

FOREIGN ACCENT IMITATION AND VARIATION OF VOT AND VOICING IN PLOSIVES

Sara Neuhauser

Friedrich-Schiller-Universität Jena, Germany

sara.neuhauser@googlemail.com

ABSTRACT

This study examines the synchronisation of voicing and VOT in German fortis and lenis stops being produced by native German speakers imitating a French accent as well as by native French speakers speaking German. The results show that native German speakers use variation of glottal activity during French accent imitation, i.e. reduction of VOT in fortis plosives and variation of voicing in lenis plosives. This suggests that they are aware of possible interference characteristics of native French speakers' German. However, the fine adjustment seems to be rather complex and the imitators exaggerate during their accent productions.

Keywords: forensic phonetics, accent imitation, VOT, voicing in plosives

1. INTRODUCTION

One possible form of voice disguise is the imitation of a foreign accent, i.e. pretending to be a non-native speaker. There seems to be general agreement that accent imitation is usually not very effective and the disguise is easily detectable. The claimed reasons are that the imitators usually do not change much of the phonetic characteristics of their native language [11] and lack linguistic knowledge which results in errors, inconsistencies or overstatements [2, 18, 19]. However, there are only few experimental studies investigating the ability of speakers to adopt a foreign accent [5, 15, 21] or the ability of listeners to judge accent authenticity [14, 16, 17, 20]. The most important results of these studies were that accent imitators use variation on a segmental and a suprasegmental level, share particular patterns in their imitations and show phonetic characteristics that match features found in authentic foreign accents produced by non-native speakers. Furthermore, listeners seem to be not very competent at judging accent authenticity but relatively good at identifying (naming) imitated accents.

The present study is part of a larger project investigating foreign accent imitation from a perception and production perspective. This paper examines whether native German speakers use variation of glottal activity during French accent imitation, in particular, variation of VOT in fortis plosives and voicing in lenis plosives. It is assumed that variation of a speaker's normal glottal activity is not only a complex articulatory process but the speaker also has to be aware of possible language specific differences.

Differences between fortis and lenis stops are realised through various articulatory and acoustic patterns, such as closure duration, force of plosive release, VOT or duration of the preceding vowel. There are not only language specific differences but also contextual variables within a particular language [9]. Since the 1960s the measurement of VOT has been adopted for the categorisation of plosives [13] and its language specific character has been demonstrated, e.g. English, French and German contrasting two categories of plosives [8]. VOT can be defined as the timing relation between the release of occlusion and onset of glottal vibration (i.e. voicing). The onset of voicing before the release (resulting in negative VOT values) is stated as voicing lead and the onset of voicing after the release (resulting in positive VOT values) as voicing lag [13].

It has been shown that VOT might be a crucial parameter in speaker identification, because it seems to be speaker specific [11], dependent on the regional origin within a particular language [4] and there might be particular characteristics in bilingual speakers [6]. A subsequent question is if this parameter may help to identify voice disguise and to distinguish between imitated and authentic French accents in German. In the standard pronunciation of German fortis plosives /p, t, k/ are articulated with strong aspiration initially in stressed syllables. Weaker aspiration is present post-tonically, after /ʃ, s/ or before a syllabic consonant. The German lenis plosives /b, d, g/ are usually realised voiceless (short lag VOT) and may

be voiced in intervocalic position [7]. By contrast, voiceless plosives in French are normally unaspirated, although in some regional varieties, with emphasis and before high vowels aspiration or friction is possible [1, 12]. Thus a native French speaker might be expected to produce German /p, t, k/ with a shorter VOT associated with the realisation of the corresponding fortis plosives in French. Furthermore, the speaker will probably produce German /b, d, g/ fully voiced. In contrast, typical interference features of German learners of French might be aspirated fortis plosives and devoiced lenis plosives.

This study tests whether native German speakers use a variation (i.e. reduction) of VOT in fortis plosives for French accent imitation. Preliminary results indicated that they do so [15]. On the other hand, in the German context, speakers might be more aware of aspiration than of voicing because the fortis-lenis contrast is realised rather through the former than through the latter, as discussed in [7]. This suggests that German speakers refrain from varying voicing of lenis plosives during French accent imitation but produce /b, d, g/ voiceless.

