Diagnostics of functional and organic voice disorders – the performance of the voice
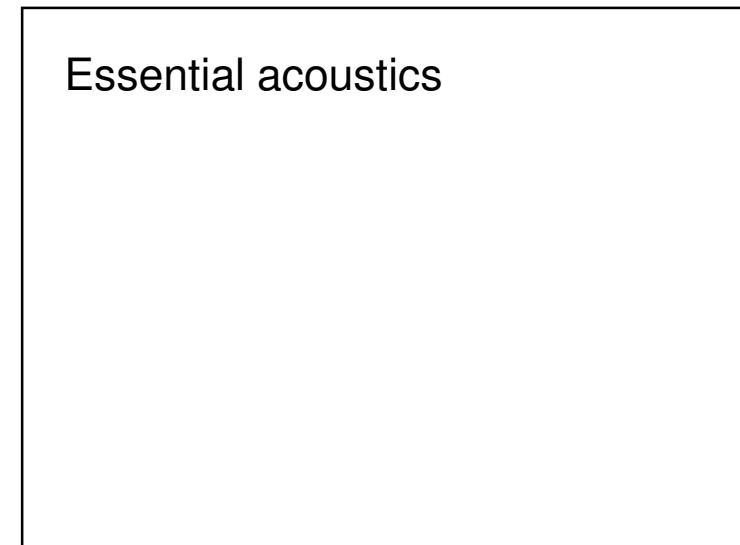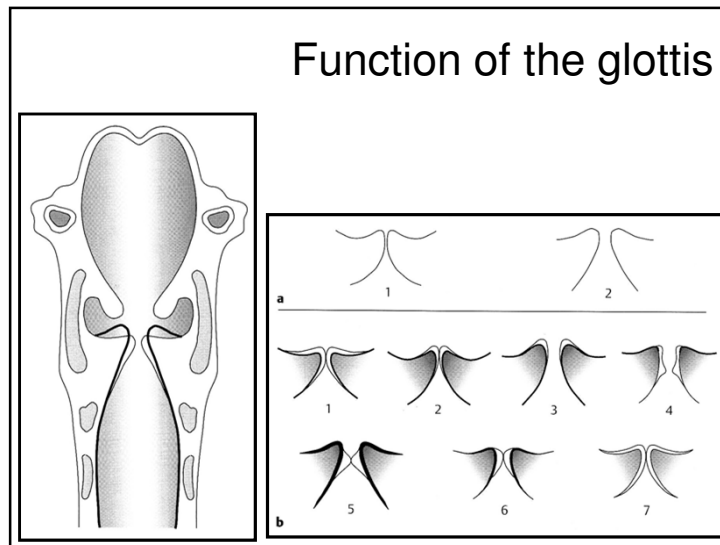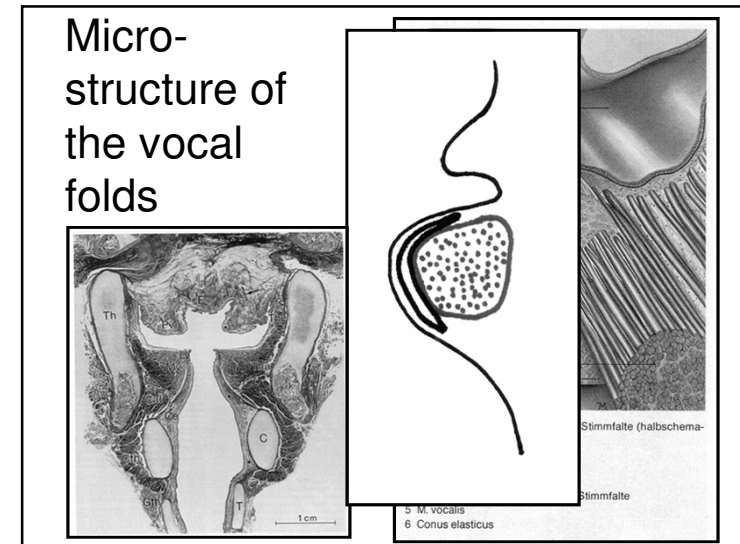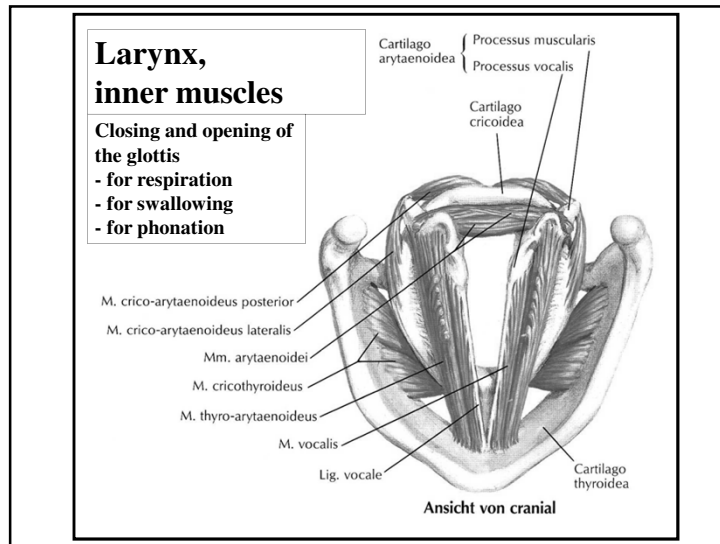
Summer school SGORL

