INTERPRETING INHALING SOUNDS

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Introduction

Sound can be defined as audible pressure variations in an elastic medium such as air, water etc. In human voice, the level of constriction, creating periodic interruptions of the airflow and thus pressure disturbance, lies at the glottis. In general, the human voice is produced on an expiratory airstream. In some cultures however, sound production on an inward airstream also occurs. In this Round Table the anatomical and physiological aspects of inhaling *phonation* are discussed (M. Moerman). The difference between inhaling phonation and inhaling *singing* is clarified (F. Vanhecke). The physiological and communicative value of inhaling *vocalization* in animals is addressed (P. Simoens). Another type of inhaling sounds, namely snoring sounds is investigated (M. Barbieri). The difficulties in modelling sound production on an inward airstream are elaborated on (M. Kob).

M. Moerman. Previous studies on an experienced vocal performer, state that there is no audible difference in the central frequencies of the first three formants between inhaling and exhaling phonation. There seems to be a slight increase in perturbation measures in the inhaling manner, although not statistically significant. High Speed Video Kymography demonstrates that inspiratory phonation is characterized by a reverse vocal fold vibration pattern. MRI imaging suggests that inhaling phonation is morphometrically characterized by a subglottal narrowing, a pharyngeal widening and a narrowing of the mouth opening.

P. Simoens. Inspiratory vocalization occurs in a wide range of vertebrate animals, and has been well documented in anuran amphibians, birds and mammals. In some anuran species (frogs and toads), closed-mouth ingressive phonation results from passive vocal cord vibrations initiated by buccal pumping and expelling air from the buccal or subgular vocal sacs. In birds, vocalization is characterized by numerous unique features of the avian respiratory system and is generated in the syrinx which is situated at the tracheal bifurcation within the thorax. The syrinx consists of bilaterally paired, variably shaped tympaniform membranes or labia which allow lateralization of sound production, prolonged singing including minibreaths, and ingressive phonation. In addition, numerous bird taxa present a vocal sac in the gular area which allows closed-mouth vocalization with inhaling sounds. In mammals, inhaling phonation has been described in many species but is often poorly documented (e.g. equid braying). More elaborate information is available about ingressive sound production observed in felid carnivores (e.g. cat and cheetah purring; leopard sawing) and in many primates such as gibbons, orangutans and chimpanzees.

F. Vanhecke. The development of new forms and techniques of vocal expression should be seen in the context of the extension of human expressive possibilities. Dr. Françoise Vanhecke developed during her doctoral research Inhaling singing (ISFV®), which is a new way of using the human voice as a valuable musical resource. This technique can be considered as a new tool for expression thereby broadening the timbral palette of contemporary music performance.

M. Barbieri. Snoring sounds can be regarded as sound generated by a less sophisticated constriction along the vocal tract (glottal level, hypoharyngeal level/tongue base, oropharyngeal level, palatal level, …). Snoring sounds are typically disturbing noises which sometimes compromise the patient's health and/or the health of his/her surroundings. What is the difference between snoring and sleep apnea? How is it measured? How and when is treatment necessary? What treatment is effective?

M. Kob. The physics of voice production implies a complex aerodynamic, vibratory and acoustic interaction. While the process of regular phonation when exhaling air from the lungs via glottis and vocal tract through mouth and nose is rather well understood, phonation based upon inverse air flow has been much less investigated despite its relevance for singing as well as medical and acoustic research. Some of the problems associated with investigating and modelling this phenomenon will be discussed in the round table.