

The phonetics of gender in Swedish and German

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Abstract

Gender specific variation in phonetic parameters exist cross-linguistically. However, differences between languages in the size of this variation point to a socio-cultural aspect influencing these gender-specific differences.

This study investigates fundamental frequency and vowel space size in 71 Swedish and German males and females, thereby comparing gender differences between the language groups. In addition, self-reported gender identity scores are gathered and set in relation to the phonetic variation.

Results reveal differences between the language groups in the size of gender-specific variation with German speakers showing larger differences in mean f_0 and vowel space size between the genders than Swedish speakers. This is mainly due to a lower mean f_0 and a smaller vowel space in Swedish females and reflects socio-cultural differences in gender identity.

Introduction

Gender specific differences in various phonetic parameters have been found cross-linguistically. Male and female speakers have been shown to differ in average fundamental frequency (f_0 , Stevens 1998), f_0 range (Mennen et al. 2012), voice quality (Henton & Bladon 1988), and also in the realization of particular phonemes such as sibilants (Romeo et al. 2013, Weirich & Simpson 2015) and vowels (Fant 1966, Diehl et al. 1996, Whiteside 2001, Simpson & Ericsson 2007, Weirich & Simpson 2013, Hillenbrandt et al. 1995).

Interestingly, differences between languages in the size of this variation suggest that in addition to anatomical differences between the genders a socio-cultural component is involved.

For example, Mennen et al. (2012) found British females to have a larger f_0 range than German females. Van Bezoojen (1995) found a larger difference between the genders in mean f_0 in Japanese speakers than in Dutch speakers, which was related to culture-specific values ascribed to mean f_0 regarding perceived attractiveness. Henton (1995) showed that gender differences in the acoustic vowel space differ from language to language. In addition, studies within one language showing gender differences in preschool children with no anatomical differences in the vocal tract point to a strong learned component (e.g. Lee et al. 1999, Perry et al. 2001, Foulkes et al. 2005).

Furthermore, Weirich & Simpson (2018) showed that intra-gender variation exists in terms of self-ascribed gender identity and that this variation is indexed in speech. In detail, males who rated themselves higher on the GEPAQ-F+ scale (reflecting higher scores on positive attributes traditionally associated with females, such as friendly, helpful and emphatic, Runge et al. 1981) show higher mean f_0 values and larger acoustic vowel spaces.

Thus, in addition to a biological grounding, gender-specific variation seems to be affected by learned, socio-psychological and cultural factors. This study adds to this line of research by analyzing and comparing gender

differences in German and Swedish participants regarding mean f_0 , variation in f_0 and vowel space size. In addition, following Weirich & Simpson (2018), gender identity of the speakers is assessed and set in relation to phonetic variation.

The following questions are investigated: Do the gender differences in terms of f_0 and vowel space size vary between German and Swedish? And if yes, is the language-specific variation between the genders reflected in culture-specific differences regarding gender identity?

Method

Participants and recordings

35 Swedish speakers (15 females and 20 males) and 36 German speakers (15 females, 21 males) participated in the study. Acoustic recordings were conducted twice for each speaker at their homes using head-mounted microphones by the same female experimenter. Data was gathered within a larger project investigating the speech of fathers and mothers to their child and to an adult (Weirich & Simpson 2016, 2017). The first recording was conducted before the child was born, the second when the child was approximately 5 months old. In the present study, the analysis concentrates on the adult-directed recordings and investigates the potential differences between Swedish and German speakers regarding gender specific variation.

Speech material

The speech material consisted of a semi-spontaneous picture describing task using 15 pictures showing objects and animals (see Fig 1).

Table 1 gives an overview of the carrier words used and the tokens included in the formant analysis and the calculation of the vowel space separated by language and gender.



Figure 1. Example pictures used to elicit the carrier words through a picture describing task.

Table 1. Overview and number of words and tokens included in the analysis of formants separated by language group and gender.

	Swedish		German	
	word	N	word	N
i	fisk	73 82	Biene	130 193
	himmel	100 137	Wiese	84 116
			Tiger	144 186
ε	äpplen	143 172	Aepfel	128 179
	väska	114 150		
a	katt	141 179	Tasse	143 175
			Katze	130 190
			Wasser	1 10
α	kaka	100 132		
u	bok	103 131	Buch	114 146
	bord	157 218	Kuchen	67 96
	ko	138 224	Kuh	168 238

Acoustic analysis

Formants and fundamental frequency measures were analyzed in PRAAT (Borersma & Weenink, 2012). F1 and F2 were estimated at the stable acoustic region in the middle of the vowels and mean values for each speaker and vowel were calculated (in Bark) for each recording session. Vowel space sizes were estimated using F1 and F2 values of /i ε a u/ for German and /i ε α u/ for Swedish. Mean fundamental frequency (f_0) and variation in f_0 (SD) were calculated for each speaker and recording session and values were converted to Bark.

Gender identity

Analogous to the study of Weirich & Simpson (2018), gender identity was assessed using the F+ scale of the GEPAQ questionnaire (German version of the Personality Attributes Questionnaire, Runge et al. 1981). For the Swedish

participants the German version was translated into Swedish. This questionnaire consists of 7 item pairs concerning positive attributes traditionally associated with females (F+), e.g., very/not at all kind/emphatic/sensitive, very gentle–very rough. Each item pair was rated on a scale from 1–7 with high numbers reflecting high self-ascribed feminine attributes. A mean score was calculated for each speaker.

