

# Instrumentation for “Dummies”

## *Simple Approaches to Support Clinical Practice*

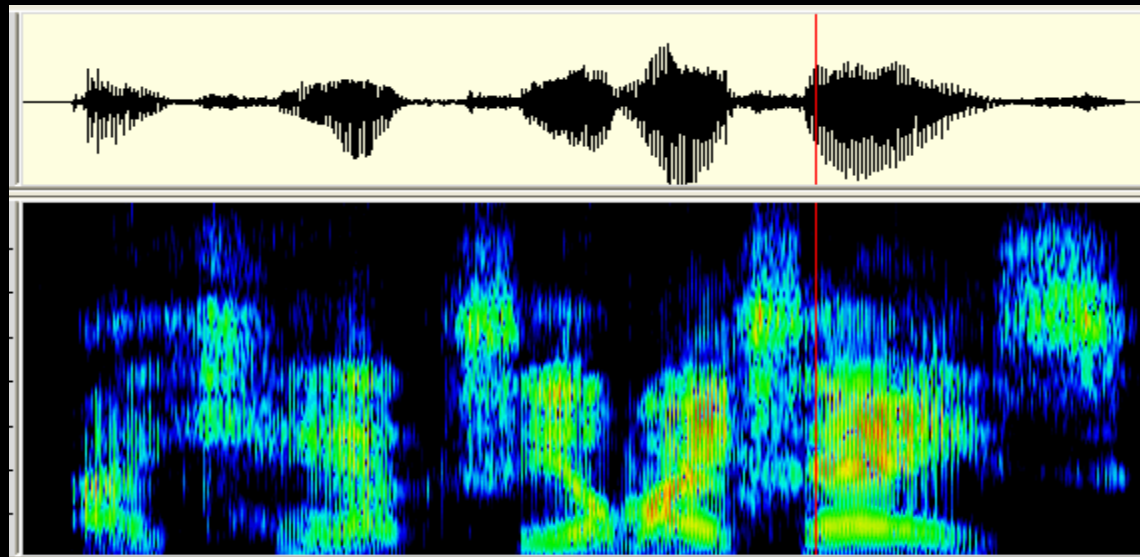
Annual Convention of the American Speech-Language-Hearing Association,  
San Diego CA, November 18-20, 2005.

*Sponsored by the Speech Science Program Committee*



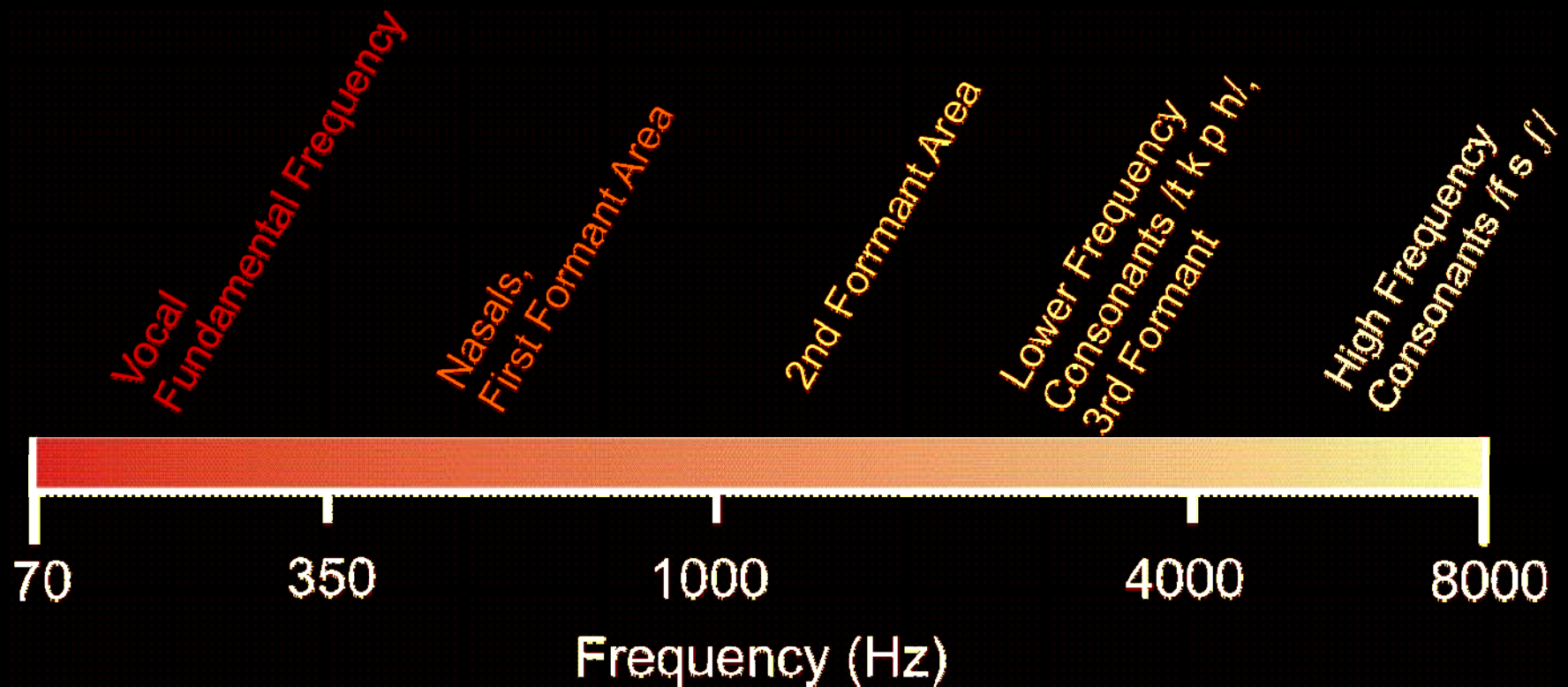
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University of Colorado

