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Inter-Nordic Communication: The Role of Extra-linguistic and Language-inherent Features for the Mutual Intelligibility of Spoken Danish and Swedish

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Abstract

This article explores how linguistic and extra-linguistic factors contribute to the asymmetry in mutual intelligibility between spoken Danish and Swedish. Positive language attitudes were found to correlate with higher intelligibility, although causality remains unclear. As the asymmetry turned out not to be present in illiterate pre-schoolers, orthography and spoken language reduction appear to play major roles: Danish speakers benefit more from orthographic cues when decoding spoken Swedish than vice versa. Overall, changes in Danish pronunciation, faster articulation, and conservative spelling combine to reduce intelligibility for Swedish listeners more than the other way around.

Keywords: Danish, Inter-Scandinavian Communication, Mutual Intelligibility, Norwegian, Swedish

Introduction

This article summarises separately published studies conducted within the framework of the project *Linguistic Determinants of Mutual Intelligibility in Scandinavia* funded by the Dutch Research Council (NWO). The three mainland Scandinavian languages Danish, Norwegian and Swedish have a reputation of being mutually intelligible, which means that the speakers are able to communicate each using their native language. However, in daily practice, inter-Scandinavian communication sometimes fails. Results from previous studies have shown that especially Danes and Swedes have difficulties understanding each other's languages. While the aim of the overall NWO-funded project

was to measure communicatively relevant linguistic distances among the spoken Scandinavian languages and to develop a model that explains mutual intelligibility in Scandinavia on the basis of these measurements, the current synthesis is the first to focus on one of the larger sub-questions within the project, i.e. the asymmetric intelligibility of spoken Danish and Swedish, and to summarise studies that were conducted to explore the origin of this asymmetry.

The Nordic countries, Denmark, Finland, Iceland, Norway and Sweden and their associated territories Åland, the Faroe Islands and Greenland, share historical events and cultural and political norms. They have co-operated officially in the Nordic Council since 1952 and in the Nordic Council of Ministers since 1971. Both authorities have strongly promoted inter-Nordic collaboration, among other things by emphasising the importance of using Nordic languages in inter-Nordic communication situations rather than English as a lingua franca. The Nordic Language Convention, signed in 1981, ensures that citizens of the Nordic countries are entitled to use their native language in written communication with authorities. As recently as in 2024, *The Declaration of Nordic Language Policy* was signed, which aims at ensuring that citizens of the Nordic countries can communicate in at least one Scandinavian language and have knowledge of the others, so that they can be part of the Nordic language community. Particularly within mainland Scandinavia, i.e. the countries Denmark, Norway and Sweden, communicating across linguistic borders using the language of the speaker has been a longstanding tradition strongly encouraged by the authorities: for many centuries, Danes, Norwegians and Swedes have used their native languages when communicating with each other. This manner of communication has been called "Receptive bilingualism" by Hockett (1958) and "Semicommunication" by Haugen (1966).

Einar Haugen was the first researcher to investigate the mutual intelligibility of mainland Scandinavian languages. In his pioneering study, published in 1953, he elicited data on inter-Scandinavian communication patterns by reaching out to inhabitants of Denmark, Norway, and Sweden by phone, and establishing how much of the neighbouring language they thought they could understand. By this, he elicited self-reported intelligibility of the neighbouring languages, and, notably, only from those that already had a telephone connection at that time. Haugen (1953) reported promising intelligibility scores for most of the six communication situations (Danish in Norway and Sweden, Norwegian in Denmark and Sweden, and Swedish in Denmark and Norway), as self-reported intelligibility was above 80% for four of the language pairs. However, communication between Danes and Swedes seemed to be problematic. More specifically, only 56% of the Danish participants in his study reported to comprehend spoken Swedish, while 54% of the Swedish participants reported to comprehend spoken Danish. Haugen's 1953 publication was written in Norwegian, but 13 years later, he published his findings in English as Haugen (1966). Haugen's (1953; 1966) seminal study was the first to document communication patterns (or rather, self-reports) in Scandinavia of the early 1950s. In the 1970s, shorter papers were published dealing with linguistic influence between the mainland Scandinavian languages, such as Bergman's *Svenska lån från danskan, norskan och finskan* (1971; Swedish Loan Words from Danish, Norwegian and Finnish), Karker's *Om svensk og norsk indflydelse på moderne dansk* (1971; On Swedish and Norwegian Influence on Contemporary Danish) and Lindegård Hjorth's *Nabosprogene i den højere danske skole* (1972; Neighbouring Languages in the Danish High School), but it took a decade before the topic of mutual intelligibility of mainland Scandinavian languages was investigated empirically again, this time by Maurud (1976). In contrast to Haugen, who based his study on the participants' self-reported comprehension abilities, Maurud conducted an investigation to assess exactly how much of their neighbouring languages Danes, Norwegians

and Swedes could understand. He did so by presenting listeners from the three capital cities Copenhagen, Oslo and Stockholm with the neighbouring languages in a translation task. In this study, the highest intelligibility scores for spoken language were achieved by Norwegians listening to Swedish, while the lowest scores were again obtained by Swedish participants confronted with Danish. Maurud thus confirmed Haugen's findings that Danes and Swedes encountered the biggest problems when communicating with each other. Interestingly, Danes comprehended more spoken Swedish (43%) than vice versa (23%).

