Chapter 2

The role of extra-linguistic factors for mutual intelligibility of spoken Danish and Swedish

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Abstract

Danish and Swedish are closely related languages that are generally mutually intelligible. Previous research has shown, however, that Danes comprehend more spoken Swedish than vice versa. It has been suggested that this asymmetry is caused by extra-linguistic factors such as literacy, contact with, and attitudes held towards the test language. However, linguistic factors, such as supra-segmental features or differences in speech rate, could also cause or increase an asymmetry. The aim of the experiment reported in this paper was to exclude three extra-linguistic factors (attitude, contact, and literacy) in order to determine their role for mutual intelligibility. Participants were 19 Danish- and 26 Swedish-speaking illiterate pre-schoolers. Their task was to match 50 cognate nouns to corresponding pictures in a multiple choice task. Results revealed that word recognition scores in Danish children (63 percent) did not differ significantly from the Swedish scores (65 percent). That means that, in contrast to adult Danes, Danish children did not perform better on the word recognition task than their Swedish peers. This finding suggests that extra-linguistic factors play an important role for intelligibility of a closely related language, and that, as extra-linguistic factors develop, the intelligibility asymmetry emerges.

2.1. Introduction

Inter-Scandinavian communication, i.e. communication between speakers of Scandinavian languages, often takes place in the speakers' native language rather than in English or another lingua franca. This custom is strongly encouraged by Nordic authorities and governments to support Scandinavian languages in a

globalised world. The recommendations rely on the fact that mainland Scandinavian languages Danish, Norwegian and Swedish are closely related and have been proven to be mutually intelligible to a large extent in adults (Bø 1978, Delsing & Lundin Åkesson 2005, Maurud 1976, Gooskens & Kürschner 2010).

In previous investigations, mutual intelligibility of the Scandinavian languages was found to be asymmetrical. This asymmetry is especially large in Danish-Swedish communication: Danes have fewer problems decoding spoken Swedish than Swedes have decoding spoken Danish. This is illustrated in Figures 1 and 2, which show word recognition scores reported by Maurud (1976), Bø (1978), Delsing & Lundin-Åkesson (2005), and Gooskens & Kürschner (2010). The first three studies report spoken as well as written intelligibility scores, whereas Gooskens & Kürschner (2010) only report spoken language intelligibility scores. The intelligibility scores for Swedish-speaking participants listening to spoken Danish range from 20 to 50 percent, whereas the intelligibility scores for Danish-speaking participants listening to spoken Swedish range from 40 to 60 percent.

Figure 1. Intelligibility scores of spoken items reported by Maurud (1976), Bø (1978), Delsing & Lundin-Åkesson (2005), and Gooskens & Kürschner (2010).

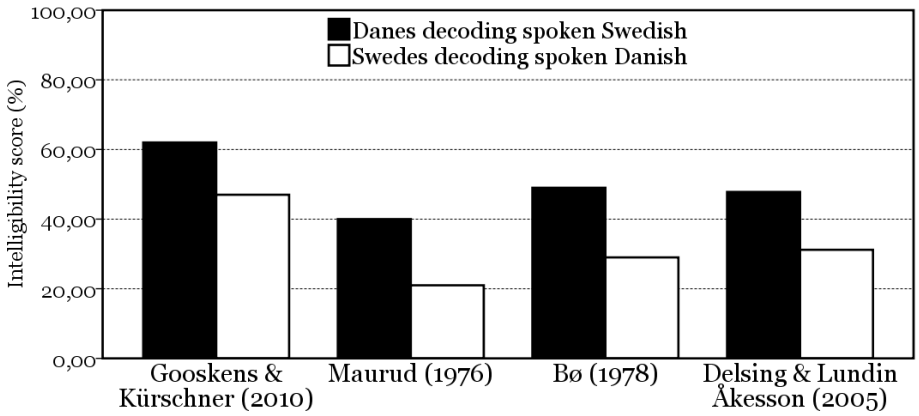
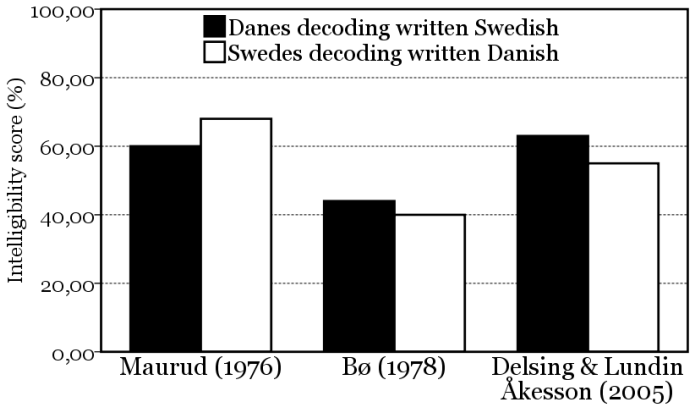


Figure 2. Intelligibility scores of written items reported by Maurud (1976), Bø (1978), and Delsing & Lundin-Åkesson (2005).



