

AN ACOUSTIC ANALYSIS OF 'KULNING' (CATTLE CALLS) RECORDED IN AN OUTDOOR SETTING ON LOCATION IN DALARNA (SWEDEN)

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ABSTRACT

The Swedish cattle call singing style 'kulning' is surprisingly understudied, despite its almost mythical status in Swedish folklore.

While some physiological-productive aspects of kulning have been treated in previous work, acoustic properties are still much lacking description. This paper adds to and extends the results presented in a previous study (Eklund, McAllister & Pehrson, 2013), where kulning and head voice ("falsetto") was acoustically analysed in two indoor settings: a normal room and an anechoic chamber.

In the present study, the same singer, singing the same kulning in the same two modes (kulning and head voice), was recorded in an outdoor setting (close to the singer's home), thus allowing for a comparison between "clinical" and more ecologically valid data.

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INTRODUCTION

• Throughout history, long-distance calls have been used at different locations where there has been a need of making oneself heard over long distances, e.g. yodeling and whistles languages

• Both human-human and human-animal calling

• *Kulning* is the most common term (of many) for a specific type of herding calls used in Dalarna, Härjedalen and Jämtland in Sweden

• Used to call free-grazing goats and cows

• Mainly used by women

• High-pitched and high-amplitude singing-style

• Vowel-heavy and overwhelmingly lyrics-free

• Surprisingly few studies carried out on the acoustic characteristics of kulning

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PREVIOUS RESEARCH

• Kulning is mentioned in early works on Swedish folk music (Moberg, 1955; Ling, 1978)

• Johnson (1984, 1986) reported that kulning is characterized by a strong correlation between frequency and amplitude (especially in higher registers), and that the larynx moves with the frequency and can be raised with ~39 mm

• Johnson recorded amplitudes at 105 dB, 0.3 m from the source

• Rosenberg (2003) largely replicated Johnson's observations

• Uttman (2002) analyzed partials obtained from CD recordings and reported clear partials up to the 16–18 kHz register, as compared to ~6 kHz in normal folk singing

• Eklund, McAllister & Pehrson (2013) compared kulning and head voice in an indoor setting and replicated Uttman's observations on partials

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DATA COLLECTION AND METHOD

• All data were collected on 7 September 2013 on location in Säter, Dalarna (Sweden), very close to where the singer (FP) grew up

• Weather conditions recorded (meteo.com)

• Two types of microphones were used: two Shure Pro Beta 58A for simultaneous recordings at different distances (1 and 11 meters) and one Audiotecnica AT813 for comparison with our previous study (2013)

• Same kulning as in previous paper (2013), the vowel [u], at around 700 Hz

• Data resampled to 44.1 kHz

• Acoustic analyses done using Cool Edit Pro 2.0, WaveSurfer 1.8.8p4 and Praat 5.3.84



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RESULTS: AMPLITUDE

• Simultaneous recordings at 1 and 11 meters from the source; results in Table 1 below

Table 1: Decibel (dB) values at two distances for two singing modes. Analysis done in Praat 5.3.84.

| Mode | 1 meter | 11 meter |
|------------|---------|----------|
| Kulning | 84.2 | 74.8 |
| Head voice | 81.5 | 56.3 |