One of the major criticisms of Maurud's investigation, however, has been the fact that he compared the intelligibility of Swedish among Danes in Copenhagen to the intelligibility of Danish among Swedes in Stockholm (Gregersen 2004). While Copenhagen is located only 30 kilometres from the Swedish border, Stockholm is located about 570 kilometres from the Danish border, which means that there is a substantial geographical asymmetry in the data. This geographical asymmetry can be assumed to be linked to the asymmetry in mutual intelligibility of spoken Danish and Swedish, reported by Maurud. Arguably, closer proximity facilitates trips to the neighbouring country and, likewise, more contact with visitors from the neighbouring country, as well as easier access to radio and television in these pre-internet times. While people living in Copenhagen in the 1970s were within reach of Swedish television and could easily visit the neighbouring country, people living in Stockholm could neither watch nor listen to Danish broadcast programmes, nor could they cross the border to Denmark within a couple of hours. However, Maurud's conclusion was that "Swedes' low understanding of the neighbour languages is a sign that the habit of hearing them and the attitude towards the need for understanding them are of major importance for the Scandinavians' ability to communicate with each other in their respective languages" (Maurud 1976, 71), thereby suggesting that attitudes towards a specific language held by the listener are linked to the listener's intelligibility of that language.

The asymmetric intelligibility between Danish and Swedish has been confirmed in studies by Bø (1978), Börestam Uhlmann (1991) and Delsing and Lundin-Åkesson (2005). Bø presented evidence in favour of the hypothesis and reported that access to broadcast programmes in the neighbouring language enhances intelligibility of that language. Delsing and Lundin-Åkesson concluded that contact as well as language attitudes correlate with intelligibility. Interestingly, however, the consistently reported asymmetry between Danish and Swedish is much less prevalent in written language compared to spoken language (Maurud 1976; Bø 1978; Lundin and Zola Christensen 2001; Delsing and Lundin-Åkesson 2005). This suggests that the asymmetry in spoken language is also linked to speech-related features. Danish and Swedish differ in a number of linguistic features such as vowel space (Disner 1978) and some suprasegmental features such as the Danish laryngeal phenomenon "stød" and the Swedish tone accents, to name just a few. These and other linguistic factors might also play a role for the asymmetry in mutual intelligibility. To further investigate this asymmetry, a research team at the Center for Language and Cognition Groningen (CLCG), consisting of Charlotte Gooskens, Nanna H. Hilton and the author of this article, conducted a series of experiments. Here, I summarise seven of these studies.

1. The Role of Language Attitudes for the Mutual Intelligibility of Danish and Swedish

One of our first studies (Schüppert and Gooskens 2011) explored the role of language attitudes, thereby picking up the assumption by Maurud (1976) that the attitude that a listener holds towards a language is linked to the ability to decode that language. We were not only interested in a potential correlation between the attitude towards the neighbouring language

and the intelligibility of that language, but also in potential differences across age groups. We therefore designed a picture-pointing task that was suitable for very young children. Participants were 19 Danish-speaking and 27 Swedish-speaking pre-schoolers between 3 and 6 years of age, as well as 21 Danish-speaking and 19 Swedish-speaking adolescents aged 17 to 20. In this study, 50 highly frequent Danish-Swedish cognate nouns (e.g. Danish "hoved" and Swedish "huvud"; English "head") were presented auditorily in randomised order. With every noun, four pictures appeared on a touch screen in front of the participant. Participants were instructed to choose the correct picture as quickly as they could by pointing to it on the touch screen. Accuracy and reaction times (RTs) to correct identifications were measured for every item and every participant. After the experiment, we asked participants to indicate if the language they had heard sounded more beautiful, less beautiful, or as beautiful as their native language. These three categories were later coded as 3, 1, and 2 points, respectively.

First of all, not surprisingly, the results showed that the adolescents outperformed the children both with respect to accuracy and reaction times. Interestingly, we found no significant difference between the accuracy scores by Danish-speaking versus Swedish-speaking children, which seems to suggest that the asymmetry reported by previous studies only develops later in life. To our surprise, however, we also found no significant difference in accuracy scores in the adolescents' data, but a closer look at the data revealed that this might have been due to a ceiling effect, which is probably a consequence of having designed a task for very young children in the first place. All Danish and 89% of the Swedish participants scored 90% or higher, which means that there is too little variation in the data to find meaningful effects, such as a language effect (Danish versus Swedish adult listeners).

As expected, the pattern was different for reaction times: while Danish-speaking and Swedish-speaking children performed comparably (i.e. the RTs were symmetrical), the Danish-speaking adolescents were significantly faster in choosing the correct picture for the Swedish noun, than vice versa. Interestingly, a similar pattern was found for the attitude that participants held towards the neighbouring language: while the children held symmetric attitudes towards the neighbouring language, Danish adolescents held a significantly more positive attitude towards spoken Swedish than vice versa. Importantly, however, we found no significant correlation between attitude and intelligibility. In other words, while the group of Danish adolescents was faster in recognising Swedish words, and generally held a more positive attitude towards Swedish than vice versa, it was not the case that individuals with a positive attitude were faster, and those with a negative attitude were slower.