A number of factors have been suggested to cause the asymmetry in mutual intelligibility of spoken Danish and Swedish. Bø (1978), for example, investigated whether access to broadcast programmes in the neighbouring language enhances intelligibility of that language (see section 2.3.2.2). Delsing & Lundin-Åkesson (2005) elicited the attitudes towards the neighbouring country and language that were held by the participants of their study (see section 2.3.2.1). Gooskens & Kürschner (2010) investigated the role of different suprasegmental factors for the asymmetry in mutual intelligibility, (see section 2.3.1.1 and 2.3.1.2). Doetjes & Gooskens (2009) suggested that literacy plays an important role for the asymmetry (see section 2.3.2.3). These suggested factors can be divided into linguistic and extra-linguistic factors. Linguistic factors are language inherent features of the spoken forms of the languages, such as supra-segmental features, the average number of phonetic neighbours in the test language, the average word length in the target language, or language-specific speech rate. Danish and Swedish have common roots, but differ in many of these respects. However, in previous research, extra-linguistic factors such as the amount of contact with and attitudes held towards the neighbouring language have mostly been considered to cause the asymmetry in mutual intelligibility between two languages (see Zeevaert 2004 for a detailed overview).

Interestingly, the consistently reported asymmetry between Swedish and Danish-speaking listeners is not found in intelligibility of written texts. As Figure 2 illustrates, intelligibility scores for Danish-speaking participants confronted with written Swedish range from 44 to 63 percent (mean = 60 percent), whereas the scores range from 40 to 68 percent (mean = 55 percent) for the opposite direction. This suggests that the asymmetry between the spoken forms is mainly caused by factors that are inherent in spoken language, such as prosodic features or speech rate.

2.2. Research question

The aim of the experiment reported in this paper is to exclude the influence of extra-linguistic factors (attitude, contact, and literacy) as far as possible and thereby investigate whether or not they play a role for the asymmetry in mutual intelligibility between Danish and Swedish-speaking participants. We hypothesise, here, that linguistic factors account for a large part of the asymmetry and therefore expect the asymmetry in mutual intelligibility to persist even when extra-linguistic factors are kept constant across the two groups of listeners (Danish and Swedish). In contrast to linguistic factors, which are usually based on the stimulus material, the extra-linguistic factors are found in the participants. Therefore, this study is conducted with a group of participants that is likely to be more neutral than participants in most other studies in these three respects: illiterate pre-schoolers from outside the border region. We assume that these participants have had a similar (low) amount of contact with the neighbouring language, cannot use their native orthography to decode the neighbouring language, and hold similar (neutral) attitudes towards it. These assumptions, however, will be tested individually (see section 2.4.1).

In the following section, we will first discuss several linguistic factors that have been found to be associated with intelligibility before turning to the discussion of extra-linguistic factors and their impact in intelligibility.

2.3. Linguistic and extra-linguistic factors

2.3.1. Linguistic factors

In this section, we introduce some linguistic factors that have been found to be associated with word recognition. Specifically, we discuss the role of the Swedish tonemes, the Danish *stød*, the number of phonetic neighbours for a specific word, and word length. We also suggest that a fifth factor, namely speaking rate, might partly account for the asymmetry in mutual intelligibility between Danes and Swedes.

2.3.1.1. Tonemes

Swedish is a pitch accent language, which means that every word has its specific prosodic contour. There are two forms of these word-specific prosodic contours, known as accent 1 and accent 2. The realization of the tonemes varies depending on regional variety. In standard Swedish, accent 1 is characterised by a single peak at the beginning of the first syllable, whereas the prosodic contour in disyllabic words with accent 2 peaks in the second syllable (see Figure 3). This means that monosyllabic words always carry accent 1. There are a number of cases where the prosodic contour is the only distinction between segmentally identical, yet semantically completely different words (Elert, 1972: 163ff). These word pairs form minimal pairs that differ only with respect to their prosodic contour. Minimal pairs, however, that can be assumed to cause problems in actual communication are rare (Schüppert 2003: 12), as many pairs consist of words belonging to different word classes, such as *rutten* /ˊɾΠτ⏌Eν/ ‘the route’ (definite noun) and *rutten* /ˋɾΠτ⏌Eν/ ‘rotten’ (past participle). In the vast majority of the cases, the linguistic context reveals the semantic content of the critical word, even if a wrong tonal contour is assigned to it. Furthermore, there are regiolects where no distinction between the tonal patterns is made (Meyer 1954). Therefore, if an incorrect prosodic contour is assigned to a word, it will seldom cause misunderstandings, but it might impair or delay word recognition. The two different pitch contours illustrated in Figure 3 show the pitch contour of two Swedish words with different tonemes produced by a native Swedish speaker of a Southern Swedish variety (Kronobergs län). The word *bäbis* ‘baby’ has accent 1 and the word *äpple* ‘apple’ has accent 2. It can be seen that the pitch contour in *bäbis* peaks at the beginning of the first syllable and falls continuously until the end of the word. In *äpple*, the first peak is at word onset, and in the middle of the second syllable, the pitch rises again and constitutes a second peak. It is commonly agreed that accent 1 is the unmarked accent (cf. Lahiri, Wetterlin & Jönsson-Steiner, 2005).

Figure 3. Pitch contours of the Swedish words *äpple* ('apple', solid line) and *bäbis* ('baby', dotted line).

