



The influence of non-native morphosyntax on the intelligibility of a closely related language



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Abstract

This study investigates the effect of morphosyntactic differences on our ability to comprehend a closely related language. Previous studies of mutual intelligibility, or receptive bilingualism, have focussed largely on the role of extra-linguistic, lexical, or phonetic factors. Although there is reason to believe that differences in morphology and syntax might worsen the ability to comprehend a closely related linguistic variety, this claim is previously untested. This article reports an experimental investigation of whether Danes' comprehension of the closely related language Norwegian is impeded by certain Norwegian grammatical constructions. We tested sentence comprehension experimentally in four different conditions to assess the relative effect of non-native morphosyntactic features as opposed to non-native phonology on intelligibility. Correctness rates of the responses and reaction times were measured. Results indicate that word-order differences cause larger problems for listeners than morphological differences. However, the non-native phonology featured in the experiment impedes comprehension to a larger degree than the morphosyntactic differences do. Our results have implications for work in natural language processing as well as for studies in speech comprehension, particularly those applied to situations of language learning and teaching in areas where receptive bilingualism is widespread.

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1. Introduction

This article discusses the role that variation in morphology and syntax might play for the comprehension of a closely related language. The claim that differences in morphosyntax influence intelligibility is investigated with a listening experiment testing Danish subjects' comprehension of Norwegian. To demonstrate how the results from this investigation could be applicable to other situations of receptive bilingualism, or semibilingualism, outside the Nordic countries we first describe the state of affairs with respect to mutual intelligibility between speakers living in that region. We then review previous work concerned with morphosyntactic variation and intelligibility, before turning to the methodology, results and a discussion of our own investigation.

1.1. Mutual intelligibility in the Nordic countries

The countries in the Nordic area, under which is understood the Scandinavian countries Norway, Sweden, Denmark, in addition to Finland, Iceland and dependent areas Faroe Islands, Greenland and Åland, share a large proportion of political and cultural norms, due to a history of mutual rulers, governments and population movements across national boundaries

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within the region. The Nordic Council and Nordic Council of Ministers put emphasis on the use of Nordic languages, rather than English, for communicative purposes within the region. Language policies put forward ensure, among other things, that inhabitants of the Nordic area can communicate with other authorities than their own in their native national majority language ([The Nordic Council, 1981](#)). This is made possible especially because of the linguistic similarities that exist between the three national varieties spoken in Scandinavia that are also used in parts of Finland (Finno-Swedish), in Iceland (where Danish is taught as a foreign language in schools) and in the Faroe Islands (where Danish is an official language).

Intelligibility levels between speakers of Norwegian, Swedish and Danish are far from perfect but the situation in Scandinavia is still referred to in literature as one of 'receptive bilingualism' ([Braunmüller and Zeevaert, 2001](#)) (The term 'semi-communication' ([Haugen, 1966](#)) is also used). The situation differs from places where inter-dialectal communication occurs as speakers do not have one standardised variety to refer to in cases of miscommunication. Compared to multilingual communities where speakers retain use of their native language while speaking to interlocutors who speak another language, such as the receptive multilingualism described for instance in [Campbell and Grondona \(2010\)](#), the Scandinavian situation stands out due to the relatively low frequency of contact that occurs between speakers; the Scandinavian languages are largely confined to each their own nation state.

The mutual intelligibility between Norwegian, Swedish and Danish has been subject to a number of investigations since the second half of the last century. [Haugen \(1966\)](#) investigated self-reported intelligibility in a seminal study. His findings indicated that Norwegian was the other variety most easily understood both by Swedes and Danes. Reported intelligibility levels between Swedes and Danes were fairly low: 40% of Danes and 44% of Swedes reported to understand the other language well as opposed to 72% and 61% who reported to understand Norwegian well. Although [Haugen \(1966\)](#) was an investigation of self-reported intelligibility, his findings were replicated in later empirically based studies. [Maurud \(1976\)](#), for example, investigated comprehension of other Scandinavian languages among 506 military recruits from Sweden, Denmark and Norway. He found that Swedes and Danes struggle with the comprehension of other Scandinavian's spoken varieties; while Norwegian informants had the overall highest comprehension scores ([Maurud, 1976](#)). In the most recent studies of mutual intelligibility within Scandinavia, mutual intelligibility *patterns* remain the same. A large-scale investigation of intelligibility rates of spoken and written language in the Nordic countries conducted in 2003 and 2004 ([Delsing and Åkesson, 2005](#)) reports that teenagers in Sweden and Denmark decipher less than their peers in neighbouring countries when listening to the other Scandinavian languages. [Delsing and Åkesson \(2005\)](#) compare their data to the scores reported in [Maurud \(1976\)](#) and show that comprehension scores of neighbouring languages have declined in all Scandinavian speaker groups.

The proposed explanations for this decline in intelligibility scores have been *extra-linguistic* as well as linguistic. [Delsing and Åkesson \(2005\)](#) report a statistically significant correlation between intelligibility levels and language attitudes. However, [van Bezooijen and Gooskens \(2007\)](#) point out that a causal relationship between attitudes and intelligibility rates is hard to establish, as these factors could influence each other (for an in-depth investigation of attitude development and mutual intelligibility, see [Schüppert et al., in press](#)).

1.2. *The relationship between linguistic differences and intelligibility*

The possible *linguistic* explanations for intelligibility problems between speakers of closely related languages are plentiful. It goes without saying that the amount of unfamiliar lexis encountered when listening to a different linguistic variety will have an effect on the intelligibility of the said variety. No quantification of lexical differences between Danish and Norwegian exist as far as the authors know, but previous research of mutual intelligibility indicates that lexical differences speakers encounter in communication situations are miniscule; [Gooskens \(2007\)](#) reports 0–1.2% non-cognates (of all words) between Norwegian and Danish written texts. The factor of lexical variability is therefore unlikely to contribute much to communication problems between Norwegians and Danes.

A number of empirically based investigations in the past have established that phonetic distances play a role for intelligibility. The more phoneme correspondences two varieties have, the higher the degree of mutual intelligibility is ([Gooskens, 2007](#); [Kürschner et al., 2008](#) for Scandinavian languages and [van Bezooijen and Gooskens, 2007](#) for West Germanic languages Dutch, Frisian and Afrikaans). The comprehension rates of *spoken* varieties across the national borders in Scandinavia are lower than those of written language ([Delsing and Åkesson, 2005](#)). This observation indicates that there might be rather substantial differences found in the phonology and phonetic realisations of the languages in question, and this is indeed the case. Phoneme inventories in Norwegian and Danish differ quite substantially. As illustrated in [Table 1](#) Norwegian has 9 distinctive long vowels while the Danish phoneme inventory consists of 13 distinctive long vowels. Also (East) Norwegian has a considerably larger number of consonant phonemes than Danish due to the retroflex sounds found in the inventory.