Peter Oppermann, KSL
Bettlach 29.08.2014

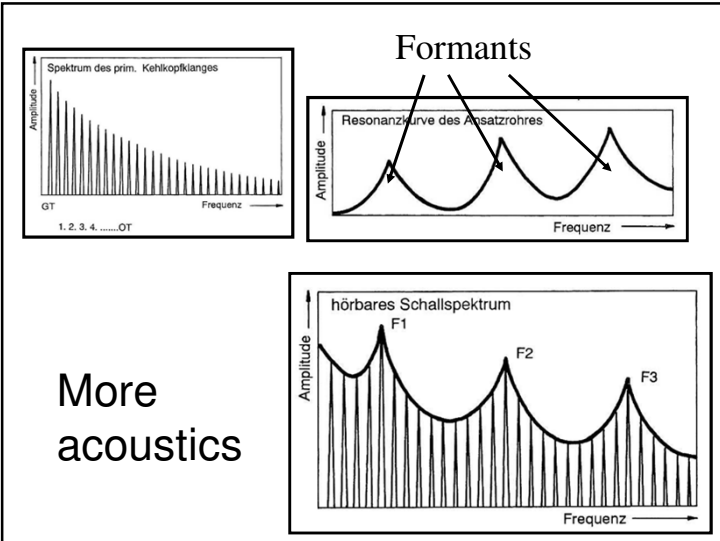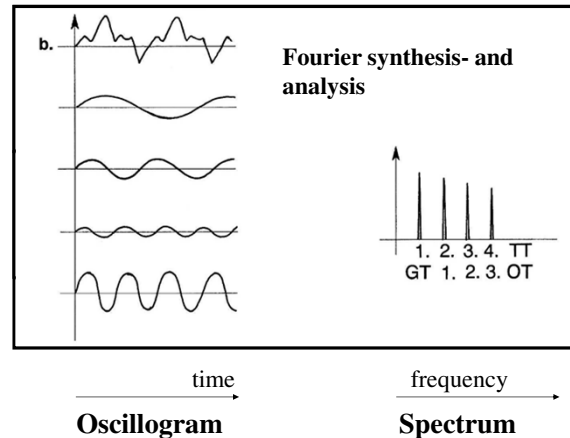# Themes

- Physiology of the voice
- Basic acoustics
- Definition of organic/functional dysphonia
- Basic examination techniques

Physiology

Larynx, inner muscles

Closing and opening of the glottis
- for respiration
- for swallowing
- for phonation

Micro-structure of the vocal folds

Function of the glottis

Essential acoustics

Rudiments of acoustics

Fourier synthesis- and analysis

1. 2. 3. 4. TT
GT 1. 2. 3. OT

time — **Oscillogram**   frequency — **Spectrum**

Formants

Spektrum des prim. Kehlkopfklanges

GT   Frequenz
1. 2. 3. 4. ....OT

Resonanzkurve des Ansatzrohres   Frequenz

More acoustics

hörbares Schallspektrum
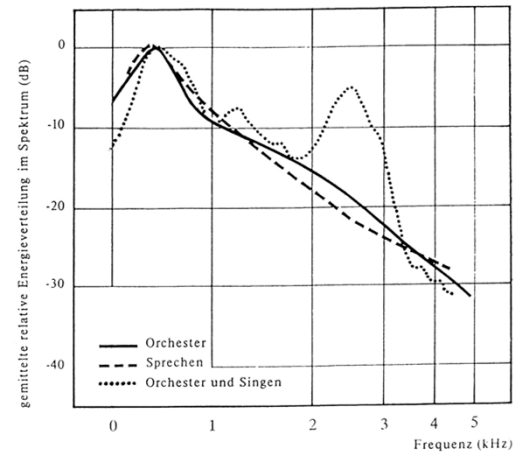F1   F2   F3
Frequenz

