Voiced labiodental fricatives or glides - all the same to Germans?

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Abstract

Dutch has a three-way contrast in labiodental sounds, which causes problems for native speakers of German in their acquisition of Dutch, since German contrasts only two labiodentals. The present study investigates the perception of the Dutch labiodental fricative system by German L2 learners of Dutch and shows that native Germans with no or little knowledge of the Dutch language categorize the Dutch labiodental voiced fricative and approximant as their native voiced fricative. Advanced learners, however, succeed in acquiring a category for the voiced fricative, illustrating that plasticity in the perception of a second language develops with the amount of exposure to the language.

1. Introduction

Dutch has three labiodental segments, namely a voiceless fricative /f/, a voiced fricative /v/, and a voiced approximant /ʋ/ ([1], [2]). Minimal triplets of the three sounds in word-initial position are given in (1).

(1)	/f/	/v/	/ʋ/	
	fee	*vee*	*wee*	'fairy, cattle, ache'
	feil	*vijl*	*wijl*	'error, rasp, while'

Many speakers of Standard Dutch, apart from those from the Southern part of the Netherlands, neutralize the voiced and voiceless distinction for labiodental fricatives (as for all fricatives) word-initially, see [2] p.74.

In addition to the three segments in (1), Dutch has a labiovelar approximant /w/ that occurs in the triphthong /auw/ in words like *blauw* 'blue'. This labiovelar is often treated as an allophone of the labiodental approximant (e.g. [2, 3]), because it occurs in coda position, only, whereas the labiodental approximant occurs only in onset position. The present article does not follow this proposal and restricts its analysis to the labiodental approximant.

A three-way distinction of labiodentals is cross-linguistically very unusual. Apart from Dutch, we know only of two other languages that have the same three labiodental categories, namely the Edoid languages Isoko and Urhobo, spoken in Nigeria [4]. In addition to the labiodentals, Isoko and Urhobo have a labiovelar fricative / ʍ/ and a labiovelar approximant /w/.

German learners of Dutch have problems acquiring the Dutch labiodental contrast since their native language differentiates only a voiced and a voiceless labiodental fricative, transcribed as /v/ and /f/, respectively, see [5, 6].

The situation for German learners of Dutch is complicated by the fact that Dutch has two voicing assimilation rules, a progressive one, which devoices the voiced fricatives before voiceless obstruents, and a regressive one, which voices voiceless fricatives after voiced obstruents, see [1] p.58f.

The present study investigates how German L2 learners of Dutch perceive of the distinction between Dutch /f/ - /v/ - /ʋ/. From the phonetic descriptions of the labiodental categories in the two languages, we expect the Germans to have no difficulties in perceiving Dutch /f/ and /v/, since they seem to correspond to the German native categories. The Dutch approximant /ʋ/, however, should pose a problem to the learners, as it has no corresponding native category. German learners of Dutch are therefore expected to confuse the approximant with their native /v/, which is phonetically and phonologically closest in terms of voicing and place of articulation.

Everyday observations only partly attest these expectations. Though German learners have problems perceiving a difference between Dutch /v/ and /ʋ/, they confuse the voiced fricative, not the approximant. The present study empirically tested this observation with a forced-choice categorization experiment.

2. Categorization experiment

A categorization experiment was created to test the perception of the distinction between Dutch /f/ - /v/ - /ʋ/ by German L2 learners of Dutch.

2.1. Speech material

Test materials comprised the twelve Dutch obstruents /p, b, t, d, k, x, f, v, ʋ, s, z, ɕ/. The whole set of obstruents has been included in this study because listeners should not be aware of the contrast under investigation, and furthermore, we also expected confusions for the Dutch distinction between voiced and voiceless plosives (due to the difference in VOT), and for the three sibilants (due to the difference in place of articulation).

To avoid effects of lexical familiarity on consonant identification, nonsense words were used in this experiment. The obstruents were embedded within syllables of the structure CV, where V was /a/. These syllables were presented in the Dutch carrier sentence "Hoor je __", 'Do you hear __', which was read as a declarative sentence with a falling intonation.

2.2. Speaker and Recording procedures

A male speaker from the South of the Netherlands who produces a contrast between all three labiodental Dutch sounds in intervocalic position recorded the test items. Eight repetitions for each obstruent were produced, yielding a total of 96 tokens. Recordings were made in a sound proof booth to a Pioneer PDR-555 CD recorder, using a Sennheiser MKH-105 microphone.

The recordings were digitized at an audio sampling rate of 22.05 kHz. The edited sound files were checked for their level of loudness, and in that process 13 items had to be adjusted to the average intensity of 60 dB.