The following two hypotheses will be tested:

1. German speakers reduce VOT of fortis plosives during French accent imitation.
2. German speakers do not vary voicing of lenis plosives during French accent imitation, i.e. /b, d, g/ remain voiceless.

Furthermore, the German productions of native French speakers will be examined. These productions will be compared (i) to the German speakers' imitations of a French accent, (ii) to the undisguised German productions and (iii) to the native French speakers' French productions.

2. DATA AND METHOD

2.1. Data

Data are drawn from a corpus consisting of 36 native and 16 non-native German speakers and 1 bilingual speaker reading various texts and producing spontaneous material in German (undisguised and with accent imitation for the native Germans) and their mother tongue (non-native Germans). All audio files were recorded in a sound treated room directly to PC, digitizing at a sampling rate of 16 kHz and an amplitude resolution of 16 bits.

This study's subjects are 22 native German speakers (15 female, 7 male, mean age of 23.5

years) speaking German in two modes (undisguised and imitating a French accent) and four native French speakers (2 female, 2 male, mean age of 21.5 years) speaking French and German. The majority of the native German speakers come from eastern central Germany, either from the eastern part of Thuringia or from Saxonia. All of them had learned English as their first foreign language (L2). Most of them also learned French as a further foreign language (L3), but only four speakers declared themselves to speak French fluently and to have spent several months in a French-speaking country, i.e. France or in the francophone part of Canada. The four native French speakers come from various places in central France. They have learned German as L2 and English as L3. They differ in their L2 competence level, but all of them have a noticeable foreign accent in German.

2.2. Method

Analyses mainly consisted of VOT measurements, i.e. the timing relation between the first distinct pulse in the amplitude (plosive release) and the zero crossing of the first periodic pulse (onset of voicing). VOT was measured in 25 initial fortis and 27 initial lenis plosives in German produced by 22 native German speakers in undisguised German and with an imitated French accent, and spoken by 4 native French speakers speaking German. All but one (Poli'zei 'police') fortis plosive occurred in stressed syllables. The lenis plosives follow a voiceless obstruent or a pause to ensure that they will be produced voiceless in undisguised German due to progressive voicing assimilation. Additionally, VOT of 5 initial fortis plosives in French spoken by 4 native French speakers was measured. Further auditory and acoustic examinations were carried out especially for lenis plosives realised with some form of voicing. The material analysed was read speech and the same words were chosen for each speaker.

3. RESULTS

3.1. Fortis plosives

In the undisguised German productions mean VOT in fortis plosives was 54 ms (sd = 9), similar to values of other studies [3, 10]. During French accent imitation native Germans reduced VOT significantly ($p < 0.001$, $V = 251$, Wilcoxon Signed Rank Test for matched-pairs; mean VOT = 37 ms, sd = 12). 21 of 22 speakers reduced VOT

and 18 showed a reduction of more than 10 ms. This suggests that native German speakers are aware of reduced VOT as a possible interference characteristic of native French speakers' German and further that they were able to conform to the French pattern of unaspirated voiceless fortis plosives. Interestingly, the reduction of VOT leads to lower values for the accent imitations than for authentic accents produced by native French speakers speaking German. Figure 1 shows a comparison of VOT values in fortis plosives in German with an imitated and an authentic French accent and in unaccented German. There are two possible explanations for the lower VOT values in imitated than in authentic French accents: (i) There is exaggeration by the native Germans during their accent imitation or (ii) the native French speakers show good competence in their German productions. A comparison of the native French speakers' productions showed that there are only minor changes in mean VOT when speaking French or German, i.e. an increased standard deviation and slightly higher maximum values in German. Table 1 gives the mean VOT values of the native French speakers' French and German productions. Since the native French speakers seem not to vary the VOT in their German productions significantly, an exaggeration of accent imitation in this parameter can be assumed. Voiced realisations of phonologically fortis stops by 4 German speakers as well as weak plosive releases realised by others indicate a variation of the plosive category from fortis to lenis and therefore supports this assumption.

Figure 1: VOT values in fortis plosives in German with an imitated and an authentic French accent and in unaccented German.

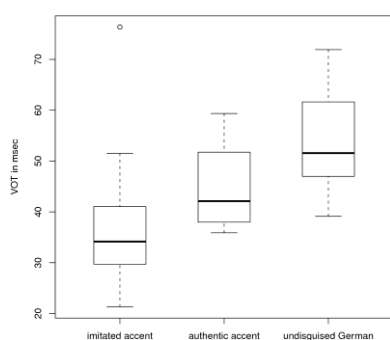


Table 1: Mean VOT (ms) of fortis plosives in the native French speakers' French and German productions.