Singer's vocal profile

Abb. 68 Idealisierte Mittelwertspektren von normalem Sprechen, Orchestermusik sowie Singen (JUSSI BJÖRLING) mit lauter Orchesterbegleitung (nach SUNDBERG)

Definitions (academic)

- Organic Dysphonia
  - Voice disorder and/or capabilities of the voice by predominantly structural changes of the vocal organs
- Functional Dysphonia
  - Voice disorder and/or capabilities of the voice by predominantly inapropriate interaction of respiration, positioning of the glottis and formation of vocal tract

Definitions (practical)

- Organic Dysphonia
  - Voice disorder and/or capabilities of the voice mainly due to structural changes of the vocal organs
- Functional Dysphonia
  - Voice disorders and/or capabilities of the voice **without obvious structural changes of the vocal organs**

Basic examination techniques

- Case history/symptoms
- Evaluation of hearing
- Endoscopy
- Stroboscopy
- Elektro-acoustic analysis
- Subjective scaling of voice quality

Case history and symptoms

- Situationally highly changeable symptoms indicate functional disturbance
- Consistent symptoms are more typical of organic changes
- Important: Evolving symptoms over a period of time – suspicion of triggering events

Auditory assessment
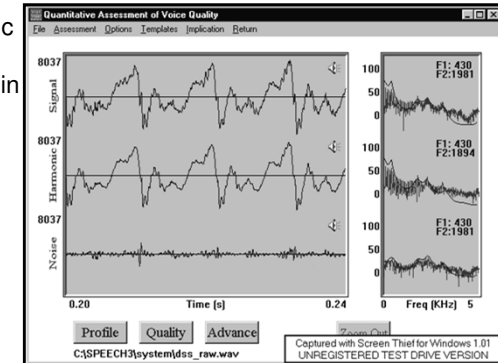
What is considered to be hoarseness?

1. Irregularity of ocillatory period with regard to:
   – amplitude (shimmer)
   – oszillation period (jitter)

are seen from a psycho-acoustic viewpoint as harshness.
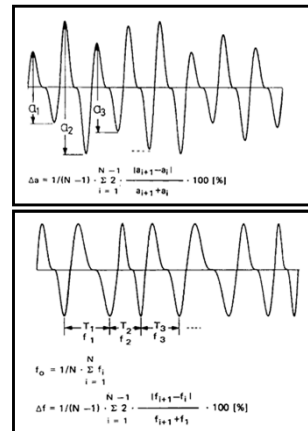
What is considered to be hoarseness?

2. Non-harmonic acoustic components in the voice (noise) are seen as breathyness.

Descriptive auditory assessment of sound of voice

Standard of auditory assessment for vocal production

- Use of defined scales for undesired elements of sound

Sample collection of auditory assessment of vocal production

Die auditive Bewertung heiserer
Stimmen nach dem RBH-System
Doppel-Audio CD mit Stimmbeispielen

Tadeus Nawka
Lutz Christian Anders

Georg Thieme Verlag Stuttgart · New York
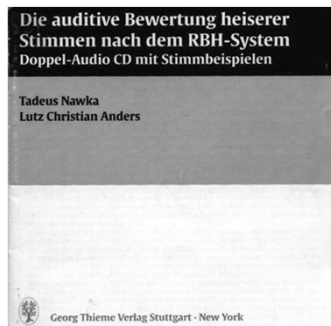
R1B0H1

R2B0H2
R2B2H2

R1B3H3

R-B3H3

Endoscopy

- Indirect micro-laryngoscopy, Laryngoscope and ear microscope with 400 mm lens (difficult)
- Magnifying laryngoscope (current standard)
- Modern „Chip on the tip" flexible endoscope with approx. 300'000 pixels (future standard)
- Conventional fibre endoscopy with approx. 10'000 pixels (only for functional assessments)
- Examination with larynx mirror (for preliminary assessment)
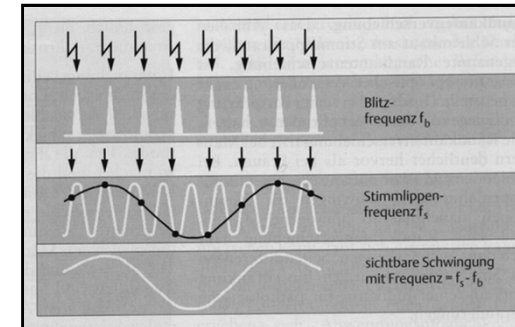
Comparison of customary optics