Stephen Tasko, Ph.D. CCC/SLP  
Western Michigan University



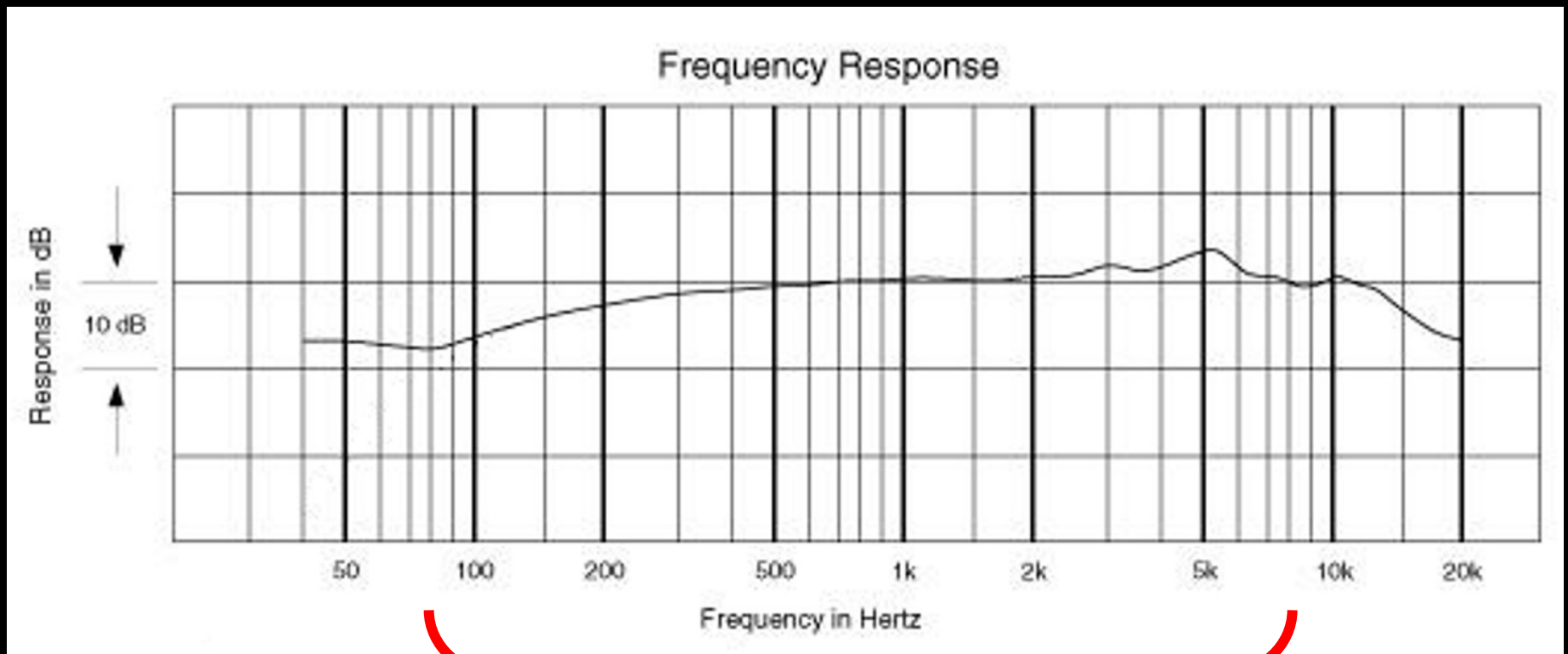
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# Frequency Range of Speech



