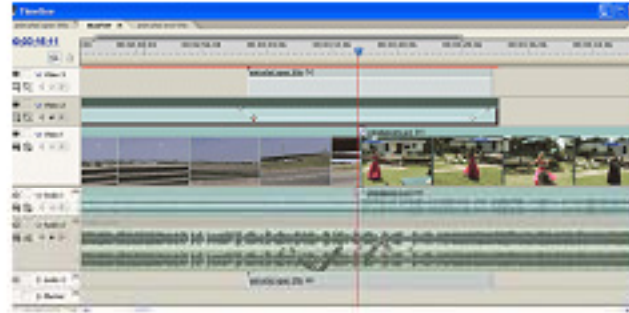


Digital Media Production



Audio – Recording and Editing

Lecture Topics

- Aesthetic in audio
- Types of microphones
- Connectors
- Microphone selection and placement
- Sound measured
- Transitions and mixing

Outcome: After this lecture you should have some insight into audio, microphones, and how it is recorded for film productions.

Aesthetics of Audio

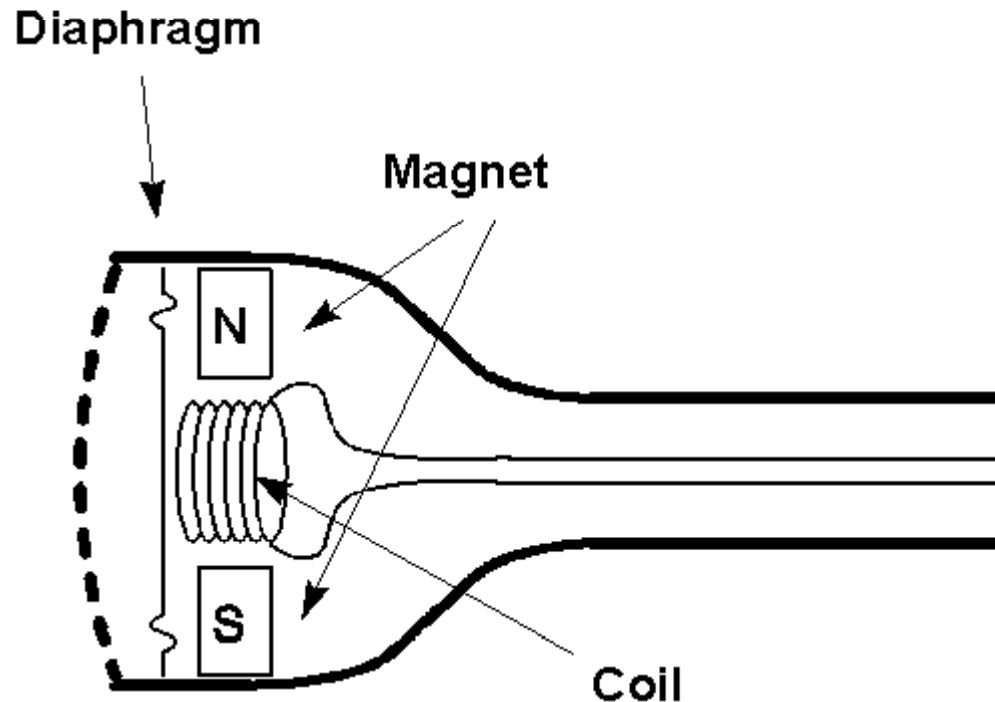
- Realism
 - Uses sound to stimulate illusion of reality, re-enforce realism of visual reality
- Modernist
 - Audio develops sound independently of visual images, more abstract impression
- Postmodernist
 - Emphasis listeners participant within production to emotionally involve the audience

Types of Microphones

- Three basic types
 - Dynamic
 - Ribbon
 - Condenser
- Pickup Patterns
 - Mics can have different pickup patterns
- Different types+pickup patterns can be used to create the audio effect needed

Mic Type (Dynamic)

- Consist of a diaphragm and moving coils



Pros

Inexpensive
Durable
Typically don't require phantom power

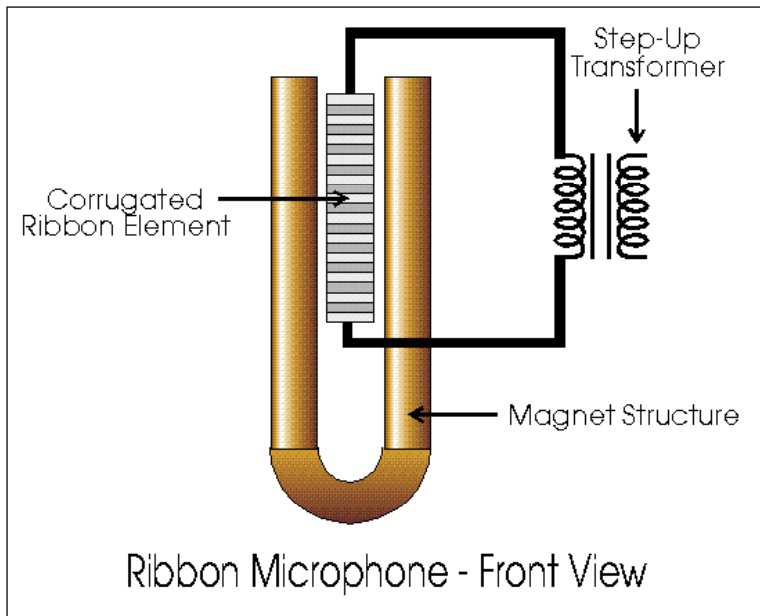
Cons

Not always the best quality sound – don't capture all the frequencies well

As the diaphragm moves/vibrates (due to sound), the coil moves and invokes an electrical current due to the magnets.

Mic Type (Ribbon)

- Consist of a thin ribbon that vibrates



A thin ribbon of corrugated metal foil is suspended in a magnet structure. Vibrations cause an electronic current.

Pros

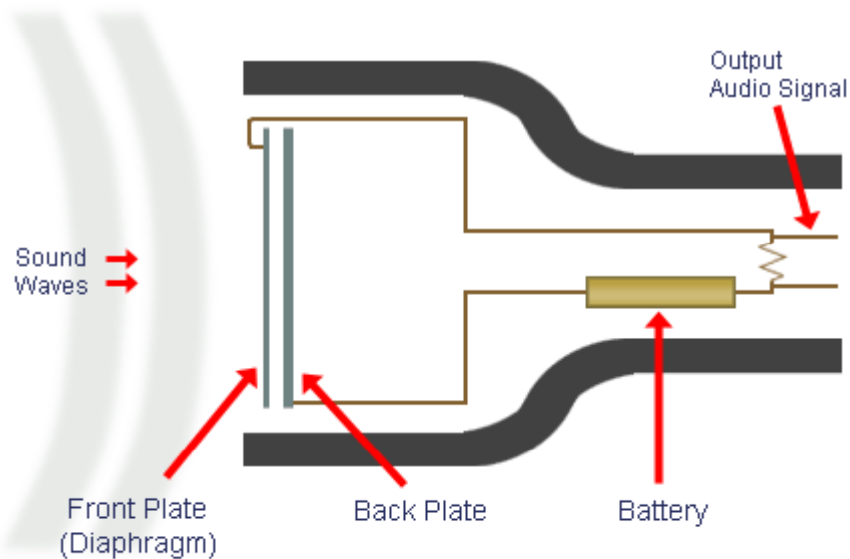
Good for high-frequencies
Typically don't require phantom power

Cons

Can be very expensive.
Generally have only one pickup pattern.

