as an extra cue during spoken language recognition. The distance between the two spoken language forms is naturally symmetric, but this extra cue facilitates word recognition. As the degree of facilitation is not equal in the two groups of listeners (Danish and Swedish), it makes intelligibility scores asymmetric in literate listeners. As Doetjes & Gooskens (2009) showed, Danish listeners benefit from it to a larger extent than Swedish listeners do. If we turn this finding around, the intelligibility of spoken Danish is impeded by the large amount of reduction and assimilation processes in contemporary Danish, which are unrecognisable for Swedish listeners as they are neither reflected in Swedish pronunciation nor orthography.

It can be concluded that three factors which are intertwined with each other account for a large part of the asymmetry in mutual intelligibility between spoken Danish and Swedish. Firstly, Danish pronunciation has changed substantially during the past centuries. Among other things reduction is reflected in the large number of processes such as schwa-assimilation (Basbøll 2005) and consonant lenition and deletion (Pharao 2010). This development has led to an articulatory drifting apart of spoken Danish from its East Nordic root on the one hand and from its neighbouring languages on the other hand.

Secondly, the high number of reduction processes goes hand in hand with a higher articulation rate in Danish compared to Swedish and leads to a large phonetic distance of cognate words across the two languages. This makes cognate words less intelligible to adults as well as to pre-schoolers, and, as they have to overcome the same (symmetric) distance, they encounter the same problems during spoken word recognition of the neighbouring language, as long as they cannot make use of an additional cue such as language-specific orthographic knowledge.

Thirdly, many of these historical reduction processes are not reflected in Danish spelling, which makes the distance between Danish orthography and Swedish pronunciation smaller than the distance between Swedish orthography and Danish pronunciation. Literate speakers of Danish therefore can use their orthographical knowledge when confronted with spoken Swedish as an additional cue, which results in asymmetric intelligibility compared to literate speakers of Swedish.

### 7.3. Future research

By investigating which factors cause the asymmetry in mutual intelligibility between spoken Danish and Swedish, this thesis sheds light on the factors that play a role for language perception in general, and intelligibility of a closely related language in particular. The results reported in this thesis confirm that linguistic as well as extra-linguistic factors have to be considered when modelling intelligibility and thereby this thesis gives important new insights about language perception. It thus lifts the discussion about which factors have a beneficial or detrimental effect on intelligibility to a higher level, which, in turn, opens up new questions and calls for future research.

For example, the three factors speaking tempo, reduction and orthography mentioned in section 7.2 might be intertwined with a fourth factor, namely language attitudes. Our experiments showed a weak, but significant link between intelligibility scores and language attitudes. However, the causal relationship remains unknown. It is possible that negative attitudes impede intelligibility because listeners make fewer efforts to decode the target language, but it might also be the case that low intelligibility of a speaker makes the attitudes held towards that speaker more negative. It is also possible that quick and/or unclear speech impedes intelligibility and makes attitudes more negative. In that case, language attitude and intelligibility would be independent coincident effects of a common cause, namely the high number of reduction processes in spoken Danish. However, this hypothesis has to be left for future studies.

Furthermore, a study investigating the validity of a matched-guise study would therefore be of high scientific value. It is possible that attitudes in contact situations such as talking to a tourist from the neighbouring country or visiting the country oneself differ from those attitudes that were measured in our experimental settings. In 'real life', people have the possibility to choose whether they want to listen to somebody at all, while this is not the case in an experiment. This could be a source of error, as language attitudes are kept within a much smaller range than in 'real life'.

This thesis argues that native spelling is used as extra cue during spoken language recognition, which presupposes that listeners make assumptions about grapheme-phoneme correspondences. These assumptions are most probably based on pure statistical knowledge, such as knowledge arising from the experience that the letter *d* in Danish can reflect the voiced dental plosive /d/ as well as the approximant /ð/ in Danish, but also which of these realisations is more likely. Kessler (2009) calls this type of inference *statistical learning*, as it involves numeric analyses by the learner, proceeding from observations of phoneme-grapheme correspondences and leading to (unconscious) conclusions about the likelihood of specific correspondences. He presents data based on frequencies for sound-spelling correspondences in English, i.e. frequencies for the reflectance of different graphemes and grapheme clusters for specific phonemes, and vice versa. It would be very useful to establish phoneme-grapheme correspondences for Danish and for Swedish, and to calculate e.g. the probability that the grapheme *d* reflects the voiced dental plosive /d/ compared to the probability that it reflects the approximant /ð/.

This would give further information on the factors causing the asymmetry in mutual intelligibility, as the activation of specific L1 graphemes could be quantified.