*Computer Programs to record/analyze speech: the sampling rate MUST be at least twice as fast as the highest frequency of interest.*

# Microphone Frequency Response, Adequately “Flat”



Speech Range

# Types of Microphones

## Dynamic

- + Very inexpensive
- + Will likely work with older computers (older soundcards)
- + Do not require any power to operate
- Perform more poorly than condenser mics (less accurate)
- Signal may be too small for some small cards

## Condenser (electret)

- + More accurate recording, better performance: “Professional”
- + More sensitive and responsive: will perform better for speech analysis
- Can be more costly
- Can be more fragile than dynamic mics (more sensitive to rough handling).
- Require a power source (bias or phantom power, depending on the mic).  
Most sound cards can provide bias power, some condenser mics come with a battery pack if they require phantom power.

# Common Microphone Connectors



XLR (balanced): found on professional microphones

Mini XLR: often on wireless microphones

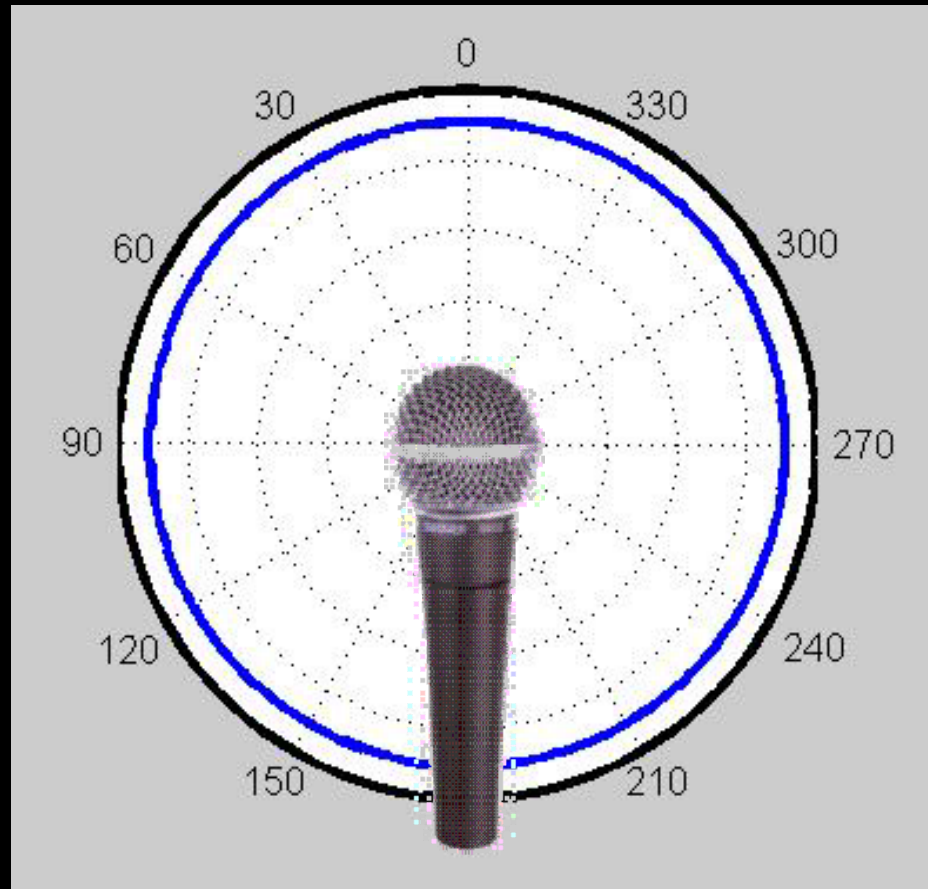
1/8" Phone Jack (mini phone jack): Required for PC sound card input

# ✗ Handheld vs. ✓ Headworn

- + Easy to set up.
- *Can't* control for mic-mouth distance (CRITICAL for intensity measurement).