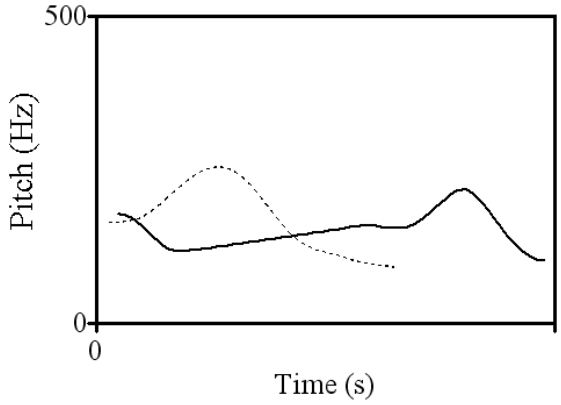
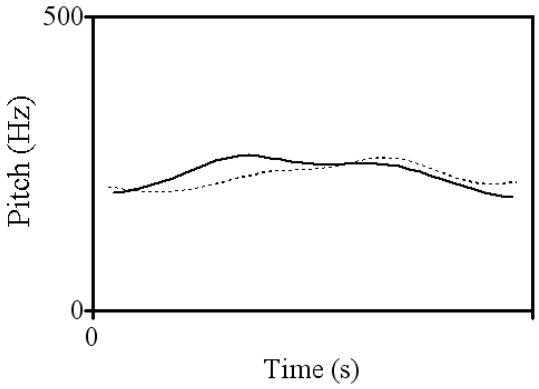
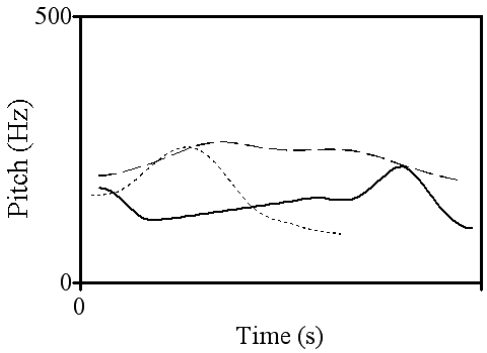


Figure 4. Pitch contours of the Danish words *æble* ('apple', solid line) and baby ('baby', dotted line).



In contrast to Swedish, Danish does not have any tonemes. All words stressed on the first syllable are essentially pronounced with the same prosodic contour. In standard Danish, stress is usually indicated by a lowering of the pitch, whereas in Jutland Danish, it is indicated by a higher pitch that falls on the next, unstressed syllable (Grønnum 1998:157, Lund 2001:79). In general, however, Danish is characterised by rather subtle movements in pitch contour. This can be seen in Figure 4, which displays the rather flat pitch contour of the Danish words *æble* 'apple' and *baby* 'baby' produced by a native speaker of Standard Danish from Funen. In both words, the pitch is low at word onset and rises only subtly in the middle of the word before it falls again. In Figure 5, it can be seen that the Danish pitch contour of a disyllabic word stressed on the first syllable resembles neither the pitch contour of Swedish accent 1 nor the contour of accent 2.

Figure 5. Prosodic contours of the Swedish words äpple 'apple' (solid line) and *bäbis* 'baby' (dotted line) and the Danish word *baby* 'apple', dashed line) from the stimulus material used in the experiment reported in the present paper.



Gooskens & Kürschner (2010) conducted a word recognition experiment with high-school students in Denmark and Sweden. The participants were auditorily presented with 96 highly frequent words in a translation task. Participants living near the Danish-Swedish border were excluded from the analysis. A translation task designed

to filter out Danish/Swedish participants that knew some Swedish/Danish showed that none of the remaining participants had substantial knowledge of neighbouring language. The authors found that Swedish intelligibility scores of Danish stimuli were significantly related to the accent the corresponding word had in Swedish. Danish cognates, i.e. words that share form and meaning across languages, of words that had accent 1 in Swedish were easier to decode for Swedish-speaking subjects than Danish cognates of words that had accent 2 in Swedish. The Danish-speaking participants, however, performed equally well in decoding stimuli from both categories. This suggests that Swedish subjects are confused by the missing tonemes in Danish to a larger degree than Danish listeners are by the unexpected presence of tonemes in Swedish.

2.3.1.2. Stød

The *stød* is a typical supra-segmental feature of the Danish language and is not found in Swedish. It is sometimes misinterpreted as a glottal stop (Lundskær-Nielsen, Barnes & Lindskog 2005; also, the phonetic symbol is /ʔ/), but generally described as a realisation of creaky voice or laryngealisation (Grønnum 1998: 179; Basbøll 2005: 83). Historically, the Swedish tonemes and the Danish *stød* are related. Generally, cognates to words that have accent 1 in Swedish have *stød* in Danish, and cognates to words that have accent 2 do not have *stød*. However, since all monosyllabic Swedish words have accent 1, this rule would imply that all Danish cognates of monosyllabic Swedish words, which are mostly monosyllabic in Danish as well, would have *stød*. This is not the case. Monosyllabic words can have *stød*, as in *mand* /mænˀ/ 'man', or not have *stød*, as in *man* /mæn/ 'generic you'. Also, as Riad (2000: 18) points out, many Danish cognates to words that have accent 2 in Swedish lack *stød* because of low sonority. There are monosyllabic and polysyllabic minimal pairs which differ only with regard to absence or presence of *stød*. As is the case for Swedish tonemes, however, there are regions in Denmark where no *stød* is employed.

Bannert (1981) found that Swedish listeners interpret words with *stød* as having one syllable more than they actually have. He argues that, because listeners have difficulties recognising words with a number of syllables deviating from the number of syllables that the corresponding word in their native language has, *stød* deteriorates intelligibility of spoken Danish for Swedish listeners. Gooskens & Kürschner (2010), however, reported that the presence or absence of the *stød* did not significantly impact intelligibility, neither for Danish subjects listening to Swedish expecting the *stød* in certain words, nor for Swedish subjects listening to Danish confronted with an unfamiliar phenomenon.