2.3. Listeners

21 German learners of Dutch participated in the experiment. Sixteen of these were recruited from the Dutch Department of the Free University of Berlin where they were students of Dutch, three listeners were university students tested at the University of Potsdam, and one listener each was tested at the University of Amsterdam and at the Centre for General Linguistics, Berlin. All had started attending Dutch language classes after the age of 19. Fourteen had had up to twelve months of Dutch language classes whilst the remaining seven had had between 18 and 34 months of Dutch classes. The length of stay in the Netherlands varied: ten learners had never been in the Netherlands, five learners had lived there for up to seven months and six learners had lived in the Netherlands for up to four years.

A German control group of six listeners with no prior knowledge of Dutch was tested at the University of Potsdam and at the Centre for General Linguistics, Berlin. A Dutch control group of five native speakers of Dutch was tested at Utrecht University and at the University of Potsdam.

The range of age of the participants was between 18 and 40 years. Listeners either volunteered for the experiment or they were paid a small sum for their participation. All participants reported normal hearing and normal or corrected vision.

2.4. Experimental task

A closed-set identification task was constructed. Orthographic representations of the target syllables were presented on the computer screen as in (2), and at the start of the experiment their phonetic realizations were explained to the listeners, in order to avoid possible orthographic confusions.

(2)	pa	ba	ta	da	ka	ga
	fa	va	wa	sa	za	sja

Then a stimulus was played and subjects were asked to make a choice and click on the consonant they thought they just had heard.

Without feedback, the program then continued by playing the next stimuli. The set of 96 items was repeated 4 times, yielding a total of 384 items. Each listener therefore heard 32 repetitions of each obstruent.

The stimuli were presented to the subjects via headphones at a comfortable listening level. The order of the sentences was randomized for each listener. The test contained three self-timed pauses.

At the end of the perception experiment, subjects were asked to read a list of six randomized repetitions of the stimuli set, and were recorded. The results of the acoustic analyses and the native listeners' ratings of the recordings are not presented in this article.

The German control group had a different set of possible answers on the screen than the Dutch group. This set is given in (3).

(3)	pa	ba	ta	da	ka	ga
	fa	wa	sa (Ass)	za (so)	scha	cha (ach)

This set includes example words, given in brackets, for /s/ and /x/, which do not occur word-initially in German, and for /z/, which is usually orthographically represented as <s>.

For the three labiodental segments under question, the German listeners had only two possible answer categories, namely the graphemes <f> and <w>, which correspond to the phonemes /f/ and /v/, respectively.

3. Results

The percentage of correct categorization for all obstruents was obtained and a confusion matrix for these segments is shown in the appendix. Since we are principally interested in the extent to which the listeners were able to perceive the contrast in labiodental fricatives, the following analysis focuses on the perception of the distinction between /f/, /v/ and /ʋ/.

Mean identification scores for /f/, /v/ and /ʋ/ were first calculated for each listener and then per group (see Table 1).

	L2 learners (Std.dev.)	L1 controls (Std.dev.)
/f/	79,0% (20.4)	94.4% (9.5)
/v/	74,6% (24.9)	94.4% (12.6)
/ʋ/	92,6% (14.2)	99.4% (1.4)

Table 1: Mean identification scores (% correct) of /f/ - /v/ - /ʋ/ for German L2 and Dutch L1.

The percentage of correctly identified target consonants indicates that German learners of Dutch had no major problems in the correct classification of the Dutch approximant /ʋ/. The categorization of /f/ and /v/ proved to be more difficult.

Native speakers of Dutch categorized /ʋ/ correctly, and with regard to /v/ and /f/ three native listeners achieved 100% correctness, whilst two listeners confused /v/ and /f/ (one speaker miscategorized 7 tokens of /f/ as /v/, the other 9 tokens of /v/ as /f/).

Of interest for the present article are the confusions made between /f/, /v/ and /ʋ/ by the German learners of Dutch. These are shown in Table 2 (confusions with other than the three labiodental segments are not included, therefore the totals of the rows do not amount to 672).

		response			
		/f/	/v/	/ʋ/	total
stimulus	/f/	**531**	119	14	664
	/v/	35	**501**	124	660
	/ʋ/	1	41	**622**	664
	total	567	661	760	1988

Table 2: /f/ - /v/ - /ʋ/ confusions by German L2 learners (in number of stimuli).

From Table 2 we see that the Dutch approximant /ʋ/ was hardly ever confused with any of the other labiodentals (only in 6.3% of the cases). The voiced fricative /v/ was categorized as approximant /ʋ/ in 18.5% of the cases, and the voiceless fricative /f/ as voiced fricative /v/ in 17.7% of the time.

Information on the performance of single speakers can be obtained from Figure 1. Here the German listeners are ordered according to how well they scored in categorizing the Dutch /v/. In addition to the classification of the voiced fricative/v/, this figure shows the categorization of /f/ and /ʋ/.

