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Mutual intelligibility of Dutch-German cognates by children: The devil is in the detail

Abstract: Several studies (e.g., Ház 2005) have found German to be easier to understand for Dutch listeners than Dutch for German listeners. This asymmetry has been attributed to the fact that German is an obligatory subject in Dutch secondary school and that many Dutch people watch German television. In contrast, it is much less common for German children to learn Dutch at school and for German people to watch Dutch television. It cannot be excluded, however, that in addition to the extralinguistic factor of language contact, linguistic factors also play a role in the asymmetric intelligibility between German and Dutch. The present study aimed at gaining insight into the phonetic-phonological factors playing a role in Dutch-German intelligibility at the word level for speakers of the respective languages in a first confrontation (i.e., assuming no prior language contact).

We presented highly frequent Dutch and German cognate nouns, recorded by a perfect bilingual speaker, to Dutch and German children between 9 and 12 years in a word translation task. The German and Dutch children were comparable in that they did not know the other language or a related dialect and expressed equally positive attitudes towards the other language, its speakers and the country. It was thus ensured that language contact and language attitude could not play a role in the present study.

Our results revealed that the Dutch subjects were significantly better at understanding the German cognates (50.2% correct translations) than the German subjects were at understanding the Dutch cognates (41.9%). Since the relevant extra-linguistic factors had been excluded, the asymmetry must have a

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linguistic basis. A thorough analysis of the 16 cognate pairs with an asymmetry larger than 20% showed that (combinations of) neighbors (lexical competitors), phonetic detail and asymmetric perceptions of corresponding sounds play a major role in the explanation of the asymmetry.

Keywords: German, Dutch, mutual intelligibility, asymmetry, phonetic detail, cognates

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1 Introduction

Several studies (e.g., Ház 2005) have revealed an asymmetric relationship in the intelligibility of Dutch and German for speakers of the respective languages. German has been found to be easier to understand for speakers of Dutch than Dutch is for speakers of German. This finding has been attributed to the fact that German is an obligatory subject at school and that many Dutch people watch German television, especially in the eastern part of the Netherlands. In contrast, it is much less common for German children to learn Dutch and for German people to watch Dutch television. Speakers of Dutch thus have more contact with the German language than speakers of German have with the Dutch language. It is logical to assume that this asymmetry in language contact would be reflected in an asymmetry in intelligibility, Dutchmen understanding German better than Germans understanding Dutch. On the basis of the research to date, it cannot be excluded, however, that in addition to the extralinguistic factor of language contact, linguistic factors may also play a role in the asymmetric mutual intelligibility between German and Dutch. This is the topic of the present study. Specifically, we aimed to establish that the asymmetry in mutual intelligibility between German and Dutch remains even when all relevant non-linguistic factors are controlled for. To that aim, we carried out a lexical translation task. The second aim of the study is to provide post-hoc linguistic explanations for the asymmetry, should it be found, thereby gaining insight into the phonetic-phonological factors playing a role in Dutch-German intelligibility at the word level for speakers of the respective languages in a first confrontation.

That, in general, linguistic factors may indeed play a part in asymmetric intelligibility can be illustrated by the Danish-Swedish language situation. Speakers of Danish have consistently been found to be better at understanding Swedish than speakers of Swedish are at understanding Danish (Maurud 1976; Bø 1978;

Börestam 1987; Delsing and Lundin Åkesson 2005). In the older literature, this finding was explained by differences in language attitude and language contact, i.e., by extralinguistic factors. Recently, however, is has been made plausible that differences in the phonological and phonetic make-up of the two languages may also be involved. Gooskens et al. (2010) tested the intelligibility of Danish and Swedish materials among native listeners of Danish and Swedish. They matched the listener groups in such a way that the amount of previous contact with the other language was the same. The study replicated the asymmetry between spoken Danish and Swedish found in earlier studies and the authors conclude that linguistic factors must explain this asymmetry. One of the phonetic/phonological factors that may be responsible for the relatively low intelligibility of Danish is the exceptionally fast development that Danish pronunciation has undergone during the last century (Brink and Lund 1975; Grønnum 1998), particularly the large number of lenition processes. According to Teleman (1987: 76), changes in the Danish pronunciation may make it more difficult for Swedes listening to Danish to 'find the letters behind the sounds' than vice versa. Hilton et al. (2011) found a significantly higher articulation rate among Danish speakers than among Swedes, which may also lead to an asymmetry in speech understanding. Both factors may account for the fact that the asymmetry in intelligibility is limited to the oral channel of communication, and does not manifest itself in the understanding of written texts.

Unfortunately, there are few studies in which asymmetric intelligibility has been analyzed systematically at the word level, so we did not start out with a comprehensive list of relevant linguistic factors to be investigated. We therefore used a bottom-up procedure in the analysis of our subjects' responses. One factor that we considered was the (asymmetry in) perceived plausibility of sound correspondences. For example, is it just as plausible for Dutch subjects that German /ʃ/ corresponds to Dutch /s/ as it is for German subjects that Dutch /s/ corresponds to German /ʃ/? This particular question can be answered by comparing the responses of the Dutch subjects for Ge. *Mensch* /mɛnʃ/ 'human' with the responses of the German subjects for Du. *mens* /mɛns/. Another linguistic factor that we looked at was the role of so-called neighbors. Neighbors are linguistically defined as word forms that are similar to the stimulus word and may therefore serve as competing responses, hindering communication. The term may both be used to explain word recognition in a monolingual situation and in a situation where two (closely related) languages or language varieties are involved. A large number of neighbors enlarges the number of possible candidates for recognition or translation and therefore reduces the chance that the correct response is given (see Luce and Pisoni [1998]). A subcategory of neighbors in cross-language intelligibility studies is formed by the so-called false friends, i.e., word forms that are more

similar to the stimulus word than the correct response. An example of a false friend in the present study is the response *Dach* 'roof' to Du. *dag* 'day' by the German subjects. Ge. *Dach* /dax/ is more similar to the Dutch stimulus word *dag* /dɑx/ than the intended Ge. cognate *Tag* /taːk/. The presence of a false friend will prevent subjects from giving the correct response. The presence of false friends in the lexicon is largely a matter of chance. The number of neighbors in general and false friends in particular is likely not be identical in the two languages, both at the level of the individual stimulus word and overall, averaged over all stimuli.

The results of our study will be relevant for research in the areas of semicommunication and receptive multilingualism. This research tradition started in Scandinavia, where it is common practice that speakers of the three closely related Scandinavian languages, Danish, Norwegian and Swedish, communicate each speaking their own language (Haugen 1966). The degree to which the interactants are intelligible to one another is called mutual intelligibility. Recently there has been a growing interest in this kind of communication as a means of solving potential communication problems, for example among speakers of Dutch and German (Beerkens 2010; Ház 2005). Looking into the specific linguistic problems that speakers of these two languages encounter when confronted with the neighboring language will enlarge our understanding of the mechanisms of receptive multilingualism.

As stated above, the main purpose of the present study is to explore the possibility of linguistic factors playing a role in the attested asymmetry in intelligibility between German and Dutch. To exclude the influence of textual context we conducted an auditory intelligibility test with single lexical items. By limiting the stimuli to Dutch-German cognates, i.e., words that are historically related, we could make a thorough analysis of specific linguistic factors affecting mutual intelligibility at the word level. To make sure we only had to do with linguistic factors, extralinguistic factors that may potentially affect mutual intelligibility were excluded beforehand. Concretely, we thought of ways to find listeners with no previous experience with the other language. This excluded the use of adults. In view of the fact that virtually all Dutch children have German as an obligatory subject in the first years of secondary school, we decided to make use of children in the last three years of Dutch primary school, i.e., children between 9 and 12 years of age, and German children in the same age range. The selection of the subjects is discussed in Section 2.1. In Section 2.2 the selection and nature of the stimuli are described, and in Section 2.3 the task.

