Linguistic and extra-linguistic predictors of inter-Scandinavian intelligibility*

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1. Introduction

This paper reports on an investigation of the mutual intelligibility of the three mainland Scandinavian languages (Danish, Swedish and Norwegian). These languages are so closely related that the speakers mostly use their own languages to communicate with each other. However, this kind of communication sometimes requires a great effort by the speakers (e.g. Maurud 1976, Bø 1978, Börestam 1987). Recently it has been investigated how well people understand each other in the Nordic countries (Delsing & Lundin Åkesson 2005, henceforth referred to as the INS-investigation).[1] In this investigation intelligibility was assessed as well as contact and attitude, but like in all previous investigations little attention was paid to linguistic distances between the languages when explaining the results. In the present investigation, a limited set of the INS-results was analyzed and extra material was added with the aim of gaining insight into the role of linguistic and extra-linguistic variables for the mutual intelligibility between speakers of the three Scandinavian languages.

2. Intelligibility

Method

The present investigation pertains to the intelligibility of the three Scandinavian languages among young Scandinavian-speaking subjects from nine towns in Denmark, Norway, Sweden and the Swedish-speaking part of Finland. The shaded cells in Table 1 show which groups of subjects and which languages were tested. Except for Vaasa (Finland), where no subjects were tested for Danish, the two neighbouring languages[2] were tested in nine towns. Since in each town (except Vaasa) one group of subjects was tested for each neighbouring

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Table 1. Overview of the number of subjects, per intelligibility test and town (shaded cells) and total, percentage of boys and girls, and mean age per town.

Subjects	Test			Total	% boys*	% girls*	Mean age
	Danish	Norwegian	Swedish				
Denmark							
Århus	–	33	59	92	43.5	54.4	18.1
Copenh.	–	62	44	106	28.3	65.1	17.5
Norway							
Bergen	47	–	40	87	51.7	46.0	16.8
Oslo	57	–	84	141	36.2	59.8	16.8
Sweden							
Malmö	44	43	–	87	47.1	46.0	16.9
Stockholm	41	47	–	88	40.9	56.8	16.8
Finland							
Mariehamn	22	25	–	47	40.4	59.6	17.2
Vaasa	**	12	–	12	33.3	66.7	16.4
Helsinki	9	21	–	30	56.7	43.3	16.8
Total	220	243	227	690	41.0	55.3	17.1

*The percentages of boys and girls do not always add up to 100, since not all subjects answered the question about their sex. ** Danish was not tested in Vaasa.

language, a total of 17 groups resulted. In total 690 secondary school pupils between the age of 16 and 19 years participated (41.0% boys and 55.3% girls). Only those subjects were included who had indicated that at home they spoke only the official Scandinavian language of the country in question (Danish, Norwegian or Swedish). Subjects who spoke more than one language at home were excluded to make sure that the subjects all had a high native competence in the Scandinavian language of the country of residence.[3]

To assess the intelligibility of a running spoken text, use was made of a news item which was translated from Norwegian into Danish and Swedish and read aloud by three professional newsreaders who were native speakers of the three standard languages. The mean number of words was 257. Each group of subjects listened to the recording in one of the two neighbouring languages. While listening to the recordings, the subjects wrote down their answers to five open questions about the text. The percentage of correct answers formed the intelligibility score.

Results

In Table 2, percentages of correct answers in the intelligibility test are given, broken down for town and test language. The results are similar to those found in previous investigations (see Section 1). Mutual intelligibility is highest

Table 2. Percentages of correct answers in the intelligibility test broken down for town and test language.

Subjects	Test		
	Danish	Norwegian	Swedish
Denmark		55.1	45.1
Århus	–		
Copenhagen	–	50.8	50.5
Norway	68.5	–	
Bergen		–	86.5
Oslo	67.2	–	86.9
Sweden			
Malmö	37.3	82.6	–
Stockholm	25.1	83.4	–
Finland			
Mariehamn	21.8	82.0	–
Vaasa	–	86.7	–
Helsinki	6.7	57.1	–
Mean	37.8	71.1	67.3

between Norwegians and Swedes (more than 80% correct) whereas Danish is hard to understand, especially for Swedish-speaking subjects (scores below 40%). Intelligibility is not symmetric. For example, the two groups of Danes understand Swedish better (45.1% and 50.5%) than the two groups of Swedes understand Danish (37.3% and 25.1%). In some cases, the percentage of correct answers differs considerably within one country. For example, the subjects in Mariehamn answered 21.8% of the questions about the Danish recording correctly, while the percentage correct was only 6.7 in Helsinki.