We therefore set out to explore the origins of these two asymmetries in a follow-up study, which was published as Schüppert, Hilton and Gooskens (2015). For this study, we collected additional data using the same picture-pointing task as in the 2011 study. This time, 86 Danish-speaking and 68 Swedish-speaking children aged 7 to 16 participated in the task, thus filling the age gap that our first study left. In addition, we collected their attitudes through a more sophisticated measure by using a matched-guise paradigm (see Lambert *et al.* 1960). For this, we recorded five bilingual speakers, who all read aloud a short story in two languages, respectively. Importantly, one of the five bilingual speakers was a female Danish-Swedish bilingual,[1] while other languages included were Dutch (several speakers), Frisian, German, Finnish, Norwegian, and Indonesian. As usual in the matched-guise paradigm, the participants were under the assumption that the ten short-story fragments were recorded by ten different speakers reading one

[1] This speaker had been selected through a so-called voice parade with Danish and Swedish native speakers, who affirmed that the speaker sounded native-like in both languages (for details, see Schüppert, Hilton and Gooskens 2015).

fragment (rather than five speakers each reading two fragments). The critical data we wanted to collect were the ratings of the bilingual Danish/Swedish speaker, while the other languages only served as fillers, to guise the fact that the participants listened to the same speaker twice (i.e. once in Danish and once in Swedish). The participants were asked to rate each of the "ten" speakers with respect to six personality traits that have been employed in previous matched-guise studies: strange/normal, ugly/beautiful, dumb/smart, unfriendly/friendly, poor/rich, and old-fashioned/modern. We conducted a Principal Component Analysis (PCA) to reduce this data, and found that the first five personality traits correlated to such an extent that they could be represented by one component, which we called "attractiveness". The last trait did not correlate sufficiently with the rest and was therefore extracted as a separate component, which we called "modernity".[2] In the next step, we found that the "attractiveness" of the bilingual speaker when she spoke Swedish was higher than when she spoke Danish, which confirmed our results from the 2011 study. Furthermore, when it came to the picture-pointing task, we found that mutual intelligibility increased with age. In this study we found a low, but significant correlation (r = .19, df = 114, p = .04) between attitude towards the neighbouring language and the ability to decode that language. This only explained 3.6% of the variance, indicating that there are far more important factors for the mutual intelligibility of Danish and Swedish among schoolchildren than language attitude. Importantly, the causality is difficult to establish. It might be the case that listeners hold more positive attitudes when they comprehend the neighbouring language better, but it is also possible that a positive attitude leads to a greater motivation to comprehend.

A concern of this study was that it is likely that the participants recognised the neighbouring language, and therefore rated the bilingual speaker according to common prejudices in the Nordic countries: Swedish is melodic and beautiful, while Danish is a monotonous and indistinctly articulated language, which is hard to grasp. This would be in line with findings reported by Kristiansen (2017), which showed that typically Swedes rate Swedish more beautiful than Danes rate Danish, and that Danes rate Swedish more beautiful than Swedes rate Danish, and that this pattern has not changed substantially between 2001 and 2014.

In a follow-up paper (Gooskens, Hilton and Schüppert 2016), therefore, we investigated if listeners who are less familiar with Danish and Swedish and hold fewer prejudices towards the languages show similar patterns to those observed in our 2015 study. For the 2016 study, we replicated the matched-guise part (but not the picture-pointing task) with 73 German-speaking and 141 Mandarin-speaking participants. For both groups of participants, we ran separate PCAs, which resulted in slightly different components: from the German data, two components representing "attractiveness" and "success" were extracted, and the Mandarin data were represented by a single component representing "attractiveness". Again, in the next step, we found that the German speakers rated the bilingual speaker significantly more attractive and more successful when she spoke Swedish than when she spoke Danish, and, surprisingly, even the Mandarin-speaking participants rated her more attractive overall when she spoke Swedish. As Mandarin is a tone language, we were wondering if the Chinese listeners rated the bilingual speaker more positively when she spoke Swedish, because unlike Danish, Swedish is a pitch-accent language. Tone languages and pitch-accent languages share the feature that pitch patterns can carry lexical meaning, and therefore they require extra attention to intonation. Therefore, in another follow-up study (Hilton *et al.* 2022), we replicated the study once more with highly artificial audio material: the speech samples from all ten speakers, among which

[2] For details of this analysis see Schüppert, Hilton and Gooskens 2015.

the bilingual Danish-Swedish speaker, were monotonised. We collected data from further 316 Mandarin-speaking participants and this time found no significant difference in ratings. This seems to confirm our hypothesis that speakers of Mandarin may prefer pitch-accent languages such as Swedish over stress languages such as Danish, and this may be equally true for speakers of Scandinavian languages. However, it has proven to be difficult to tease apart extra-linguistic factors, such as stereotypical beliefs about the languages involved, from language-inherent features such as intonation. To sum up, we found that Swedish sounds more attractive to adult listeners from various linguistic backgrounds, and there is evidence that this is partially due to differences in Danish and Swedish intonation.