Table 1
Phonemic long vowels and consonants in Norwegian and Danish.^a

	i:	e:	ɛ:	æ:	ɑ:	y:	ø:	œ:	u:	ʉ:	o:	ɔ:	ɒ:
Norwegian	✓	✓		✓	✓	✓	✓		✓	✓	✓		
Danish	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	p	b	t	ʈ	d	ɖ	k	g	f	v	s	ʃ	
Norwegian	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Danish	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓
	ç	h	r	ʀ	l	j	m	n	ŋ	ɲ	ʎ		
Norwegian	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Danish		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

^a This table presents the phonemic long vowel and consonant inventories of the Norwegian variety spoken around the capital city Oslo (as presented in [Kristoffersen, 2000](#)) – a variety often referred to as Standard Norwegian ([Røyneland, 2005](#)) – and is juxtaposed to Standard Danish (as presented in [Basbøll, 2005:50](#)).

Phonetic processes occurring in linked speech production can also affect intelligibility. Reduction phenomena such as schwa-assimilation and vocalisation of consonants are well-documented phenomena in Danish ([Basbøll, 2005](#); [Grønnum, 1998](#)) but do not occur to the same extent in Norwegian. [Schüppert et al. \(2012\)](#) show that syllable reduction (as well as articulation speed) has a negative effect on intelligibility of the speech signal.

The relationship between speech intelligibility and variability in morphosyntax is one we know little about as of yet. [Gooskens \(2007:447\)](#) suggests that morphological and syntactic differences between the Scandinavian languages could be unimportant for mutual intelligibility between their speakers. This argument is made on the basis of the relatively few accounts that exist about the differences that occur in the languages.¹ Norwegian and Danish are similar on the level of morphology and syntax but a number of differences do exist, some of which are described in section 2.1 (for a discussion of more syntactic similarities between Scandinavian languages see [Holmberg and Platzack, 2005](#)). Importantly, previous studies of speech comprehension, or intelligibility, in Scandinavia have paid much less attention to morphosyntactic differences than to differences in phonology or lexicon.

The likelihood that morphosyntactic differences could have an effect on the intelligibility of a variety that is linguistically similar to one's own is substantial, based on theories and accounts of sentence processing. Most such accounts agree that grammatical constructions are created online by the listener during the comprehension process (e.g. [Frazier, 2002 \[1987\]](#)). Differences between closely related languages on the level of word order are somewhat comparable to differences created by scrambling. Experiments testing the effect of scrambling on comprehension make clear that listeners show a preference for canonical word orders in the input when attempting to parse sentences (cf. [Sekerina, 2003:305](#)). When faced with sentences where a word is not in its canonical order, a listener is likely to rely on the distance between the canonical gap and the word that has been moved. This means that nearby words are more likely to be associated with one another ([Fodor and Frazier, 1980:442](#)) and it is therefore assumed that, at least locally *within* a sentence, the greater the linear distance of the displacement (between the actual and the canonical sentence position of a word, or larger constituent), the longer comprehension will take (cf. [Sekerina, 2003](#)).

Previous empirical studies investigating word order effects on intelligibility have focussed on comprehension of or by second language learners. [Van Heuven \(1986\)](#), for example, investigated the impact of foreign sound-based features versus foreign structure-based features (word order, lexical choice and morphological features) on the comprehension of spoken non-native Dutch. The structure-based factors were influential for comprehension of the speech material by the native listeners but sound-based factors contributed more to comprehension scores (see also [van Heuven and de Vries, 1981:316](#)). [Blau \(1990\)](#) found that although syntactic modifications to English affect second language learners' comprehension when reading, the effect of such modifications was not significant for the comprehension of spoken language.

The role of morphosyntactic differences for comprehension of a different dialect or, specifically, a standard variety, has also been investigated previously, but only to a limited extent. [Speidel et al. \(1985\)](#) looked at the degree to which a simplified

¹ One of the few studies to focus on variability in syntax and communication is [Ridell \(2008\)](#) who studies accommodation in talk-in-interaction between Swedes and Danes working together. [Ridell \(2008\)](#) notes that word-order differences between Danish and Swedish are rare and that particle placement in phrasal verb constructions is the only difference frequent enough to study quantitatively. Her results show that Swedish speakers accommodate their particle placement patterns towards that of Danes ([Ridell, 2008:65,203](#)) but it is unknown whether these results mean that particle placement differences play a role for Danes' comprehension of Swedish in the first place.

syntax or a native phonology might improve the comprehension of Standard English by Hawaiian English school children. A simplified syntax, attained by reducing morphological complexity, had no significant effect on comprehension.

1.3. Importance of understanding the effects of morphosyntax on comprehension

Because of the rather inconclusive findings of the studies summarised above, more empirical data are needed, not only to describe and resolve communication problems occurring in situations of receptive bilingualism, but also to address problems encountered by dialect speakers in educational environments throughout the world. Information about whether variations in morphology or syntax indeed lead to a slower or impeded comprehension is valuable for teachers in settings where children are expected to learn through a standard variety that is both syntactically and morphologically different from their own variety. This is the case, for instance, for speakers of African American Vernacular English (AAVE) in the US education system (e.g. Labov, 1995).

Furthermore, examining whether syntactic differences play a role for the comprehension of a closely related variety adds to our understanding of sentence processing in general. By exploring to what extent the processing of a different syntax and morphology is more problematic than the processing of native grammatical constructions, we hope to describe how language processing works in contexts of receptive bilingualism, something that has not previously been done.

1.4. Predictions about morphosyntactic differences and intelligibility in our study

Our investigation compares intelligibility of differences in syntax and morphology to intelligibility of phonological differences. We do not test here the effect of separate phonological aspects on comprehension, but rather consider phonology as one factor. Since previous research into intelligibility in receptively bilingual communities (see above) show that lexical and phonological factors can impede intelligibility, we hypothesise that if the input consists of lexically identical sentences, aural comprehension of sentences is the most efficient in one's native phonology and morphosyntax. Input with native phonology but foreign morphosyntax will make comprehension slightly more difficult but less difficult compared to input with foreign phonology but native morphosyntax. The prediction is also that sentences where both phonology and morphosyntax is foreign are the most difficult to comprehend for listeners.

2. Methodology

2.1. Selecting language pairs and stimuli

It is difficult to create an exhaustive overview of all the syntactic differences that exist between two languages. We know little about all the syntactic constructions that are possible in spoken varieties of the Scandinavian languages (although these are currently being mapped; ScanDiaSyn, 2010). Constructions that are pointed out as problematic in literature for Scandinavian learners of neighbouring languages (Brøndsted, 1967; Lundeby, 1969; Fjeldstad and Hervold, 1989; Fjeldstad and Cramer, 1992; Cramer and Kirkegaard, 1993; Mårtenson and Fjeldstad, 1993; Rekdal, 2002; Christensen, 2007; Teleman, 2008) were used for the creation of stimuli for the current study. These are all constructions that occur in the *written* Standard varieties of the Scandinavian languages. The biggest discrepancy in syntactic constructions identified in said literature is between Danish and the other two Scandinavian national varieties. The differences between Standard (Bokmål) Norwegian and Standard Danish are the focus of our experiment as the number of cognate words has been shown to be somewhat larger between these two varieties than between Swedish and Danish (e.g. Gooskens, 2007). Creation of investigation stimuli consisting only of cognate words enables testing of the particular influence of phonology and morphosyntax, as opposed to the influence of lexical differences.