2 Method

2.1 Subjects

Twenty-eight Dutch and 34 German subjects participated in the intelligibility test. The Dutch subjects were all in the last three years of primary school (groups 6, 7 and 8); the German subjects were in the first year of the Gymnasium. For none of them had the other language been a formal school subject. The Dutch subjects went to school in the town of Spijkenisse, which is about 160 km west of the German border. The German subjects went to school in Oldenburg, which is about 80 km to the east of the Netherlands' border. All participants filled in a questionnaire concerning their language background, previous contact with the other language and attitudes toward the other language. On the basis of the answers to the questionnaire, we selected subjects from a larger pool of candidates such that they (i) only spoke their respective native language at home, (ii) had no familiarity with the neighboring language, (iii) spoke no local Low-German dialect (so-called Plattdeutsch, which might be an undue help understanding Dutch), and (iv) expressed no negative attitudes towards the other language, speakers of that language or country where that language is spoken. It was thus ensured that the two main extralinguistic factors that have been postulated to influence the intelligibility of a related language, namely, language contact and language attitude, could not play a role in the present study. Details on the distribution of the selected participants' age and sex are shown in Table 1. It can be seen that all children were between 9 and 12 years of age. The German group is more homogeneous, but the mean age is almost the same for the two groups of subjects (10.4 for the Dutch subjects versus 10.3 years for the German subjects). There is a slight difference in the distribution according to sex, in the Dutch group there are six more males than females while in the German group there are four more females than males.

Table 1: Selected subjects' age and sex

	Dutch subjects (N = 28)		**German subjects (N = 34)**	
age	range	9–12	range	10–11
	mean	10.4	mean	10.3
sex	17 males	(60.7%)	15 males	(44.1%)
	11 females	(39.3%)	19 females	(55.9%)

2.2 Stimuli

We had at our disposal an annotated and transcribed database of 768 Dutch German cognate pairs of singular nouns. These cognates are among the 3,000 most frequent nouns in the CELEX databases for Dutch as well as for German (Baayen et al. 1995). In other words, they constitute the intersection in the 3,000 most frequent cognate nouns in the two languages. To reduce the risk of presenting unknown words to a minimum, we decided to exclude all loan words and to limit our study to the intelligibility of hereditary words only. Moreover, we only included words with a high frequency of use in both languages. We applied two frequency criteria. First, all members of the selected word pairs had to occur at least 20 times in the original CELEX databases. Second, all selected word pairs had to be among the 100 word pairs with the highest mean frequency (across the two languages). In this way 40 hereditary cognate pairs of singular nouns with a high frequency of use in both Dutch and German were selected.

The Dutch and German members of the cognate pairs were recorded onto tape by a Dutch-German bilingual speaker. This speaker was born in Switzerland in 1976 from Dutch parents. She spoke Dutch at home and Swiss-German at school. She moved to the Netherlands when she was 20 years of age. She studied both Dutch and German. From 2000 onwards she was intermittently employed in Germany (Berlin, Potsdam, and Dortmund) and in The Netherlands (Amsterdam). To check whether she spoke both Dutch and German at a native level, she was presented in voice line-ups to groups of 12 Dutch and 49 German-speaking subjects. They heard the bilingual speaker in a Dutch and German guise mixed with four other native speakers of either language. The subjects were asked to decide whether one or more of the speakers they heard did not have Dutch (or German, depending on the listener group) as their mother tongue. Only one German and five Dutch subjects indicated the bilingual speaker as not being native. This is below chance level. Moreover, the monolingual distractors were identified more often as non-native than the bilingual speaker, in both the Dutch and German listener panels. We therefore deemed the bilingual speaker fit to be used in the present intelligibility study. The advantage of using a perfect bilingual speaker is that any difference in intelligibility between the two languages cannot be attributed to voice-and-articulation differences (e.g., speech tempo, precision of articulation) of the speaker(s).

2.3 Task

The subjects started out by filling in a written questionnaire related to age, sex, place of birth, language use at home, knowledge of the other language, and three

aspects of language attitude: beauty of the language, friendliness of the speakers of the language and beauty of the country where the language is spoken. As described in the preceding section, the responses to these questions were used to select the subjects.

The written questionnaire was followed by the auditory intelligibility test, which consisted of two parts. Both parts contained a series of 40 test stimuli, preceded by 5 practice stimuli. All stimuli were separated by an interstimulus interval of 7 seconds, during which the subjects had to write down their response. The Dutch children first heard the German members of the 40 Dutch-German word pairs and were asked to translate these into their own language. They heard, for example, Ge. *Haus* 'house' and had to write down Du. *huis*. After the translation task they were given a dictation task; they heard, in the same order, the Dutch members of the 40 word pairs and had to write down what they heard in Dutch. So when hearing Du. *huis* 'house' they had to write down Du. *huis*. The tasks for the German children were identical, but with the languages reversed. So, in the first part of the test they heard the 40 Dutch members of each cognate pair and in the second half they heard the 40 German counterparts. Both groups of subjects were split in half. One group heard the stimuli in one order and the other group heard them in the reversed order.

The second part of the intelligibility test, in which the children heard the stimuli in their own language, served two purposes. In the first place we can check whether all stimulus words are indeed known to the children. If too many children give the wrong response for the stimulus presented in their own language, it is unfit to be presented to the subjects of the other language and it should be removed from the analysis. In the second place we can check whether the two groups of children have the same level of word knowledge. The two groups should be comparable in this respect to ensure that a possible asymmetry in the intelligibility results for the two languages cannot be attributed to this factor.

3 Results

3.1 Checking the responses

The responses of the subjects were checked manually. We distinguished three degrees of accuracy: correct, half-correct and incorrect. We applied the following procedure when judging the accuracy of the responses.

– Missing responses are counted as incorrect. In total, 4.5% of the incorrect responses were missing responses. The Dutch subjects had no missing

responses for the Dutch stimuli and 4.4% missing responses for the German stimuli. For the German subjects the percentages were 0.5% for the German stimuli and 9.4% for the Dutch stimuli.

- In principle, all stimuli correspond with one specific response ("designated response"), in both the translation and the dictation parts of the experiment. However, there are some special cases.
- In the translation part: when a stimulus word has two meanings in the stimulus language with two corresponding cognate forms in the response language, both forms are counted as correct responses. For example, Du. *zijde* has two meanings, namely 'side' or 'silk'. Du. *zijde* may therefore be responded to with either Ge. *Seite* 'side' or Ge. *Seide* 'silk'.
- In the dictation part: when a stimulus word is homophonous to another word, both words are counted as correct responses. Example, Du. *hart* 'heart' may be responded to with either Du. *hart* /hɑrt/ 'heart' (*hart* being the spelling of the intended noun) or Du. *hard* /hɑrt/ 'hard' (*hard* being the spelling of the homophonous adjective).
- In the translation part, alternative responses that have different forms in the response language but the same meaning as the designated response are counted as correct. Example, Ge. *Seite* 'side' may be responded to with both Du. *zijde* 'side' (intended response) and Du. *zijkant* 'side'.
- In the translation and in the dictation part, plural responses, although deviating from the designated response, are counted as half correct. An example from the translation part would be Du. *jaar* 'year', which was responded to with Ge. *Jahre* (plural) instead of *Jahr* (singular, designated response).
- In the translation and in the dictation part, obvious spelling mistakes are disregarded. A spelling mistake is defined as a response that deviates from the designated response by one letter, without leading to another existing word. Example from the translation part: Ge. *Grund* 'ground' is responded to with Du. *gront* (a non-existing word in Dutch) instead of Du. *grond* (intended response). A special case are the spellings *ei* and *ij*, which, although differing by two letters, represent the same phoneme in Dutch, namely /ɛi/. Both spellings are counted as correct.