2. The Role of Linguistic Factors for the Mutual Intelligibility of Danish and Swedish

In addition to investigating such extra-linguistic factors, we also conducted a series of studies that focused on the role of language-inherent features for the reported (adult) asymmetry in mutual intelligibility between spoken Danish and Swedish. Danish and Swedish both originally stem from East Old Norse, but have undergone different linguistic processes since then, most notably with respect to pronunciation. Schwa-assimilation and the vocalisation of consonants are well-documented phenomena in Danish (Basbøll 2005; Grønnum 1998 and 2007). While phonological reduction is a characteristic of colloquial language use in most languages (in English, e.g. [fɛb.jə.ɹi] or even [fɛb.ɹi] for /fɛb.ɹu.ɛ.ɹi/ for the word spelled <february>), it seems that such processes may occur with different frequencies across languages. In Hilton, Gooskens and Schüppert (2011), we explored if the degree of reduction indeed differs structurally between Danish and Swedish. To do so, we analysed highly comparable speech samples, i.e. radio news aired on the national broadcasting stations Danmarks Radio (DR) and Sveriges Radio (SR). In addition, we included radio news from Norsk Rikskringkasting (NRK). Snippets of ca. 20-40 seconds from 19 Danish speakers, 18 Norwegian speakers, and 18 Swedish speakers were transcribed orthographically, and the number of canonical syllables was defined for each snippet using the pronunciation dictionaries published by Molbæk Hansen (1990) for Danish, Berulfsen (1969) for Norwegian, and Hedelin (1997) for Swedish. According to these, for instance, Danish <hoved>, Norwegian <hode>, and Swedish <huvud> all have two canonical syllables, independent of how they are actually pronounced by a certain speaker and in a certain context. Pauses of more than 150 milliseconds were removed from the samples, and from the number of canonical syllables per speaker, we calculated each speaker's "canonical articulation rate" (i.e. the number of canonical syllables per second) to normalise for the differences in sample length. In a next step, we used a Praat script developed by De Jong and Wempe (2009) to establish the number of phonetic syllables per snippet. Here, phonetic syllables were defined as intensity peaks in the speech signal that have voicing. Intensity peaks were defined as being at least 2 dB louder than the preceding and following parts of the signal. This means that while the number of canonical syllables per word is a stable measure, the number of phonetic syllables is sensitive to the speaker's actual articulation, which may partly depend on the linguistic context in which a word is pronounced, but also on individual differences, and, importantly, on language-specific peculiarities. Again, just as for canonical articulation rate, we normalised for the differences in sample length, and defined phonetic articulation rate as the number of phonetic syllables per second for every speaker and language. The canonical and the phonetic articulation rates were then analysed.

We found that phonetic articulation rate was highly comparable across the three languages: on average, the 19 Danish and the 18 Norwegian news readers produced 4.4 phonetic syllables

per second, while the 18 Swedish news readers produced 4.5 phonetic syllables per second. In other words, the purely acoustic input is very similar across the three languages. When it came to the canonical articulation rate, the pattern was different: while the Norwegian and Swedish news readers produced 5.4 canonical syllables per second, the Danish news readers produced 6.2 canonical syllables per second. A one-way ANOVA confirmed that this difference is highly significant. This indicates two important findings. (1) First of all, as expected, all three languages reduce the speech signal, i.e. not all underlying canonical syllables can be measured in the acoustic signal. (2) Secondly, this degree of reduction is significantly higher in Danish than in Norwegian and Swedish. This left us wondering if the Danish speakers indeed managed to transport more "content" per second than the Norwegian and Swedish speakers did; however, to explore this further, different speech samples were needed, that only consisted of cognate words.

Therefore, in a follow-up study published as Hilton, Schüppert and Gooskens (2011), we complemented the news readers' data with a second corpus, i.e. 16 semantically unpredictable sentences (SUS) that only consisted of cognate words that exist in all three languages. Examples of such sentences are "Et folk deler et job som går"[3] in Danish, "Et folk deler en jobb som går" in Norwegian, and "Ett folk delar ett jobb som går" in Swedish. These 16 sentences per language were read aloud by three speakers per language, all hailing from the capital regions of Copenhagen, Oslo and Stockholm. We analysed these speech samples in a similar way to the analysis in Hilton, Gooskens and Schüppert , i.e. we calculated phonetic and canonical articulation rates per speaker and per language. The results from this highly controlled corpus showed a similar trend as the news readers' data, although less clear-cut: just as in Hilton, Gooskens and Schüppert (2011), a one-way ANOVA revealed that the phonetic articulation rates were not significantly different across the three languages, while the canonical articulation rates were. Here, a Tukey post-hoc test showed, however, that only the difference between Danish and Swedish was significant: Danish speakers produced 4.7 canonical syllables per second, Swedish news readers produced 3.4 canonical syllables per second, while the Norwegian speakers' articulation rate was situated in-between with 3.9 canonical syllables per second.

We can therefore conclude that the three Danish speakers managed to communicate more content per second than the three Swedish speakers did. These are two important findings for the reported asymmetric mutual intelligibility of spoken Danish and Swedish. (1) Firstly, this confirms that speakers of Swedish listening to Danish need to decode the neighbouring language faster than their native language, while the opposite is true for speakers of Danish listening to Swedish. (2) At the same time, speakers of Swedish not only have to process the Danish auditory input faster, but they also have to reconstruct the lexical equivalent with fewer phonetic features, as the degree of reduction in spoken Danish is significantly higher.

To tease apart these two factors and to further investigate the effect of the relatively high degree of reduction in spoken Danish on Norwegian- and Swedish-speaking listeners, we conducted an experimental study (Schüppert, Hilton and Gooskens 2016), for which we asked one native Danish speaker to read aloud a list of 50 semantically unpredictable sentences. All sentences contained four content words, and the speaker was instructed to produce all sentences twice, and in two different ways: (1) slowly and clearly, and (2) fast and (subsequently) less clearly. In these two recordings, the factors "articulation rate" and "reduction" are still intertwined: fast-produced speech is typically less clear, and clear speech is typically somewhat more slowly produced. In a second step, therefore, we manipulated these recordings: we

[3] Trans.: A people share a job that walks.

time-compressed the sentences that were produced slowly and clearly to align their duration with the sentences that were produced fast and less clearly, and we expanded the duration of the sentences that were produced fast and less clearly to align their duration with those from the slow and clear recording. The factors of time-compression and expansion were established sentence-wise and hence different per sentence "pair"; however, the mean factors for duration manipulation were 1.67 and 0.6, respectively. We now had a speech sample of 50 sentences per condition: (1) slowly and clearly, (2) fast and less clearly, (3) fast and clearly, and (4) slowly and less clearly produced. Using this material in a perception study would allow us to tease apart the effects of the factors "articulation rate" and "reduction" on intelligibility, as conditions (1) and (3) contain the same high degree of phonetic information but differ in duration, while conditions (2) and (4) contained the same low degree of phonetic information, and differ in duration. Likewise, conditions (1) and (4) have have exactly the same long duration but differ in the degree of phonetic detail, while conditions (2) and (3) have the exact same short duration while differing in phonetic detail.