Testing whether constructions in Norwegian are problematic for Danes (rather than the other way around) was believed the most likely to yield results in the study. Differences between Norwegian and Danish are not symmetric; syntactic variability is wide-spread in the languages, and perhaps especially in Norwegian. The problematic syntactic constructions for Danes in Norwegian do not necessarily have corresponding problematic constructions for a Norwegian in Danish. Five Norwegian syntactic or morphosyntactic constructions that Danish learners struggle with when learning the language were chosen for the experimental study.² Two of these differ between the languages in word orders, two are different due to their

² A sixth construction was identified in the literature but deemed unsuitable for the experimental design chosen for the current study (i.e. a sentence plausibility task, see below). The construction identified is the possibility in Norwegian to pre-pose negation, as in *Ikke er han snill heller* (not is he kind either) 'he is not kind either', a construction which is impossible in Danish. During a pilot experiment even most Norwegian informants performing the task were not able to correctly determine the plausibility of the semantic content of these types of sentences. They were therefore removed from the final version of the experiment.

morphology, and one has both a different word order and a different morphology. All of the Danish variants are also possible, although somewhat archaic, in Norwegian. Examples 1–5 below are all given in Bokmål Norwegian.

2.1.1. Construction type 1: particle placement (word order difference)

A number of Germanic languages, including Norwegian, have variable particle placement in clauses consisting of a transitive particle verb (a phrasal verb) and its object, but Danish does not (cf. [Svenonius, 1996](#); [Holmberg and Platzack, 2005:427](#)). In Norwegian both construction 1a and 1b exist, whereas in Danish, 1b is ungrammatical. In phrases consisting of a transitive particle verb and a direct object, the particle always follows the object in Danish. In Norwegian the particle can be placed before the object. Construction 1b may therefore present a comprehension problem for a Dane listening to Norwegian.

1a *En mann spiser maten opp*
A man eats food+THE up
'A man eats the food'

1b *En mann spiser opp maten*
A man eats up food+THE
'A man eats the food'

2.1.2. Construction type 2: infinitive marker and negator placement (word order difference)

The second syntactic difference tested in our study is the placement of infinitive markers and negators, another word-order difference between the two varieties. In Danish the infinitive marker cannot precede a negator, whereas in Norwegian, the infinitive marker (*å*) can both precede and follow negation (*ikke*) before a verb phrase. Sentences like 2b will be ungrammatical to a Dane, whereas it will be one of two possible constructions in Norwegian. 2a is grammatical in Danish.

2a *Fotomodeller prøver ikke å bli tykke*
models try not to become fat
'Models try not to become fat'

2b *Fotomodeller prøver å ikke bli tykke*
models try to not become fat
'Models try to not become fat'

2.1.3. Construction type 3: possessive pronoun type (morphological difference)

There exists a difference between Norwegian and Danish in the usage of the reflexive possessive pronouns. In Norwegian, the reflexive possessive pronoun *sine* (with singular forms *sitt* and *sin*) can refer back to both plural and singular subjects, whereas the form can only refer back to a singular subject in Danish. The Danish plural reflexive pronoun is *deres*, which is the same form as the 3rd person plural possessive pronoun, also used as such in Norwegian. The semantic scope of the reflexive marker *sine* is thus that it can express either possession by a singular or a plural subject in Norwegian, while it can only express possession by a singular subject in Danish. The sentence presented in 3b is ungrammatical in Danish and is believed to cause some comprehension difficulty for a Danish listener of Norwegian.

3a *Gartnere vanner deres blomster*
Gardeners water their/their own Flowers
'Gardeners water their flowers'

3b *Gartnere vanner sine blomster*
Gardeners water their own flowers
'Gardeners water their own flowers'

2.1.4. Construction type 4: double definiteness (morphological difference)

Another morphosyntactic difference that exists between Danish and Norwegian is in the marking of definiteness in nouns. In Norwegian demonstrative noun phrases the marking of definiteness occurs twice, once with a demonstrative determiner such as *den* 'the' or 'that' or *denne* 'this', as well as with a definite article suffix. In the example *denne bilen* 'this

car' we see the marking with a determiner (*denne*) and a masculine definite article suffix *-en* postposed to the noun *bil* 'car'. In Danish noun phrases, the definiteness is only marked once.³ A definite phrase is marked with a definite article suffix on the noun. Demonstrative phrases (and definite noun phrases with adjectives) are marked with a (demonstrative) determiner before the noun phrase. The morpheme used in Norwegian for definiteness in a demonstrative phrase or a noun phrase with an adjective is not foreign to Danes. The same definite-article morpheme is found in their native language. It is the double marking of definiteness that is the anomaly.

To Danes, the extra marking of definiteness on the Norwegian nouns may cause some comprehension problems. 4a is grammatical in Danish (and archaic in Norwegian). 4b is ungrammatical in Danish and the unmarked variant in Norwegian.

4a *Februar er den korteste måned*
February is the shortest month
'February is the shortest month'

4b *Februar er den korteste måneden*
February is the shortest month+THE
'February is the shortest month'

2.1.5. Construction type 5: possessive pronoun placement (word order and morphological difference)

The final construction that may prove difficult for Danes in Norwegian is both morphological and word-order based: the placement of possessive pronouns and the addition of a definite article suffix in possessive noun phrases. In Danish possessive pronouns are placed before the object noun. The pre-posed possessive marker also marks definiteness (cf. [Holmberg and Platzack, 2005:440](#)). In Bokmål Norwegian, however, the possessive pronoun can be post-posed. When post-posed, the possessive pronoun does not work as a definite marker and a definite article suffix must be added to the noun. Norwegians have available sentence type 5a as well as 5b, whereas the 5b is ungrammatical in Danish.

5a *En bonde arbeider på sin traktor*
A farmer works on his tractor
'A farmer works on his tractor'

5b *5b En bonde arbeider på traktoren sin*
A farmer works on tractor+THE his
'A farmer works on his tractor'

2.2. Experimental design

To test the effect of the Norwegian morphosyntactic constructions described above on Danish listeners' comprehension, a sentence plausibility experiment was designed, where informants had to judge the content of aural input as 'plausible' or 'implausible'. This approach was chosen over a more traditional sentence verification test (where the content would be deemed as either 'true' or 'untrue') as it was considered impossible to design enough sentence types for the experiment that are universally true at the same time as being formulated within the syntactic frameworks discussed above.