3. Extra-linguistic variables

In the INS-investigation, the subjects had been asked questions about their contact with and attitude towards the neighbouring languages. It can be expected that a positive attitude will encourage subjects to try and understand the language in question, whereas a negative attitude will discourage subjects from making an effort. Also, contact with the language, either in its written or spoken form, is likely to improve the performance on the test. In the following sections, these two extra-linguistic factors will be examined more closely.

3.1 Attitude

Method

Two scales had to be filled in by the subjects for each of the neighbouring languages. First they were asked to indicate on a five-point scale how beautiful they thought that each of the two neighbouring languages was (0 = ugly, 4 = beautiful). Next, they were asked whether they would like to live in each of the neighbouring countries (no = 0, maybe = 2, and yes = 4).

Results

In Table 3, the mean attitude scores are shown for each combination of town and test language. Inspection of the table reveals that attitudes may vary considerably depending on the geographical origin of the subjects, even within a country. In general, the listeners are more positive about living in Denmark than in Norway and Sweden. On the other hand, they find the Danish language less beautiful than Norwegian and Swedish. The two attitude scales do not correlate significantly (r=.09, p=.72).

Table 3. Mean attitude scores (0 = least positive, 4 = most positive) broken down for country, town and test language, per attitude question.

Subjects	Danish		Norwegian		Swedish	
	Live in	Beautiful	Live in	Beautiful	Live in	Beautiful
Denmark						
Århus	–	–	1.2	2.5	0.9	1.9
Copenh.	–	–	0.7	1.9	1.3	2.0
Norway						
Bergen	2.0	1.5	–	–	1.8	2.6
Oslo	1.8	1.1	–	–	2.1	2.7
Sweden						
Malmö	2.6	0.9	2.0	2.6	–	–
Stockh.	2.0	1.3	2.3	2.1	–	–
Finland					–	–
Marieh.	1.7	1.1	1.8	2.8		
Vaasa	–	–	3.3	2.9	–	–
Helsinki	2.2	2.3	1.6	2.2	–	–
Mean	2.1	1.4	1.8	2.4	1.5	2.3

3.2 Contact

Some subjects come from places in Scandinavia where personal contact with people from the neighbouring countries is easy. This holds especially for

Copenhagen and Malmö, which have recently been connected by the Øresund Bridge, and also for Oslo, which is geographically close to Sweden. Furthermore, Scandinavians have many opportunities to acquaint themselves with the neighbouring languages via the written and spoken media. Finally, in some schools neighbouring languages are part of the curriculum, though mostly to a very limited degree.

Method

The subjects were asked to fill in four four-point scales from 0 (least often) to 3 (most often) about their contact with each of the neighbouring languages. They were asked how often they watch television, read newspapers and magazines and meet people from the neighbouring contries and how often they go to these countries.

Results

In Table 4 the mean contact scores for each combination of town and test language are presented. Most scores are very low (close to zero), which makes clear that young people in Scandinavia in general make little use of the possibilities to have contact with the neighbouring languages. However, some groups of subjects sometimes watch television from the neighbouring countries (mean scores of 0.6 for Danish and Norwegian and 1.4 for Swedish). Subjects from

Table 4. Mean contact scores (0 = least contact, 3 = most contact) broken down for town and test language, per contact question.

Subjects	Danish				Norwegian				Swedish			
	TV	news-paper	pers. cont.	visit	TV	news-paper	pers. cont.	visit	TV	news-paper	pers. cont.	visit
Denmark												
Århus	–	–	–	–	1.1	0.1	0.6	0.2	1.2	0.2	0.5	0.1
Copenh.	–	–	–	–	0.8	0.1	0.5	0.2	1.2	0.4	0.8	0.7
Norway												
Bergen	0.8	0.4	0.7	0.4	–	–	–	–	1.1	0.2	0.5	0.2
Oslo	0.4	0.3	0.8	0.5	–	–	–	–	1.9	0.5	0.9	1.1
Sweden												
Malmö	1.7	0.3	1.0	1.2	0.3	0.1	0.3	0.2	–	–	–	–
Stockh.	0.4	0.0	0.2	0.3	0.3	0.1	0.4	0.1	–	–	–	–
Finland												
Marieh.	0.2	0.0	0.1	0.1	0.5	0.0	0.2	0.0	–	–	–	–
Vaasa	–	–	–	–	0.4	0.3	0.3	0.0	–	–	–	–
Helsinki	0.1	0.2	0.0	0.0	0.5	0.3	0.4	0.1	–	–	–	–
Mean	0.6	0.2	0.5	0.4	0.6	0.2	0.4	0.1	1.4	0.3	0.7	0.5

Malmö have some personal contact with Danes (1.0) and also visit Denmark every now and then (1.2).