For the perception experiment, we instructed 103 Norwegian-speaking and 66 Swedish-speaking participants to translate every sentence into their native language. A control group of 42 native-Danish speaking participants also took part, but as the material was presented in Danish, their task was obviously not to translate, but simply to write up what they heard. For all three groups of participants, we established the number of correctly translated content words (four per sentence), so that every participant could achieve a maximum of 200 points (4 content words x 50 sentences). Not surprisingly, the mean intelligibility of all conditions was much higher for the native Danish listeners (88.1%), and with 46.3%, the Norwegian listeners outperformed the Swedish listeners, who scored 30.4% on average. Interestingly, the pattern in intelligibility scores across the four conditions was the same for all three groups of listeners: slowly and clearly produced sentences (condition 1) were most intelligible, followed by slowly and less clearly produced sentences (condition 4) and fast and unclearly produced sentences (condition 2). Surprisingly, least intelligible of all were the sentences that were produced fast and clearly (condition 3). This suggests that all three groups of listeners, native and non-native, are able to compensate better for reduction phenomena when the amount of reduction fits the articulation rate, compared to a situation in which there actually would have been enough time for a clear pronunciation, but it remained reduced. To sum up, we found that intelligibility improves with increased clarity of the pronunciation, and not so much with longer duration. This suggests that Swedish listeners mainly encounter problems to "restore" the missing phonemes and syllables, and that the increased articulation rate in Danish weighs less heavily on the asymmetry in mutual intelligibility.

In addition to the well-established reduction processes in Danish mentioned above, such as schwa-assimilation and the vocalisation of consonants, there is evidence that [aj] and [ɑw] are becoming subject to monophthongisation and that the unvoiced, unaspirated plosives /p̬/, /t̬/ and /k̬/ are increasingly reduced, at least in Copenhagen Danish (Pharao 2010), where e.g. /he:ˀld/ (<helt>; Engl. "completely") is reduced to /he:ˀl/. Apart from these recent developments, there are many reduction processes in standard Danish that took place several centuries ago, and are so well-established that pronunciation dictionaries only indicate this reduced pronunciation. In the word <mild> pronounced /milˀ/, Engl. "mild" (Molbæk Hansen 1990), for instance, the word-final phonetic segment was dropped several centuries ago, while it is preserved in its Swedish cognate word, which is pronounced /mil:d/ in colloquial Swedish (Hedelin 1997). Importantly, however, the words' orthographic structure is CVCC in both languages, but while the number of segments in spoken Danish has been reduced to three, namely CVC, the num-

ber of phonetic segments remains unreduced in Swedish. The first three phonetic segments of the spoken forms /milˀ/ and /mil:d/ are identical in Danish and Swedish, but while the word ends with /d/ in Swedish, this final plosive has been deleted in contemporary Danish. Nevertheless, the phonetic segment /d/ is found frequently in spoken Danish and generally written with the letter [d], e.g. in [dansk], pronounced /dænsg/ (Engl. "Danish"). It can therefore be assumed that Danes hearing the Swedish word /mil:d/ are able to match the word-final /d/ to the grapheme of their native orthography. In other words, the Danish spelling is consistent with Swedish pronunciation /mil:d/ for literate Danish listeners, while the Swedish spelling is considered to be inconsistent with the Danish pronunciation /milˀ/ to literate Swedish listeners. It can therefore be assumed that literate speakers of Danish match the Swedish word more quickly or more accurately to its native cognate than Swedes do. In a recent study, we tested this assumption experimentally.

Building on previous research that showed that native speakers of English, French, and Chinese activate their orthographic knowledge of these languages not only when reading, but even when listening to their native language (Seidenberg and Tanenhaus 1979; Jakimik, Cole and Rudnicky 1985; Slowiaczek *et al.* 2003; Chéreau, Gaskell and Dumay 2007; Pattamadilok *et al.* 2009; Perre and Ziegler 2008; Perre *et al.* 2009; Qu and Damian 2017), we set up a study to explore if this also holds true for non-native speech. More specifically, in Schüppert *et al.* 2022, we investigated if native speakers of Danish who listened to spoken Swedish made use of their native Danish spelling when asked to translate spoken Swedish words into Danish.

The participants in this study were 26 students aged 23.5 years on average, who were all right-handed, neither had hearing problems nor dyslexia, and had never learnt Swedish. They mainly hailed from the Danish capital Copenhagen and were paid for their time and had travel expenses reimbursed. Half of the participants (N = 13) were male. We compiled a list of 112 isolated Swedish words that had cognates in Danish and that were spelled in the same way, with the exception of the ä–æ and the ö–ø analogies. These words were produced by a male speaker of the Southern Swedish regiolect with no strong dialectal features. Importantly, the words were selected to form two conditions: 56 words for which the listeners were expected to have an advantage from their native orthography because their native Danish spelling was consistent with the phonemic realisation in Swedish (Orthography+ condition, henceforth O+), and 56 words where the listeners were expected to have no advantage from orthography because their native Danish spelling was inconsistent with the phonemic realisation in Swedish (Orthography– condition, henceforth O–). In both conditions, native and non-native pronunciations form minimal pairs that are spelled identically, but differ in their phonemic realisation in exactly one phonetic segment. It was the realisation of this critical phonetic segment, that was either consistent or inconsistent with native orthography, thus forming the two conditions. An example of the O+ condition is the previously mentioned Swedish word [mil:d], which is pronounced /milˀ/ and spelled <mild> in Danish. The critical phoneme, here, is the [d], which has ceased to exist in spoken Danish, but is preserved in the Danish spelling (and preserved in Swedish in spelling as well as in pronunciation). In contrast, an example of the O– condition is the Swedish word /jif:t/ (Engl. "poison"), which is pronounced /gifd/ in Danish, and spelled <gift> in both languages. Here, the critical phoneme is the /j/. Therefore, just as the word /mil:d/, the word /jif:t/ differs with respect to exactly one phoneme, but in contrast to the word /mil:d/, literate Danish listeners cannot benefit from their native orthography for translation purposes when they encounter the Swedish word. If it holds true that the asymmetry in mutual intelligibility between spoken Danish and Swedish is due to the activation of native orthography, it is likely that the words in the O– condition would be