2.3.1.3. Number of phonetic neighbours

Linguistic neighbours are words that are very similar to a specific target word, usually differing in one sound only. The three Danish neighbours *syng* /σON/ 'sing', *hæng* /ηεN/ 'hang', and *stæng* /σδ∞εN/ 'close', for example, are neighbours to the Danish target word *seng* /σεN/ 'bed'. It can be assumed that words that are less ambiguous, i.e. less likely to be mixed up with a segmentally similar, but semantically unrelated

word, are easier to understand. Luce & Pisoni (1998) computed neighbourhood density by considering three factors: the number of words that fall within a neighbourhood range (i.e. the number of words that differ in only one phoneme from the target word), the degree of similarity to the target word (i.e. the degree of similarity of the two differing phonemes), and the frequency of the neighbours. They found that word recognition correlates negatively with neighbourhood density, i.e. words in a dense neighbourhood are more ambiguous and therefore more difficult to understand than words with a low neighbourhood density. For example, the probability that the Danish word *syng* is misinterpreted by subjects is likely to be higher than the probability that the word *motorcykel* ('motorcycle') is misinterpreted, as neighbourhood density is higher for *syng* than for *motorcykel*. Indeed, Kürschner et al. (2008) found a low, but significant correlation (r = -.13, p < .001) between neighbourhood density and intelligibility scores in Danish participants confronted with spoken Swedish in a translation task. Neighbourhood density, therefore, has to be considered a linguistic feature which might be able to cause or increase an asymmetry in mutual intelligibility between Danish and Swedish.

2.3.1.4. Word length

Kürschner et al. (2008) showed that intelligibility scores correlate positively with word length (r = .21, p < .001). These results are consistent with findings from previous research, showing that longer words are easier to decode than shorter words (Scharpff & Van Heuven, 1988; Wiener & Miller, 1946). It is assumed that this is caused by the fact that short words are more ambiguous, because they have more 'neighbours'.

2.3.1.5. Speaking rate

It has been shown that higher speech rate deteriorates the intelligibility of speech (Vaughan & Letowski 1997, Gordon-Salant et al. 2007). It is still controversial; however, whether speech rate (i.e. number of syllables produced per second, pauses included) and articulation rate (number of syllables per second omitting pauses) generally differ cross-linguistically (cf. Roach 1998). Osser and Peng (1964) compared American English to Japanese, and did not find a significant difference in speech rate between these two languages. Neither did Kowal et al. (1983), who re-evaluated findings from earlier studies based on spontaneous speech in English, German, French, Spanish, and Finnish. In her comparative study of Italian and Dutch, Den Os (1988) analysed speech and articulation rate in six native speakers per language and did not find any significant differences, when syllables per second were compared across languages. When phonemes per second were compared, however, Italian articulation and speech rate were both significantly slower than Dutch articulation and speech rate. Verhoeven et al. (2004) compared speech tempo in Belgian and Netherlandic Dutch and found that Netherlandic Dutch is spoken at a significantly higher speech rate than Belgian Dutch.

To our knowledge, hitherto, there has been no comparative study of Danish and Swedish speech or articulation rate. As we are interested in comparing the

intelligibility of a concept and the tempo of communicating this concept, we consider that a third measure should be employed for investigating the asymmetry in mutual intelligibility between speakers of Danish and Swedish, namely the number of concepts communicated per second ('*communication rate*'). Alternatively, if isolated words with a similar underlying phonological structure are compared, the duration of these items could be analysed. For example, the monosyllabic Danish word *vand* /ϖE4ˀ/ and the disyllabic Swedish cognate *vatten* /ϖατ˺ən/ may be produced at a similar speech rate in the standard languages, but as they differ in number of syllables, the Danish word would have a communication rate that is twice the Swedish one. We assume, therefore, that communication rate might capture the difference between the recognition problems that a Danish and a Swedish speaker are confronted with in a more accurate way than the traditional measures articulation and speech rate do for our population, as the vast majority of words in Danish and Swedish are cognate words.

2.3.2. Extra-linguistic factors

2.3.2.1. Attitude

Wolff (1959) suggested that attitude towards a closely related variety may influence the effort made to decode it. Having investigated mutual intelligibility between speakers of two Nigerian languages (Kalabari and Nembe), he concluded that negative attitude held towards a language variety might result in less effort to decode it, while a positive attitude might encourage listeners to do their best in decoding the other variety. In Scandinavia, Sweden has been the country with the biggest population and the most prosperous industry for a long time. Therefore, within Scandinavia, Sweden is often called *storebror* (Engl. lit. 'big brother'), indicating that Norwegians and Danes generally regard Sweden as more influential and more dominant than their own country. Following Wolff's (1959) assumption, the fact that Sweden has had a higher status in Scandinavia than Denmark might cause a bias in the willingness to understand the neighbouring language, and thereby a bias in actual intelligibility. In other words, Danish adults may be more willing to understand Swedish than the other way around, and therefore perform better in perception tasks. However, the causal relationship between intelligibility and attitude is not known. It might also be the case that intelligibility influences attitude, instead of vice versa. This would mean that Danish adults have fewer difficulties decoding Swedish than the other way around, and therefore have a more positive attitude towards the Swedish language.