Statistical analysis

Linear mixed models were run for the dependent variables mean f_0 , variation in f_0 , vowel space size and gender identity using the package lme4 (Bates et al. 2016) in R (R Core Team 2018). Speaker was included as a random factor and recording session as a control variable. The test variables were gender and language. P-values were obtained by likelihood ratio tests comparing the model with the factor or interaction in question with the model without that factor/interaction. Post-hoc Tukey tests were then run to look for significant differences between the levels of the respective factors.

Results

Fundamental frequency

For mean f_0 , a significant interaction between gender and language was found ($\chi^2(1) = 3.9, p < .05$). Both language groups show significant differences between the genders ($p < .001$), but the difference is larger in German (Estimate = 0.86) than in Swedish (Estimate = 0.75). When comparing the genders between the language groups, the females show a significant difference with lower mean f_0 in Swedish than in German (Estimate = .143, $p < .001$), while the males do not differ (cf. Figure 2 top panel).

For variation in f_0 , significant main effects were found for gender ($\chi^2(1) = 44.36, p < .001$) and language ($\chi^2(1) = 7.64, p < .01$). Thus, females reveal larger variation in f_0 , irrespective of the

language and Swedish speakers (both males and females) show larger variation in f_0 than German speakers (cf. Fig. 2 bottom panel).

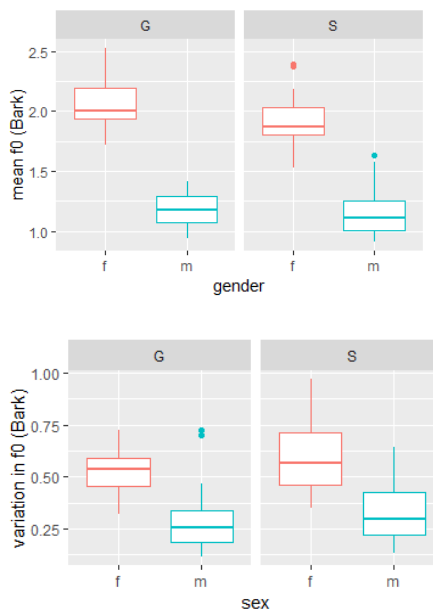


Figure 2. Distribution of mean f_0 (above) and variation in f_0 (below) separated by language group (G: German, S: Sweden) and gender (f, m).

Vowel space size

For vowel space size (cf. Fig. 3) a significant interaction between gender and language was found ($\chi^2(1) = 10.42, p < .01$). Significant differences were found between the genders in both languages, but these were again larger in German than in Swedish (Estimate: German = 7.09 vs. Sweden = 3.98).

When comparing the language groups, both genders differ significantly ($p < .01$). Larger vowel spaces were found in German than in Swedish for males and females, but the difference was larger between female speakers (Estimate: 5.04) than between male speakers (Estimate: 1.93).

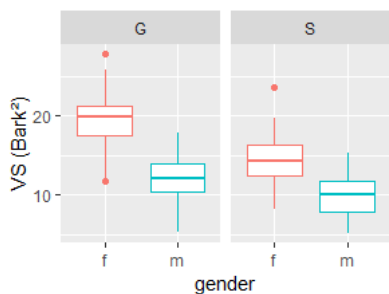


Figure 3. Distribution of vowel space size separated by language group (G: German, S: Sweden, and gender (f, m))

Gender identity

As for the phonetic parameters mean f_0 and vowel space size also for gender identity a significant interaction between gender and language was found ($\chi^2(1) = 19.6, p < .001$). While German males and females differ, with higher scores for females than for males (Estimate: 0.71, $p < .0001$), Swedish males and females do not. When comparing the genders between the language groups the females differ significantly with lower scores in Swedish females (Estimate: 0.725, $p < .001$), while the males do not.

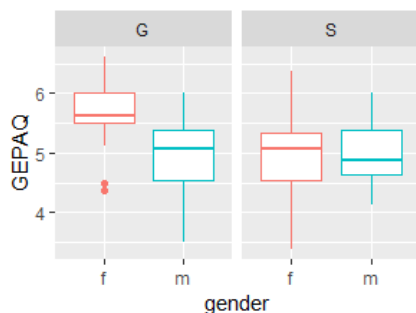


Figure 4. Distribution of gender identity (F+GEPAQ) separated by language group (G: German, S: Swedish) and gender (f, m).

Discussion

For variation in f_0 main effects of language and gender were found. The larger variation in f_0 in Swedish than in German might be related to Swedish being a tone accent language.

Language-specific variation between the genders showed up for mean f_0 and vowel space size (as reflected in the significant interactions). A similar picture showed up regarding the self-ascribed gender identity scores. In both, the phonetic parameters and the gender identity scores, the differences between males and females were larger in the German than in the Swedish group. The decreased gender differences in the Swedish group were mostly due to the female speakers which differed from the German females in terms of lower mean f_0 and smaller vowel spaces and thereby showing a shift towards the male values. Especially regarding the gender identity scores, a striking difference between the languages appeared, with a lack of variation between the genders in the Swedish group, due to decreased values in females.

What is most striking in our results is not that we have found differences both in self-ascribed gender-identity and the phonetic correlates of gender expression between the two languages, but that both languages exhibit such a clear relationship between the social and phonetic variables. This relationship points to a significant socio-cultural influence on gender-specific speech (in addition to anatomical based reasons). The results are also interesting in the light of language change possibly related to ongoing changes in gender roles and identities.

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