The German control group had two answer categories, their native /f/ and /v/, instead of the Dutch three-way contrast. Their categorizations are shown in Table 3. The German L2 learners classified the Dutch voiceless fricative as their native /f/ in 99.5%. The Dutch approximant /ʋ/ was categorized as their native voiced fricative /v/ in 99.5% of the cases. The Dutch voiced fricative /v/ was categorized as German voiced fricative in 82.8 % of the cases. However, this result was very listener-dependent, as three listeners categorized all Dutch voiced fricatives /v/ as German voiced fricatives, the other three speakers categorized respectively 4, 8 and 20 tokens as /f/.

		response		
		/f/	/v/	total
stimulus	/f/	**191**	0	191
	/v/	32	159	191
	/ʋ/	0	**191**	191
	total	223	351	287

Table 3: /f/ - /v/ - /ʋ/ confusions by German control group (in number of stimuli).

To sum up, the German L2 learners performed well in categorizing the Dutch approximant /ʋ/, but confused /f/ with /v/ and the reverse (albeit with strong evidence of individual variation). The German control group categorized Dutch /ʋ/ consistently as /v/, and showed some variation in the categorization of Dutch /v/.

4. Discussion

The results of the present experiment illustrate that the categorization of Dutch /f/ - /v/ - /ʋ/ by German L2 learners depart from the expectations made on the basis of the phonemic descriptions of these sounds. The assumed category correspondences are represented in Figure 2a. According to these expectations, the German L2 learners at the beginner's level (and the German control group) were to classify the Dutch /v/ and /ʋ/ as one segment corresponding to their native voiced fricative /v/, and to classify the Dutch voiceless fricative /f/ as their native /f/ (left of Figure 2a). In the progress of acquiring Dutch, the learners are then supposed to create a new category for the Dutch approximant /ʋ/ (right of Figure 2a).

What we found instead is the following. The German L2 learners at the beginner's level and the German control group categorize the Dutch /f/ mainly as /f/, which is in agreement with our expectations. However, the Dutch approximant /ʋ/ is categorized by the learners as such, and by the German controls as their voiced fricative /f/, both almost exclusively. This indicates that Germans acquiring Dutch set the Dutch approximant equal to their native voiced fricative, see left of Figure 2b. The Dutch voiced fricative /v/ is categorized mostly as the German /v/ by the control group, showing that both /v/ and /ʋ/ are perceptually similar to their /v/. The German L2 learners of Dutch thus have to acquire a new category that lies in between their two native categories (right of Figure 2b). This causes some confusion at the beginning of the acquisition process, but can ultimately lead to a correct categorization of the three labiodentals in Dutch, as shown in the results of the five most advanced learners.