more challenging for the Danish-speaking participants than the words in the O+ condition. Our data confirmed this hypothesis: translation accuracy of words in the O– condition (50%) was significantly lower than in the O+ condition (63%).

In addition to behavioural results, we monitored the whole translation process using an on-line method: event-related potentials. Participants took part in the translation task in the ERP-lab, and we recorded their continuous electroencephalogram (EEG) via 128 electrodes. The continuous EEG recordings were divided off-line into epochs beginning 100 milliseconds prior to the start of the auditory presentation of the word and ending 1100 milliseconds after word-onset. This rendered brain responses that were directly linked to the onset of the word, the so-called event-related potentials (ERPs), for which the 100 milliseconds prior to the onset of the auditory presentation were used as a baseline. Importantly, separate ERPs were formed for the two experimental conditions (only for correctly translated items). This means that brain responses to all 56 words in the O– condition were averaged across all 26 participants, and likewise, brain responses to all 56 words in the O+ condition were averaged across all participants. On parietal-occipital electrodes (O1 and O2, but not Oz), we detected significant differences in the voltages in a time window of 300-350 milliseconds. Here, the voltages for words in the O– condition were significantly more positive than in the O+ condition. This finding is in line with findings by Pattamadilok *et al.* (2008), Perre and Ziegler (2008), and Perre *et al.* (2009), who typically reported an effect of orthographic inconsistency on centro-posterior and occipital electrodes in a 300-350 ms time window. In contrast to these studies, however, inconsistency did not elicit a negativity but a positivity. This effect only reached significance on two occipital electrodes in a pairwise t-test with condition (O– versus O+) as independent factor, and voltage as dependent factor. Furthermore, on central electrodes (Cz, Pz, Oz), we found significant voltage differences in a time window of 750-1000 milliseconds after word-onset. Here, orthographically inconsistent items evoked significantly lower voltages, i.e. significantly more negative-going potentials on centro-posterior and occipital sites than consistent items did. In other words, O– produced more negative voltages than O+ did. This consistency effect reached significance across the whole time window, and was broadly distributed topographically and highly significant, particularly in a smaller window stretching from 800 ms to 900 ms post-stimulus onset. The voltage differences across the two conditions were large enough as to also produce a significant main effect. That means, if averaged across the scalp, voltages elicited by inconsistent items were more negative than those for consistent items. Our ERP data thus suggest that native orthography is accessed during speech recognition of a closely related language. Specifically, in the case of literate Danes confronted with spoken Swedish, this access enhances spoken word recognition of a closely related language.

Conclusion

This research synthesis reported on seven studies conducted within the project *Linguistic Determinants of Mutual Intelligibility in Scandinavia* that focused on the asymmetric intelligibility of spoken Danish and Swedish. By investigating this asymmetry from various angles, we can identify four larger trends. (1) While attitudes held towards spoken Danish are almost universally more negative than attitudes towards spoken Swedish (and Norwegian), in the Danish-Swedish context the attitudes only account for a very small share of the variance in intelligibility. Furthermore, the causality remains unclear. (2) Spoken Danish shows a higher articulation rate and a larger degree of syllable reduction than spoken Swedish (and Norwegian). The second factor seems to cause more problems for Norwegian and Swedish listeners. (3) Danish-Swedish mutual intelligibility is symmetrical in very young children and becomes asymmetrical roughly

in the period when children attend school. (4) Danish- and Swedish-speaking adults confronted with the spoken variety of the neighbouring language (i.e. Swedish and Danish, respectively) make use of their native orthography during speech recognition.

Generally, Danish has a more conservative orthography than Swedish, and, in recent centuries, spoken Danish has been developing further away from its East Nordic root than spoken Swedish (Elbro 2006; Hjorth *et al.* 2018). This has been confirmed by Gooskens and Doetjes (2009), who reported that spoken Swedish is generally closer to written Danish than spoken Danish is to written Swedish. Furthermore, findings reported by Pharao (2010) suggest that, even today, further reduction in colloquial Danish is ongoing. Together with these findings, the evidence that native orthography is accessed not only during written, but also during spoken language recognition supports the hypothesis that the asymmetry in mutual intelligibility between spoken Danish and Swedish, with Danes having fewer difficulties to decode spoken Swedish than vice versa, can at least partly be explained by differences in the depth of the speakers' native orthographic systems. Generally, the combination of two factors (conservative orthography and ongoing syllable reduction during the last centuries until today) makes Danish orthography less transparent than Swedish orthography (Elbro 2006). These differences may partly explain the finding reported by Elley (1992) and Seymour, Aro and Erskine (2003), who showed that Danish children have more difficulties acquiring Danish orthography than their peers from other Nordic countries. However, it seems that, once speakers of Danish finally have mastered the relatively non-transparent orthographic system of their native language, it serves as an additional cue for spoken language recognition in Swedish.