2.2.1. Stimulus material

Forty sentences consisting of cognate words only were constructed for the experiment: eight sentences for each syntactic construction type (sections 2.1.1–2.1.5). Four of these eight had a semantic content that could be deemed plausible while the other four were semantically implausible. All sentences used in the experiment are given in [Appendix A](#).

A large number of the implausible sentences can be said to be universally untrue due to their lexical content. One such example is 'An only child plays with its sister'. Furthermore, some sentences in the corpus consisted of semantically related words, as 'only child' and 'sister' as above or 'doctors' and 'patients' in the sentence 'doctors treat their patients'. Semantically related concepts like these were found both in implausible as well as plausible conditions. Some sentences

³ In certain instances, spoken Norwegian also shows single marking of definiteness in these types of sentences. This is variable in certain expressions, like *den amerikanske president* or *den amerikanske presidenten* 'the American president'. These sentences are excluded from our experimental design.

did not consist of concepts that were particularly related semantically speaking, but could still be deemed plausible or implausible. An example is the sentence 'A man prints out an article', a sentence with plausible content.

Due to the variable semantic content of the sentences, response times and number of correct responses will not be compared across sentence types in the analysis, but rather between the phonology and morphosyntax conditions (where the same sentences were used). Following [Vissers et al. \(2007:12\)](#) we expect parsing of implausible utterances to take longer than the parsing of plausible utterances.

Only sentences that were deemed unmistakably plausible or implausible to a small group of native speakers of Danish (3) and Norwegian (8) in a pilot experiment were included in the experiment. All 40 statements in the experiment were articulated in the present tense. None of the content words in the stimuli are used more than twice.

2.2.2. Stimulus recording

The 40 sentences described above were recorded in four different conditions: with Danish phonology and Danish morphosyntax (condition A), with Danish phonology but Norwegian morphosyntax (condition B), with Norwegian phonology but Danish morphosyntax (condition C), and with Norwegian phonology and Norwegian morphosyntax (condition D). A bilingual speaker was chosen to produce the stimuli to control for differences in personal voice characteristics between the conditions. All sentences consisted of morphemes that are Danish as well as Norwegian (but that could have different syntactic functions in the two languages; see sections 2.1.1–2.1.5). The bilingual speaker was therefore presented with an unnatural, yet fairly unproblematic task when producing the sentences in different conditions.

The bilingual speaker was born in the Aarhus area in Denmark but had lived in Oslo, Norway, from the age of 8. Two 'voice parades' were designed to test how native the bilingual speaker sounded to Norwegian and Danish listeners. For both voice parades text passages were recorded and presented to listeners through a web site. Listeners were asked to state to which degree the recordings they heard sounded foreign. In the Danish voice parade, four recordings of the same text passage were presented to listeners. One of these recordings was made by the bilingual speaker. The three others were produced by native Danish speakers from Aarhus and Aalborg, i.e. the same geographical area that the bilingual hailed from. The Norwegian voice parade consisted of five recordings (also of the same text passage). The distracter recordings in the Norwegian version were all recorded by speakers from Oslo. In neither test was the bilingual speaker rated significantly less native sounding than the other speakers. In both tests, one, or more, recordings of native speakers scored worse on a perceived nativeness scale than the bilingual speaker. We claim therefore that all stimuli recorded for the experiment sound natively Norwegian and Danish, phonetically speaking.

2.3. Execution of the experiment

Our experiment was designed and conducted using E-prime, version 2.08.22, an application for designing computerised experiments. Informants were first presented with a short demonstration task where they heard two sentences with Danish phonology and two sentences with Norwegian phonology. The syntactic structure of these test sentences was both grammatical in Norwegian and Danish, and sentences consisted of cognate words only.

In both the demonstration task, as well as the actual experimental setting, listeners were instructed to listen to sentences and evaluate their content as either 'plausible' or 'implausible'. Subjects wore headphones and heard the stimuli while an hourglass and the two alternative answers 'implausible' and 'plausible' were displayed on the computer screen in front of them. Two keys on the keyboard, M and Z on a Standard Dutch Qwerty Keyboard, were marked with a green and a red sticker, respectively. The green key (to the right) represented a plausible reply, and the red (to the left) represented an implausible reply. All informants were informed explicitly, by the experimenter, that they should respond as quickly and correctly to the stimuli as possible by pressing the appropriate key on the keyboard.

The recorded sentences (160 in total) were not all presented to the same informants. A crossed design was used, such that each informant heard 20 plausible and 20 implausible sentences divided equally over the four phonology-by-morphosyntax conditions. Listeners heard the same sentence in just one version and heard an equal number of sentences (10) from every morphosyntax-by-phonology condition. Correct responses as well as decision times were collected from the informants. All informants participated in the experiment on the same laptop computer.

To measure reaction times, a point of decision was identified in the sentences as to when these could be deemed plausible or implausible. The identification of such decision points were done independently by two researchers, native speakers of Danish and Norwegian respectively. These researchers agreed on all decision points in the sentences.

The decision point modification was done to make the analysis of reaction times more sophisticated. We wanted to ensure that the time point in a sentence where the listener can start to form a decision about the plausibility of the semantic content would not interfere with our results. To exemplify why such a modification was necessary, the sentence 'A cat speaks with your mother' *En katt snakker med din mor* can be judged as clearly implausible before the sentence ends. The end of the preposition 'with' is the point where the sentence can be deemed implausible, as adding a negator after 'speaks' would still have made the sentence plausible ('a cat speaks not'). The reaction time in this sentence is therefore measured

from the end of 'with' *med*, in both syntactic versions (the Norwegian version of the sentence is *En katt snakker med moren din*). In the end, the modifications of decision points were applied to only 3 of the 32 sentences that were part of the reaction time analysis (only correct answers to a subset of the sentences were used for that analysis). For many sentences no modifications were made because it would be possible to add information towards the end that could change the plausibility value of the information in the sentence. The sentence 'A library lends out coffee', for instance, is only implausible when the listener can be sure the sentence has ended, and that a construction like '-themed books' does not occur at the end. The three sentences that were part of the reaction-time analysis data and that had decision points modified were 'A pig advances money' (construction type 1); 'An elephant looks up a word' (construction type 1) and 'A cat speaks with your mother' (construction type 5). In the latter two, the decision point remains the same throughout the morphosyntax conditions. The only sentence where a difference in measuring points occurred between morphosyntactic conditions was 'A pig advances the money', where the decision point was modified to after the word *penger* (money), hence at the end of the sentence with Norwegian morphosyntax, while before the end with Danish morphosyntax, where a particle is still to occur before the end of the sentence has been reached. The reaction times measured in the correct responses for this sentence were compared statistically to the reaction times of correct responses to the other implausible sentences in the same morphosyntactic category (construction type 1). This was to check that reaction time measurements from modified decision points did not differ significantly from unmodified decision points. In a two-tailed *t*-test of reaction times, the difference between reaction times to the sentence 'a pig advances the money' and reaction times to other implausible sentences from category 1 is far from being significant.