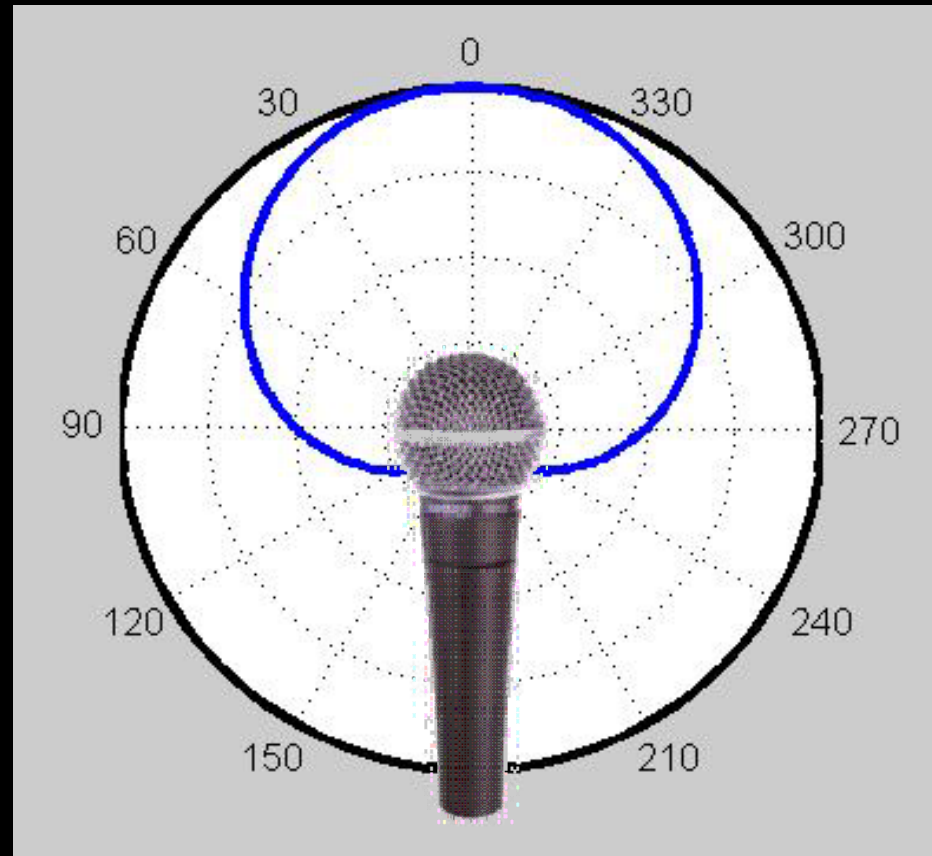
- + CAN control mic-mouth distance
- May be more fragile

# Microphone Response Pattern: Omnidirectional ✘



- Picks up sound all around the microphone.
- Good for if the sound source is moving, and the microphone is stationary.

# Microphone Response Pattern: Unidirectional ✓



- Unidirectional (Cardioid): Sound is mostly picked up from the front.
- Good for eliminating outside noise.

# Recording environment

- *As quiet as possible (a sound treated room is best)*
- Ambient noise can have an adverse affect on recording quality and analysis results.
  - Fundamental frequency measurement is relatively robust.
  - Jitter & shimmer analyses are more susceptible to noise influences.

# Measuring Speech Intensity

- Mic-Mouth distance *MUST* be the same across sessions.
- Microphone gain (volume) *MUST* be the same across sessions.
- You can't make absolute measurements of dB SPL, but you *CAN* make relative comparisons.