Taken together, the results from the summarised studies suggest that the asymmetry in mutual intelligibility of spoken Danish and Swedish is mainly caused by phonetic features that distinguish the two languages. As Danish schoolchildren become literate, they can start to make use of their native orthography when listening to spoken Swedish, and as adults, their orthographic knowledge helps them to bridge the pronunciation gaps more efficiently than vice versa.

References

Basbøll, Hans. 2005. *The Phonology of Danish*. Oxford: Oxford University Press.

Bergman, Gösta. 1971. "Svenska lån från danskan, norskan och finskan" (Swedish Loans from Danish, Norwegian, and Finnish). *Språk i Norden / Sprog i Norden* (Languages in the Nordic Region) vol. 2, no. 1: 49-55.

Berulfsen, Bjarne. 1969. *Norsk uttaleordbok* (Norwegian Pronunciation Dictionary). Oslo: Aschehoug & Co.

Bø, Inge. 1978. *Ungdom og naboland: en undersøkelse av skolens og fjernsynets betydning for nabospråksforståelsen* (Youth and Neighbouring Country: An Investigation of the School's and Television's Influence on Inter-Scandinavian Comprehension). Stavanger: Rogalandsforskning.

Börestam Uhlmann, Ulla. 1991. *Språkmöten och mötesspråk i Norden* (Language Meetings and Meeting Languages in the Nordic Region). Oslo: Nordisk språksekretariat.

Chéreau, Céline, M. Gareth Gaskell, and Nicolas Dumay. 2007. "Reading Spoken Words: Orthographic Effects in Auditory Priming". *Cognition* vol. 102, no. 3: 341-60. doi: 10.1016/j.cognition.2006.01.001.

De Jong, Nivja H., and Ton Wempe. 2009. "Praat Script to Detect Syllable Nuclei and Measure Speech Rate Automatically". *Behavior Research Methods* vol. 41, no. 2: 385-90. doi: 10.3758/BRM.41.2.385.

Delsing, Lars-Olof, and Katarina 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 on Young People's Understanding of Danish, Norwegian and Swedish). Copenhagen: Nordisk Ministerråd.

Disner, Sandra. 1978. "Vowels in Germanic Languages". *UCLA Working Papers in Phonetics* vol. 40: 1-79.

Elbro, Carsten. 2006. "Literacy Acquisition in Danish: A Deep Orthography in Cross-Linguistic Light". In *Handbook of Orthography and Literacy*, edited by R. Malatesha Joshi and P.G. Aaron, 31-45. Mahwah: Lawrence Erlbaum Associates.

Elley, Warwick B. 1992. *How in the World do Students Read?* Amsterdam-Hamburg: International Association for the Evaluation of Educational Achievement.

Gooskens, Charlotte S., and Gerard Doetjes. 2009. "Skriftsprogets rolle i den dansk-svenske talesprogsforståelse" (The Role of Orthography in Spoken Language Comprehension Between Danish and Swedish). *Språk och stil* (Language and Style) vol. 19: 105-23.

Gooskens, Charlotte S., Nanna Haug Hilton, and Anja Schüppert. 2016. "Is Swedish More Beautiful Than Danish? Matched-Guise Investigation". In *Nooit het Noorden kwijt* (Never Lose the North), edited by Sara Van den Bossche and Martje Wijers, 165-88. Gent: University of Gent.

Gregersen, Frans. 2004. "Hvorfor kan vi københavnere ikke forstå svensk, når jyder kan forstå københavnsk?" (Why Can't We Copenhageners Understand Swedish while Jutlanders Can Understand Copenhagen Danish?). *Sprogforum. Tidsskrift for Sprog-og kulturpædagogik* (Language Forum. Journal of Language and Cultural Pedagogy) vol. 10, no. 29: 31-34. doi: 10.7146/spr.v10i29.112480.

Grønnum, Nina. 1998. *Fonetik og Fonologi: Almen og Dansk* (Phonetics and Phonology: General and Danish). Copenhagen: Akademisk forlag.

—. 2007. *Rødgrød med Fløde: en lille bog om dansk fonetik* (Rødgrød med fløde: A Book on Danish Phonetics). Copenhagen: Akademisk forlag.

Haugen, Einar. 1953. "Nordiske språkproblemer – en opinionsundersökelse" (Nordic Language Problems – A Poll.) *Nordisk tidskrift för vetenskap, konst och industri* (Nordic Journal for Science, Art and Industry) vol. 29: 225-49.

—. 1966. "Semicommunication: The Language Gap in Scandinavia". *Sociological Inquiry* vol. 36, no. 2: 280-97.

Hedelin, Per. 1997. *Norsteds svenska uttalslexikon* (Norstedt's Swedish Pronunciation Dictionary). Norstedt-Stockholm: Norstedts Akademiska Förlag.

Hilton, Nanna H., Anja Schüppert, and Charlotte S. Gooskens. 2011. "Syllable Reduction and Articulation Rates in Danish, Norwegian and Swedish". *Nordic Journal of Linguistics* vol. 34, no. 2: 215-37.

Hilton, Nanna H., Charlotte S. Gooskens, and Anja Schüppert. 2011. "Artikulasjonshastighet i norske, svenske og danske radionyheter" (Articulation Speed in Norwegian, Swedish and Danish Radio News). *Norsk Lingvistisk Tidsskrift* vol. 29: 205-20.

Hilton, Nanna H., Charlotte S. Gooskens, Anja Schüppert, *et al*. 2022. "Is Swedish More Beautiful than Danish? Matched Guise Investigations with Unknown Languages". *Nordic Journal of Linguistics* vol. 45, no 1: 30-48. doi: 10.1017/S0332586521000068.