4. Linguistic distances

In addition to attitudes and contact, intelligibility is likely to be influenced by the linguistic distance between the languages involved. In order to investigate the importance of linguistic differences for the intelligibility, I measured the phonetic and lexical distances between the language variety of each group of subjects and the standard varieties of the neighbouring languages tested.

4.1 Phonetic distances

Method

In order to measure the phonetic distances relevant for explaining the intelligibility scores, new recordings had to be made in each of the nine towns. For example, I wanted to measure how difficult it was for the pupils from Stockholm in Sweden to understand the news item in standard Danish. Therefore the phonetic distance was measured between the Stockholm variety of Swedish and standard Danish as pronounced by the Danish news reader on the tape used for the intelligibility experiment.

The texts were read aloud onto tape by pupils from the participating schools. The language of these pupils was regarded as representative for the language of the subjects participating in the listening experiment by their teacher and their classmates. They were instructed to read the text aloud in the language variety which they used for daily communication with their classmates. The language of the pupils can in all cases be characterized as a locally coloured accent (regiolect) rather than a dialect.

All recordings, the versions read by the newsreaders as well as the versions read by pupils from the nine towns, were transcribed phonetically by one phonetician and checked by another phonetician in order to achieve consistent transcriptions. Use was made of the machine-readable phonetic alphabet SAMPA.[4] I wanted to quantify the distances between each of the 17 combinations of language varieties shown in Table 1 (shaded cells), for example the distance between the Bergen variety of Norwegian and standard Danish. To this end, for each combination of language varieties the texts were aligned, i.e. the corresponding words of the texts were placed next to each other. The degree of similarity between word forms was assessed by means of the so-called Levenshtein distance. This is an objective measure which can be calculated

automatically by computer. The measure has been used with success to measure dialect distances and to characterize dialect areas (Heeringa 2004). The Levenshtein distances were based on the phonetic transcriptions of the aligned cognate words only, since it makes no sence to calculate phonetic distances between historically non-related words.

The Levenshtein distance is based upon the minimum number of symbols that need to be inserted, deleted or substituted in order to transform the word in one language into the corresponding word in another language. The fewer operations are needed, the greater the similarity. In the present study insertions and deletions were assigned a cost of 1 point, substitution of identical symbols 0 point, substitutions of a vowel by a vowel or a consonant by a consonant 0.5 point, and substitutions of a vowel by a consonant or of a consonant by a vowel 1 point. Diacritics were joined with the preceding symbol, adding an extra 0.25 point. So, for example the distance between [a] and [a:] was 0.25, that between [a] and [o] 0.5, and that between [o] and [a:] 0.75. The unwanted effect of word length was compensated for by dividing the total sum of costs by the number of symbols aligned.[5] As an example we present the calculation of the distance between the word *gaderne*, 'the streets', in the pronunciation of the Danish variety of Århus and the corresponding standard Swedish word *gatorna.*

alignments	**1**	**2**	**3**	**4**	**5**	**6**
Århus variety	g	ɜ:	ð	ʌ	n	ə
Standard Swedish	g	*a*:	t	ə	n	ə
costs	0	0.5	0.5	0.5	0	0

The transformation involved one substitution of a consonant by another consonant (ð by t) and two substitutions of a vowel by a vowel (ɜ: by *a*: and ʌ by ə). The sum of costs (0.5 + 0.5 + 0.5 = 1.5) is divided by the number of alignments (6). The result is a distance of 25%. The total distance between two languages is the mean distance over all word pairs. The maximum distance score is 100%.

Results

Table 5 shows the phonetic distance between the language varieties of the subjects and the three Scandinavian standard languages. Standard Norwegian is the language in the middle. It is most similar to both the Swedish and the Danish language varieties (a mean distance of 21.1). The largest distance is found between standard Danish and the Swedish varieties in Sweden and Finland (distances between 29.7 and 31.1). In contrast with the attitude scores and the contact scores the differences within one country are not large. This is what could be expected, since the subjects all spoke a regiolect rather than the local dialect.

Table 5. Phonetic distances between the varieties spoken in nine Scandinavian towns and the three Scandinavian standard languages.