To investigate the relationship between attitude and comprehension, Delsing & Lundin Åkesson (2005) conducted an intelligibility experiment, in which every participant completed a detailed questionnaire. Among other things (see section 2.3.2.2), subjects were asked two questions to elicit their attitude towards the neighbouring country and language: (a) Do you think Danish/Swedish sounds beautiful? (b) Would you like to live in Denmark/Sweden? They showed that Danish-speaking subjects considered the Swedish language more beautiful than Swedish-

speaking subjects considered the Danish language. However, in the same investigation, the asymmetry of the attitude scores was reversed when the same subjects were asked if they would like to live in the neighbouring country. Danes were less willing to move to Sweden than vice versa. In a correlation analysis, Danish comprehension scores were better predicted by the subjects' answer to question (a), whereas Swedish comprehension scores were better predicted by the answer to question (b). Unfortunately, only *p*-values, but no correlation coefficients are reported by Delsing & Lundin Åkesson (2005), which makes it difficult to interpret these results. It seems that intelligibility and attitude are somehow associated with each other, but Delsing & Lundin Åkesson's (2005) data provides evidence neither about the direction, nor of the strength of the causal relationship between these two factors. It is possible that a positive attitude enhances intelligibility, but it might also be the case that higher intelligibility of a given language results in a more positive attitude towards that language.

2.3.2.2. Contact

Several investigations have been concerned with the relationship between the amount of contact to a closely related variety and intelligibility of that language. It has been assumed that a higher amount of previous exposure in form of watching television, reading newspapers, visiting the neighbouring country and other forms of personal contact enhance one's ability to decode a closely related variety.

Maurud (1976) tested mutual intelligibility in young recruits coming from the three Scandinavian capitals Copenhagen, Oslo and Stockholm. Copenhagen is located about 40 km from the Swedish border, whereas Stockholm is located about 570 km from the Danish border. This means that Copenhageners have access to Swedish broadcasting programmes and can visit the neighbouring country rather easily, while people living in Stockholm neither can receive Danish broadcasting programmes nor cross the border to Denmark within a couple of hours. If contact plays a role for intelligibility of the neighbouring language, one would expect the asymmetry between Swedish and Danish intelligibility scores found by Maurud (1976) to be larger than in other investigations. This tendency is indeed confirmed by Figure 1. In Maurud's study, Swedish participants had a comprehension score of 21 percent, whereas Danish participants comprehended 40 percent. The Swedish-speaking subjects thus reached only slightly more than half of the Danish score (53 percent), whereas this figure is higher in all other investigations (Bø, 1978: 59 percent; Delsing & Lundin Åkesson, 2005: 74 percent; Gooskens & Kürschner, 2010: 76 percent).

Bø (1978) investigated mutual intelligibility of Danish, Swedish and Norwegian. The subjects were chosen in such a way that they formed two groups, one living inside and one living outside the border regions. The group of subjects living within the border regions not only had more opportunities to visit the neighbouring country, but also had access to television programmes in the neighbouring variety. Bø (1978) found that subjects living near the border had fewer difficulties decoding the neighbouring variety than subjects living outside the border region, thereby indicating that a high degree of contact enhances intelligibility abilities.

Delsing & Lundin Åkesson (2005), in addition to eliciting individual language attitudes (see section 2.3.2.1), also collected data on four different types of contact for every participant in their intelligibility experiment. Specifically, they asked the participants whether or not they had watched television in the neighbouring language, read newspapers in the neighbouring language, had personal contact to the neighbouring language, and visited the neighbouring country. In line with Bø (1978), they found a significant correlation between contact and comprehension scores. As for the attitude data, however, the authors chose not to present any correlation coefficients, which makes the interpretation of the results difficult.

2.3.2.3. Literacy

The fact that Danish and Swedish are very closely related languages leads to their having a similar morphology, syntax, and orthography. They also share a large part of their vocabularies, i.e. there is a great number of Swedish-Danish cognates. However, contemporary Danish and Swedish differ considerably in pronunciation of these cognates. Spoken Swedish has stayed closer to its East Nordic root than spoken Danish has (Elbro 2006), resulting in a more "opaque phoneme to grapheme relation in Danish" (Bleses & Thomsen 2004) compared to Swedish. This is illustrated in the first two rows in Table 1.

In the first example given in Table 1, the Swedish word *huvud* and the Danish word *hoved* 'head' are both spelt CVCVC. However, the Swedish pronunciation is CVCVC, whereas the Danish pronunciation comes close to CVV(V), if we interpret the approximant /ð̞/ as semivowel. Note that the phonetic sound which is transcribed by the IPA character ð̞ is an approximant articulatorily, and not a fricative.

Table 1. Three words ('head', 'hand' and 'star') written in Swedish and Danish contemporary orthography and IPA symbols to indicate standard pronunciation.

Swedish		**Danish**	
Orthography	**Pronunciation (IPA)**	**Orthography**	**Pronunciation (IPA)**
huvud	hʉ:vəd	*hoved*	ho:əð̞
hand	hand	*hånd*	hʌˀn
stjärna	ɧæ:ɳa	*stjerne*	sd̥jæɐ̯nə

In the second example *hand* vs. *hånd* 'hand', the final (written) consonant is pronounced in Swedish, but not in Danish. As a consequence, it can be assumed that a Dane has advantages when decoding the Swedish word because the final consonant is still written in Danish. On the other hand, a Swede has less support from the Swedish orthography when he or she hears the Danish pronunciation without the final consonant, as this form is found neither in spoken nor in written Swedish.