	Min.	Q1	Median	Q2	Max.
French	38	41	43	46	47
German	36	39	42	48	59

3.2. Lenis plosives

In their undisguised productions native German speakers produced 99% of the lenis plosives voiceless (mean VOT = 18.9 ms, $sd = 3.3$). During French accent imitation 80% are still produced voiceless but with significantly lower VOT ($p < 0.05$, one-tailed paired t-test; mean VOT = 17.9 ms, $sd = 3.3$). The remaining 12% are realised with some form of voicing, e.g. constantly voiced or partially prevoiced. 13 of 22 speakers produced voiced realisations of lenis plosives, but only 3 of them did so in 10 or more tokens (out of 27). Apical lenis plosives in phrase initial position are the ones most often realised voiced. One speaker used prenasalisation which enabled her to maintain voicing by avoiding the pressure build up associated with a regular plosive occlusion. These results demonstrate that native Germans do not only vary the VOT of fortis plosives during French accent imitation. Though most of the lenis plosives remain voiceless during accent imitation there is also variation, e.g. reduction of VOT and voiced realisations. The analyses of native French speakers' German productions show that 90% of the lenis plosives are realised voiceless (mean VOT = 22.7 ms, $sd = 1.3$) and only 10% voiced. Prenasalised forms were not found in their productions.

3.3. Gender specific tendencies

During the analyses some gender specific tendencies for the VOT values of fortis and lenis plosives were detected. Due to the subject number further analyses were carried out for native German speakers only. Table 2 contains the VOT values of female and male native German speakers during their undisguised productions and during French accent imitation. In their undisguised German productions female speakers showed significantly longer VOT values in fortis plosives than male speakers ($p < 0.05$, $t = 2.5123$, $df = 19.767$). On the other hand, they realised lenis plosives with significantly shorter VOT ($p < 0.05$, $t = 2.2128$, $df = 10.216$). Statistically, this gender specific effect is only relevant in the undisguised material. In the accent imitations these differences are not significant, which might be explained by an increased variance. The data indicate that female speakers contrast the fortis-lenis opposition more than male speakers do. This is of special interest since it has been shown that the fortis-lenis contrast is increased by female speakers when the

hormones oestrogen and progesterone are at their highest levels during the menstrual cycle resulting in enhanced speech clarity [22, 23].

Table 2: Mean VOT values (ms) of fortis and lenis plosives produced by native German speakers during French accent imitation (disg.) and in their undisguised (undisg.) German text versions

	/p, t, k/		/b, d, g/	
	disg.	undisg.	disg.	undisg.
female	37.6	56.9	17.2	17.8
male	34.2	48.8	19.6	21.5
total	36.6	54.3	17.9	18.9

4. DISCUSSION

Variation of VOT and voicing of plosives is variation of glottal activity. This study shows that native German speakers use variation of glottal activity during foreign accent imitation. Hypothesis 1 could be confirmed – most native German speakers reduce VOT during French accent imitation and produce unaspirated fortis plosives. In contrast, hypothesis 2 could not be confirmed – native Germans do not only vary the VOT in fortis plosives but there is also variation in the realisation of lenis plosives, i.e. reduction of VOT and voiced realisations. It can be concluded that voiceless realisation of lenis plosives is not unsusceptible to disguise attempts. Though direct comparison of variation in fortis and in lenis plosives is not possible there seems to be a tendency towards more variation in fortis plosives. Detailed analyses and comparison between imitated and authentic French accents in German also showed that imitators exaggerate during their accent productions resulting in lower VOT values for imitated than for authentic accents or produce other features consistent with the phonetic correlates of German lenis plosives. Though the native French speakers were able to produce voiceless lenis plosives in German in most cases, they did not achieve native-like VOT values in fortis plosives. These results show that glottal variation is possible but the fine adjustment is rather complex and they also show that forensic analyses must be based on phonetic details.