2.4. Participants

The participants in this investigation were all native Danish speakers from the Jutland ($N = 44$) and Copenhagen ($N = 8$) areas. In the chi-square analysis of correct answers and a two-tailed independent samples *t*-test of reaction times, there were no significant differences between speakers from these two regions in the sample. The informants are therefore all included together in the analysis. The subjects ranged between 21 and 36 years old (mean age 25.3). 24 informants were female and 28 were male. The informants had all attended university. Only subjects who had not previously lived in Norway and had not studied Nordic languages were included in the sample. Subjects were recruited by two Danish students of linguistics. For the analysis of reaction times (discussed in section 3.2), a subsample of 41 right-handed informants was used.

3. Results

3.1. Overall results: correctness

A number of sentences with Danish phonology and Danish morphosyntax were judged incorrectly by the Danish listeners, i.e. sentences we had predicted to be implausible were deemed plausible, or vice versa. No listener replied correctly to all stimuli. The errors the listeners made in each condition are presented in Table 2.

As expected, the Danish listeners had fewest difficulties comprehending sentences with Danish phonology and morphosyntax (condition A) and most difficulties comprehending sentences with Norwegian phonology and morphosyntax (condition D). They responded correctly to 92.5% of the sentences in condition A, but to 80.6% of the sentences in condition D. The data also suggests that sentences with Danish phonology and Norwegian morphosyntax (condition B) are easier to comprehend than sentences with Norwegian phonology and Danish morphosyntax (condition C). 90.8% of the sentences in condition B were decoded, but 86.6% of the sentences in condition C.

Certain sentence types were judged incorrectly in condition A by a number of informants. Some sentences were judged incorrectly only by one informant, and these are kept in the analysis. The remaining eight sentences that were judged incorrectly at least twice in the Danish phonology and Danish morphosyntax condition are excluded from the remainder of the analysis, however, as we believe that these sentences were too problematic, semantically speaking, for the experimental design. For an overview of all the sentence types that were judged incorrectly (also

Table 2
N of correct replies to stimuli in the four conditions, total N responses: 2120.

Response	DaPhon DaSyn (A)	DaPhon NoSyn (B)	NoPhon DaSyn (C)	NoPhon NoSyn (D)
Error	40 (7.5%)	49 (9.2%)	71 (13.4%)	103 (19.4%)
Correct	490 (92.5%)	481 (90.8%)	459 (86.6%)	427 (80.6%)
Total	530	530	530	530

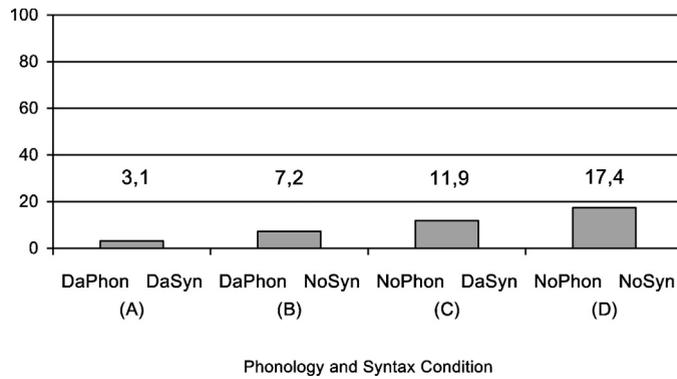


Fig. 1. % of incorrect replies in the listening experiment when sentences are excluded that had more than one incorrect response in condition A.

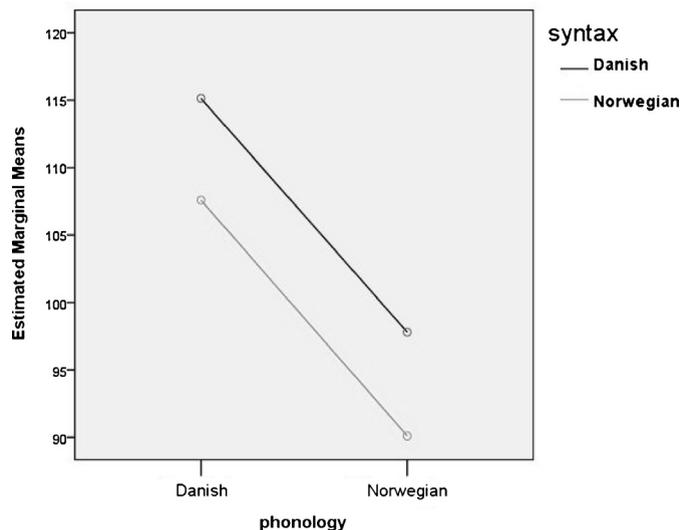


Fig. 2. The effect of phonology on correctness results for sentences of the two morphosyntax types.

those with only one incorrect response that were retained in the data), see [Appendix B](#). The percentages of incorrect answers for the remaining 32 sentences are presented in [Fig. 1](#). The Figure is based on 1696 responses from 52 informants.

The percentages of correct replies across categories were transformed using a rationalised arcsine transform ([Studebaker, 1985](#)) to make them more suitable for statistical purposes. The arcsine transforms percentage data to a scale where the variance size is not related to the size of the mean ([Studebaker, 1985:455](#)) and is especially well suited for percentage data. A 2×2 repeated measures analysis of variance (ANOVA) was conducted on the transformed data. The effect of phonology and morphosyntax were both reported as significant at $p < .05$. There was a significant effect of phonology on the correctness results $F(1) = 44.203$ and of morphosyntax on the correctness results $F(1) = 10.203$. As can be seen from [Figs. 2 and 3](#), the introduction of a foreign phonology results in a more dramatic decline in comprehension scores than the introduction of a foreign morphosyntax does (note that the y-axis reflect the transformed correctness results).

3.2. Correctness and type of construction

To explore whether there is a difference between word order and morphology anomalies when it comes to sentence comprehension, the numbers of incorrect replies for the different types of constructions were investigated. The number

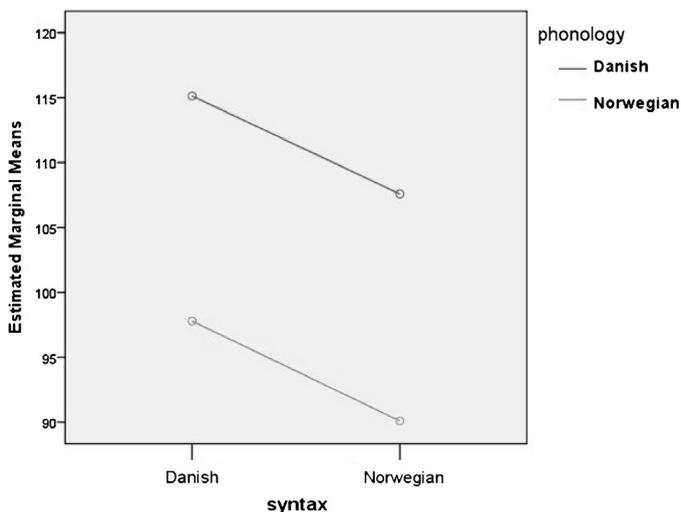


Fig. 3. The effect of morphosyntax on correctness results for sentences of the two phonology types.