Mic Type (Condenser)

- Consist of a diaphragm that vibrates to change voltages



Pros

Generally reproduces high-quality sound.

Cons

Require phantom power (or battery)

Element is a capacitor that requires two charged plates. One plate can move (diaphragm) another is fixed. When the plates move, the electrical current changes due to change in capacitance. This change is very weak, so power is needed to amplify the signal.

Variations

“Electret condenser” has permanently charged plates, that can reduce power consumption.

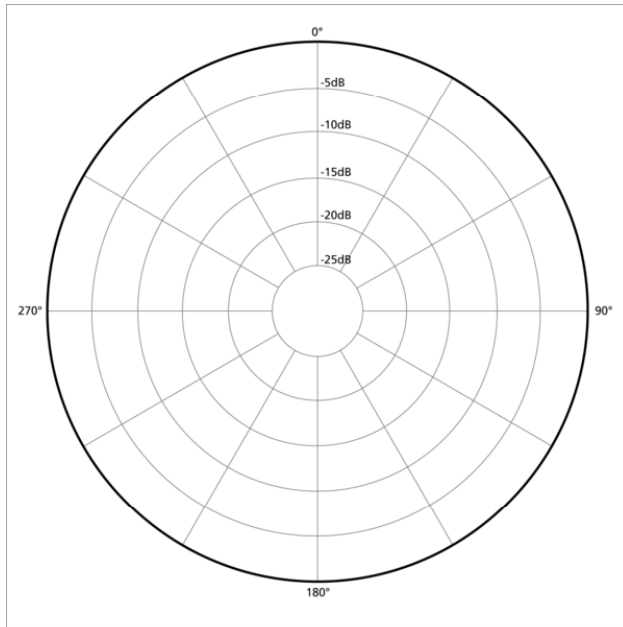
Phantom Power

- Condenser microphone often need power
 - Certain dynamic & ribbon may require power too
- Some audio cables often supply power
 - We call this *Phantom power*
 - Need to hook cable up to a power source
- Be careful, if you think a mic is “dead”
 - It may require power
 - If a microphone doesn't require power
 - Giving it power may damage the microphone!

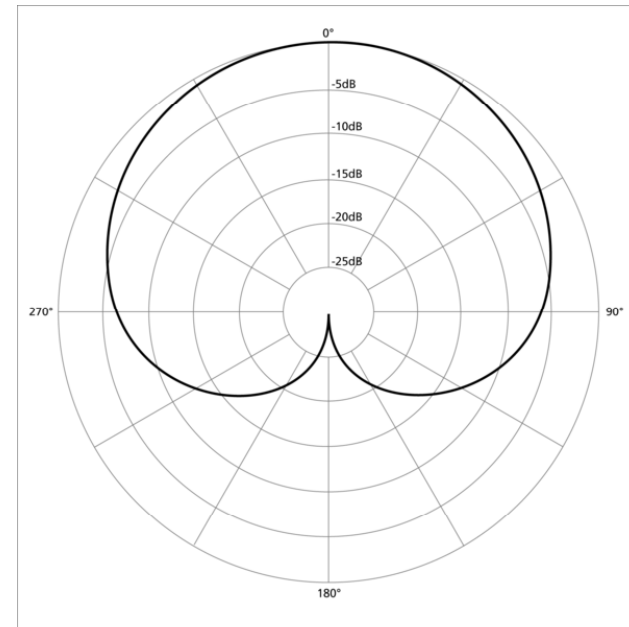
Pickup Pattern

- Omnidirectional
- Bidirectional
- Unidirectional
- Cardioid
- Supercardioid (shotgun)

Pickup Patterns*



Omnidirectional

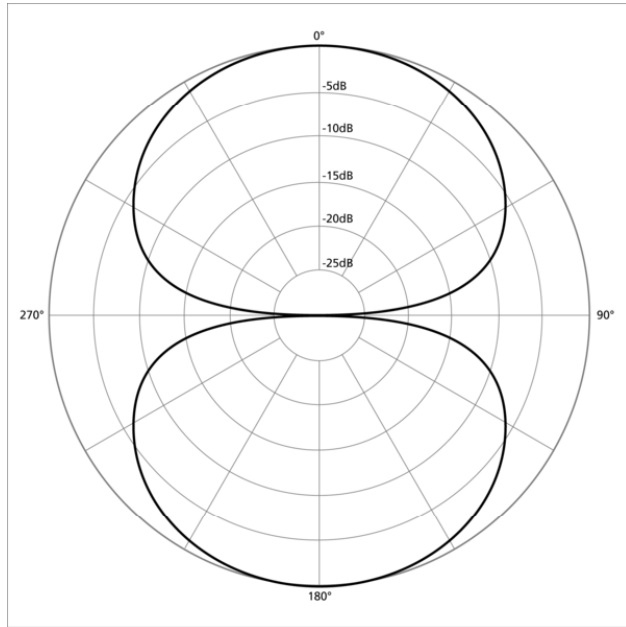


Cardioid
(Because looks like a heart)

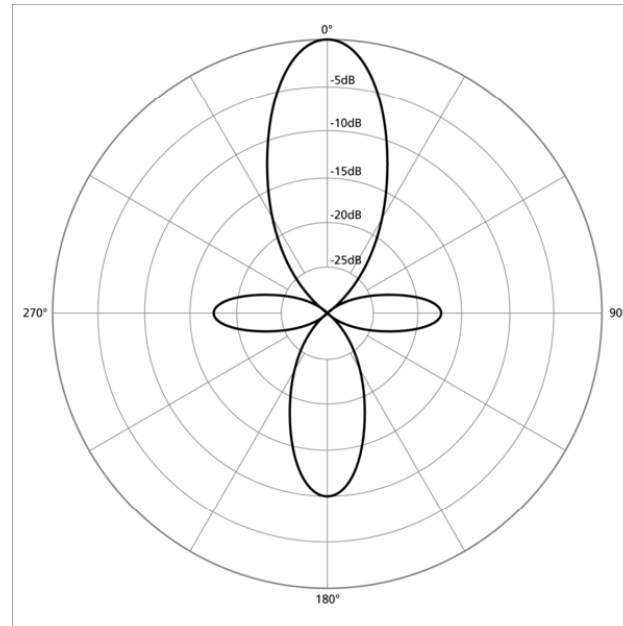
This diagram shows how the microphone responds to sound. Note that the loudness also drops off as you move away from the center.