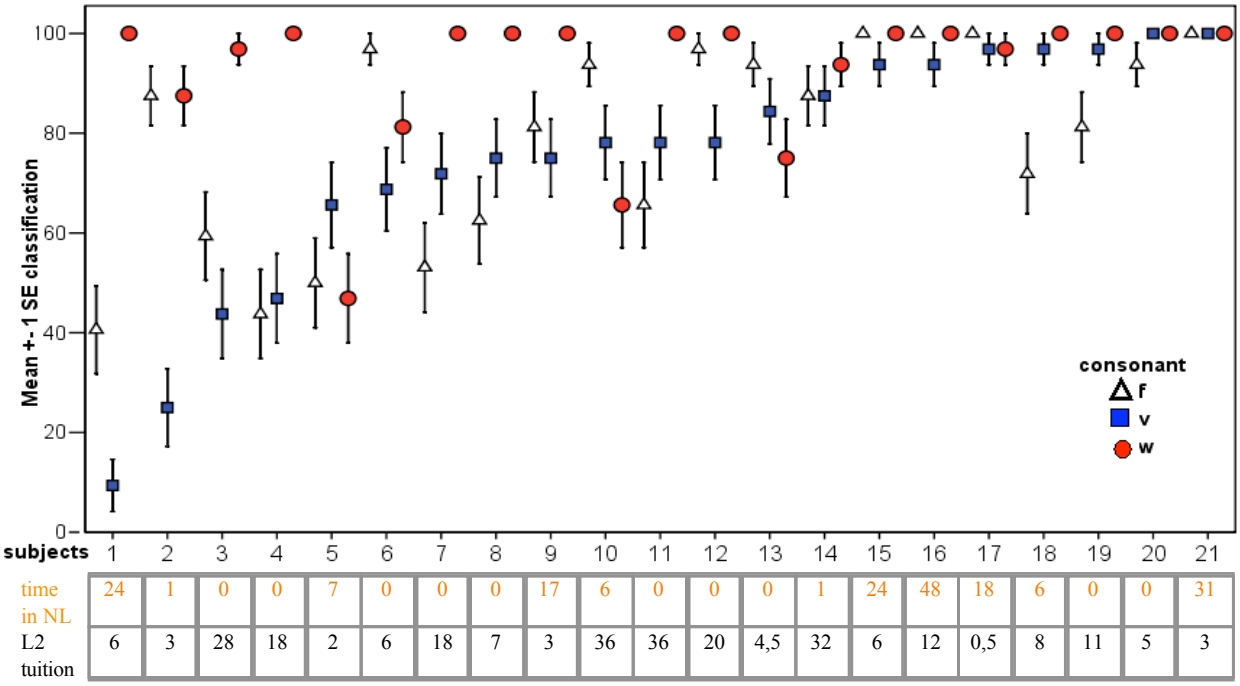

Figure 1: Consonant classification rates obtained for individual subjects of the German L2 group. <f> stands for /f/, <v> for /v/, and <w> for /ʋ/. The table below the figure gives information on the individual subjects, namely time spent in the Netherlands (in orange) and language tuition (in black), both given in months.

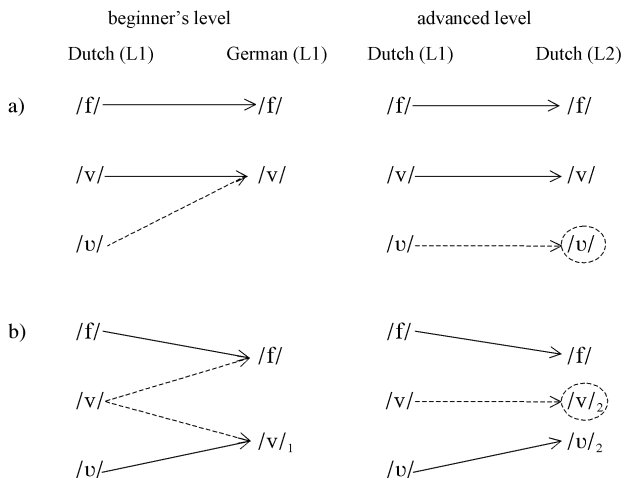

Figure 2: Simplified category corresponcendes between Dutch and German labiodentals (at beginner's level) and creation of L2 categories (at advanced level), a) as expected from phonemic descriptions, b) as based on the present experiment. Dashed lines stand for correspondences that have to be changed in the course of acquisition, dashed circles for categories that have to be created. Subscripts indicate a change of category label from beginners to advanced level.

5. Conclusions

The examination of the data suggests that German native speakers acquiring Dutch have no problems perceiving the Dutch labiodental approximant correctly, though they do not have such a category in their native language. At the same time, the German L2 learners have problems perceiving the Dutch labiodental fricative, though they have the same category in their native language. These findings illustrate the danger of equating categories of two languages that are described as the same but have different phonetic realizations: the German labiodental fricative /v/ differs from the Dutch labiodental fricative /v/ in being primarily distinguished from its voiced counterpart by vocal-fold vibration [7], whereas friction does not seem to be employed as a distinguishing cue. This explains why Germans at the beginning of their L2 acquisition do not distinguish Dutch /v/ and /ʊ/, both being voiced.

Furthermore, the investigation shows the plasticity of speech perception by the ability of L2 learners to acquire native-like performance: although many learners had problems in the perception task, a substantial group of advanced learners (five German listeners in the present categorization experiment) attained the three-way labiodental contrast of Dutch.

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Appendix: Confusion matrix for 12 Dutch obstruents by 21 German learners of Dutch.

		response												
		b	d	f	k	p	s	ɕ	t	v	ʊ	x	z	total
stimulus	b	**653**	3	1	0	9	2	2	1	0	0	0	1	672
	d	1	**653**	1	0	2	1	1	5	2	2	2	2	672
	f	0	0	**531**	1	1	2	3	1	119	14	0	0	672
	k	0	1	1	**663**	1	1	1	1	0	0	2	1	672
	p	45	0	1	2	**619**	0	1	0	4	0	0	0	672
	s	1	0	1	1	3	**416**	5	0	2	3	1	239	672
	ɕ	0	0	0	2	0	3	**659**	0	0	1	1	6	672
	t	1	37	0	1	1	1	3	**626**	0	1	1	0	672
	v	3	2	35	2	0	0	2	2	**501**	124	0	1	672
	ʊ	2	0	1	2	1	1	1	1	41	**622**	0	0	672
	x	0	1	0	1	0	1	0	1	0	1	**666**	1	672
	z	0	1	2	0	0	200	2	0	0	2	1	**464**	672
	total	706	698	574	675	637	628	680	638	669	770	674	715	8064