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Boer, M.M. de; Heeren, W.F.L.

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## Language-dependency of /s/ in L1 Dutch and L2 English

*Meike de Boer and Willemijn Heeren*

*Leiden University Centre for Linguistics, Leiden, The Netherlands*

{m.m.de.boer|w.f.l.heeren}@hum.leidenuniv.nl

Forensic casework increasingly often involves speech samples in more than one language [1], showing a need to explore language-independent characteristics within speakers. However, knowledge on such characteristics is limited, and at this point the general consensus is merely to ‘exercise particular caution with cross-language comparisons’ [2]. As part of a bigger study, the current research investigates cross-linguistic within-speaker consistency of /s/ among speakers with Dutch as a first language (L1) and English as a second language (L2). Research on speaker-dependency in consonants shows that /s/ contains speaker-specific information [5, 6]. The voiceless alveolar fricative /s/ is phonetically similar but not identical in the Dutch and English language. According to the Speech Learning Model [3], this increases the chance that L2 speakers fail to realize that the Dutch and English /s/ have phonetic differences and that they use their Dutch /s/ also when speaking English. Such L1 transfer would be helpful in forensic phonetics, as it would allow for the inclusion of /s/ as a feature in cross-linguistic comparisons.

According to [4], who looked into read speech /s/ by L1 Dutch speakers with a relatively high proficiency of L2 English, speakers use different /s/ realizations in the L1 and L2. This implies that /s/ is not useful as a feature in cross-linguistic speaker comparisons. However, these same speakers have also been recorded producing spontaneous speech, which may be more representative for forensic casework data and may evoke less formal language use. Hence, this study investigates the language-dependency of /s/ in spontaneous speech.

**Method.** Using a sample from the same speakers as [4], this study investigates the language-dependency of /s/ in 2-minute spontaneous monologues in L1 Dutch and L2 English (N = 52; n = 4,904). Linear mixed-effects models were built for the spectral Centre of Gravity (CoG, 550–8000 Hz), its standard deviation (SD), skewness, kurtosis, and the spectral tilt of /s/,<sup>1</sup> testing the fixed factor Language (levels: Dutch, English), random by-speaker slopes, and random slopes of Language over Speaker.

**Results.** For all models but SD, the optimal model included the fixed factor Language and random slopes for Language over Speaker. Table 1 shows the intercepts and adaptations when the speakers spoke L2 English. For example, the CoG was on average 783 Hz higher in L2 English than in L1 Dutch (intercept: 5,007 Hz). Although the effect of Language was speaker-dependent, for all speakers, the English CoG was on average higher than the Dutch one (see Fig. 1). For SD, again, random slopes for Language were included in the optimal model. However, there was no overall Language effect.

	<i>Intercept</i>	<i>SE</i>	<i>t</i>	<i>Language</i>	<i>SE</i>	<i>t</i>
CoG	5,007	99	50.83	783	78	10.09
SD	1,307	29	45.08	-	-	-
Skewness	0.90	0.05	17.87	0.34	0.07	5.02
Kurtosis	4.91	0.48	10.30	1.06	0.40	2.63
Spectral tilt	12.03	0.73	16.47	3.33	0.54	6.21

**Table 1.** Overview of the fixed parts of the optimal models.

<sup>1</sup> Note that these features were all correlated except for skewness and kurtosis.

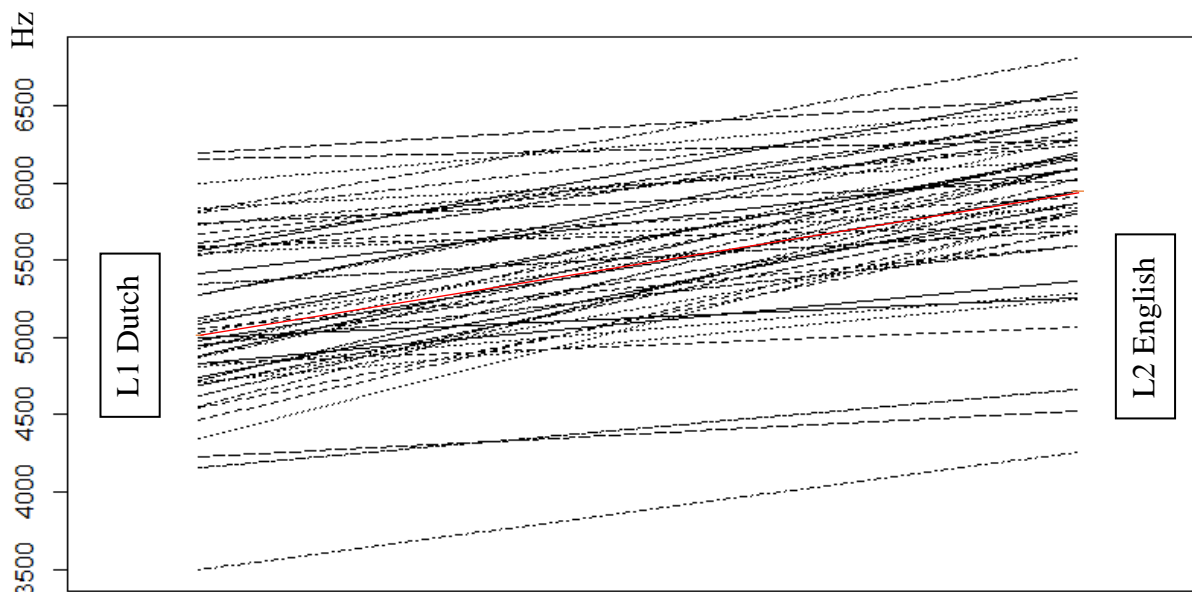


Fig. 1. By-speaker Means of the Centre of Gravity of /s/ in L1 Dutch (left) and L2 English (right); lines connect Means belonging to the same speaker. The grand mean is provided in red.

A follow-up analysis includes left and right phonetic context as fixed factors (levels: rounded/labial, unrounded/non-labial, cf. [5]) and will be presented at the conference. Preliminary results show that the language effect remains; the differences between L1 Dutch and L2 English cannot be attributed to context effects.

**Discussion.** We found that the Centre of Gravity and Spectral Tilt of /s/ are language-dependent within speakers. In addition, the language effect may vary with speaker, which makes the effect unpredictable. Hence, based on these findings, /s/ does not seem to be a suitable feature to be used in cross-linguistic forensic speaker comparisons, at least for highly proficient L2 speakers. A follow-up study using a likelihood ratio approach will investigate this matter in more detail.

## References

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