* often call this a microphone's polar pattern...

Pickup Patterns

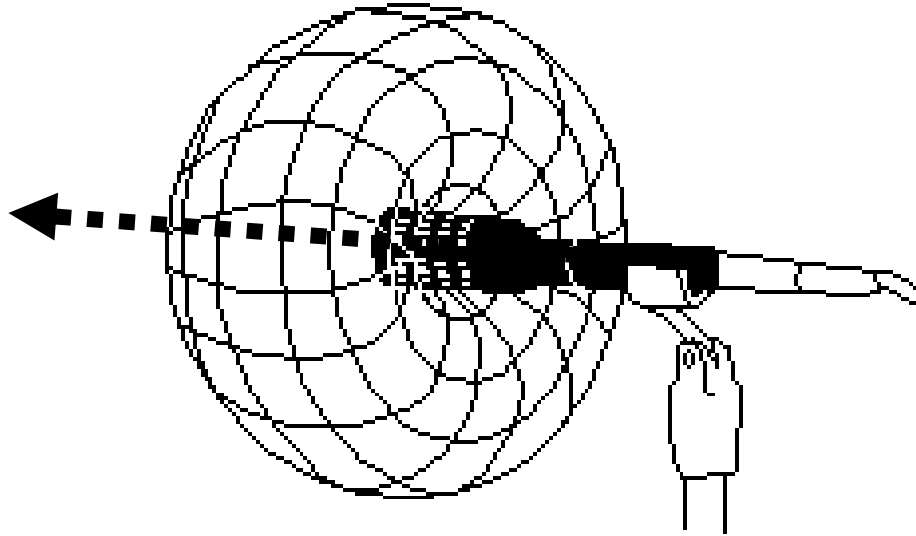


Bidirectional
(Typical of Ribbon Mics)



Shotgun
(Also called Super-Cardioid)

Pickup Patterns (Unidirectional)



We can consider the cardioid and shotgun to be unidirectional.

Microphone Impedance

- Impedance
 - Technically speaking, impedance refers to a microphones resistance to AC current
 - The letter **Z** is often used to refer to impedance
 - The greek letter Ohm, **Ω**, is used to measure impedance
- Impedance in Ohm
 - Low Impedance (less than 600Ω)
 - Medium Impedance (600Ω - 10,000Ω)
 - High Impedance (greater than 10,000Ω)
- Microphones that use TSR then to be high-impedance
- Microphones that use XLR often are low-impedance

Microphone Impedance

- Which is better, low or high?
 - In general, high-impedance means lower quality (but not always)
 - High-end microphones are almost always low-impedance
- High-Impedance microphones
 - Typically cheaper
 - Don't do well with very long cables
- Low-Impedance
 - Better quality
 - Can use a longer cable

Source and Load

- We call the device generating the sound signal a source
 - This is generally a microphone
 - It could be some other device (synthesizer, etc)
- We call the device receiving the signal the “load”
- Source and load impedance needs to match

Microphone Characteristics

- Three characteristics to a microphone
 - Type: Condenser, Ribbon, Dynamic
 - Condenser and Dynamic are the most common
 - Pickup Pattern:
 - Omni, cardioid, shotgun, bi-directional
 - Impedance rating
 - Ohms (low, medium, high)

Microphone Connectors (RCA)



RCA Connectors

Radio Corporation of America (RCA)

Each cable is one signal for audio (mono)

Used to carry various signals (audio, video, video components)

Convention: White = left or mono
Red = right

Microphone Connectors (TSR)

Tip/Sleeve/Ring (TSR) Connectors

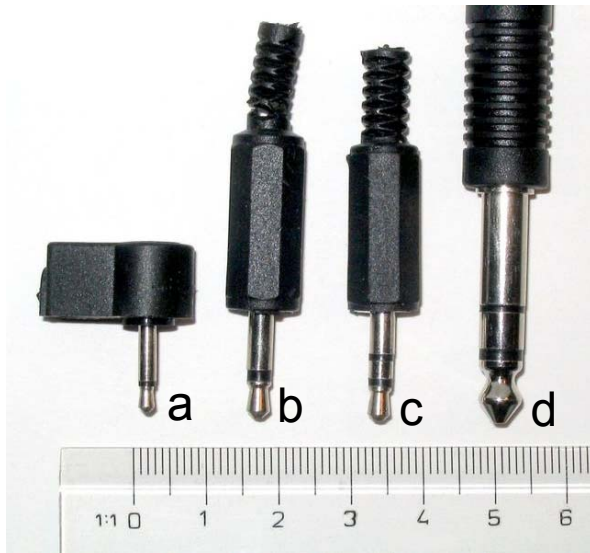
Also called:

audio jack plug
phone plug (long time ago)
jack plug
mini-jack plug
mini-stereo plug

If only 2 elements (TS)

If 3 elements (TSR)

If 4 elements (TSRR)



(a) 2.5mm mono (TS)

(b) 2.5mm mono (TS)

(c) 3.5mm (1/8") stereo (TSR)

(d) 6.3mm (1/4") stereo (TSR)

Microphone Connectors (XLR)



(Most common 3 pin XLR3)

XLR Connectors

Used for professional Mics

Invented by James Cannon (founder of Cannon), sometimes called a cannon plug/connector



(Variations with more pins)

Connectors (Plug/Jack)

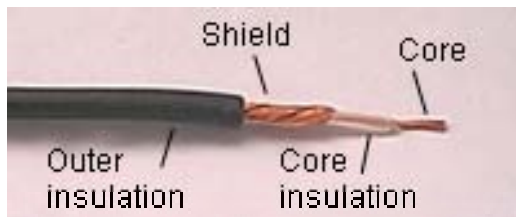


Also called “male” and “female” – I’ll let you figure it out.

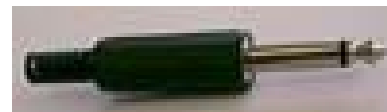
Note, sometimes people will refer to an audio plug as an audio jack, but they really mean plug.

Balanced and Unbalanced Audio

- Unbalanced
 - Traditional unbalanced cables use two lines - a *hot* line (core) which carries the signal and an *earth* line.
 - This is all that is required to transmit audio and is common in short cables (where noise is less of a problem) and less professional applications.