Hjorth, Ebba, Henrik Galberg Jacobsen, Bent Jørgensen, *et al.* (eds). 2018. *Dansk sproghistorie: Ord for ord for ord* (Danish Language History: Word for Word), vol. 2. Århus: Aarhus Universitetsforlag.

Hjorth, Lindegård P. 1972. "Nabosprogene i den højere danske skole" (The Neighbouring Languages in the Danish High School). *Språk i Norden / Sprog i Norden* (Languages in the Nordic Region) vol 3, no. 1: 25-44.

Hockett, Charles F. 1958. *A Course in Modern Linguistics*. New York: Macmillan.

Karker, Allan. 1971. "Om svensk og norsk indflydelse på moderne dansk" (On Swedish and Norwegian Influence on Modern Danish). *Språk i Norden / Sprog i Norden* (Languages in the Nordic Region) vol. 2, no. 1: 29-36.

Jakimik, Jola, Ronald A. Cole, and Alexander I. Rudnicky. 1985. "Sound and Spelling in Spoken Word Recognition". *Journal of Memory and Language* vol. 24, no. 2: 165-78.

Kristiansen, Tore. 2017. "The *Hows* and *Whys* of Language-related Stereotypes: A Discussion Based on Scandinavian Examples". In *Stereotypes and Linguistic Prejudices in Europe*, edited by Anna Dąbrowska, Walery Pisarek and Gerhard Stickel, 247-69. Budapest: EFNIL – European Federation of National Institutions for Language.

Lambert, Wallace E., Richard C. Hodgson, Robert C. Gardner, *et al*. 1960. "Evaluational Reactions to Spoken Language". *Journal of Abnormal and Social Psychology* vol. 60, no. 1: 44-51.

Lundin, Katarina, and Robert Zola Christensen. 2001. *Grannspråksförståelse i Öresundsregionen år 2000: Gymnasisters läsförståelse* (Neighbouring Language Comprehension in the Öresund Region in the Year 2000: High School Students' Reading Comprehension). Lund: Lunds Universitet.

Maurud, Øivind. 1976. "Reciprocal Comprehension of Neighbour Languages in Scandinavia: An Investigation of How Well People in Denmark, Norway and Sweden Understand Each Other's Written and Spoken Languages". *Scandinavian Journal of Educational Research* vol. 20, no. 1: 49-72.

Molbæk Hansen, Peter. 1990. *Udtaleordbog* (Pronunciation Dictionary). Copenhagen: Gyldendal.

Pattamadilok, Chotiga, Laetitia Perre, Stéphane Dufau, *et al*. 2009. "On-line Orthographic Influences on Spoken Language in a Semantic Task". *Journal of Cognitive Neuroscience* vol. 21, no. 1: 169-79.

Perre, Laetitia, and Johannes C. Ziegler. 2008. "On-line Activation of Orthography in Spoken Word Recognition". *Brain Research* vol. 1188, no. 1: 132-38.

Perre, Laetitia, Chotiga Pattamadilok, Marie Montant, *et al*. 2009. "Orthographic Effects in Spoken Language: On-line Activation or Phonological Restructuring?" *Brain Research* vol. 1275: 73-80.

Pharao, Nicolai. 2010. *Consonant Reduction in Copenhagen Danish: A Study of Linguistic and Extra-linguistic Factors in Phonetic Variation and Change.* Copenhagen: Det Humanistiske Fakultet, University of Copenhagen.

Qu, Qingqing, and Markus F. Damian. 2017. "Orthographic Effects in Spoken Word Recognition: Evidence from Chinese". *Psychonomic Bulletin and Review* vol. 24, no. 3: 901-06. doi: 10.3758/s13423-016-1164-9.

Schüppert, Anja, and Charlotte S. Gooskens. 2011. "Investigating the Role of Language Attitudes for Perception Abilities Using Reaction Time". *Dialectologia*, Special Issue 2: 119-40.

Schüppert, Anja, Nanna H. Hilton, and Charlotte S. Gooskens. 2015. "Swedish is Beautiful, Danish is Ugly? Investigating the Link Between Language Attitudes and Intelligibility". *Linguistics* vol. 53, no. 2: 375-403. doi: 10.1515/ling-2015-0003.

—. 2016. "Why is Danish so Difficult to Understand for Fellow Scandinavians?" *Speech Communication* vol. 79: 47-60. doi: 10.1016/j.specom.2016.02.00.

Schüppert, Anja, Johannes C. Ziegler, Holger Juul, *et al*. 2022. "Online Activation of L1 Danish Orthography Enhances Spoken Word Recognition of Swedish". *Nordic Journal of Linguistics* vol. 45, no. 1: 80-98. doi: 10.1017/S0332586521000056.

Seidenberg, Mark S., and Michael K. Tanenhaus. 1979. "Orthographic Effects on Rhyme Monitoring". *Journal of Experimental Psychology: Human Learning and Memory* vol. 5, no. 6: 546-54.

Seymour, Philip H. K., Mikko Aro, and Jane M. Erskine. 2003. "Foundation Literacy Acquisition in European Orthographies". *British Journal of Psychology* vol. 94, no. 2: 143-74. doi: 10.1348/000712603321661859.

Slowiaczek, Louisa M., Emily G. Soltano, Shani J. Wieting, *et al*. 2003. "An Investigation of Phonology and Orthography in Spoken-word Recognition". *Quarterly Journal of Experimental Psychology* vol. 56, no. 2: 233-62.