BREATHINESS IN MALE AND FEMALE SPEAKERS

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ABSTRACT

The present study provides data on degree of breathiness produced by Dutch male and female speakers in a neutral and an emotive context. The acoustically defined parameter DH indicates significant differences between male and female speakers in both contexts. There is an increase in breathiness for either population from neutral to emotive context. Analysis of average F0 and average intensity levels show decreased values for both male and female speakers in the emotive condition as opposed to the neutral condition.

1. INTRODUCTION

Breathiness can be defined in various domains. In **articulatory** terms breathy phonation arises from an incomplete adduction of the vibrating vocal folds and can lead to an increase of the average airflow of up to 60% in comparison to non-breathy (vowel) production. Extreme breathiness can be indicative of pathological speech and function as a **perceptual** marker of various laryngeal disorders. On a less extreme note breathiness can impair the general perceptibility and understandibility of speech and convey the impression of increased monotony. Various **acoustic** correlates can account for breathiness [1I,13I. Due to the incomplete vocal fold closure during phonation of a breathy vowel there is considerable leakage of air through the glottis which causes interspersed noise at higher frequencies of the acoustic spectrum. Presumably in connection with a slackening of the folds a slight lowering of F0 has been observed for breathy vowels and, probably most notable, there is a fairly consistent increase of the amplitude of the first harmonic in relation to the second as opposed to an opposite amplitude relationship between the first two harmonics of a non-breathily phonated vowel, see Fig.1.

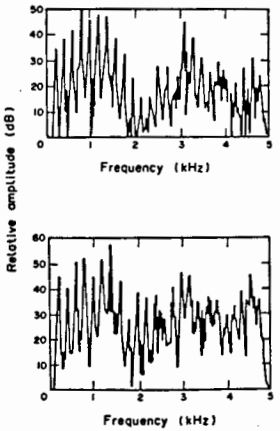

Fig.1: Spectra of non breathy vowel (top) and breathy vowel (bottom). Figure from Bickley (1982).

Since our investigation of breathiness of male and female speakers partly follows the one by Henton and Bladon [2I, we take the amplitude relationship between the two lowest harmonics as an operational means to define breathiness: H1 - H2 or DH (delta H). In addition, this acoustic cue seems to correlate fairly well with listeners' judgements about the breathiness of perceived vowels.

2. OCCURRENCE OF BREATHINESS AND EXPERIMENTAL OUTLINE

In numerous languages breathiness is used to form phonemic contrasts (for references see [2I). These languages, however, are not our present area of interest, nor is breathiness as a marker of pathological speech. Evidence has been adduced (ibid) that female speakers of two British accents consistently used a more breathy voice quality than men in ordinary speech. Although breathiness may be considered an inefficient way of voice production with a number of communicative limitations, the claim has been put forward that, consciously or unconsciously, women use breathiness as a means of communicating arousal, intimacy, or, in other words, to sound more "sexy".

Our present experiment was set up to a) compare Dutch breathiness data of male and female speakers in an ordinary speaking mode those of English and b) to investigate whether in an emotive context there would be an increase in breathiness by either speaker sex.

As corollary variables to DH, average F0 and average intensity of the vowels under investigation will be considered as well.

3. EXPERIMENTAL PROCEDURE

13 male and 13 female speakers participated in the experiment. Their ages varied between 19 and 38 years. They belonged - either as staff or students - to the University of Utrecht and were speakers of the Dutch equivalent of RP.

The vowel to be analysed was decided to be an /a/ since this open vowel's first formant is high enough to be of no influence on the first harmonic. Monosyllabic words containing the vowel /a/ were embedded in unpretentious sentences which, on their part, were combined to form an unpretentious piece of running prose. Due to their monosyllabicity all stimulus words carried lexical stress. In addition a semantically intimate passage containing numerous /a/'s was selected from a sultry-romantic piece of fiction in order to simulate an emotive context.

Speakers were instructed to read the first text in an ordinary and the second text in a sexually charged way.

Recordings were made individually in a sound-proof room using a Revox B77 mkII tape recorder and a Sennheiser microphone. A mouth-to-microphone distance of 30 cm was used. The input volume control was held constant and subjects were given some practice time.

Data were further processed digitally. Per reading mode and subject 12 35 ms steady state portions of the /a/ vowels were excised and relative amplitudes of the first two harmonics, and F0 and amplitude of the steady states were established.