3.2 Intra-language intelligibility

We first looked at the percentages correct for the individual words presented in the subjects' mother tongue. We wanted to see whether there were any words that were so poorly understood by the native subjects that we should consider them unfit to be presented to the subjects of the other language. When one member of

a cognate pair was found to be unfit, the corresponding member in the other language was also removed.

With respect to the Dutch stimulus material presented to the 28 Dutch subjects, there were 24 words (60.0%) with a percentage correct of 100, and an additional 11 words (27.5%) with a percentage correct of 96.4 (one subject giving the wrong response). So 35 out of the 40 Dutch stimuli (87.5%) were understood (almost) perfectly by the Dutch subjects. There were only three stimuli that obtained a percentage correct of less than 90, namely Du. *kerk* 'church' (71.4%), Du. *zijde* 'side' (89.0%) and Du. *maal* 'meal' (78.6%). For Du. *kerk*, there were 8 wrong responses, namely 6 × *cap*/*kep* 'cap', 1 × *kerp* (a non-existing word in Dutch), and 1 × missing. The nature of these responses suggests that the final consonant(s) of *kerk* were not clearly pronounced or recorded. We decided to remove this stimulus from the material. For Du. *zijde*, there were 8 wrong responses, 4 × wrong plural/adjective *zijden* (counted as 0.5 error), 2 × *zeilen* 'sail' and 2 × *zijn* 'be'. This word was also removed from the analyses. For Du. *maal*, there were 6 wrong responses, 5 × *mouw* 'sleeve' and 1 × *mour,* a non-existing word in Dutch. We think that these erroneous responses are not due to poor quality of the stimulus, but reflect normal acoustic ambiguity, the difference between final /l/ and final /ɑu/ often being difficult to hear in Dutch. This word was therefore retained in the analyses.

With respect to the German stimulus material presented to the 34 German subjects, there were 21 words (52.5%) with 100% correct responses and an additional 13 words (32.5%) with a percentage of 97.1 (one subject giving the wrong response). So 34 out of the 40 German stimuli (85.0%) were understood (almost) perfectly by the German subjects. There were only two German stimuli that were understood by less than 90% of the German subjects, namely Ge. *Bad* 'bath' (76.5%) and Ge. *Herr* 'gentleman' (88.2%). For Ge. *Bad*, there were 8 wrong responses, 7 of which involved an intrusive *r* (*Bart* or *Bard*). Pre-alveolar /r/ is often hard to hear, which may render listeners insecure of whether /r/ is present or not and may give rise to incorrect *r*-intrusions. As this phenomenon does not result from poor audio quality, we do not think that the subjects' response behavior gives cause to remove the word *Bad* from the analysis. For Ge. *Herr* there were 4 wrong responses, 1 × *Heer*, 1 × *Dad*, and 2 × *Herb*. Because of the diversity of the incorrect responses, we decided to remove this word from the analyses. Therefore, based on the responses to the stimuli presented in the subjects' own language, 3 cognate pairs were discarded, namely Du. *kerk* together with Ge. *Kirche*, Du. *zijde* together with Ge. *Seite* and Ge. *Herr* together with Du. *heer*. The remaining 37 cognate pairs formed the basis for the further analyses.

We calculated the intra-language intelligibility of the 37 stimuli to see whether the two groups of subjects were comparable as to the lexical knowledge in their

own language. The mean intelligibility scores, based on 37 cognates, were 98.2% for the Dutch subjects listening to the Dutch stimuli and 97.6% for the German subjects listening to the German stimuli. The difference was not significant ($t = -.6$, $df = 60$, $p = .544$), so that a possible cross-language asymmetry in the responses cannot be attributed to a difference in lexical knowledge between the Dutch and German children.

3.3 Cross-language intelligibility

The mean percentage correct responses for the 37 Dutch stimuli presented to the German subjects was 41.9, whereas the mean percentage correct responses for the 37 German stimuli presented to the Dutch subjects was 50.2. The difference was significant ($t = -4.3$, $df = 60$, $p < .001$). So, apparently, the mutual intelligibility of Dutch and German cognate nouns is asymmetric, Dutch children having fewer problems understanding German nouns than German children have in understanding Dutch nouns. This allows us to draw one important intermediate conclusion, viz. since we have made sure that the extralinguistic factors language contact and language attitude cannot play a role and since the lexical knowledge of the subject for their own language appears to be the same, the asymmetry found in our study must have a linguistic basis. To gain insight into possibly relevant linguistic factors, we calculated for all cognate pairs the difference in intelligibility between the two subject groups. Figure 1 presents the cognates that were better understood by the Dutch subjects than by the German subjects. Figure 2 presents the cognates that were better understood by the German subjects than by the

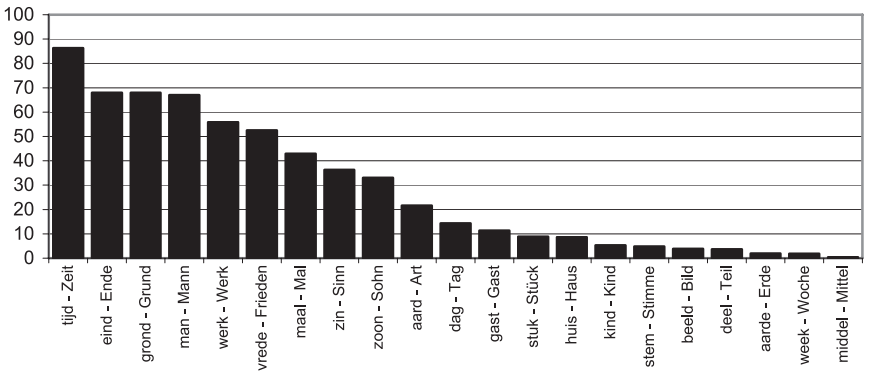

Fig. 1: Cognates that were better understood by the Dutch subjects than by the German subjects. The vertical axis plots the percentage of correct translations per word.

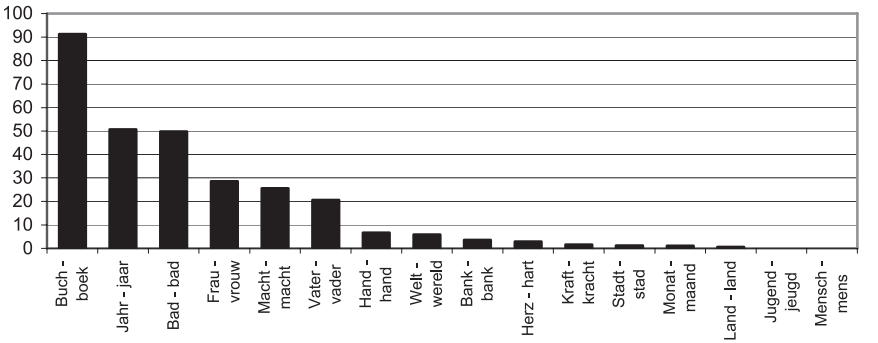

Fig. 2: Cognates that were better understood by the German subjects than by the Dutch subjects as well as two words that were equally well understood. The vertical axis plots the difference in percentage of correct translations between German and Dutch stimulus words.

Dutch subjects as well as the two cognate pairs that yielded identical scores for the two subject groups (*jeugd* / *Jugend* 'youth' and *mens* / *Mensch* 'person'. We will only discuss the word pairs where there is an asymmetry exceeding 20 percent.

Twenty-one cognates are easier for the Dutch subjects to understand than for the German subjects. The relevant data can be found in Table 2. In ten cases, there

Table 2: Intelligibility results for the ten cognates with a difference of at least 20% in favor of the Dutch subjects, ordered from the largest to the smallest difference. For both groups of subjects from left to right: stimulus word, number of missing responses, number of other erroneous responses, and percentage of correct responses. The two rightmost columns contain the difference score and the meaning of the stimulus word.