Local accents	Standard varieties		
	Danish	Norwegian	Swedish
Denmark			
Århus	–	21.6	28.5
Copenhagen	–	20.3	28.2
Norway			
Bergen	23.8	–	23.4
Oslo	23.1	–	22.0
Sweden			
Malmö	30.7	22.5	–
Stockholm	30.8	21.2	–
Finland			
Mariehamn	31.1	19.9	–
Vaasa	–	21.2	–
Helsinki	29.7	20.7	–
Mean	28.2	21.1	25.5

4.2 Lexical distances

Method

Lexical distances between two language varieties were expressed as the percentage of non-cognates, i.e. historically non-related words, which the listeners heard during the test. Non-cognates should be unintelligible to listeners with no prior knowledge of the test language and a large proportion of these words will impede comprehension.

In contrast with the phonetic distances it is not necessary to measure the lexical distances from the variety of each town to the test language, since there is hardly any variation at the lexical level between the varieties spoken by the groups of listeners within one country. For this reason the distances were calculated between each pair of languages, for example between standard Swedish and standard Danish.

To measure the lexical distances, the word pairs of the aligned texts were given points. A non-cognate was given one point, a compound that is partly cognate was given half a point, and a cognate was given zero points. In some cases a word pair consisted of non-cognates, but still a common synonym cognate existed in the native language of the listeners which would make it possible for them to understand the word in the other language. In such cases the word pair was also given zero points, since what matters is how well the listeners would be able to understand the word.

Distances were calculated in two directions, for example from Swedish to Danish and also from Danish to Swedish. This results in two lexical distances between each language pair. These two distances can be different, since two languages do not always have the same synonyms. For example, in the original Swedish text, the word *förvånade* 'surprised' corresponded to the Danish non-cognate *forbløffede*. However, in Swedish also the common cognate word *förbluffade* exists and therefore the Danish word is likely to be intelligible to Swedish listeners. This word pair was therefore given zero points when measuring the distance from Swedish to Danish. The Swedish word *förvånade*, on the other hand, does not have a cognate synonym in Danish and therefore Danish listeners cannot be expected to understand the Swedish word. When measuring the distance from Danish to Swedish the word pair was therefore given one point.

Results

In Table 6 the lexical distances between each language pair are presented. We see that the Norwegians were confronted with no non-cognates when listening to the Danish text and the Danes encountered only very few non-cognates (1.2%) when listening to the Norwegian text. The highest percentage is found for the Swedes listening to Danish (3.6%).

Table 6. Percentage of non-cognates between the Scandinavian languages. Between brackets the number of point are given (see text).

Listeners	Danish	Norwegian	Swedish
Danish	–	1.2 (3)	2.6 (6.5)
Norwegian	0.0	–	1.4 (3.5)
Swedish	3.6 (9)	3.4 (8.5)	–

5. Predictors of intelligibility

We will now investigate to what extent the extra-linguistic variables (contact and attitude) and the linguistic variables (phonetic and lexical similarity) can predict the results of the intelligibility tests. First, the intelligibility scores (the dependent variable) will be correlated with the different extra-linguistic and linguistic variables (the independent variables). Those variables that show a significant correlation with intelligibility will then be included in a multiple regression analysis in order to investigate which combination of variables leads to the best prediction of intelligibility.

5.1 Correlation between intelligibility scores and predicting variables

The results of the intelligibility tests, i.e. the mean percentage correct answers per town and test language (see Table 2), were correlated with the corresponding linguistic and extra-linguistic scores (Tables 3, 4, 5 and 6). The correlation coefficients and the *p*-values are presented in Table 7. Positive correlations can be expected for the contact and attitude scales and negative correlations for the linguistic distances.

Table 7. Correlation between intelligibility scores and the predicting variables, * = significant at the .05 level and ** = significant at the .01 level (*df*=16).

Scales	*r*	*p*
attitude		
live in	.20	.45
beautiful	.56	.02*
contact		
TV	.18	.49
newspapers	.30	.24
personal contact	.27	.30
visit	.02	.94
linguistic distance		
phonetic	−.82	.00**
lexical	−.41	.10

The correlation between intelligibility scores and attitude scores is low and not significant for the scale 'live in' (*r*=.20, *p*=.45). The correlation with the other attitude scale, 'beautiful', is significant at the .05 level (*r*=.56, *p*=.02). Unfortunately, a correlational analysis does not give any information about cause and effect. It is possible that the subjects tend to make a greater effort understanding a language which they find beautiful, but it could also be the case that they find languages which are relatively easy to understand more beautiful. Furthermore, there could be one or more intervening variables. In Section 5.2, I will return to this point.