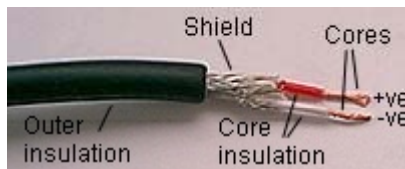
Unbalanced Cable



Mono-TS Jack and RCA are unbalanced

Balanced and Unbalanced Audio

- Balanced
 - Balanced audio cables use an extra line, and consist of a *hot* line (positive), *cold* line (negative) and *earth*.
 - The audio signal is transmitted on both the hot and cold lines, but the voltage in the cold line is inverted (i.e. the polarity is changed) so it is negative when the hot signal is positive.
 - These two signals are often referred to as being 180 degrees out of phase with each other but this is technically incorrect — the signals are not actually out of phase, they are opposite polarities, i.e. one signal is effectively flipped upside.
 - The mixer will inverse the negative signal and combine it with the positive line
 - This results in a stronger signal and less susceptible to noise



Balanced Cable



TRS & XLR connectors are balanced

Mixer Board





Typically can take several inputs (with different connections) with one output

Always you to adjust the volume and equalize (various frequencies) of each input

Make sure impedance of input matches microphone

Mixer and Impedance

Part #	Description	Photo	Price
	*****MICROPHONE MIXERS*****		
	*		
10-114	MICROPHONE MIXER-MIXES UP TO 3 MICROPHONES (LOW or HIGH IMPEDANCE)		\$49.75
200M	MICROPHONE MIXER-MIXES UP TO 4 MICROPHONES (LOW IMPEDANCE) or 3 MICROPHONES AND 1 LINE LEVEL SOURCE-REQUIRES 12 VOLTS DC or NEEDS SHURE PS20 120 VOLT AC ADAPTOR (NOT INCLUDED)		\$190.80

Mixers are usually designed for different type of impedances..

They will often list the impedance they can handle in the specifications.

Typically it is OK to connect a low-impedance source to high-impedance load, but not the other way around.

Mixers



2input Mixer



16input Mixer



32input Mixer

Microphone Placement

- On-Camera Mics
 - Visible to the viewer
 - Handheld, desk, stand microphone
- Off-Camera Mics
 - Not visible to the viewer
 - Can use boom poles, hanging microphones
 - Can hide out of view, or inside clothing/props

Microphone Placement

- Handheld, desk, and stand mics



Handheld Microphones

Intended to be moved around, not always right in front of the speaker (typically omnidirectional or cardioid)

Speaker needs to learn to hold mic at constant distance



Desk Microphones

Not intended to be moved around, often right in front of the speaker (typically cardioid) (omni or bi-directional can be used if two speakers)

Typically placed 2 feet from speaker



Stand Mic

Similar to desk microphones, but on a stand

Typically placed 2 feet from speaker

Lavalier Microphones

- Small microphones to attach to clothing
- Sometimes called Lapel Mics, Lavs, or Vega Microphones (after a popular brand)



Wireless Microphones

- Handheld and Lav Microphones
- Microphone is connected to a radio transmitter (sometimes worn on the speaker)
- Transmits to a receiver that outputs the microphone signal



Transmitter build into microphones



Lav microphones with transmitter

Off-Screen Microphones

- Microphone Boom
 - Holds microphone out of the view of the camera



Unidirectional Microphones are most commonly used.

Either shotgun or cardioid.

Optimal placement 1-4 feet from speaker.

Boom Types

- Fishpole Boom
 - Can be expanded/retracted for easy carrying
 - Made for lightweight microphones
- Giraffe Boom
 - More bulky, with a stand (and often wheels)
 - Can move more smoothly
- Perambulator Boom
 - Heaviest type of boom
 - Large strong pole
 - Sometimes require 2 operators
 - Designed for studio use (not portable)



Perambulator Boom



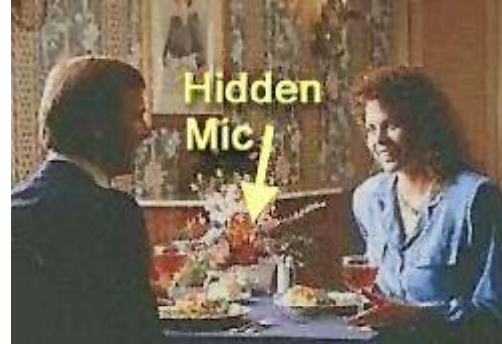
Boom Operation

- Movement of microphone must be smooth
- Movement of the talent must be anticipated by boom operator
- Must be careful not to create shadows on the talent/speaker
- Must keep the microphone out of the video frame



Off-Camera Microphones

- Hiding Microphones
 - In scene props



- In or under clothing



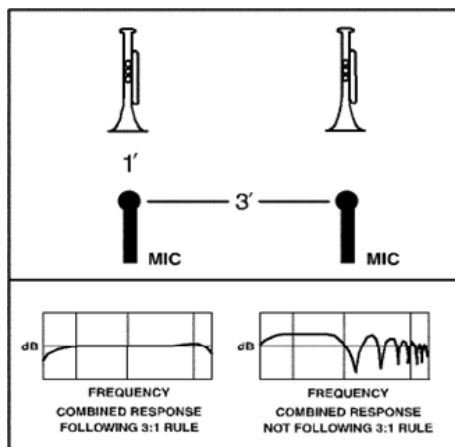
Wireless microphone under a shirt

Using Multiple Microphones

- When recording multiple people
 - Sometimes omni-directional picks up too much other sound
 - We can use multiple microphones
- Also, we may want different types of microphones
 - Singer cardioid
 - Band has omnidirectional