28 Dutch subjects				34 German subjects				Diff.	Meaning
Word	N missing	N errors	% correct	Word	N missing	N errors	% correct		
Zeit	1	2	89.3	tijd	14	19	2.9	86.3	time
Grund	0	9	67.9	grond	7	27	.0	67.9	ground
Ende	4	5	67.9	eind	8	26	.0	67.9	end
Mann	0	1	96.4	man	2	22	29.4	67.0	man
Werk	0	0	100.0	werk	9	10	44.1	55.9	work
Frieden	2	8	64.3	vrede	10	20	11.8	52.5	peace
Mal	5	11	42.9	maal	9	25	.0	42.9	meal
Sinn	0	3	89.3	zin	10	6	52.9	36.3	sense
Sohn	0	13	53.6	zoon	12	15	20.6	33.0	son
Art	3	14	39.3	aard	12	16	17.7	21.6	nature

is a difference of more than 20%. There are five cases of a difference larger than 50%. The largest asymmetry at the word level pertains to Du. *tijd* / Ge. *Zeit*, the Dutch subjects obtaining a score of 89.3% correct compared to a mere 2.9% for the German subjects.

Fourteen cognates are easier to understand for the German subjects than for the Dutch subjects. The relevant data can be found in Table 4. In six cases, there is a difference of more than 20% and two asymmetries exceed 50%. Here the largest asymmetry at the word level is found for Du. *book* / Ge. *Buch*, with a percentage of 91.2 correct for the German subjects contrasting with 0 percent correct for the Dutch subjects.

It can be concluded that the significant asymmetry in intelligibility in favor of the Dutch subjects manifests itself at all levels. There are more cases where the Dutch subjects performed better than the other way around (21 versus 14). The number of cognate pairs with a difference in intelligibility exceeding 20% is larger for the Dutch subjects than for the German subjects (10 versus 6) and the same holds for the number of cases where the difference exceeds 50% (5 versus 2).

In order to gain insight into the nature of the linguistic factors determining the asymmetry in intelligibility we made a detailed analysis of the erroneous responses for the 16 cognates presented in Tables 2 and 4. The responses are listed in Tables 3 and 5. We will first discuss the data in Table 3, separately for each cognate pair, comparing the responses from the Dutch subjects to those from the German subjects and trying to understand why the former performed better than the latter.

Du. *tijd* /tɛit/ versus Ge. *Zeit* /tsait/. It can be observed that the Dutch subjects made few mistakes interpreting Ge. *Zeit*. 89.3% of the Dutch subjects gave the correct response *tijd*. It must be noted that there are no Dutch words with initial /ts/ followed by /ai/, which limits the number of neighbors to a considerable extent and forces the Dutch listeners to look for corresponding sounds in their own language. Interestingly, the Dutch children had no problem relating Ge. /ts/ to Du. /t/. Either they consider the affricate /ts/ an allophone of plain /t/, or they analyze the /ts/ as a consonant cluster, in which case they are willing to disregard the /s/. Many more words in Dutch begin with single /t/ than with single /s/. Also, German /ai/ seems to have been easily linked by the Dutch subjects to Du. /ɛi/. This may be facilitated by the fact that in popular avant-garde Du. /ai/ is used as a new form of standard Du. /ɛi/ (van Heuven et al. 2005; van Bezooijen and van Heuven 2010), so that /ai/ functions as an allophone of /ɛi/ for the Dutch listeners. In contrast, the German subjects experienced many problems interpreting Du. *tijd*, and there was only one correct response. Du. /ɛi/ is not perceptually assimilated to /ai/ by the German listeners, presumably because the onset is not open enough (see the comparison of German and Dutch diphthongs in ten Cate

Table 3: Responses to the ten cognates with an intelligibility difference of at least 20% in favor of the Dutch subjects. The number of responses is only indicated for responses given by more than one subject.

28 Dutch subjects									
Zeit	**Grund**	**Ende**	**Mann**	**Werk**	**Frieden**	**Mal**	**Sinn**	**Sohn**	**Art**
teen	kond	einden 2	mijn		vrienden 6	maan 7	zingt	zon 10	aarde 5
tijger	kont	eenden 2			ieder	maar	zing	zoen 2	eet 4
	rond	lente			frietjes	mais	zitten	gloei	at 2
	krom	en				mal			dart
	kroont					meel			gaat
	krant								aarden
	groen								
	groente								
	groeit								
34 German subjects									
tijd	**grond**	**eind**	**man**	**werk**	**vrede**	**maal**	**zin**	**zoon**	**aard**
date 6	hund 13	eins 14	mama	weg 4	freude 5	maus 11	singen	jon 3	akt 3
dad 4	rund 6	ein 3	17	weck	pfeerde 3	maul 2	3	schön 2	arbeid 3
dait	und 2	einz 2	mam 2	bett	freitag 3	mau 2	sind 2	schon 2	axt 3
det	punkt 2	angst 2	mutter 2	wecker	fliegen 2	hallo 2	jim	joint 2	arzt 2
datum	hond	acht 2	mum	sack	träne	malen 2		john 2	akst
papa	schront	und		werkzeug	feund	miau		jan	acht
das	brot	ente		werg	freede	man		schauen	angst
dank	mund	los			friede	mam		schor	hand
kacht					feder	kakau		strom	alt
tag					frage	maler			
denken					freie	mein			

and Jordens [1990: 21]). Instead /ɛi/ is interpreted as /e/ or /ɛ/. Moreover, many German subjects did not think of /ts/ when hearing initial /t/ in /tɛit/. In practically all cases the German listeners produced responses starting with /d/. This behavior can be understood if we consider that Dutch voiced plosives are prevoiced (negative Voice Onset Time), whereas their German counterparts have 0 VOT. Conversely, German voiceless plosives are aspirated (long positive VOT), whereas their Dutch counterparts are not (ten Cate and Jordens 1990: 49). Because of the phonetic differences in the realization of Du. and Ge. /t/, Du. /t/ sounds like /d/ to a German listener. Since there are no German words beginning with /dɛt/ or /det/, the subjects took recourse to English loans such as *date* and *dad*. This shows that the children had some knowledge of English and that they used this knowledge in the task. In general, the results suggest that phonetic details are responsible for the asymmetry in the intelligibility scores for Du. *tijd* and Ge. *Zeit*.

Du. *grond* /ɣrɔnt/ versus Ge. *Grund* /grʊnt/ 'ground'. Most Dutch subjects (67.9%) gave the correct response, relating Ge. /g/ to Du. /ɣ/ and Ge. /ʊ/ to Du. /ɔ/. Although /g/ is not a Dutch phoneme, there are a few loans in Dutch starting with /g/, such as *garage* and *goal*. These words are often pronounced with initial /ɣ/, in order to comply with the Dutch phonological system. Ge. /ʊ/ and Du. /ɔ/ are both back, rounded, short vowels; they only differ in height (see the comparison of German and Dutch vowels in ten Cate and Jordens [1990: 34]). The Dutch subjects' mistakes are varied. It is interesting to see that some of the subjects opted for the voiceless counterpart /k/ as the nearest sound in Dutch to Ge. /g/. On the other hand, none of the German subjects succeeded in giving the right response. There are two clear clusters of erroneous responses, namely *hund* /hʊnt/ 'dog' (13 subjects) and *rund* /rʊnt/ 'round' (six subjects). As expected because of their similarity, Ge. /ʊ/ is seen as a plausible correspondence to Du. /ɔ/. It is initial Du. /ɣ/ which is problematic, and which seems to be responsible for the asymmetry in intelligibility for this cognate pair. Dutch velar fricative /ɣ/ does not occur in the onset of Ge. words. German listeners, therefore, either ignored the presence of friction and heard /r/ instead, or they assimilated the Du. /ɣr/ cluster (which sounds like a uniformly scraped /ɾ/) to a back fricative, which in onset position would have to be glottal /h/.