Table 3

N and % Incorrect replies to different construction types in the four conditions.

	DaPhon DaSyn (A)		DaPhon NoSyn (B)		NoPhon DaSyn (C)		NoPhon NoSyn (D)	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
1 Variable particle placement (word order)	1/53	1.9	6/55	10.9	4/50	8	14/54	25.9
2 Variable negator and infinitival placement (word order)	5/79	6.3	9/81	11.1	16/80	20	24/78	30.8
3 Variable possessive marker type (morphological)	3/106	2.8	9/106	8.5	9/106	8.5	11/106	10.4
4 Variable definiteness marking (morphological)	2/106	1.9	2/106	1.9	16/106	15.1	12/106	11.3
5 Variable possessive marker and definiteness marking (word order and morphological)	2/78	2.6	5/81	6.2	5/78	6.4	13/81	16

and percentage of incorrect answers in the five different construction types are presented in Table 3. This analysis, again, was done on the basis of the 32 sentence types, excluding eight sentences that a number of informants answered incorrectly in the Danish phonology and morphosyntax condition.⁴

From Table 3 it is clear that there is variability in how detrimental the construction types used in the experiment are for listeners' intelligibility of the stimuli. The largest differences in correctness occur in row 1, between morphosyntax conditions (columns A and B compared and columns C and D compared) in sentences with variable particle placement. The smallest differences in correctness between morphosyntax conditions are found in row 4, in sentences with variable definiteness marking.

To see whether a significant effect of construction type (rows 1–5 in Table 3) on correctness could be found in the data a logistic regression was performed in Rbrul (Johnson, 2012) in R (R Development Core Team, 2012). The logistic regression tested the effect of the different construction types on the correctness score, as well as the effect of phonology and morphosyntax condition (A, B, C or D in Table 3) on correctness scores. Both predictors came out significant in the model. The results from the 2 × 2 repeated measures ANOVA reported above are confirmed as far as phonology and morphosyntax conditions go. When it comes to construction type, the coefficients (logodds) from the logistic regression indicate that construction types 1 and 2 (see Table 4) have the most favouring effect on the number of incorrect replies in the experiment (cf. Johnson, 2009).

⁴ Note that the total numbers of replies in every condition vary due to these missing replies (certain informants could have had all their responses to condition C excluded, for instance, while others only one).

Table 4
Summary of logistic regression analysis for construction type effect on incorrect replies.

Factor: construction type	Logodds	Tokens
1. Variable particle placement (word order)	0.157	212
2. Variable negator and infinitival placement (word order)	0.561	318
3. Variable possessive marker type (morphological)	−0.247	424
4. Variable definiteness marking (morphological)	−0.247	424
5. Variable possessive marker and definiteness marking (word order and morphological)	−0.203	318

The regression analysis would thus indicate that it is word order differences that create the largest problems for Danes listening to Norwegian sentences while morphological differences play a smaller role for the comprehension problems.

3.3. Response times

Response times were recorded in informants' correct replies and only data from 41 right-handed informants were used. It is assumed here that response times are a more sensitive measure of comprehension than correctness data. It could be that syntactic and phonological differences merely delay comprehension more than preventing it altogether, and response times are a good measure of this potential delay. Fig. 4 shows the mean response times to sentences in the four phonology and morphosyntax conditions by the 41 right-handed participants in the study. The response times were z-standardised (to allow for comparison of observations with different normal distributions) by speaker and used for a repeated measures ANOVA of the effect of phonology and morphosyntax condition on response times.

The differences in the z-standardised mean response times between the phonology conditions were significant at $p < .01$, $F(1) = 8620$. The differences in response times between the morphosyntax conditions are not significant. This is also illustrated in Figs. 5 and 6 that model the effect of phonology (5) and morphosyntax (6) on the other factor. Note that the y-axis represents the z-standardised scores.

Fig. 5 illustrates how Norwegian phonology in the stimuli results in longer reaction times both for sentences with Danish morphosyntax as well as sentences with Norwegian morphosyntax. It is not the case in Fig. 6, however, that Norwegian morphosyntax makes the response times longer for sentences with Norwegian phonology.

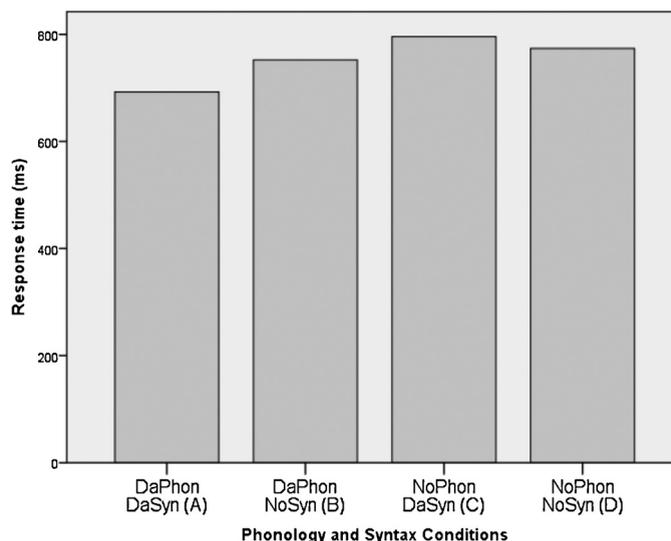


Fig. 4. Mean (raw) response times for correct replies to 32 sentences in the four conditions, $N = 1176$.

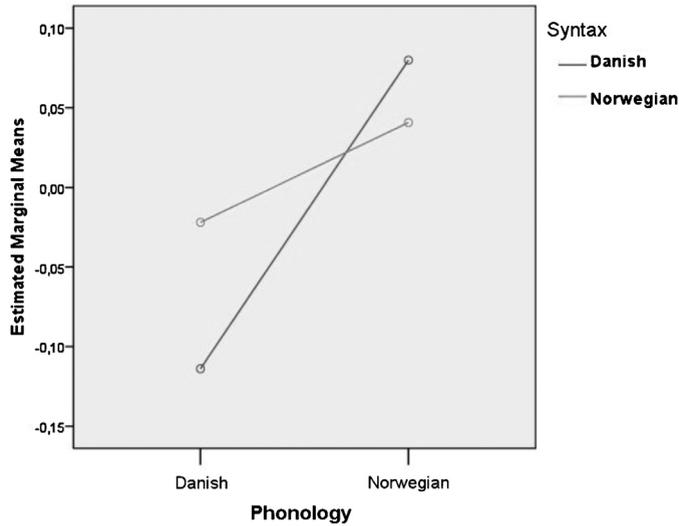


Fig. 5. The influence of the phonology factor on the response times to sentences with Danish and Norwegian morphosyntax.