Avoiding Phasing

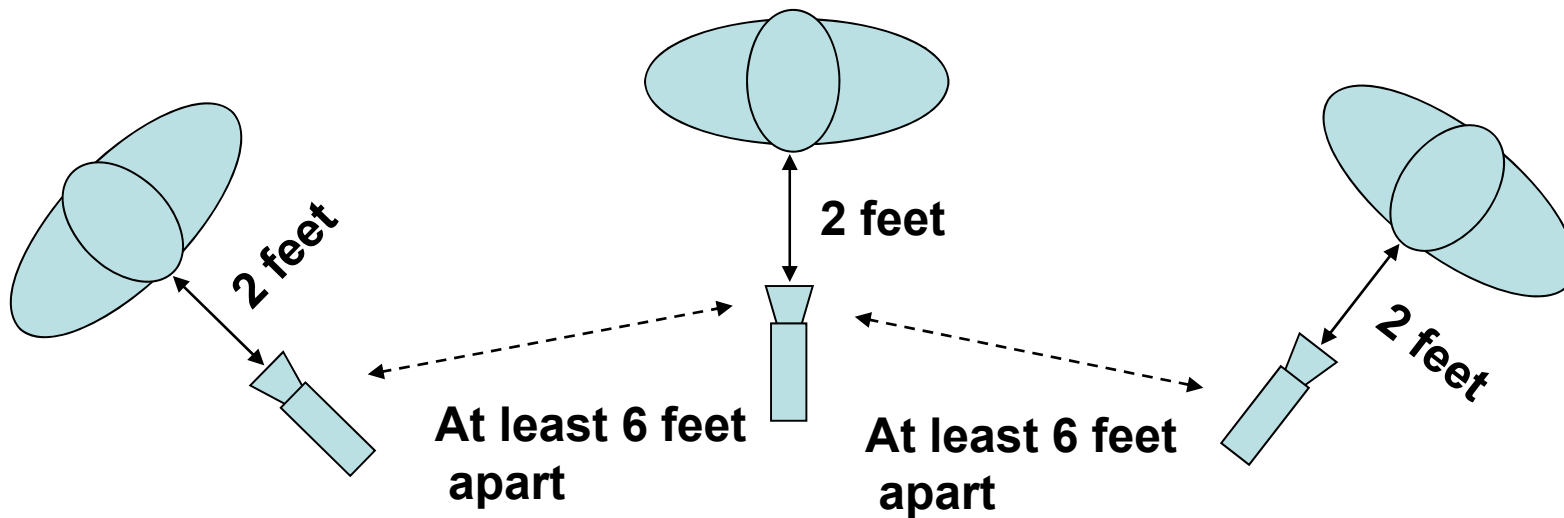
- If microphones are placed too close, we can get phasing
 - This is an interference pattern in the sound waves
- One rule is to place mics 3x away from each other as they are from the source



Example. Two microphones 1 foot from source, should be 3 feet apart.

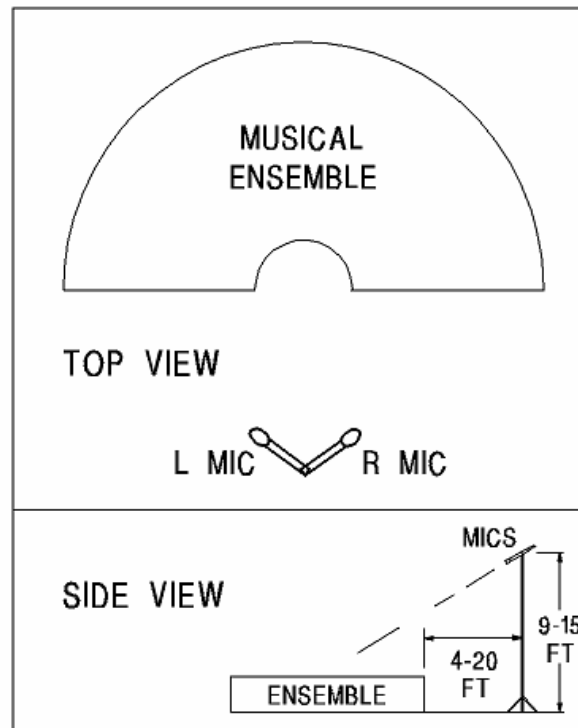
3-Times Rule

- Another Example


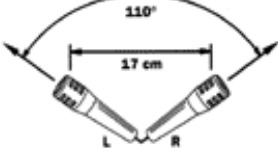
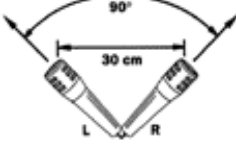

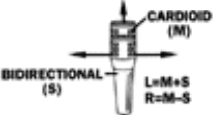
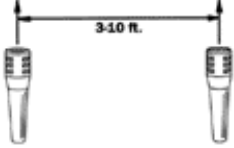


Stereo Mic Placement

- Use two cardioid mics can give stereo effect
- Example for recording music (orchestra)

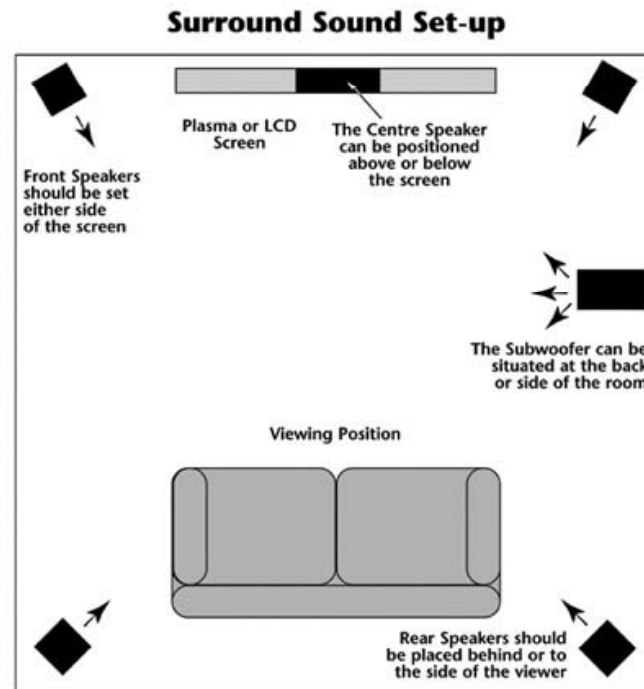


Other Examples

STEREO PICKUP SYSTEMS	MICROPHONE TYPES	MICROPHONE POSITIONS	
X-Y	2 - CARDIOID	AXES OF MAXIMUM RESPONSE AT 135° SPACING: COINCIDENT	
ORTF (FRENCH BROADCASTING ORGANIZATION)	2 - CARDIOID	AXES OF MAXIMUM RESPONSE AT 110° SPACING: NEAR-COINCIDENT (7 IN.)	
NOS (DUTCH BROADCASTING FOUNDATION)	2 - CARDIOID	AXES OF MAXIMUM RESPONSE AT 90° SPACING: NEAR-COINCIDENT (12 IN.)	
STEREOSONIC	2 - BIDIRECTIONAL	AXES OF MAXIMUM RESPONSE AT 90° SPACING: COINCIDENT	
MS (MID-SIDE)	1 - CARDIOID 1 - BIDIRECTIONAL	CARDIOID FORWARD-POINTED; BIDIRECTIONAL SIDE-POINTED; SPACING: COINCIDENT	
SPACED	2 - CARDIOID OR 2 - OMNIDIRECTIONAL	ANGLE AS DESIRED SPACING: 3-10 FT.	

