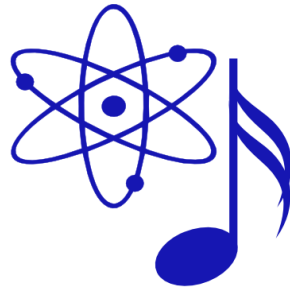


Session 4
Perception of sound
and music
Malik Refaat



Science of Music

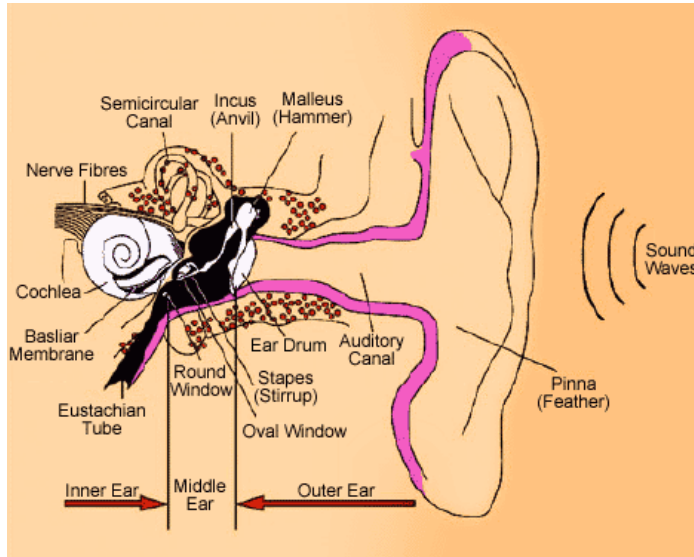


Overview

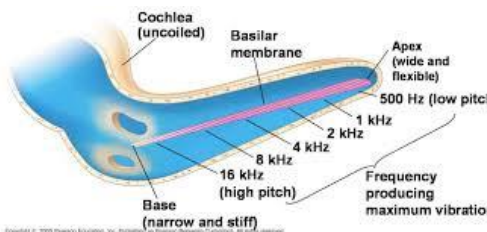
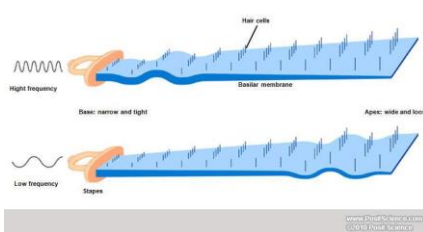
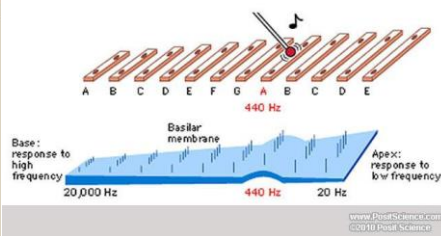
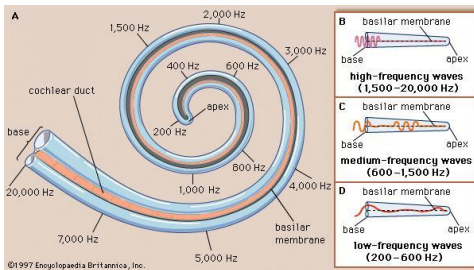
- Anatomy of the Ear
- Pitch
- Memory
- Harmony
- Psychoacoustics
- Rhythm
- Emotion



Anatomy of the Ear



Anatomy of the Ear

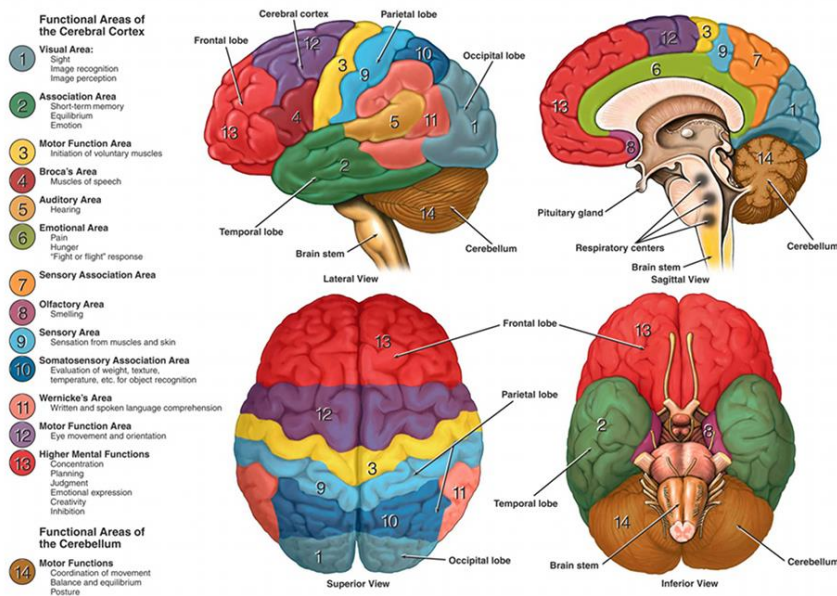




Pitch

- Pitch recognition
 - Cilia on basilar membrane
 - Auditory nerve
 - Brain lobes
 - Temporal lobe
 - Broca's Area
 - Wernicke's Area