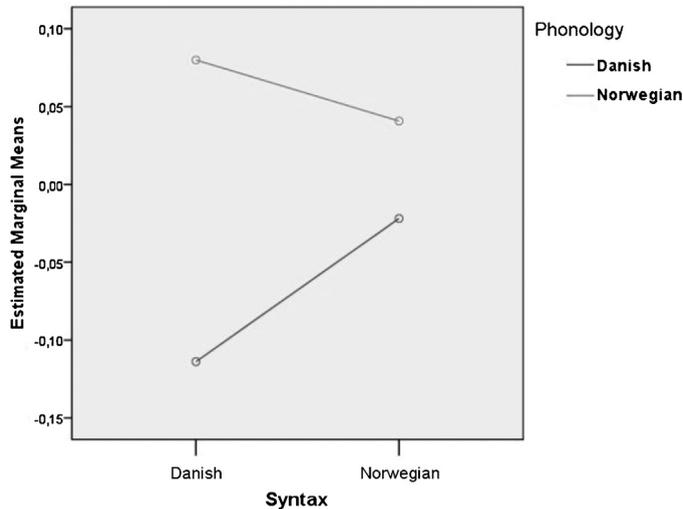


Fig. 6. The influence of the morphosyntax factor on the response times to sentences with Danish and Norwegian phonology.

4. Discussion

4.1. The relationship between phonology, morphosyntax and receptive bilingualism

Our study shows that there is an effect of morphosyntax on Danish listeners' comprehension of the closely related language Norwegian. When listening to sentences made up solely of cognate words and native morphemes Danish listeners do not comprehend sentences with Norwegian morphosyntactic constructions as well as sentences with Danish morphosyntactic constructions. Likewise, a Norwegian phonology impedes sentence comprehension for Danish listeners. Although they both play a role, the foreign phonology appears to have a more dramatic effect on comprehension than foreign morphosyntax does. It must be noted, however, that only five morphosyntactic anomalies existed in the experimental material, whereas the number of phonological differences that exist between Danish and Norwegian, and hence also in the experimental material, are more numerous.

Our prediction that comprehension would be slowest for Danish listeners when hearing sentences with phonology and morphosyntax from the closely related language Norwegian and the fastest with sentences in Danish phonology and morphosyntax were borne out to a certain extent. There is evidence from the response time data that foreign

phonology slows sentence comprehension down significantly, but a foreign morphosyntax does not affect results in the same way. Interestingly, Norwegian morphosyntax shows no effect on correct response times in the experiment when the input is in a Norwegian phonology. This, again, could indicate that a foreign phonology is more important than a foreign morphosyntax for correct comprehension of a closely related language, but the current data are not enough to conclusively establish this.

The indication that phonological differences play a larger role for comprehension than syntactic differences do was already postulated by [van Heuven and de Vries \(1981\)](#). They found that word order, morphological features, as well as lexical choice affect comprehension of spoken non-native Dutch (see also [van Heuven, 1986](#)), but concluded that the role of sound-based factors was much larger than that of structure-based factors, however.

The phonological factors that can influence mutual intelligibility between Danish and Norwegian speakers are touched upon briefly in the introduction to this article. The languages at hand have different phoneme inventories as well as prosodic characteristics that set them apart, and all of these differences are present in our experiment stimuli. [Gooskens \(2007\)](#) and [Kürschner et al. \(2008\)](#) report that the occurrence of foreign sounds in a closely related language has a negative effect on the intelligibility of such a variety. Recent work has also established a difference in articulation tempos and reduction rates between Scandinavian languages ([Hilton et al., 2011](#)), and work in speech comprehension indicate that different speech tempos are noticeable to listeners ([Jones et al., 2007](#)). In our experiment we have controlled for individual differences in speech tempos and voice qualities by using the same speaker for all stimuli. The effect of related typological factors such as syllable reduction and phoneme realisations for the communicative success of receptive bilingualism should be looked at in more detail in future studies.

4.2. *The relationship between word order differences, morphological anomalies and receptive bilingualism*

The data from our experiment adds important knowledge to the field of receptive bilingualism, or semi-communication, by telling us more about the linguistic frameworks that speakers are (or are not) able to employ when they find themselves in such situations. [Speidel et al. \(1985\)](#) found no effect of a simplified morphology on comprehension of Standard English by Hawaiian school children; a finding that has also been established to some degree in our results: results presented in this article show a statistically significant difference in the comprehension rates of sentences with morphological anomalies versus comprehension rates of sentences with word order anomalies, where the latter type of sentences are the largest contributors to unsuccessful comprehension by the Danish listeners. The fact that word order differences influence intelligibility between speakers who speak closely related languages is a finding predicted by theories put forward about sentence processing (e.g. [Fodor and Frazier, 1980](#)) but that had previously not been investigated in an experimental setting, or with response time data.

There are some reasonable claims to be made for why sentences where particles or negators do not occur in their canonical (Danish) position are more difficult to comprehend correctly than sentences with double definiteness marking or a different possessive marker in our experiment. As explained in sections 2.1.3 and 2.1.4, the Norwegian definiteness and possessive marking in our experiment are possible in Danish, but in different syntactic positions. The reason why these constructions cause fewer problems for listeners in our experiment could lie herein. When a morpheme is already known but occurs additively in an unexpected place this does not necessarily falter the comprehension of the sentence. It is an entirely different situation, however, when a word is missing from its canonical position, such as is the case for the sentences where particles or negators have been moved.

Perhaps surprisingly, the sentences with anomalies in particle or negator order are more difficult to comprehend than sentences where the possessive marker occurs in a non-canonical place as well as in a different form. Changes in the position of possessive markers cause fewer problems for listeners than changes in the order of particles and negators. This finding indicates that one could find a strong relationship between the *types* of lexical item that occur in a non-canonical position and the *effect* of its position on correct comprehension. This question could be an interesting focus for further investigations of receptive bilingualism: answers would provide important information for research areas such as that of natural language processing. Studies of receptive bilingualism in the past have already concluded that lexical factors play a large role for intelligibility (e.g. [Börestam Uhlmann, 1997](#)). Future studies could also investigate whether the usage of a word that is a cognate, but that does not entirely overlap semantically in two languages, provides difficulties for comprehension of a closely related language. Neither word frequency nor semantic overlaps were controlled for in the stimuli for the current experiment.