Surround Sound

- At least four channels recorded
- Typical corresponding to four corners of the listening area
- Requires surround sound speakers for true playback
- Double 5.1 and 6.1 are designed for up to 6 channels



Surround Sound
Microphone

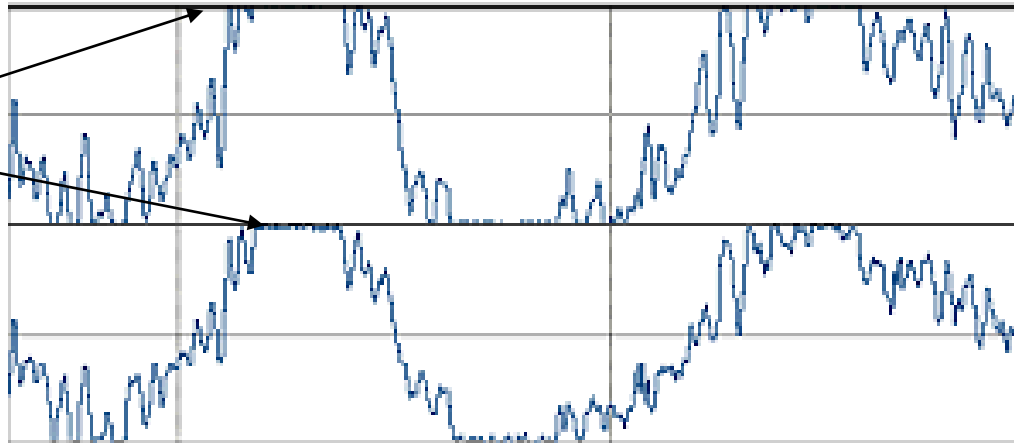
Choosing a Microphone

- Dynamic and “electret condenser” cardioid microphones are the most versatile
 - Durable, have a range of ½ omni, but more coverage than shotgun
 - Good for handheld and hanging from a boom
- Cardioid Mics
 - Good when microphone is relatively close to the speaker
- Shotgun Mics
 - Good when off-camera is far away
 - Be careful not to pickup sounds behind talent
- Ribbon Mic
 - Good for stationary mikes, talk shows, interviewers, etc
 - Typically have bi-directional pickup
- Omni-directional Mic
 - Good for multiple speakers
 - Can be used overhead in fixed position
- Condenser Mic
 - Have very good frequency response
 - Often used for instruments, vocals
 - Can be miniaturized – dynamic mics cannot be miniaturized

Noise in Audio

- Most common “Distortion”
 - When the audio level exceeds level of electronic system

**Distortion
because
sound is too
loud**



Other Noises

- Ambient Noise
 - Noise in the background of the scene
 - Unwanted noise captured by the mic
- System Noise
 - Due to the microphone sets, cabling
 - Cabling need electrical power sources, high powered lights, etc, can introduce noise
 - Usually sounds like a hum or buzzing

Sound Intensity Measures



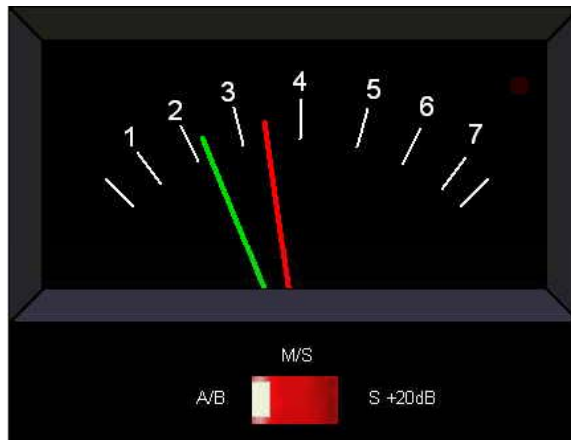
Volume Unit - American Standard

0db means “peak” loudness*

Each 3db is approximately a doubling in loudness.

Needle reading represent average of short time span.

We try to keep sound at -6 to 0db.



PPM meter (Peak Performance Meter) (European Standard)

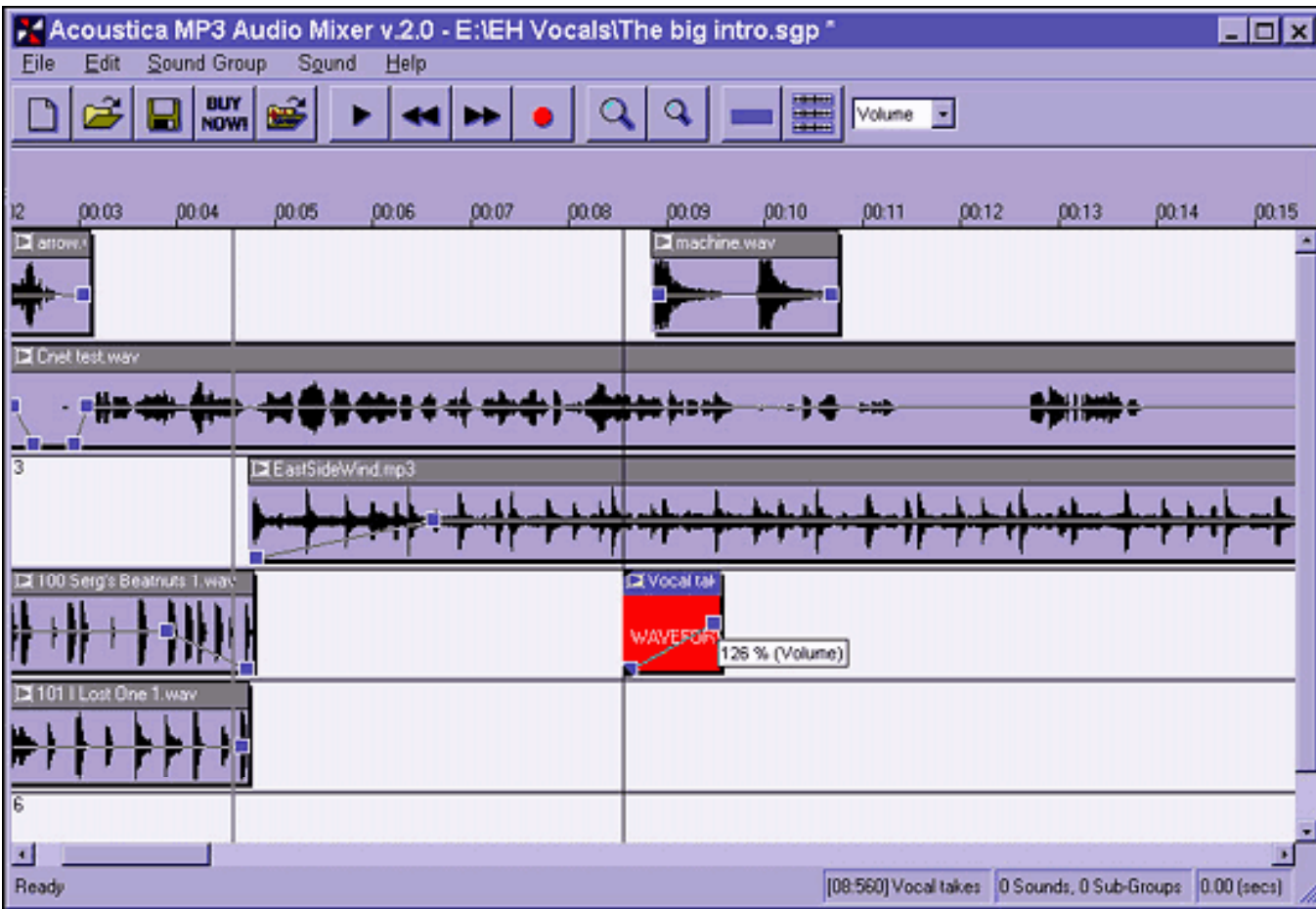
Reports immediate reading (very little averaging)