As far as the contact scores are concerned, the highest correlations are found for the scales 'newspapers' (*r*=.30) and 'personal contact' (*r*=.27). However, none of the correlations are significant. This is probably due to the fact that there was very little contact in the first place (see Table 4). Furthermore, the contact taking place may be of such a nature that it would not improve the passive understanding of the neighbouring languages. Swedish television programs broadcasted in Denmark, for example, are almost always subtitled. It is possible to receive Swedish television in Denmark, but many programs

are in English. Scandinavians are even sometimes reported to communicate in English.

The correlation with the phonetic distance scores is higher than the correlation with the extra-linguistic variables and the correlation is significant at the .01 level (r=.82, p<.01), so there is a clear relationship between phonetic similarity and intelligibility. In contrast with the attitude scores, phonetic similarity is likely to be the predictor of intelligibility and not the other way round since phonetic similarity is not expected to be influenced by intelligibility. So in this case there is less doubt about the direction of the possible effect. The correlation with the lexical distance scores is not significant (r = .41). The effect of lexical differences is probably more difficult to predict than in the case of phonetic differences. The effect of lexical differences is likely to depend on the nature of the lexical deviances. In some cases one single deviant word can be very disturbing for the comprehensibility of a text while in other cases a number of non-cognates in the text is hardly disturbing because they are not important concepts.[6]

5.2 Linear regression analysis

Because phonetic similarity correlates most strongly with the intelligibility scores, it is likely to be the most important variable for a successful understanding. However, the correlation with the attitude scale 'beautiful' was also significant though less high than with phonetic similarity. In order to investigate whether attitude still has a significant additional contribution to the understanding, a linear regression analysis was performed. The intelligibility scores are the dependent variables and the scores on the scale 'beautiful' and the phonetic similarity scores are the independent variables.

In Table 8, the outcomes of the regression analysis are presented. As expected, the analysis found phonetic similarity to be the main predictor. Attitude does not have a significant additional contribution and was therefore excluded by the procedure. This means that in this study, attitude does not play a significant role for the explanation of the intelligibility scores. A combination of attitude scores and phonetic similarity scores is not a better predictor of intelligibility than phonetic similarity alone. Still, correlation between phonetic similarity and intelligibility is not perfect. Phonetic distance only explains 66% of the variance (r^2). Part of the remaining variance may be explained by noise, but it is also possible that a higher correlation will be achieved if linguistic distance is calculated in a more detailed way.

The reason that attitude does not add to the prediction of intelligibility might be that attitude does in fact correlate highly with phonetic similarity.

Table 8. Results of multiple regression analysis, where intelligibility scores are the dependent variable and phonetic similarity and attitude scores on the scale 'beautiful' are the independent variables.

Independent variables	*r*	*t*	*p*	
phonetic similarity	.81	5.495	.000	included
beautiful	.56	.494	.629	excluded

The correlation is significant at the one percent level (r=.62). The subjects are in general more positive about the neighbouring languages if they are phonetically similar to their own variety and less positive if the phonetic distance is larger. Therefore it is also reasonable to conclude that the subjects are in general more positive about the neighbouring languages if they understand them well. It is less likely to be the case that they understand varieties well if they feel positive toward them.

6. Conclusions

The present investigation has shown that the phonetic distance between cognates is a good predictor of mutual intelligibility of the three Scandinavian languages, while the relationship between lexical distances and intelligibility is less clear. In future research more detailed studies — using more refined linguistic measurements and levels — will be carried out of the relationship between linguistic distances and intelligibility.

Also attitude scores on a scale from 'beautiful' to 'ugly' correlate significantly with intelligibility scores, but this seems to be due to the fact that there is also a high correlation between attitude and phonetic distances. More detailed studies of the relationship between attitude and intelligibility are planned for the future.

Notes

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1. See www.nordkontakt.nu for a description of the project and some preliminary results.

2. 'Neighboring language' is the translation of the Scandinavian *nabosprog/grann(e)språk* and refers to the two Scandinavian languages spoken in the other Scandinavian countries. For example, the neighboring languages of a Norwegian person are Swedish and Danish. Note that only Swedish-speaking subjects were tested in Finland.

3. An exception was made for bilingual Finnish/Swedish subjects since in this case at least one of the parents can be expected to speak Swedish as a mother tongue. The Finnish subjects all attended schools where Swedish was used as the language of instruction.

4. See http://www.phon.ucl.ac.uk/home/sampa/

5. In Heeringa (2004) a more extensive explanation of the procedure is given and a more advanced method is presented where the phonetic distances between the individual sounds are taken into account.

6. In Gooskens (submitted) a more detailed presentation of the relation between intelligibility and linguistic distances is given. Here the Scandinavian results are compared to results of a similar investigation on mutual intelligibility of Dutch, Frisian and Afrikaans.

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