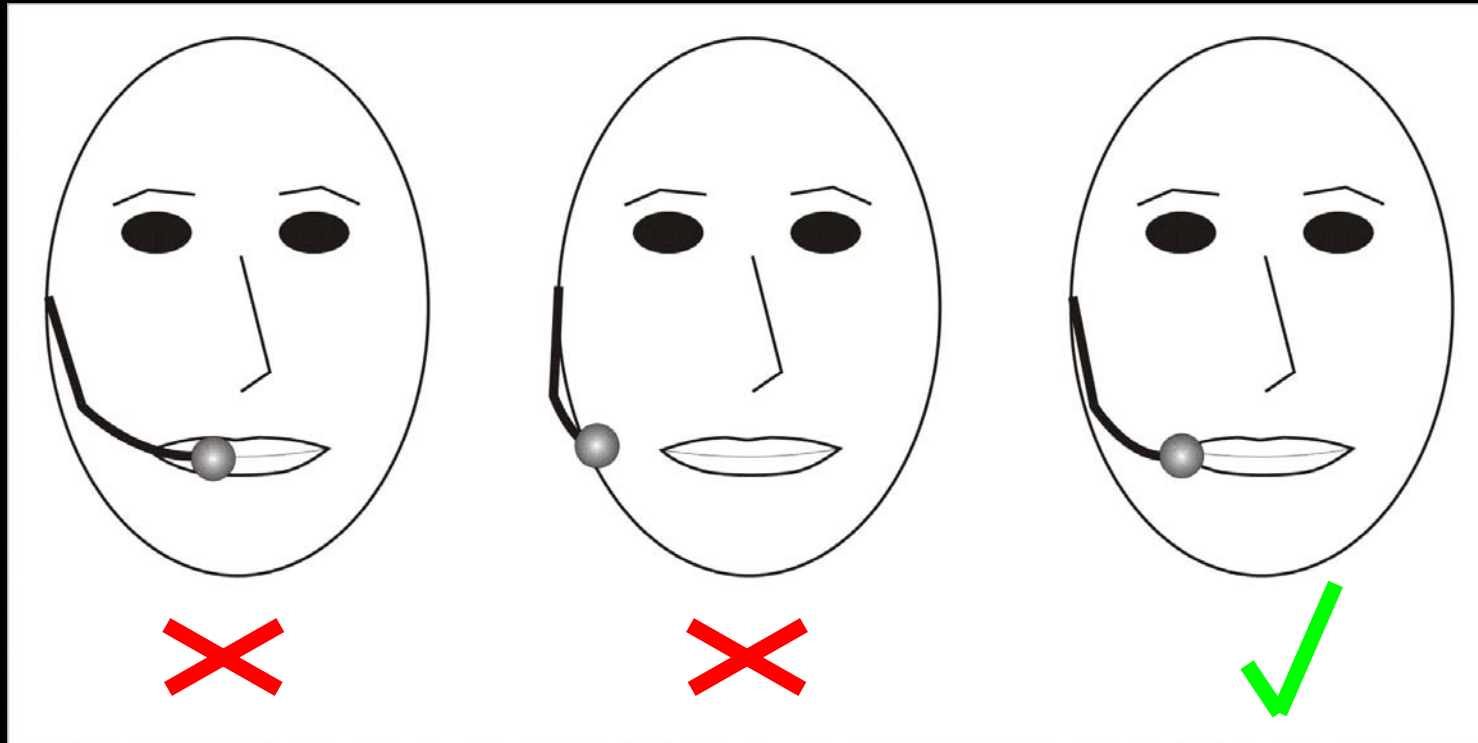
# Measuring Speech Frequency Variables

- Need good signal to noise (i.e. make sure the signal is large enough, but not clipped).