Examples of advantages in the opposite direction can also be given, however. The Danish word *stjerne* 'star', pronounced with the word-initial consonant cluster /sd̥j/, is presumably easier to understand for a Swede than the corresponding Swedish word *stjärna,* word-initially pronounced with the fricative /ɧ/, is for a Dane. For a

Dane it is unexpected that the written consonant cluster *stj* can be pronounced as /ɧ/. It can be assumed, however, that it is not equally unexpected for a Swede that *stj* is pronounced /sd̥j/ because this approximates an accumulated pronunciation of the three isolated phonemes /s/ /t^{h}/ /j/. Moreover, a phonological rule generally changes the consonant cluster /st^{h}/ into [st] in Swedish (Engstrand 1990), which is similar to the pronunciation in Danish /sd̥j/.

The fact that the Danish and Swedish orthographies are rather closely related makes the written forms of the languages highly mutually intelligible. This has been confirmed by many investigations (see Figure 2). However, as the Danish pronunciation has changed considerably, the distance between the spoken and written language forms is larger for contemporary Danish than for contemporary Swedish. Orthography reflects pronunciation more accurately in Swedish than in Danish. But what is more, as spoken Danish has developed further away from the common East Nordic root than Swedish has, there are instances when Danish orthography reflects Swedish pronunciation more accurately than Danish pronunciation.

Doetjes & Gooskens (2009) calculated the phonetic and orthographic distance for every pair of Danish and Swedish cognate words using the Levenshtein algorithm (for a detailed account of the application of the Levenshtein algorithm in dialectology see Nerbonne & Heeringa 2010). They then corrected the phonetic distance for the advantage that Danes and Swedes have from their native orthography. By comparing corrected and uncorrected phonetic distances, they found that both Danish and Swedish literate listeners have advantage from their reading and writing skills when confronted with the neighbouring language, since for both languages the averaged corrected distances were smaller than the averaged uncorrected distances. Interestingly, however, their data suggested that the advantage of native orthography in spoken word recognition of a closely related language is larger for Danish listeners than for Swedish listeners. In other words, the *hand - hånd* example given in Table 1 is more representative for the Swedish-Danish spelling-pronunciation situation than the *stjärna - stjerne* example. The findings by Doetjes & Gooskens (2009) therefore suggest that the asymmetry in mutual intelligibility could be caused or boosted by an asymmetric advantage from native orthography. It has not been shown, however, whether Danish or Swedish listeners actually can use their native orthography in a word recognition task.

2.4. Method

2.4.1. Participants

Initially, 19 Danish-speaking and 30 Swedish-speaking children aged three to six years old were tested. To make sure that the children had not been exposed to the neighbouring language prior to the experiment, we chose participants living 200 km from the Swedish-Danish border. The Danish participants hailed from Odense and the Swedish participants from Växjö.

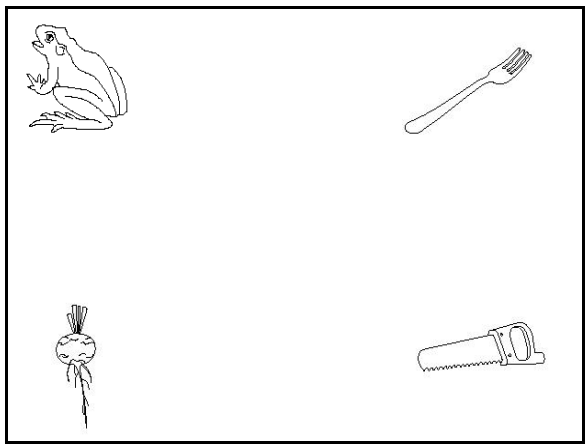
In order to be able to control for the three extra-linguistic factors attitude, contact and literacy, a questionnaire was completed for every participant. In addition to general information such as place and date of birth, the children's parents were asked if their children were monolingual. All parents were asked if their children had visited the neighbouring country, if they had heard the neighbouring language, and if they had watched undubbed TV in the neighbouring language. The parents were also asked if the child had learnt to read and write and, if so, to indicate how many words the child could write. The participating children were asked after the experiment whether they thought the language they had heard during the experiment sounded as nice as, nicer than, or less nice than their native language.

After questionnaire evaluation, one Swedish child was excluded analysis due to extensive exposure to the Danish language through his Danish father. Three Swedish children were excluded because their parents indicated that they could write "many" words or "almost everything". No children were excluded on the basis of their attitude. Forty-five participants (19 Danish and 26 Swedish-speaking) remained for the analysis. The Danish children ranged in age from 4;6 to 6;7 and the Swedish children were aged between 4;0 to 6;8. There was no significant age difference between the language groups.

2.4.2. Stimulus material

The stimulus material was derived in the following manner: First, in a pre-experiment, 112 pictures, selected from the picture database developed at the Max-Planck-Institute for Psycholinguistics, were shown to five four-year-old Danish and five four-year-old Swedish-speaking children from Odense (Denmark) and Växjö (Sweden). These children were not used as participants in the word recognition experiment. The children were asked to label the depicted objects as spontaneously as possible. Then, a labelling consistency per picture was calculated for the most frequent label. To be selected for the experiment, a picture had to fulfil two criteria: It had to have a labelling consistency of at least 80 percent, i.e. it had to be given the same label by at least four of five children (intra-language criterion), and it had to be labelled with a cognate word (inter-language criterion). 53 pictures met these two criteria. Three of them were used in a demo version, leaving 50 pictures for the experiment. Their labels were used as auditory stimuli. In this way, it was ensured that the target pictures (i.e. the pictures that corresponded to the auditory stimuli in the actual experiment) were recognised and produced by children even younger than the age group tested in the experiment and labelled unambiguously by these children. The remaining 59 pictures, supplemented with further 91 pictures from the same database, served as distracter pictures for the word recognition experiment reported below. Figure 6 gives some examples of the pictures employed.