The link between reduction and intelligibility needs to be investigated more closely in order to tease apart the factors speaking tempo and reduction. This could be done by presenting listeners with Danish and Swedish sentences in different conditions: slowly and clearly produced speech (condition 1) and quickly and highly reduced speech (condition 2) as well as manipulated versions of these two conditions, namely reduced duration of the sentences recorded as condition 1 and extended duration of the sentences recorded as condition 2. This results in four conditions, namely quick and clear, quick and reduced, slow and clear, slow and reduced. By analysing how intelligible utterances from these four conditions are to native speakers as well as speakers of the neighbouring language, the relative contribution of reduction and speaking tempo could be established.

A thorough investigation of mutual intelligibility between other closely related languages could give valuable information on the role of different linguistic and extra-linguistic factors. Asymmetric intelligibility scores have been reported anecdotally for the Nigerian languages Kalabari and Nembe (Wolff 1959), and experimentally for Spanish and Portuguese (Jensen 1989), Dutch and German (Gooskens et al. submitted), Dutch and Afrikaans as well as Frisian and Afrikaans (Gooskens 2007). Studying factors that cause the asymmetric intelligibility in other closely related languages is likely to shed more light on the processes underlying the asymmetry in mutual intelligibility between spoken Danish and Swedish, and thereby on factors influencing intelligibility and language perception in general.

## References

- Basbøll, H. 2005. *The Phonology of Danish*. Oxford: University Press.
- Bø, I. 1978. *Ungdom og naboland. En undersøkelse av skolens og fjernsynets betydning for nabospråksforståelsen*. [Youth and neighbouring country. An investigation of the influence of school and TV on inter-Scandinavian comprehension.] Stavanger: Rogalandforskning.
- Delsing, L.O. & K. Lundin Åkesson. 2005. *Håller språket ihop Norden? En forskningsrapport om ungdomars förståelse av danska, svenska och norska*. [Does the language keep together the Nordic countries? A research report of mutual comprehension between young Danes, Swedes and Norwegians.] Nordiska ministerrådet, Copenhagen.
- Doetjes, G & C. Gooskens. 2009. Skriftsprogets rolle i den dansk-svenske talesprogsforståelse. [The role of orthography in spoken language comprehension between Danish and Swedish.] *Språk och stil*.
- Elbro, C. (2006). Literacy Acquisition in Danish: A deep orthography in cross-linguistic light. In: M. Joshi & P.G. Aaron (Eds). *Handbook of Orthography and Literacy*. Mahwah, NJ: Lawrence Erlbaum.

- Gooskens, C. & S. Kürschner. 2010. Hvilken indflydelse har danske stød og svenske ordaccenter på den dansk-svenske ordforståelse? [What influence do the Danish stød and the Swedish tonemes have on Danish-Swedish word recognition?] In: C. Falk, A. Nord, R. Palm (eds.), *Svenskans beskrivning 30. Förhandlingar vid Trettionde sammankomsten for svenskans beskrivning, Stockholm den 10 och 11 oktober 2008*, 82-92.
- Gooskens, C., R. Van Bezooijen & V. Van Heuven. Submitted. Mutual intelligibility of Dutch-German cognates by children: The devil is in the detail.
- Gooskens, C. 2007. The contribution of linguistic factors to the intelligibility of closely related languages. *Journal of Multilingual and Multicultural Development*, 28 (6), 445-467.
- Jensen, J. 1989. On the mutual intelligibility of Spanish and Portuguese. *Hispania* 72(4), 848-852.
- Kessler, B. 2009. Statistical learning of conditional orthographic correspondences. *Writing Systems Research* 1 (1), 19-34.
- Maurud, Ø. 1976. *Nabospråksforståelse i Skandinavia. En undersøkelse om gjensidig forståelse av tale- og skriftspråk i Danmark, Norge og Sverige.* [Neighbouring language comprehension in Scandinavia. An investigation of mutual comprehension of written and spoken language in Denmark, Norway, and Sweden.] Stockholm: Nordiska rådet.
- Pattamadilok, C., Perre, L., & Ziegler, J. C. 2011. Beyond rhyme or reason: ERPs reveal task-specific activation of orthography on spoken language. *Brain & Language* 116(3), 116-124.
- Perre, L. & Ziegler, J.C. 2008. On-line activation of orthography in spoken word recognition, *Brain Research* 1188, 132-138.
- Perre, L., Pattamadilok, C., Montant, M., Ziegler, J.C. 2009. Orthographic effects in spoken language: On-line activation or phonological restructuring? *Brain Research* 1275, 73-80.
- Pharao, N. 2010. *Consonant Reduction in Copenhagen Danish. A study of linguistic and extra-linguistic factors in phonetic variation and change.* Unpublished Ph.D. dissertation, University of Copenhagen.
- Wolff, H. 1959. Intelligibility and inter-ethnic attitudes, *Anthropological Linguistics*, 1, 34-41.