Scale 1 to 7 represents loudness

Example here shows stereo needles

*recall db is a relative value, can be relative to what you want. In the previous notes on compression it was relative to minimum audible level. This is quite different, 0db is the loudless level before distortion. So, you want a -dB value.

Mixing – Tracks



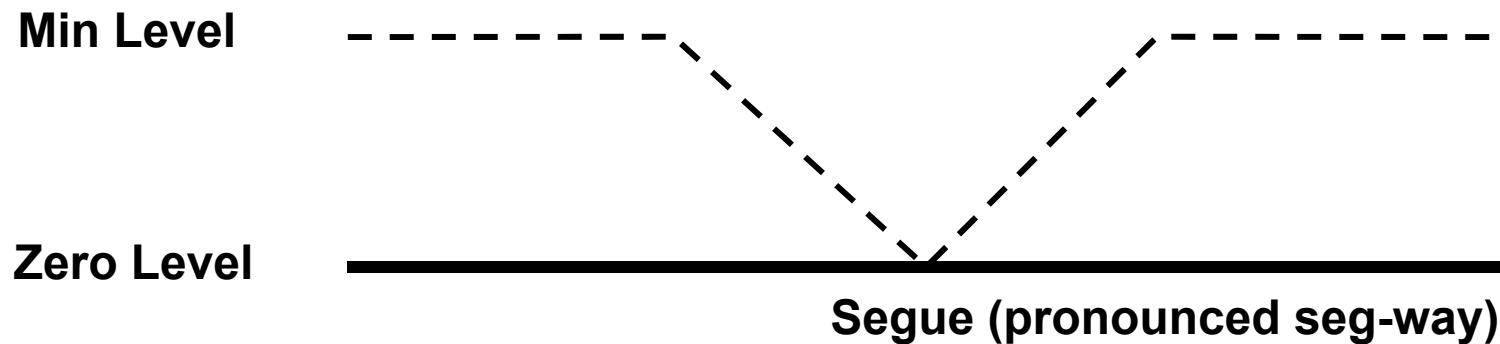
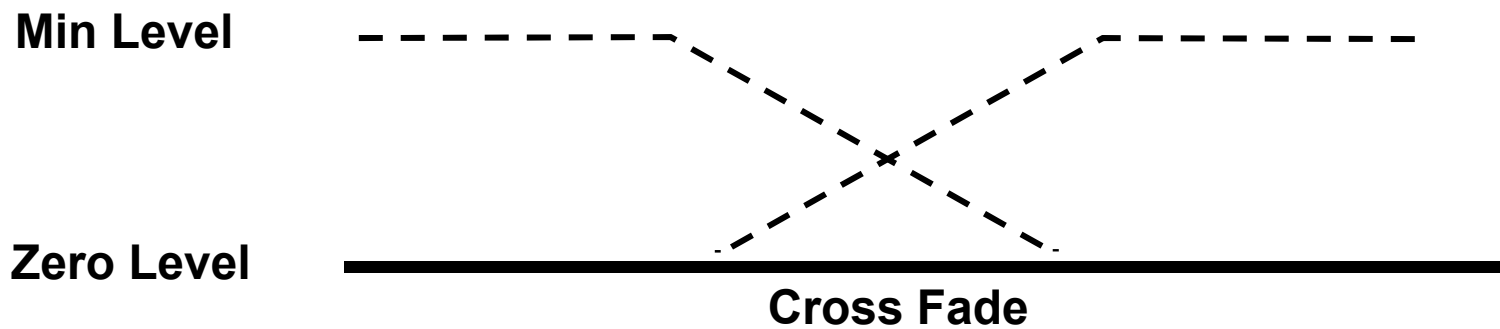
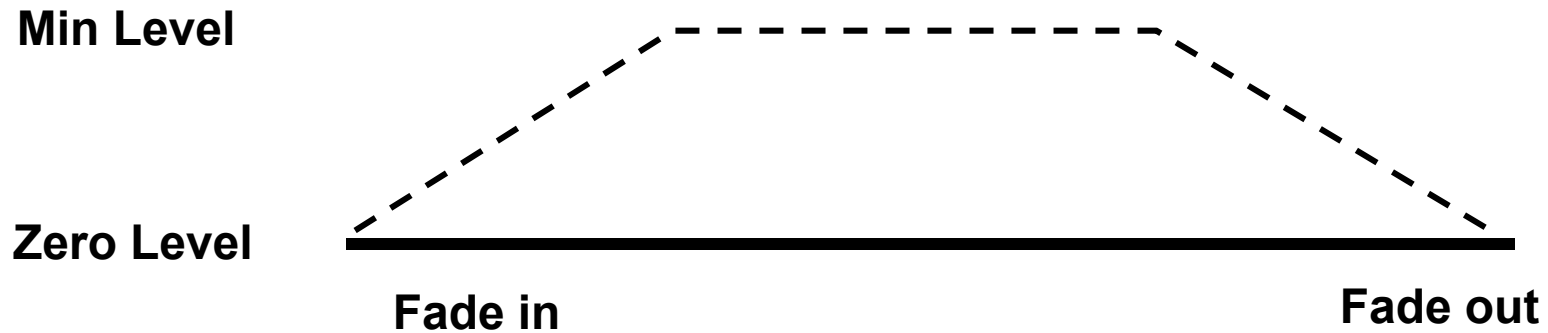
The screenshot shows the Acoustica MP3 Audio Mixer v.2.0 interface. The window title is "Acoustica MP3 Audio Mixer v.2.0 - E:\EH Vocals\The big intro.sgp". The menu bar includes File, Edit, Sound Group, Sound, and Help. The toolbar contains icons for file operations, playback, and volume control. The main area displays five tracks with their respective audio waveforms:

- Track 1:** Contains two audio segments: "atlow" and "machine.wav".
- Track 2:** Contains a single audio segment: "Cnet test.wav".
- Track 3:** Contains a single audio segment: "EastSideWind.mp3".
- Track 4:** Contains two audio segments: "100 Seig's Beatnuts 1.wav" and "Vocal tak". The "Vocal tak" segment is highlighted in red and has a tooltip that reads "WAVEFORM 126 % (Volume)".
- Track 5:** Contains a single audio segment: "101 I Lost One 1.wav".