Figure 6. Example set of pictures, taken from the picture database of the Max-Planck-Institute for Psycholinguistics in Nijmegen, the Netherlands. These four pictures were presented simultaneously with the stimulus *gaffel* 'fork'.



To ensure that linguistic features could be interpreted in a reliable manner between the employed varieties, we had to make sure that the children would be presented with a regional standard that corresponded to the variety that was spoken in their environment. The speakers were therefore primarily chosen on the basis of their regional standard language. The 53 labels per language (henceforth ‚stimuli') were therefore produced by two female native speakers from Odense (Denmark) and Växjö (Sweden), respectively. The recordings took place in sound-attenuated rooms and the sound files were digitised at 44.1 kHz.

The stimulus material was originally chosen on the basis of frequency, cognateness, and 'picturebility', and not primarily on the basis of linguistic features. This is true for basically all other studies cited in section 2.1., which reported an asymmetry in mutual intelligibility between Danish and Swedish. To make sure, however, that the material exhibits the linguistic features discussed in section 2.3.2, we conducted an analysis on toneme distribution, distribution of *stød*, word length, and communication rate. The neighbourhood density was not calculated for our material. We assume that the influence of the neighbourhood effect is excluded, as the experiment employed a multiple-choice task. The results of the evaluation are displayed in Table 2. It shows the linguistic features of the stimulus material, and gives the corresponding values for the stimulus material used by Kürschner et al. (2008), who, in line with all other investigations, reported a significant asymmetry, but did not control for literacy, attitude, and only partly for contact (see section 2.3.1.1).

Table 2. Linguistic features of the stimulus material used in Kürschner et al. (2008) and in the present study.

	Present experiment		**Kürschner et al. (2008)**	
	Danish	Swedish	Danish	Swedish
Words with toneme 1 (%)	-	64.0	-	72.4
Words with *stød* (%)	54.0	-	54.8	-
No. of phonemes	4.42	4.60	5.28	5.40
No. of syllables	1.70	1.68	1.99	1.95
No. of phonemes per syllable	2.86	2.92	2.88	2.99
Duration (ms)	478	719	543	820

As can be seen in Table 2, some of the investigated linguistic features are distributed differently across the two languages. Both in the present study and in Kürschner et al. (2008) study, a slight majority of the Danish stimuli had *stød*, and a clear majority of Swedish stimuli had accent 1. The latter is due to the fact that highly frequent words are often monosyllabic, and monosyllabic words always have accent 1. These figures are therefore not necessarily representative for other Swedish samples, but they should be roughly comparable across the two experiments. Furthermore, in both experiments, the Swedish words consist of slightly more phonemes than the Danish words do. Interestingly, however, in both studies, the number of syllables is slightly larger for the Danish stimuli than for the Swedish. This means that, at least in these two samples, Danish syllables consist of fewer phonemes than Swedish syllables do. In both sets of stimuli, word duration was shorter for Danish stimuli (478 and 543 ms) than for Swedish stimuli (719 and 820 ms).

We therefore assume that the stimulus material we used in the experiment reported in this paper has linguistic features similar to the materials used in Kürschner et al. (2008) experiment, where a clear asymmetry in mutual intelligibility was found. As three crucial extra-linguistic factors are held constant here, an asymmetry in mutual intelligibility could indicate that linguistic features play an important role for the asymmetry in mutual intelligibility.

2.4.3. Procedure

The testing session consisted of a picture-pointing task followed by a short interview with every child. Before the experiment started, the children were familiarised with the task by being presented a short demo version of the experiment. The child sat in front of a touch screen (LG L1510SF) wearing a head set. The demo version of the experiment consisted of two trials with stimuli in the children's native language, followed by one trial with a stimulus in the test language. Four pictures per stimulus were presented on the touch screen. The children were instructed to point to the picture that corresponded to the stimulus. Before the word-recognition experiment started, it was ensured that the children had understood the task.

The experimental design and the task of the word-recognition experiment were the same as in the demo version. 50 trials were presented in random order. In every trial, one auditory stimulus was presented in the neighbouring language.