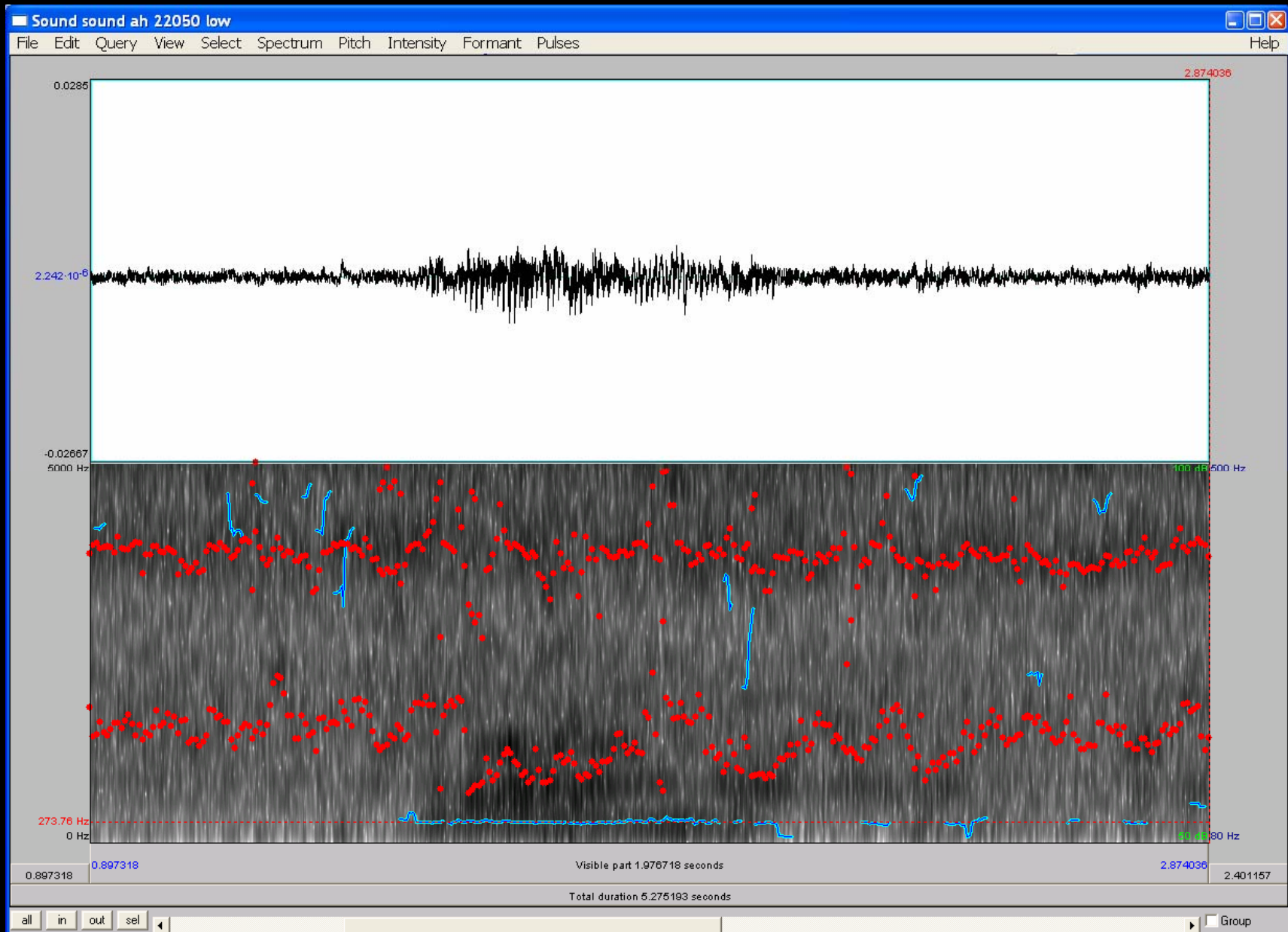
# Headset Microphone Placement

- The microphone element should be placed so that it is not directly in the airstream, but close enough to the mouth in order to pick up speech sounds adequately.
- Placement should be approximately at the corner of the mouth.