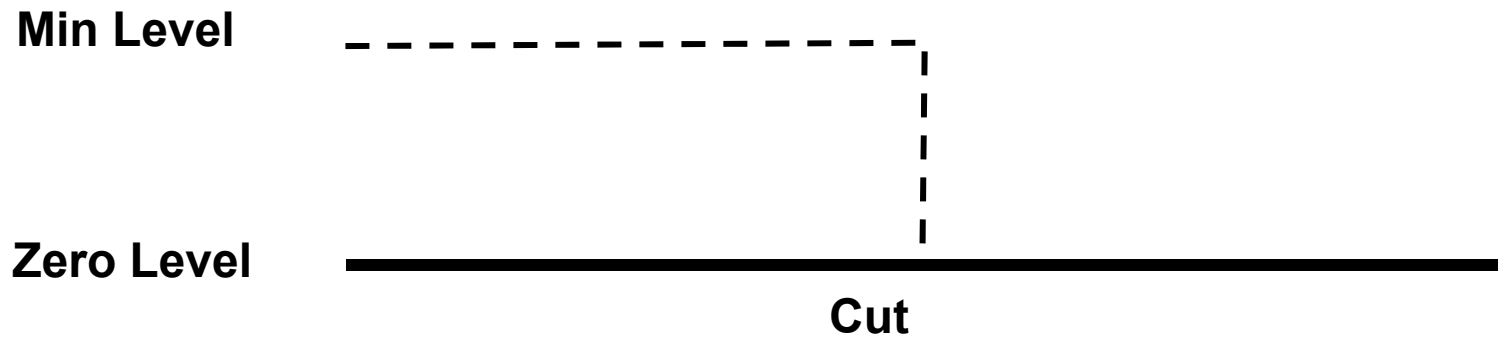
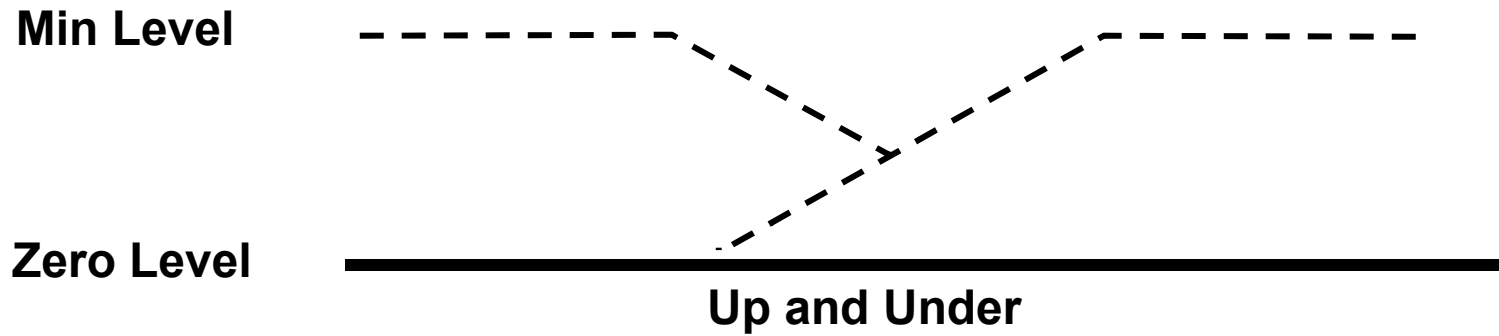
The bottom status bar shows "Ready" and "[08:560] Vocal takes 0 Sounds, 0 Sub-Groups 0.00 (secs)".

Multiple audio recordings can be combined. We call each one of these a track. Note that once they have been combined (in the output), it is very hard to separate them back into individual tracks.

Mixing – Transitions



Mixing – Transitions



Foley Sound and Artistry

Most Sounds

- Most sounds you hear on the movies are not truly recorded on the set
- Instead they are sounds produced in a studio and are matched to the action
- People who do this are known a “foley artist”



Jack Foley

- Jack was a sound editor for Universal Studios, started in 1914
- Pioneered the art of sound effects for movies by playing the movie and doing effects “in real time” to record another “track”.



We now call this “off set” sound production “Foley sound”.

Foley Artist Setup

- Sounds has to be matched closely to the action
- Artist watch the movie and dynamically capture the sounds



Foley Tips

- Keep microphone about 3" away from the foley artist



- Record individual sounds on their own track
- Balance the sound carefully when added it into the production

Some examples

- Break bones (fresh carrots)
- Kissing (water [for lips] and your forearm)
- Slap/Punch (slap raw meat in your hand)
- Swoosh (thin stick waved quickly)
- Gun sound (heavy staple gun)
- Bird wing lap (old gloves)

Other resources: youtube – search “foley”

http://www.youtube.com/watch?v=l_mJhv_gNCY&feature=related

<http://www.youtube.com/watch?v=5RqDW4wKXnU&feature=related>

Sound's Impact on Image

- High pitch = tension, suspense
- Low pitch = less tension, mystery
- Loud sounds = intense, threatening
- Quiet sounds = delicate, hesitant
- Fast tempo = more tension
- Silence = highlights, isolates image, can represent death, sticks out if a mistake

Sound's Impact on Image

- Sound effects both atmospheric and diegetic quality of the movie
- Off screen sounds can expand the film world beyond the frame
- Sounds can be used like motifs and serve symbolic functions
- Sounds can be used as to aid transitions and foreshadow action

Sound's Impact on Image !

- Music
 - sets a mood
 - suggest historical references, a time period
 - can suggest locales, classes or ethnic groups
 - used as foreshadowing and musical warnings
 - atonal music can create anxiety
 - can reference other settings of music
 - music can provide ironic contrasts with image

Summary

- Audio is important for any media production
 - Need to understand audio equipment and its uses
- Microphones
 - 3 characteristics
 - Type, pickup pattern, impedance
- Cabling/Mixers
 - Various connectors and cable types
 - Mixers need to match impedance of mics
- Strategies for microphone placement
 - On-screen/off-screen, placement rules
 - Rules of 3:1 to avoid interference
- Microphone choice
- Sound measurement and mixing
 - Used to avoid distortion
 - Can combine multiple tracks
 - Various transitions
- Foley
 - Making sound in the “lab”