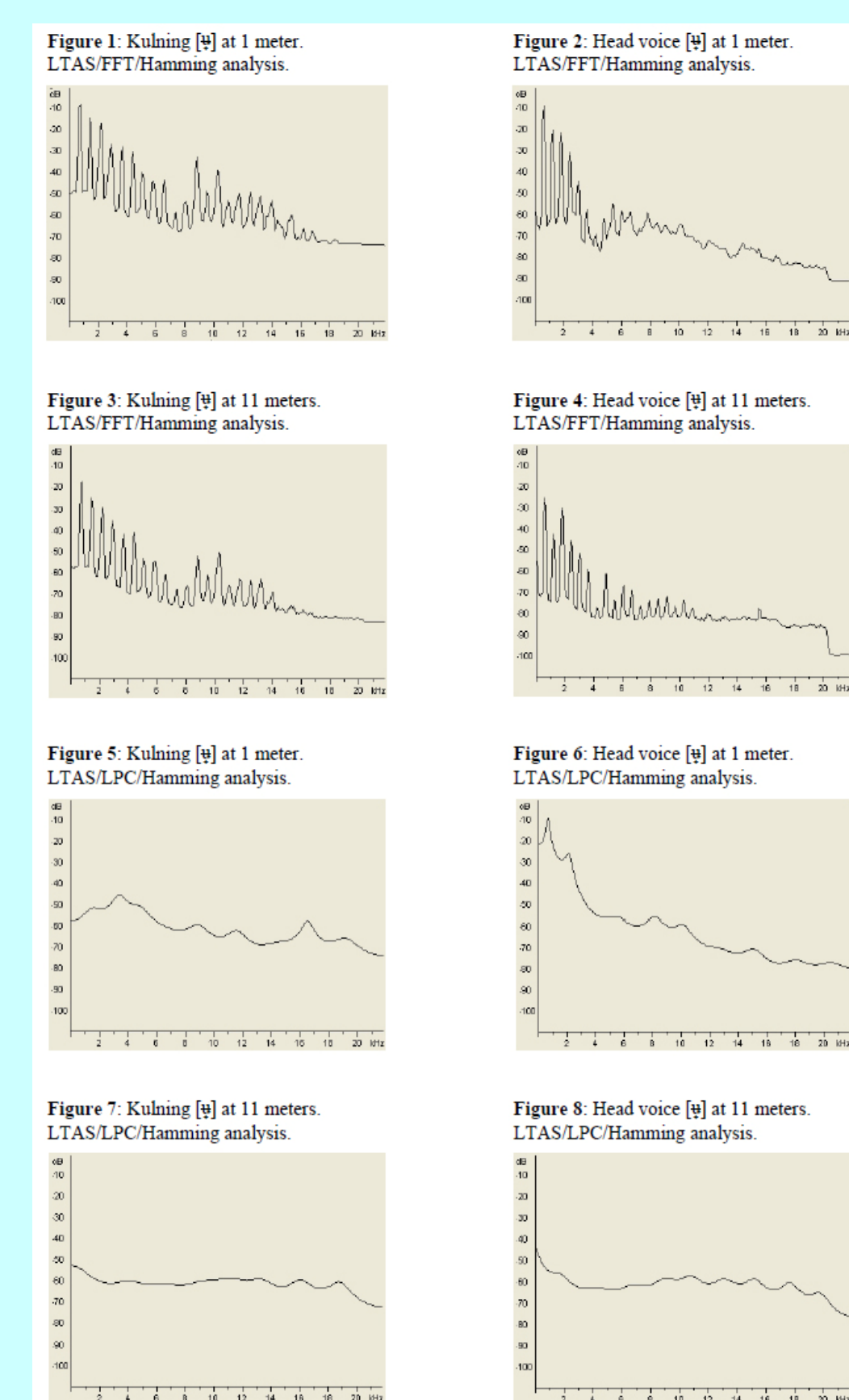
• Loudness was measured using an Extech sound level meter, model 407732 (factory calibrated)

• In head voice mode there is an amplitude drop of 25.2 dB at 11 meters compared to 1 meter

• In kulning the corresponding figure is 9.4 dB, which means that the perceived loudness ten meters further from the source is about halved

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RESULTS: PARTIALS AND FORMANTS



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OBSERVATIONS AND DISCUSSION

• Results of our partials and formant analyses are shown in the figures on plate 6 (above/right)

• We created Long-Term Average (LTAS) spectra for both FFT/Partials and LPC/Formant analyses, at the two distances 1 and 11 meters from the source (see above)

• For *partials*, two main observations were made:
1. Partials were visible in far higher registers in kulning (~15 kHz) than in head voice (~5 kHz)
2. Partials "gestalts" were more or less unperturbed by the greater distance in kulning, and were more or less just downshifted c. 10 dB

• For *formants*, the main observations were:
1. At 1 meter, formants are clearer in head voice
2. At 11 meters, formants disappear in both kulning and head voice

• Note that exact vowel quality is difficult to establish in high-pitched singing

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CONCLUSIONS AND FUTURE RESEARCH

• Compared to our 2013 study, this study is based on ecologically more valid data, using outdoor data instead of indoor (anechoic chamber)

• It was observed that kulning was less perturbed as a function of a greater distance from the source than was head voice

• The results were not surprising since kulning was developed to carry over great distances

• Sound propagation is very dependent on the exact nature of the vegetation where the sound is produced, as reported in a number of papers on animal vocalizations (e.g. Marten & Marler, 1977; Richards & Wiley, 1980)

• Our observation indicated that kulning is well adapted for long-distance propagation in its natural habitat

• Ongoing studies also include high-speed film footage and EMG of vocal folds

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THANKS TO FANNY PEHRSON



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