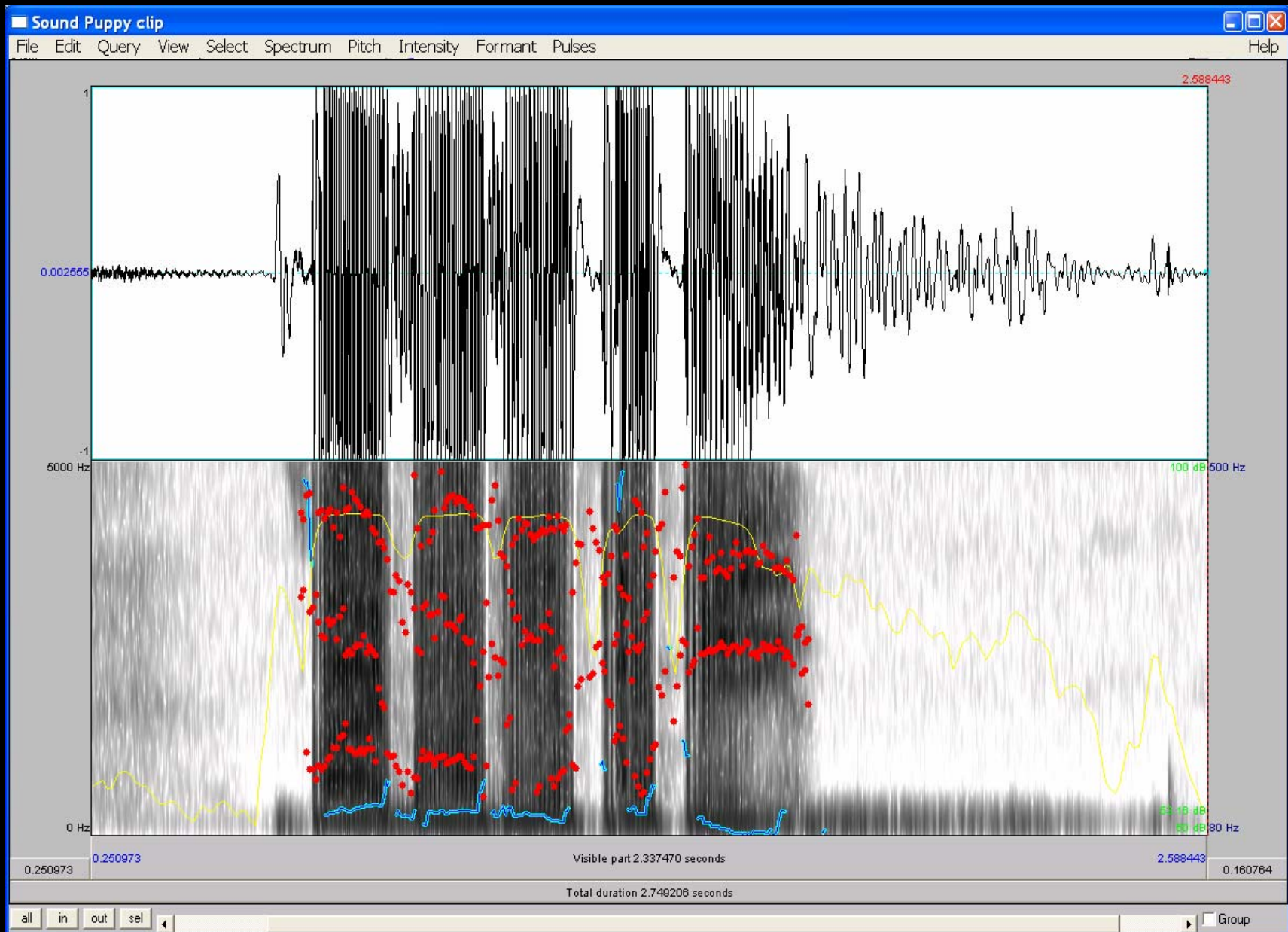
# Headset Microphone Placement



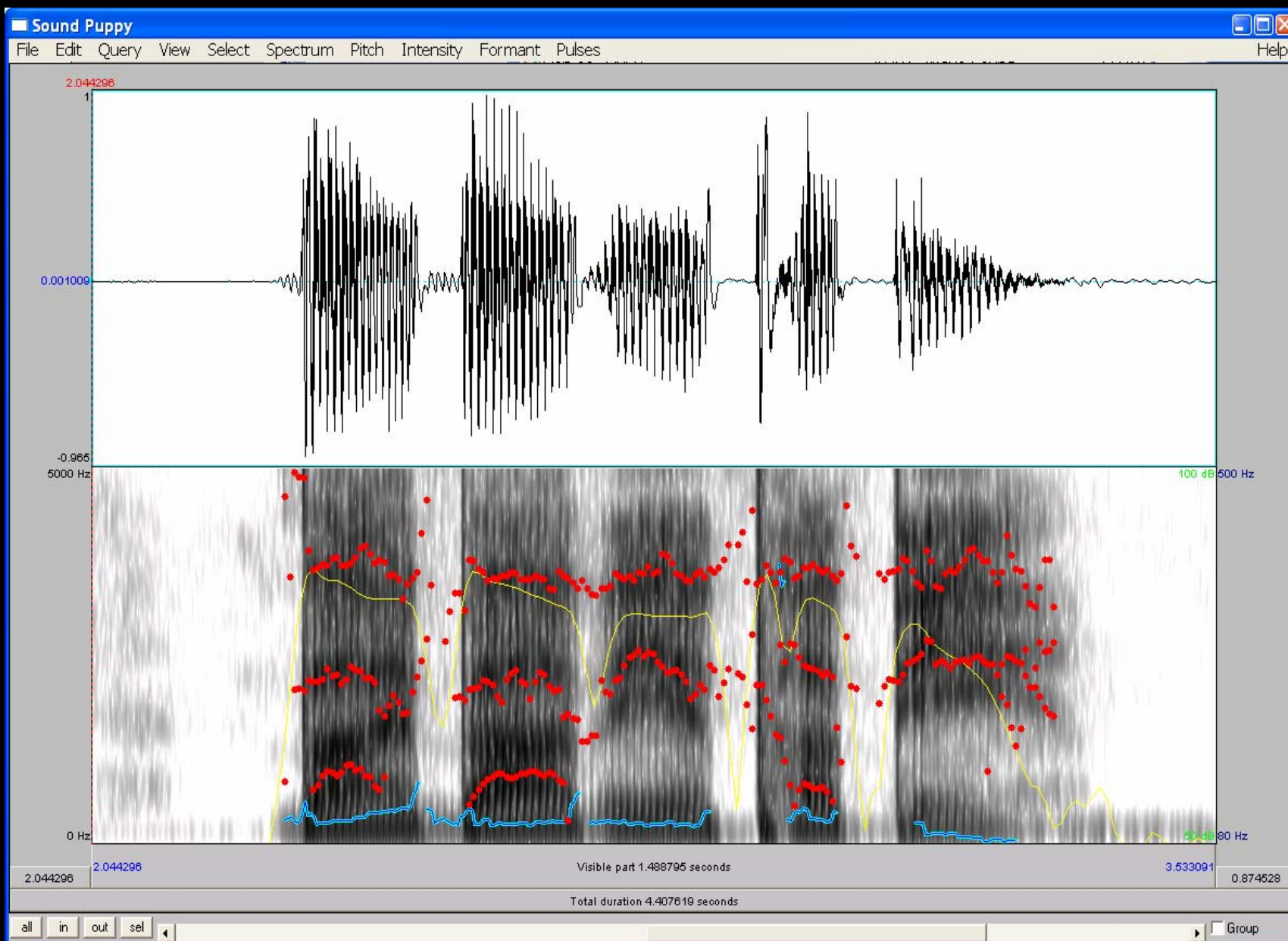
# /a/ - Recording level too low



# “Buy Bobby a Puppy” *Clipped*



# “Buy Bobby a Puppy” – clean recording



# Olympus Voice Recorders - Recommended



- Frequency Range (Super High Quality Recording): 100-17000Hz
- Recording time: At least 1 hour at super high quality.

## *Not Recommended:*

- Voice recorders using DSS (Digital Speech Standard) recording format.
  - (Some recorders use DSS format only for their lower quality recordings)
- Voice recorders with a frequency range of less than 100-8000Hz
  - (many have a range of ~300-7000Hz)

# Portable Audio/Video Recorder: Archos Gmini402 *recommended*



- External microphone jack
  - Frequency Range (best quality): 20-20000Hz
- Large storage capacity (20GB)
- Integrated digital camera/video recorder
- Downloadable to PC via USB port
- ~\$300

# Free Speech Analysis Programs

- **WaveSurfer**:  $F_0$ , spectrogram, relative intensity, formants, real-time display.
- **WASP/Speech Filing System**: Analyses – like WaveSurfer.
- **Praat**: Analyses – like WaveSurfer, plus voice analysis (jitter, shimmer, harmonics/noise).
- **TF32**: Similar to Praat for speech analysis. (Can't record with the free version).
- **ALVIN**

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