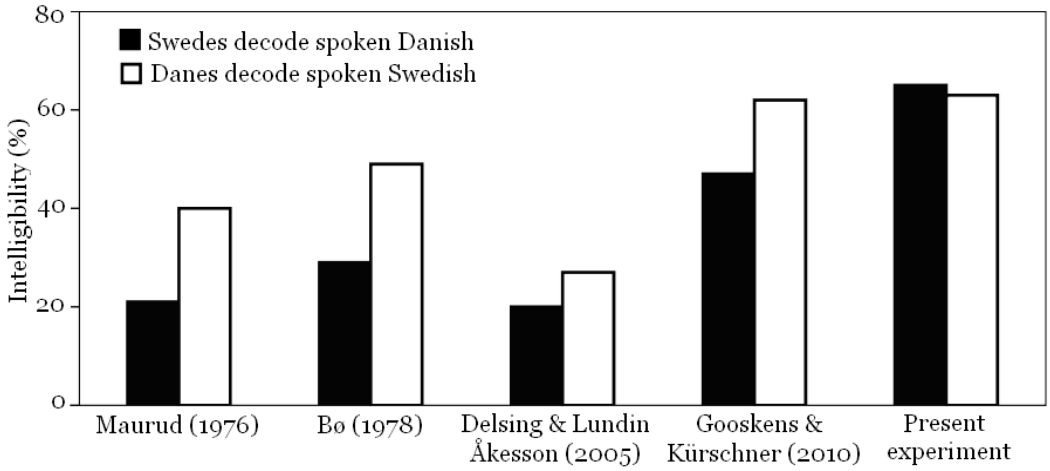
Simultaneously to word onset, four pictures appeared on a touch screen and remained on the screen until the participants touched the screen or for 10 000 ms. Every auditory stimulus was presented together with the same set of four pictures across sessions and languages. The inter-stimulus interval was 1000 ms and no feedback was given. After the experimental part, attitudes towards the neighbouring language held by the participants were assessed by asking the children to rate the language in question on a three-point scale. The scale was designed in such a way that also the youngest children were able to make a choice. The question was posed to the children after the experiment had been conducted. Specifically, the children were asked the following question: "The language you just heard was Danish/Swedish. Did you like it more or less than the language you speak yourself?" The children could provide answers by choosing one of the following categories: (a) nicer than my native language, (b) as nice as my native language, or (c) less nice than my native language.

2.5. Results

Both groups of children held rather neutral attitudes: 89.4 percent of the Danish and 57.8 percent of the Swedish children either had no opinion about the neighbouring language or indicated that they found the neighbouring language as nice as their native language, i.e. answer (b). From the remaining Danish children, 50.0 percent indicated that they found Swedish nicer than their native language and from the remaining Swedish children, 45.4 percent indicated that they found Danish nicer than their native language (answer (a)). The two groups of children (Danish and Swedish) did not hold significantly different attitude towards the neighbouring language ($t(43) = 0.23$, $p = .82$).

The Danish children decoded 63 percent ($S = 0.12$) and the Swedish children decoded 65 percent ($S = 0.12$) of the presented stimuli. This difference was not significant $t(43) = -.50$, $p = .60$, $r = .08$). That means that, in contrast to adult Swedes, Swedish children did not encounter more problems decoding the neighbouring language than their peers from Denmark. The results are illustrated in Figure 7, which displays our results next to the results from previous research that were presented in section 2.1. Note that absolute intelligibility scores cannot be compared between adults and children, because the experimental design differed substantially across the studies. It can therefore not be concluded that children outperform adults from earlier investigations. The asymmetry, however, should be comparable, as the same experimental designs were used across the two languages in all investigations.

Figure 7. Child and adult intelligibility scores in Danish listeners confronted with Swedish stimuli, and Swedish listeners confronted with Danish stimuli found in the present experiment, and those reported by Maurud 1976, Bø 1978, and Delsing & Lundin Åkesson 2005, and Kürschner et al. (2008).



2.6. Discussion and conclusion

Generally, the intelligibility scores obtained in this experiment were slightly higher than the scores reported in previous investigations, so we judged the task to be appropriate for this age group. As our aim was to investigate the role of extra-linguistic factors for mutual intelligibility between Danish and Swedish, we conducted a word recognition experiment with stimuli that had similar linguistic features as the stimuli employed in Kürschner et al. (2008) study. At the same time, we controlled for extra-linguistic factors by choosing participants that were shown to be illiterate, to hold similar (neutral) attitudes towards the test language, and had a similar (very low) amount of contact with the test language. We hypothesised that linguistic factors account for a large part of the asymmetry and expected the asymmetry in mutual intelligibility to persist in our subjects even if the influence of three extra-linguistic factors suggested by previous researchers (attitudes, contact, and literacy) were excluded. Our results, however, revealed that mutual intelligibility of Danish and Swedish in pre-schoolers did not differ significantly across the two language groups. This finding suggests that extra-linguistic factors play an important role for the asymmetry in mutual intelligibility between adult Danes and Swedes. A comparison of our data with results from previous research suggests that, when one or several of the three extra-linguistic factors change with age, they give rise to an asymmetry in mutual intelligibility.

We hypothesised that the fact that mutual intelligibility of spoken language is asymmetric, while mutual intelligibility of written language is not, is due to linguistic factors that are found in spoken language only. Our results suggest, however, that the asymmetry is due to extra-linguistic factors that are relevant in spoken communication only, such as attitude towards a spoken variety or activation of native orthography during word recognition of the neighbouring language. These topics should be investigated more in depth in future research.

We cannot make assumptions about which of the three extra-linguistic factors are the most influential. As all three factors were close to being excluded, it is not possible to run a regression analysis with the three extra-linguistic factors per participant as independent variables and the individual intelligibility score as dependent variable. Therefore, we plan to conduct further studies investigating the roles of attitude and literacy for receptive bilingualism in children, as well as elicit intelligibility scores from Danish and Swedish adults.

Finally, we have to consider the possibility that the asymmetry in adult mutual intelligibility is caused by the neighbourhood effect (see above). This factor is almost completely excluded in a multiple-choice task as employed in our experiment, since our subjects did not have the possibility to translate freely, but had to select from only four different answers. The influence of this linguistic factor needs therefore to be examined in more detail as well.

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