konventionelle Fiberoptik
Xenonlicht

Stroboscopy
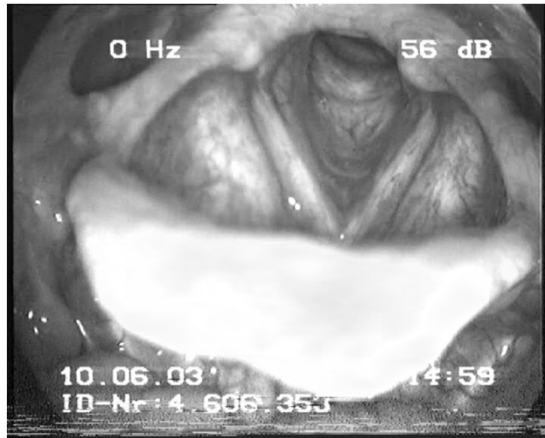
Stroboscopy techniques

- Helpful trick to our visual perception using slowed-down presentation of fast periodic events

Electro-acoustic examination

- Measurement of wave form irregularity (jitter, shimmer)
- Measurement of added noise (glottal to noise exitation ratio, GNE)
- Hoarseness diagram (Göttinger)
- Dysphonia Severity Index DSI
- Vocal range measurement
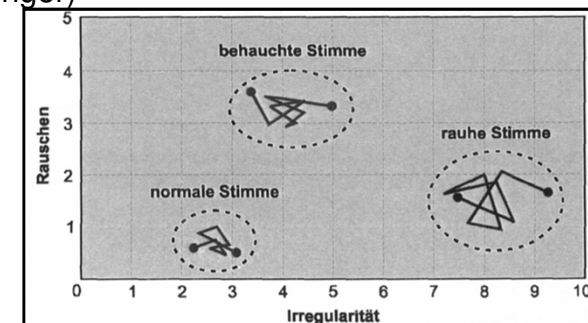
Hoarseness Diagram
(Göttinger)

Abb. 1: Heiserkeitsdiagramm für drei Stimmproben: Eine normale, eine rauhe und eine behauchte Stimme. Bei den Stimmproben handelt es sich jeweils um den Vokal /ä/, der einige Sekunden lang gehalten wurde. Die Analyse erfolgt abschnittsweise (Blocklänge = 0,4s).

Dysphonia Severity Index

DSI	**=**	**0.13 x MPT + 0.0053 x Fo-High**
		- 0.26 x I-Low - 1.118 x Jitter
		+ 12.4
MPT	**=**	**maximum phonation time / sec**
Fo-High	**=**	**highest frequency / Hz**
I-Low	**=**	**lowest intensity / dB**
DSI	**=**	**5** **good voice**
DSI	**=**	**-5** **poor voice**

Singing voice range
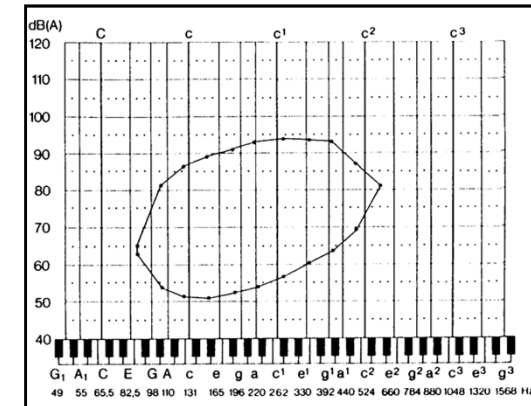
Subjective scaling of voice production problems

- Voice handicap index, questionnaire with 30 or 12 questions. For example:
  - „Because of my voice, people have difficulty understanding me"
  - Possible answers
    - 0 = never
    - 1 = rarely
    - 2 = often
    - 3 = always
- Evaluation 0 - 100 %

Practical Minimal Documentation e.g. pre-operative

- Video-stroboscopy
- Subjective scale 0 – 100%
- Length of tone production, best score of 3 trial attempts
- PC-documentation of tonal-sounds (tip: No23 recorder freeware)
  - several standard sentences
  - several sustained vowels