5. REFERENCES

- [1] Abdelli-Beruh, N.B. 2004. The stop voicing contrast in French sentences: Contextual sensitivity of vowel duration, closure duration, voice onset time, stop release and closure voicing. *Phonetica* 61, 201-219.
- [2] Baldwin, J., French, P. 1990. *Forensic Phonetics*. London, New York: Pinter Publishers.
- [3] Braun, A. 1988. Zum Merkmal "Fortis/Lenis". *Phonologische Betrachtungen und Instrumentalphonetische Untersuchungen an Einem Mittelhessischen Dialekt*. Zeitschrift für Dialektologie und Linguistik (Beiheft 55). Stuttgart: Franz Steiner.
- [4] Braun, A. 1996. Zur regionalen Distribution von VOT im Deutschen. In Braun, A., (ed.), *Untersuchungen zu Stimme und Sprache. Papers on Speech and Voice*. Stuttgart: Franz Steiner, 19-32.
- [5] Cunningham-Andersson, U., Engstrand, O. 1989. Perceived strength and identity of foreign accent in Swedish. *Phonetica* 46, 138-154.
- [6] Gurski, C. 2006. Voice onset time as a parameter for identification of bilinguals. *Proc. 15th Annual Conference of the IAFPA 2006*, Göteborg.
- [7] Jessen, M. 1998. *Phonetics and Phonology of Tense and Lax Obstruents in German*. Amsterdam, Philadelphia: Benjamins.
- [8] Keating, P.A. 1984. Phonetic and phonological representation of stop consonant voicing. *Language* 60(2), 286-319.
- [9] Kohler, K.J. 1984. Phonetic explanation in phonology: The feature fortis/lenis. *Phonetica* 41, 150-174.
- [10] Künzel, H.J. 1977. *Signalphonetische Untersuchung deutsch-französischer Interferenzen im Bereich der Okklusive*. Forum linguisticum (10). Frankfurt a.M. etc: Lang.
- [11] Künzel, H.J. 1987. *Sprechererkennung. Grundzüge forensischer Sprachverarbeitung*. Heidelberg: Kriminalistik Verlag.
- [12] Léon, P.R. 2009. *Phonétisme et Prononciations du français*. Paris: Armand Colin.
- [13] Lisker, L., Abramson, A. 1964. A cross-language study of voicing in initial stops: acoustical measurements. *Word* 20, 384-422.
- [14] Markham, D. 1999. Listeners and disguised voices: the imitation and perception of dialectal accent. *Forensic Linguistics: The International Journal of Speech, Language and the Law* 6(2), 289-299.
- [15] Neuhauser, S. 2008. Voice disguise using a foreign accent – phonetic and linguistic variation. *The International Journal of Speech, Language and the Law* 15(2), 131-159.
- [16] Neuhauser, S., Simpson, A.P. 2007. Imitated or authentic? Listeners' judgements of foreign accents. *Proc. 16th ICPhS Saarbrücken, 1805-1808*.
- [17] Purschke, C. 2010. Imitation und Hörerurteil – kognitive dialekt-prototypen am beispiel des hessischen. In Anders, C., Hundt, M., Lasch, A. (eds.), *Perceptual Dialectology. Neue Wege der Dialektologie*. Berlin, New York: Walter de Gruyter, 151-178.
- [18] Rose, P. 2002. *Forensic speaker identification*. Forensic Science Series. London, New York: Taylor & Francis.
- [19] Storey, K.C.J. 1996. Constants in auditory and acoustic voice analysis in forensic speaker identification in cases of disguised voice. In Kniffka, H., Blackwell, S., (eds.), *Recent Developments in Forensic Linguistics*. Frankfurt am Main [etc.]: Lang 203-216.
- [20] Tate, D.A. 1979. Preliminary data on dialect in speech disguise. Current issues in the phonetic sciences. *Proc. of IPS-77 Congress*, Vol.9. Amsterdam: Benjamins, 847-850.
- [21] Torstensson, N., Eriksson, E.J., Sullivan, K.P.H. 2004. Mimicked accents – Do speakers have similar cognitive prototypes? *Proc. 10th Australian International Conf. on Speech Science & Technology* Sydney, 271-276.
- [22] Wadnerkar, M.B., Cowell, P.E., Whiteside, S.P. 2006. Speech across the menstrual cycle: A replication and extension study. *Neuroscience Letters* 408, 21-24.
- [23] Whiteside, S.P., Henry, L., Dobbin, R. 2004. Sex differences in voice onset time: A developmental study of phonetic context effects in British English. *J. Acoust. Soc. Am.* 116, 1179-1183.