Du. *eind* /ɛint/ versus Ge. *Ende* /ɛndə/ 'end'. Most Dutch subjects have no problems relating Ge. *Ende* to Du. *eind* (67.9% correct). The fact that in Dutch *end* /ɛnt/ exists as a synonym for *eind* is likely to have played a role. In contrast, none of the German subjects gave the correct response. Many German subjects did not think of /ɛ/ when hearing /ɛi/. Instead they thought of German words starting with /ai/. In fact, 19 German subjects gave an (incorrect) response with initial /ai/ followed by /n/. So, our interpretation for the lack of /ai/-including responses

given above for *tijd* /tɛit/ (see above) is not confirmed. We suspect that the assimilation of Du. /ɛi/ to the German sound system is made differently depending on the following consonant. There are several high-frequency words in German that begin with /ain/, but not with /dai/; as a result Du. /ɛin/ is heard as /ain/ as in *Einz* but Du. /tɛi/ as /dɛ/ (*dad*) or /de/ (*date*). This cognate pair shows how responses may be influenced by the accidental presence of synonyms (Dutch *end* in addition to *eind*) and the frequency of occurrence of certain sounds and sound sequences in a language.

Du. *man* /mɑn/ versus Ge. *Mann* /man/ 'man'. All but one of the Dutch subjects identified Ge. *Mann* correctly as Du. *man*. Apparently, /a/ is easily assimilated to /ɑ/. German /a/ is a short low vowel, for which only one counterpart exists in Dutch, viz. /ɑ/. If the vowel is clearly short, the German front articulation does not compromise its identification (van Heuven 1986). The performance of the German subjects, however, shows that the perception of the sound correspondence is not symmetric. Although 29.4% of the subjects successfully made the link between *man* and *Mann*, many German subjects did not succeed in relating /ɑ/ to /a/. Instead, half of the German subjects responded to Du. *man* with *mama*, and all other errors (*mam*, *mutter*, *mum*) are semantically related to this response. Two erroneous responses contain back /ʊ/ (see also Du. *grond* / Ge. *Grund* above), indicating that indeed the Dutch vowel is perceived as a back vowel. Presumably the German children mistook the syllable /mɑ/ as the beginning of Ge. *Mama*, the informal word for mother, which has stress on the second syllable, and a reduced (i.e., [ɑ]-like) vowel in the first syllable. In this cognate pair an asymmetry at the sound level seems to underlie the asymmetry at the word level.

Du. *werk* /wɛrk/ versus Ge. *Werk* /wɛrk/ 'work'. All Dutch subjects correctly identified Ge. *Werk*, despite the fact that /r/ was not realized as [r] but as a schwa-like transition to /k/, accompanied by creak. Conversely, more than half of the German subjects experienced problems identifying Du. *werk* correctly. The problems appear to reside in the perception of Du. /r/, which is absent in almost all incorrect responses. Listening to the Dutch realization of *werk* and inspection of the corresponding oscillogram and spectrogram reveals that the Du. /r/ was realized as a weak approximant, which apparently was hard to identify as /r/ by many German subjects. This shows that a broad transcription does not suffice if one is interested in the mutual intelligibility of words in related languages. Subtle phonetic differences in the realization of identical phonemes may have serious consequences for cross-language perception and communication.

Du. *vrede* /vreːdə/ versus Ge. *Frieden* /friːdən/ 'peace'. About one third of the Dutch subjects did not succeed in relating Ge. *Frieden* to Du. *vrede*. The problems did not reside in relating Ge. /f/ to Du. /v/. In fact, the common realization of

initial /v/ in Dutch is rather voiceless so that the difference with German is smaller than the transcription symbols suggest. The erroneous responses reveal another problem, namely that the Dutch subjects were intent on finding a response containing /i/. Compared to the Dutch subjects, the problems experienced by the German subjects were much larger. Only 11.8% gave the correct response. Again, it is not the interpretation of Du. /v/ as /f/, since initial /f/ is present in virtually all incorrect responses. There seem to be few, if any, words in German that begin with /fre/, so alternative vowels had to be found. Apparently, since Dutch /e/ is phonetically diphthongized as [ei], see Mees and Collins (1983), responses such as *Freude* (5×) and *Frei(tag)* (4×) were seen as plausible alternatives. Du. /eː/ and Ge. /iː/ seems to represent a perceptual asymmetry of a sound correspondence, enhanced by differences in phonetic detail.

Du. *maal* /maːl/ versus Ge. *Mal* /maːl/ 'meal'. In contrast to what the identical broad transcriptions suggest, the mutual intelligibility of Du. *maal* and Ge. *Mal* is not perfect and symmetrical. The responses indicate that the main problem resides in the differential realization of final /l/ in German and Dutch. German final /l/ is 'clear', resulting in quite a few erroneous identifications by Dutch subjects of this sound as /n/. The misperceptions of final /l/ by the German subjects, however, are much more frequent. In fact, none of the German subjects succeeded in giving the right response. Many of them gave responses containing a diphthong *au*. Dutch /l/ in coda position is dark (velarized). Dark [ɫ] does not occur in German at all (ten Cate and Jordens 1990: 53). Therefore, the combination of /aː/ followed by dark [ɫ] is highly unusual for a German listener, who assimilates the [ɫ] to the nearest available velar vowel-like consonant, which is /w/. The combination [aw] would then be indistinguishable from the Ge. diphthong /au/. The reader is reminded (see Section 3.2) that even some of the Dutch native listeners had a hard time hearing the difference in Du. *maal* between [aːɫ] and [au]. Here, too, we seem to have a case where a broad transcription is a poor predictor of mutual intelligibility.

Du. *zin* /zɪn/ versus Ge. *Sinn* /zɪn/ 'sense'. Most Dutch subjects (89.3%) correctly translated Ge. *Sinn* to Du. *zin*. This is what one would expect on the basis of the identical transcriptions. However, conversely for the German subjects the correct identification of Du. *zin* was much more difficult (52.9% correct). In many cases, the German subjects were so confused that they did not produce any response. The three incorrect responses that were given do not reveal what caused the problems. Again, this case shows that subtle phonetic details may lead to large perception problems.

Du. *zoon* /zoːn/ versus Ge. *Sohn* /zoːn/ 'son'. The fact that as many as ten Dutch subjects responded to Ge. *Sohn* with Du. *zon* /zɔn/ 'sun' instead of *zoon*, has to be explained by the circumstance that in Dutch /oː/ is phonetically diph-

thongized to [ou], see Mees and Collins (1983). The monophthong in Ge. *Sohn* (with a slight transition to schwa) led the Dutch listeners to come up with alternatives with pure vowels, such as in Du. *zoen* 'kiss' with /u/ and Du. *zon* with /ɔ/. This behavior is all the more plausible as Ge. /o:/ is somewhat shorter than Du. /o:/ (van Dommelen 1980: 87). On the other hand, the errors made by the German subjects, which are much more frequent, seem to have been caused not so much by a wrong interpretation of the vowel but rather by the realization of Du. initial /z/. Dutch has no pre-palatal fricatives such as /ʃ, ʒ/. As a result, Dutch alveolar fricatives /s, z/ have a less fronted articulation than their counterparts in German (ten Cate and Jordens 1990: 57). As a result Dutch /s, z/ are very often misperceived by non-native listeners as pre-palatal /ʃ, ʒ/. Fourteen of the German error responses (e.g., *schön*, *schon*, *joint*) suggest this (pre-)palatal articulation in the Dutch stimulus word. In addition, the second half of Du. /z/ as produced by the speaker in the present experiment was voiceless, which has also influenced the kind of responses given by the German subjects. So, here again, the intelligibility problems seem to reside in phonetic details which are not apparent in broad transcriptions.