4. RESULTS

4.1. RELATIVE AMPLITUDE OF HARMONICS

Table I shows the average values and corresponding SD's of DH produced by male and female speakers in the two reading modes. A negative DH value indicates that the amplitude of the first harmonic is lower than that of the second harmonic and v.v. According to Bickley (1982) a negative DH value is the consequence of breathy phonation.

Figure 2 represents per speaker the DH values in the ordinary and the emotive reading mode.

From table I and figure 2 it can easily be seen that female DH values are higher than male values and that DH values of both sexes are higher in the emotive context than in the ordinary context. Statistical analysis shows the between-sexes difference to be significant in either reading mode ($p<.05$ and $p<.01$ resp.) and the between-reading mode difference to be not more than a strong tendency. Moreover it was shown that there is no significant difference in breathiness between the female-ordinary condition and the male-emotive condition which means that female speakers used the same degree of breathiness in reading the ordinary text as did male speakers in reading the emotive text.

4.2. FUNDAMENTAL FREQUENCY

Results of the F0 analysis of the measured /a/ steady states are shown in table II.
As can be seen there is a decrease in fundamental frequency for the emotive reading text for either sex; differences, however, do not reach the level of significance.

Interindividually, however, a significant positive correlation exists between F0 and DH.

Table I: Average DH in dB for ordinary and emotive reading mode.

	female speakers (n=13)		male speakers (n=13)	
	ordinary	emotive	ordinary	emotive
x	+3.9	+5.4	-0.6	+1.1
SD	5.2	4.6	3.0	2.6

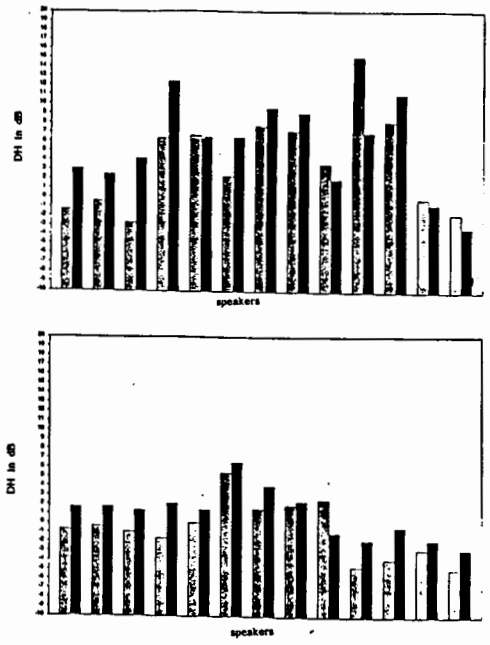

Figure 2: DH in dB for ordinary reading mode (light bars) and emotive reading mode (dark bars) for female speakers (above) and male speakers (bottom).

Table II: F0 in Hz for ordinary and emotive reading mode

	female speakers (n=13)		male speakers (n=13)	
	ordinary	emotive	ordinary	emotive
x	213	204	131	122
SD	25	25	20	18

4.3. AMPLITUDE

For either sex there is a slight decrease of amplitude values for the emotive context in comparison with the ordinary context (female: 2.9 dB; male: 1.9 dB). Differences are insignificant.

5. DISCUSSION AND CONCLUSION

Female speakers produce significantly more breathiness in comparison with male speakers in the ordinary reading mode as well as in the emotive reading mode. The degree of breathiness produced by female speakers in the ordinary context turns out to be even equivalent to that of male speakers in the emotive context. We found a decrease of both F0 values and amplitude values for the emotive context for male as well as female speakers, but these differences fail to reach the level of significance.

As stated in our introductory section, a breathy spectrum contributes to perceptual limitations. Why, Henton and Bladon [2] ask themselves, should women adopt articulatory postures that render their own speech less efficient in communicative terms? The answer to this question lies, according to these authors, in the ethological-sociolinguistic domain: "...[women] imitate the voice quality associated with arousal. ...A breathy woman can be regarded as using her paralinguistic tools to maximize the chances of her achieving her goals, linguistic or otherwise"

With all due respect we would like to regard this explanation with some caution. First of all perceptibility of speech is affected only in extreme cases of breathiness. Secondly, not only was DH in the afore-mentioned experiment the only acoustic correlate considered to indicate breathiness, whereas other parameters probably deserve consideration as well, but breathiness in its turn is certainly not the only characteristic of a "sexy" voice.

As to voice source characteristics, it is generally assumed that female speakers have a greater open quotient which implies that they produce more breathiness for physiological reasons.

In connection with our tentative F0 - DH correlation data we suggest that more research should be addressed to the question of whether a systematic relationship can be found between pitch and breathy phonation on an interindividual level.

6. REFERENCES

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