4.3. *Practical implications of this research*

Our results have certain implications for fields that apply research into semi-communication, or receptive bilingualism. Our findings can, of course, be applied to teaching methods developed for enhancing mutual intelligibility between speakers of closely related languages, such as the EuroCom method ([Klein et al., 2002](#)). Another practical application of

the findings is in the field of natural language processing where variability in phonology and lexicon naturally receive a lot of attention, but where, as we have shown, variability in word order and morphology ought to be taken more into account. Another situation that our findings have important bearing upon is that of the multilingual or multidialectal classroom. As pointed out by sociolinguists as early as in the 1960s children who speak dialects linguistically dissimilar to a standard variety can often experience reading problems in school (Labov, 1995). Our results indicate that aural comprehension in the classroom can also be dependent on a modified syntax and morphology to accommodate listeners of a different language or dialectal backgrounds.

5. Conclusion

Overall, the results presented in this article indicate that there is an effect of morphosyntactic differences on the mutual intelligibility between speakers of closely related languages. The number of correct responses by Danes participating in a sentence plausibility task was influenced by the presence of Norwegian phonology as well as Norwegian morphosyntax in the aural input. We can conclude that the problems listeners encounter in situations of receptive bilingualism are likely to be due to phonological (and possibly other linguistic and extra-linguistic) factors, but that morphosyntactic differences also play a role for comprehension. The finding that phonology plays a large role is in line with previous studies of the linguistic factors that influence receptive bilingualism (e.g. Gooskens, 2007) but morphosyntactic differences should not be disregarded in future studies of the linguistic dependencies of receptive bilingualism.

There are other parts of the linguistic repertoire that could play a role for receptive bilingualism that we do not have sufficient knowledge about. These are, for instance, lexical factors such as the semantic relatedness of concepts and word frequencies. These factors could be included with further investigations of the relative effect of phonology to better understand how to ease the intelligibility between speakers of closely related languages.

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Appendix A. All sentences in the listening experiment

Training sentences

Plausible

Drager finnes i eventyr
 'Dragons exist in fairy tales'
 Et hus er større enn en bil
 'A house is larger than a car'

Implausible

Russland er Europas minste land
 'Russia is the smallest country in Europe'
 En fisk leser sin avis
 'A fish reads his newspaper'

Test sentences

Plausible

Particle placement:

En mann skriver ut en artikkel
 'A man prints out an article'
 En rådgiver ramser opp en liste
 'A councillor regurgitates (*up) a list'
 En politibetjent legger ned en penn
 'A police officer puts down a pen'
 En nabo finner frem en sykkel
 'A neighbour takes out a bike'

Negator and infinitival placement:

De fleste mennesker håper å ikke bli syke

'Most people hope to not become ill'

Konkurransedeltagere ønsker å ikke tape

'Competitors wish to not lose'

Flaggermus pleier å ikke pusse vinduer

'Bats usually do not clean windows'

Fotomodeller prøver å ikke bli tyke

'Photo models try to not become fat'

Possessive marker type:

Lærere underviser sine elever

'Teachers teach their pupils'

Leger behandler sine pasienter

'Doctors treat their patients'

Gartnere vann sine blomster

'Gardeners water their flowers'

Hunder følger gjerne sine eiere

'Dogs follow their owners gladly'

Definiteness marking:

I kristendommen er bibelen den viktigste boken

'In Christianity the Bible is the most important book'

I Danmark er København den største byen

'In Denmark, Copenhagen is the largest city'

Februar er den korteste måneden

'February is the shortest month'

I England er engelsk det viktigste språket

'In England English is the most important language'

Possessive marker place:

Farmor er i familie med faren min

'Grandma (lit. Father's mum) is related to my father'

Du ser med øynene dine

'You see with your eyes'

En statsminister leder regjeringen sin

'A prime minister leads his government'

Ministerens sekretær skriver brevet hans

The minister's secretary writes his letter'

*Implausible***Particle placement:**

Et bibliotek låner ut kaffe

'A library lends out coffee'

Et insekt leser av temperaturen

'An insect reads off the temperature'

En gris legger ut penger

'A pig advances money'

En elefant slår opp et ord

'An elephant looks up a word'

Negator and infinitival placement:

Piloter håper å ikke lande trygt

'Pilots hope to not land safely'

Forfattere ønsker å ikke skrive

'Writers wish to not write'

Fugler pleier å ikke kunne fly

'Birds are usually not able to fly'

Vektløftere prøver å ikke bli sterke
 'Weight lifters try to not become strong'

Possessive marker type:

Hester spiser sine hover
 'Horses eat their hooves'
 Kaniner selger sine haler
 'Rabbits sell their tails'
 Elektrikere drikker sine ledninger
 'Electricians drink their cables'
 Mekanikere koker sine biler
 'Mechanics boil their cars'

Definiteness marking:

Sukker er den sunneste maten
 'Sugar is the healthiest food'
 I Sverige er gress den sjeldneste planten
 'In Sweden grass is the rarest plant'
 Murstein er den mest dyrebare edelstenen
 'Bricks are the most valuable jewel'
 Skilpadden er den hurtigste fisken
 'turtles are the fastest fish'

Possessive marker type and place:

Et enebarn leker med søsteren sin
 'An only child plays with its sister'
 Du lukter med hendene dine
 'You smell with your hands'
 En katt snakker med moren din
 'A cat speaks with your mother'
 Jeg er eldre enn faren min
 'I am older than my father'

Appendix B. Sentences that were judged incorrectly in the condition with native phonology and syntax

Construction type	Sentence	Plausible?	N error responses
Particle placement	<i>A police officer puts a pen down</i>	Yes	6
	<i>A councillor reads a list out loud</i>	Yes	5
	<i>A neighbour takes the bike out</i>	Yes	4
	<i>An insect reads (out) the temperature</i>	No	2
	<i>A pig makes an advance payment</i>	No	1
Negator and infinitival placement	<i>Bats usually do not clean windows</i>	Yes	3
	<i>Photo models try not to become fat</i>	Yes	2
	<i>Participants in contests do not wish to lose</i>	Yes	1
	<i>Most people hope not to become ill</i>	Yes	1
	<i>Pilots hope not to land safely</i>	No	1
	<i>Weight lifters try not to become strong</i>	No	1
	<i>Birds usually do not fly</i>	No	1
Possessive type	<i>Dogs like to follow their owners</i>	Yes	1
	<i>Doctors treat their patients</i>	Yes	1
	<i>Mechanics boil their cars</i>	No	1
Demonstrative marking	<i>February is the shortest month</i>	Yes	1
	<i>Bricks are the most valuable precious stone</i>	No	1
Possessive placement	<i>You smell with your hands</i>	No	3
	<i>I am older than my father</i>	No	2
	<i>An only child plays with its sister</i>	No	1
	<i>The minister's secretary writes his letters</i>	Yes	1

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