Du. *aard* /a:rt/ versus Ge. *Art* /a:rt/ 'nature'. The German word *Art* was correctly translated to Du. *aard* by 39.3% of the subjects. Another six responses began with /a:r/ so that it generally seems that the German /a:r/ combination does not deviate far from its Dutch counterpart. Nevertheless, /r/ was not really present in Ge. *Art*; the only thing we heard and saw was a noticeable lengthening of /a:/. The German listeners had more trouble with Du. *aard*. In the majority of the error responses the postvocalic /r/ is not reflected (11 out of 16). Listening to the stimulus and inspection of the corresponding oscillogram and spectrogram reveals that the /r/ was realized as a weak approximant, which is rather common nowadays. It is often referred to as the Gooise r (van Bezooijen 2005). Apparently, the approximant in Du. *aard* is too weak or too unusual to be recognized as /r/ by the German subjects, whereas its realization is clear enough for native Dutch listeners to pick up. It has been contended that /r/ is the most variable in its manifestation of all phonemes (Ladefoged and Maddieson 1996). Some realizations are easily recognized as variants of the same phoneme, but apparently here this is not the case.

We will now discuss the asymmetries in the six cognate pairs which were clearly recognized better by the German than by the Dutch listeners (a difference of at least 20%), as listed in Table 4. The relevant error responses are listed in Table 5.

Ge. *Buch* /bu:x/ versus Du. *boek* /buk/. Almost all German listeners (91.2%) successfully related Du. *boek* to Ge. *Buch*. There is no Ge. word form /bʊk/ (even though this non-word response occurred once), so that, apparently, the most

Table 4: Intelligibility results for the six cognates with a difference of at least 20% in favor of the German subjects. Further see Table 3.

34 German subjects				28 Dutch subjects				Diff.	Meaning
Word	**N missing**	**N errors**	**% correct**	**Word**	**N missing**	**N errors**	**% correct**		
boek	2	1	91.2	Buch	4	24	0	91.2	book
jaar	0	9.5	72.1	Jahr	0	22	21.4	50.6	year
bad	5	6	67.7	Bad	0	23	17.9	49.8	bath
vrouw	0	0	100.0	Frau	3	5	71.4	28.6	woman
macht	0	1	97.1	Macht	0	8	71.4	25.6	power
vader	1	9	70.6	Vater	1	13	50.0	20.6	father

Table 5: Responses to the six cognates with an intelligibility difference of at least 20% in favor of the German subjects. The number of responses is only indicated for responses given by more than one subject.

34 German subjects					
boek	**jaar**	**bad**	**vrouw**	**macht**	**vader**
buk	ja 5 jagen 3 jagd jahre (1/2)	bett mit blad bach waffe putten		nacht	fahrer 5 fahren 2 fahre farbe
28 Dutch subjects					
Buch	**Jahr**	**Bad**	**Frau**	**Macht**	**Vater**
boer 8 boeg 2 ploeg 2 oog 2 broeg vroeg boog oogst por poep oor doe boef cake	ja 21 aap 1	paard 15 baard 7 pat	touw bal koe gauw buik	mag 4 maagd mat markt winkel	water 9 vaten vaart valen apen

reasonable alternative was to replace the velar plosive by its fricative counterpart. In contrast, none of the Dutch listeners succeeded in relating Ge. *Buch* to Du. *boek*. One reason is the presence in Dutch of the false friend *boeg* /bux/ 'bow of a ship' (/x/ is realized as a uvular fricative [Ξ] in Standard Dutch (e.g., Gussenhoven 1999: 74). However, this response was given only twice; the word is perhaps not known to the relatively young children serving as subjects. Another reason is the circumstance that postvocalic /r/ in Dutch may be pronounced as a uvular fricative (as in French), resulting in a second false friend (at the phonetic level), namely *boer* [buːʁ] 'farmer'. In Du. *boer*, the vowel is lengthened as a consequence of following /r/ (van Oostendorp 1996: 106), which makes it more similar in this respect to Ge. *Buch* than the intended response Du. *boek*. The word *boer* was the most frequent error response (8×) given by the Dutch subjects. In fact, most of the Dutch error responses reflected a rhyme with either /u/ or /oː/ followed by /x, r/.

Ge. *Jahr* /jaːr/ versus Du. *jaar* /jaːr/ 'year'. In contrast to what the identical transcriptions suggest, Du. *jaar* and Ge. *Jahr* were not perfectly understood cross-linguistically. Du. *jaar* was translated correctly by 72.1% of the German subjects, but in eight cases the coda /r/ was not picked up, or mistaken for a voiced velar stop /ɣ/. Indeed, final /r/ in *jaar* was realized as a very weak approximant (see the comments for Du. *aard* / Ge. *Art* above). In the reversed case, Dutch listeners massively (21 out of 28) mistook Ge. *Jahr* for Du. *ja* /jaː/ 'yes'. Indeed, listening to the stimulus and inspection of the concomitant oscillogram and spectrogram, showed that not even a trace of [r] was present at the end of Ge. *Jahr*. It is well known that final /r/ after long vowels is no longer pronounced in German but reduces to a vowel-like segment (ten Cate and Jordens 1990: 55; Kohler 1995: 165) or is deleted altogether (Simpson 1998).

Ge. *Bad* /baːt/ versus Du. *bad* /bɑt/ 'bath'. Du. *bad* is successfully related to Ge. *Bad* by most German listeners (67.7%). Du. /ɑ/ is a short back vowel, which normally should not be readily assimilated by German listeners to long, front /aː/. In the present case, however, there is no word candidate /bat/ in German, so that /baːt/ is the nearest alternative. In the reversed case, however, Dutch listeners equate long front Ge. /aː/ with the Du. long front /aː/, yielding no fewer than 22 error responses (out of 28) containing long /aː/. Fifteen of these centered on the response *paard* /paːrt/ 'horse'. Another seven subjects responded with Du. *baard* /baːrt/ 'beard'. Again, Ge. onset /b/ has no prevoicing, so that the majority of the Dutch listeners interpret the sound as a token of /p/, which has no aspiration in Dutch. The distribution of the responses indicates that Ge. /b/ is in between Du. /b/ and /p/ but closer to /p/ than to /b/. This case shows how seemingly minor phonetic differences combined with the presence of a plausible alternative compromise the correct interpretation of a cognate.

Ge. *Frau* /frau/ versus Du. *vrouw* /vrau/ 'woman'. Du. *vrouw* was recognized by the German subjects as Ge. *Frau* without a single error. As mentioned above, in Dutch the realization of initial /v/ is not very voiced (Van de Velde 1996). Furthermore, German does not have word-initial /v/, let alone /vr/, so that this cluster is readily assimilated to Ge. /fr/. The Dutch subjects had more problems relating Ge. *Frau* to Du. *vrouw*. However, the Dutch error responses are too few and unsystematic (3 missing responses, and 5 singleton errors) to allow any explanation of the asymmetry.

Ge. *Macht* /maxt/ versus Du. *macht* /mɑxt/ 'power'. Du. *macht* was heard correctly as Ge. *Macht* with just one exception. Ge. *Macht*, on the other hand, was incorrectly translated in eight cases out of 28. In four of these the final /t/ was lost, yielding the Dutch word *mag* 'may', a high-frequency modal auxiliary. Only one error response contained long /a:/, which seems to show that the front articulation of German /a/ does not compromise its assimilation to Du. /ɑ/ and is perceptually outweighed by the length feature: both Ge. /a/ and Du. /ɑ/ are short vowels. Therefore, this is a case where a phonemic comparison of a pair of cognates predicts a problem that does not arise in actual phonetic perception.

Ge. *Vater* /fa:tər/ versus Du. *vader* /va:dər/ 'father'. Du. *vader* is incorrectly recognized by German listeners in nine out of 34 cases (plus one non-response). In all cases the listener failed to relate the intervocalic Du. /d/ to Ge. /t/ so that instead of /fa:tər/ they reported a word with a weaker (or absent) intervocalic consonant. The Dutch listeners were thrown off course by Ge. /fa:tər/. Although they know that initial /f/ can represent underlying /v/ (see above Ge. *Frau* / Du. *vrouw*), this does not help, as there is no Du. word /va:tər/. Therefore they allow one more repair, which is to reinterpret initial /f/ as the homorganic semivowel labiodental /w/, yielding the high-frequency item *water* 'water' in nine cases.

