

## Extracting lombard speech from a noisy environment: review of technics

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What we express does not only come from what we say, i.e. the words we use, but also, and sometimes even more, from how we say it, i.e. the voice quality we use. One problem is to define this notion of voice quality. Our problematic is to understand what are the parameters that we are listening to when we hear a voice, and what are the indicators which enable us to differentiate voice qualities ?

Intuitively, we could have compared voice quality to the notion of timbre like for music instruments, that is, all that differs between two voices at same pitch and same intensity.

The methodology we develop in our laboratory is based on the listener's point of view. If the whole information is carried by the acoustic signal, we assume that its perceptively relevant part is accessible through the listener's opinion. The linguistic analysis of listeners' verbalisations can help us to find this relevant part because it brings information about their conceptions of the world's objects.

In a study conducted on the perception and the verbalisation of voice quality in western operatic singing (Garnier et al 2004), the linguistic analysis of singing teachers' speech has brought information about the specific lexis used in this field, about the different conceptions of voice quality, and about the listening modes of western operatic voices. Particularly, this approach has shown that voice quality does not seem to be limited to the notion of timbre. Timbre appears to be just an indicator of voice quality, as it gives some information about the singer's vocal technique. In fact, the perception of a voice seems to be strongly influenced by the production knowledge of the listener. More than 22 % of the terms used to describe voice quality refer to vocal technique or physiology factors. Moreover, the experts seem to have the need to "feel" the voice they listen to: they tend to reproduce the vocal gesture before describing what they perceive. When they focus on the sound in their description (39 % of the expressions), they use a lot of onomatopoeias or also metaphors derived from other sensory modalities such as colour, light, heat, taste or texture.

Voice quality is also changed when a speaker tempts to communicate under noisy conditions. He adapts his articulation, prosody, pitch, intensity and spectral contents. Several studies consider these modifications as a physiological reflex, in relation to the different auditory feedbacks a speaker has got to hear and regulate his own voice. Others rather think that these changes are motivated by a search for intelligibility. In particular, some articulation modifications may contribute to an easier labial reading. The speaker in these conditions has to manage three feedbacks : the perception of the environment, the perception of his own voice and the feedback on the success or not of his communication. We are actually conducted two experimentations: The first one aims at studying the influence of the type of noise on the speech modifications. The second one aims at observing the contribution of the different auditory feedbacks on the speaker response, particularly if this one is linear or not with the increase of noise.