4 Conclusions and discussion

In the present study, we presented Dutch and German cognate nouns to Dutch and German children in the 9–12 year age bracket to see whether the level of cross-linguistic intelligibility between Dutch and German is symmetric or asymmetric. The results revealed that the Dutch subjects were significantly better at understanding the German cognates than the German subjects were at understanding the Dutch cognates. Concretely, there are more cognate pairs where the Dutch subjects performed better than the other way around and the size of the asymmetry is generally larger for the Dutch subjects than for the German subjects.

As we had ascertained beforehand that the extra-linguistic factors of language experience and language attitude, as well as differences in lexical knowl-

edge of the two subject groups, could not play a role, we are confident that the overall asymmetry must have a linguistic basis, i.e., has to be related to the characteristics of the two languages involved. It has been suggested, in this context, that knowledge of one or more foreign languages could be a source of non-linguistic information that might provide an alternative explanation for the asymmetry in mutual intelligibility established in our study. Specifically, children in the Netherlands get considerably more exposure to English than German children do. Dutch television (including children's programs) offers far more English-mediated programs, whereas in Germany children's programs are German-mediated or dubbed into German. As a consequence, Dutch children – despite the claim of no knowledge of German – are more acquainted with foreign languages and might therefore be able to transfer this competence to perceiving and processing German words. The results of our experiment, however, suggest that it were the German children who took recourse to their knowledge of English when asked to provide a translation of certain Dutch words rather than the other way around. There are no indications in our results that the Dutch children used their knowledge of English. Although it would be advisable in experiments such as ours to establish knowledge of other languages other than the target language pair, we feel safe to say at this time that knowledge of English cannot provide a non-linguistic explanation for the Dutch-German asymmetry found in our experiment.

To gain insight into the relevant linguistic factors, we made a thorough analysis of the Dutch and German responses to 16 cognate pairs with an asymmetry larger than 20%. Ten of these were in favor of the Dutch subjects and six were in favor of the German subjects. Each contrastive analysis can be seen as a separate case, with its own explanations. We will now focus on the question whether there are any general conclusions to be drawn from the analyses as to the kind of linguistic processes that have led to the asymmetries found. Are there clear examples of asymmetries at the sound level? Can certain asymmetries be attributed to the coincidental presence of a neighbor in one of the two languages? Are there other relevant tendencies that can be observed?

In the introduction we raised the question whether, for example, there is an asymmetry in the perception of German /ʃ/ by Dutch subjects and the perception of Dutch /s/ by German subjects. These two sounds are often found in corresponding Dutch German cognates, both in final and initial position. There are four cognate pairs in the present study containing the /s/-/ʃ/ correspondence, namely Du. *stuk* /stʏk/ versus Ge. *Stück* /ʃtʏk/ 'piece', Du. *stad* /stɑt/ versus Ge. *Stadt* /ʃtat/ 'city', Du. *mens* /mɛns/ versus Ge. *Mensch* /mɛnʃ/ 'person', and Du. *stem* /stɛm/ versus Ge. *Stimme* /ʃtɪmə/ 'voice'. Looking at the responses, no systematic asymmetry is revealed for any of the four cognate pairs, the percentages

correct being 100 and 91.2, 92.9 and 94.1, 100 and 100, and 10.7 and 5.9, respectively, where the first percentage pertains to the Dutch subjects and the second percentage to the German subjects. Nevertheless, speaking more generally, one would expect that it should be easier for the Dutch subjects to link /ʃ/ to /s/, these two phonemes not being in opposition, than for the German subjects to link /s/ to /ʃ/. In German there are minimal word pairs such as *Rasse* /rasə/ 'race' and *Rasche* /raʃə/ 'fast' in intervocalic position or *Fleiß* /flais/ 'diligence' and *Fleisch* /flaiʃ/ 'flesh' in coda position. The /s/ ~ /ʃ/ contrast does not occur as such in word onsets, since underlying |s| surfaces as /ʃ/ in word-initial clusters and as /z/ when singleton. The absence of the predicted asymmetry between /s/ and /ʃ/ would seem primarily due, therefore, to phonotactic constraints that affect potential sequences of consonants in clusters. Whenever a plosive in the syllable onset of a Dutch or German word is preceded by a fricative sound, in fact by any tautosyllabic sound at all, there is just one possibility left in either language, viz. /s/ in Dutch and /ʃ/ in German.

Are there any other sound correspondences in the stimuli that suggest a perceptual asymmetry? Perhaps the correspondence between initial Du. *t* /t/ and Ge. *z* /ts/ as in Du. *tijd* /tɛit/ versus Ge. *Zeit* /tsait/ 'time' qualifies as an example. Except for one missing response, all Dutch subjects correctly came up with a response with initial /t/ for German /ts/. On the other hand, practically all German subjects produced incorrect responses with initial /d/ for Du. /t/. We attributed this asymmetry to the fact that Dutch /t/, unlike in German, is not aspirated (see above for more details). Therefore, we argue that the perceptual asymmetry is caused by a phonetic difference between Dutch and German in the realization of /t/.

There are more examples of asymmetric perceptions of corresponding sounds in the material. Quite a few have to do with differences between Dutch and German in the production of /r/, especially in pre-consonantal position in the coda. Dutch subjects seem to have no problems identifying /ɾ/ in for example Ge. *Werk* /wɛrk/ 'work' and Ge. *Art* /aːrt/ 'nature', even though no clear [r] is present in the stimulus words and even though neighbors such as *wek* /wɛk/ '*wake up, 1sg.*' and *Aad* 'proper name, short for Adrian', are present in Dutch. In contrast, many German subjects find it difficult to interpret /r/ in the corresponding Dutch cognates *werk* /wɛrk/ and *aard* /aːrt/. In these words /r/ is realized as a weak alveolar approximant, reflecting a fairly new development in Dutch (van Bezooijen 2005). Apparently, this realization is not easily linked by German subjects to /r/. This is another clear example of a perceptual asymmetry at the sound level, caused by phonetic detail.

In word-final position the situation seems to be reversed. There the German subjects seem to have fewer problems interpreting the approximant realization of

/r/ in the Dutch cognate than the Dutch subjects have in interpreting the absence of [r] in the German cognate. This can be deduced from the responses for Du. *jaar* /ja:r/ and Ge. *Jahr* /ja:r/ 'year'. The percentages *ja* 'yes' and *jaar* 'year' given by the Dutch subjects as a response to Ge. *Jahr* (produced without a trace of final /r/) are 75.0 and 21.4, respectively. The percentages *ja* 'yes' and *Jahr* 'year' given by the German subjects as a response to Dutch *jaar* (with final /r/ produced as a weak approximant) are 14.7 and 72.1, respectively. This shows that one should be very careful generalizing perceptual asymmetries in sound correspondences. Context seems to play an important role.

In addition to differences in the phonetic realization of phonemes in German and Dutch, the coincidental presence of lexical neighbors or false friends may lower the percentage of correct responses. Sometimes, there is a false friend in both languages, so that a (potentially high) symmetrical intelligibility is transformed into a low symmetrical intelligibility. A good example is Du. *dag* /dɑx/ versus Ge. *Tag* /ta:k/ 'day'. Du. *dag* was identified correctly as Ge. *Tag* by 0% of the German subjects. There was one missing response and all other responses consisted of *dach* /dax/ 'roof'. Ge. *Tag* was identified correctly as Du. *dag* by 14.3% of the Dutch subjects, 60.7% opting for Du. *taak* /ta:k/ 'task' instead. So, in both languages there happened to be an alternative response that was considered to be more plausible than the intended response.

Of course, when there is a plausible alternative in only one of the two languages, this may lead to an asymmetry in intelligibility. 53.6% of the Dutch listeners responded with *paard* /pa:rt/ 'horse' to Ge. *Bad* /ba:t/ 'bath', and another 25.0% with *baard* /ba:rt/ 'beard'. In German there are no plausible alternatives for Ge. *Bad* as a response to Du. *bad* /bɑt/ 'bath'. The asymmetry in the availability of alternative responses in the lexicon must have played an important role in the attested asymmetry in intelligibility of Du. *bad* and Ge. *Bad*, namely 67.7% correct for the German subjects compared to 17.9% correct for the Dutch subjects.

What are the consequences of our findings for the relationship between the phonetic similarity of words and word recognition? It is common practice to quantify phonetic similarity by means of the so-called Levenshtein algorithm. The Levenshtein algorithm is a measure of string edit distance based on the smallest number of operations needed to map a given string on another string. Applied in linguistics, a string of sounds, represented by phonetic symbols, from one variety is mapped on the corresponding string in another variety (cf. Heeringa 2004). There are three possible operations, namely insertions, deletions, and substitutions. First, the two strings are aligned, so that identical sounds are matched. Subsequently, the minimum number of operations that is needed to transform the one string into the other is assessed. Each operation is assigned a

cost of one point. To relate the distance to word length, the total cost is divided by the number of alignments. The maximum Levenshtein distance (no phonetic similarity) is 100% and the minimum distance (phonetic identity) is 0%.

The Levenshtein distance has often been used as a predictor of mutual intelligibility between related languages. Some studies showed high correlations between intelligibility scores and the Levenshtein distance. Gooskens (2007), for example, obtained a correlation of $r = -.80$ ($p < .001$) between intelligibility scores and the Levenshtein distance for varieties of the Scandinavian languages Danish, Norwegian, and Swedish. Beijering et al. (2008) even found an overall correlation of $r = -.86$ ($p < .01$) for Copenhagen Danish and a range of other Scandinavian varieties. In these cases the correlation was computed at the level of language variety, i.e., averaged over words. Apparently, if the global linguistic distances between languages or language varieties are large enough, these distances will parallel overall differences in intelligibility. However, when phonetic similarity and intelligibility are correlated at the level of the individual word, not much is left of the correlation. This appears, for example, from the study by Kürschner et al. (2008), in which 384 Swedish words were presented to a group of Danish subjects to be translated. In this case there was a correlation of $r = -.27$ ($p < .01$). This means that in the Kürschner et al. study no more than 7 percent (i.e., r^2) of the variance in the intelligibility data is explained by phonetic similarity quantified by means of the Levenshtein distance measure. In the materials we used for the present study, the correlation between the Levenshtein distance and the intelligibility of Dutch words for German listeners was computed at $r = -.435$ ($p < .01$) and for Dutch listeners responding to German cognates at $r = -.468$ ($p < .01$). Although both correlations are significant, the Levenshtein distance accounts for less than 22 percent of the variance in the intelligibility scores, leaving at least 78 percent of the variance unaccounted for. Moreover, since the Levenshtein distance is a symmetrical measure of the difference between pairs of segment strings, the asymmetry found between Dutch and German cannot be explained by it in principle.

The question is why the correlation at the word level is so low. For intuitively it seems plausible that a word in another language or language variety will be easier to understand as it is more similar to the cognate in one's own language. We think that our study yields some possible answers, which we will now discuss.

First, correlations are always symmetric, whereas the present study shows considerable asymmetries in intelligibility between pairs of cognates. Extreme examples are Ge. *Zeit* /tsait/ versus Du. *tijd* /tɛit/ 'time' with a difference in intelligibility of 86.3 percentage points in favor of the Dutch subjects and Du. *boek* /buk/ versus Ge. *Buch* /bu:x/ 'book' with a difference of 91.2 percentage points in

favor of the German subjects. Asymmetric relationships cannot be represented in a correlational analysis and will lower the coefficient.

Second, the effect of phonetic similarity may be cancelled by the presence of false friends and neighbors. However similar a stimulus and the intended response may be, if there is another possible response that is even closer to the stimulus, the latter may be preferred by the listeners, leading to (severely) reduced intelligibility. Several of such cases were described above.

Third, it is essential that phonetic similarity be represented in the right way. The present study has shown convincingly that broad transcriptions are unfit to be used as a basis for the calculation of the phonetic distance between pairs of words with a view of predicting intelligibility. There are several cases where the word in the stimulus language and the corresponding cognate in the response language were represented by the same phonetic symbols and where nevertheless many subjects did not succeed in recognizing the stimulus word. This holds, for example, for Du. *zoon* /zoːn/ 'son' which is phonetically transcribed with the same symbols as its German cognate *Sohn* /zoːn/, but which was nevertheless correctly identified by no more than 20.6% of the German subjects. The incorrect responses given suggest that this must be due to subtle differences in the phonetic realization of Dutch and German /z/ and /oː/ (see above), which are not expressed in the broad transcription we used and which is commonly used in other intelligibility studies as well). Similarly, phonetic details in the realization of /r/ seem to be responsible for the low intelligibility of Du. *aard* /aːrt/ 'nature' corresponding with Ge. *Art* /aːrt/ (17.7% correct by the German subjects), whereas phonetic differences in the production of final /l/ may explain the poor recognition of Du. *maal* /maːl/ 'meal' corresponding with Ge. *Mahl* /maːl/ (0% correct by the German subjects). On the other hand, there were cases of different transcriptions yielding high intelligibility. For example, half of the transcription symbols in Du. *stad* /stɑt/ 'city' differ from those in Ge. *Stadt* /ʃtat/, resulting in a Levenshtein distance of 50%, but the mutual intelligibility was nevertheless high, namely 92.9 for the Dutch subjects and 94.1 for the German subjects.

Phonetic detail seems to play an important role in the intelligibility of cognates in related languages and language varieties. However, the results of our study do not allow us to make predictions because each word pair seems to have its own constellation of factors affecting intelligibility, where one factor may overrule another factor. Simply replacing broad transcriptions by features is no solution. One of the most noteworthy results of our post-hoc contrastive response analysis is in our view that indeed the devil is in the detail. It has been shown in recent literature that phonetic detail matters when it comes to recognizing words in one's native language when it is spoken with a regional (e.g., Adank and McQueen 2007) or foreign accent (e.g., Witteman et al. 2011). It has also been

shown that even advanced learners persist in applying their native-language phonotactics (Weber and Cutler 2006; Hanulikova et al. 2011) and expectations with respect to assimilation phenomena (e.g., Weber 2002) when having to recognize speech in a foreign language. However, the literature mentioned here aims to uncover the psycholinguistic processes that a listener applies to non-native language input. We are not aware of any experimental research that allows one to predict how phonetic differences between two languages affect word recognition across the board. Such an undertaking would require a complete contrastive analysis of how listeners of one language in the pair assimilate the sounds of the other language to their native sound system.

In order to find out with which sound in the listener's native language a non-native sound (from a close related language) is identified, and how well the two categories match, we might fruitfully turn to the Perceptual Assimilation Model (PAM) developed by Best and co-workers (e.g., Best 1995; Best et al. 2001). PAM was developed to predict and explain the behavior of learners of a second language when first confronted with the sounds of the target language. The results of perceptual assimilation experiments reveal which categories in the listener's native language can possibly be matched with a non-native sound, while typicality judgments given for matches of native and foreign sounds indicate the relative likelihood of the matching (Sun and van Heuven 2007; van Heuven 2008). PAM would be well suited to establish asymmetries in the matching of sound categories between two languages. Unfortunately, no such systematic experimental comparison within the PAM framework has been done on Dutch and German at this time. Therefore, no a priori hypotheses could be generated as to what asymmetries might be found in the mutual intelligibility scores of subjects. Such an undertaking remains to be done in future research.

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