Anatomy and Functional Areas of the Brain





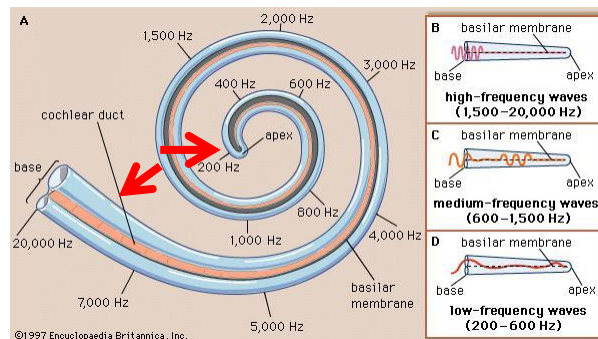
Memory

- Pitch labels (Letters or numbers)
- Verbal labels of pitch
- Making verbal labels
- Keeping them in your head
 - Neural pathways and synapses
- Accessing labels from memory
- Linking sound with labels



Pitch 2

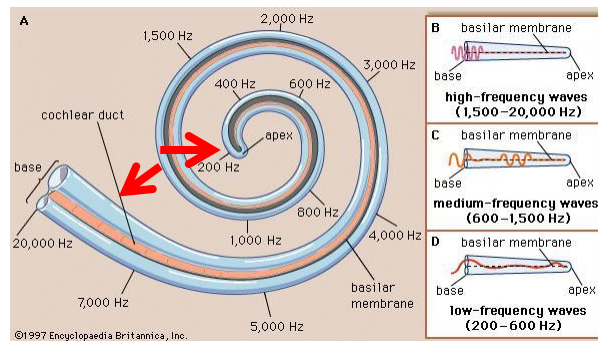
- Pitch discrimination
 - Cilia on basilar membrane
 - Frequency of sound
 - 10Hz click
 - 20Hz Sound
 - 10000Hz + ?





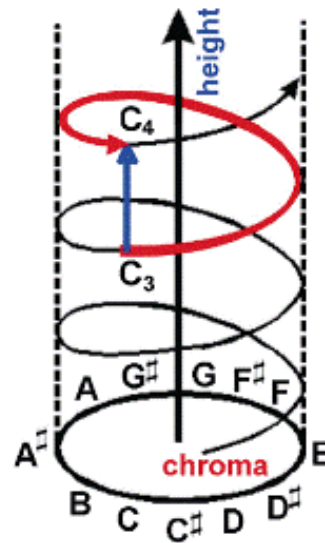
Pitch 3

- Pitch discrimination
 - Beats
 - Just Noticeable Difference
 - scales



Pitch 4

- Pitch height
 - Pitch is not linear
 - Logarithmic
 - Helical
 - Roger Shepard (1982)
 - Octave relationship
 - Cycle of 5ths





Absolute vs Relative pitch

Absolute

- Use it or lose it
- Tonal languages
- Critical age (various schools of thought)
- Practice makes perfect
- Direct access to verbal labels
- No reference (OR internal reference)

Relative

- Everyone has it
- Good musicians get better
- Will never become AP
- Calculation based on external reference

NB. Information in Measured Tones is very vague and a little bit wrong.







Loudness

Sound	Decibel Level	Musical Dynamics	Number of Times Louder than Threshold
Threshold of Hearing	0		1
Normal Breathing	10		10
Leaves Rustling	20		100
Empty Theater	30	ppp	1,000
Mosquito Buzzing	40	pp	10,000
Quiet Restaurant	50	p	100,000
Normal Conversation	60	mp	1,000,000
Traffic	70	mf	10,000,000
Vacuum Cleaner	80	f	100,000,000
Truck Engine	90	ff	1,000,000,000
Subway Train	100	fff	10,000,000,000
Rock Band	110		100,000,000,000
Threshold of pain	120		1,000,000,000,000
Machine Gun	130		10,000,000,000,000
Jet Engine	140		100,000,000,000,000



Timbre

- Pure tone 
- Complex tone 
- With fundamental 
- Without fundamental 



Psychoacoustics

Auditory illusions

- Masking (Louder sounds result in other sounds not being heard)
- Cocktail party effect (Cherry, 1953)
 - Ability to focus on sounds and shift attention to important stimuli



Psychoacoustics

Auditory illusions

- Shepard tone



- Notes played with timbres constructed so that the main amplitude is in the middle. The frequency increases in a way that means that the first fundamental is repeated after 5 notes.
- Your brain fills in the gaps and makes it sound like it constantly rises in pitch.



Psychoacoustics

Octave illusion



♩-left ♩-right ♩=240

SOUND PATTERN

PERCEPTION

The pattern that produces Deutsch's octave illusion, and a way that it is often perceived.



Psychoacoustics

Scale illusion

♩-left ♩-right ♩-400

A.

SOUND PATTERN

B.

C.

PERCEPTION

The pattern that produces Deutsch's scale illusion (A), and a way that it is often perceived (C). The notation in (B) shows how the pattern is composed of ascending and descending scales.



Psychoacoustics

Chromatic illusion

♩-left ♩-right ♩-400

SOUND PATTERN

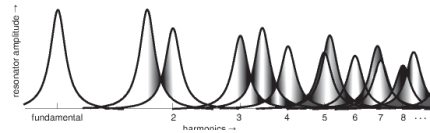
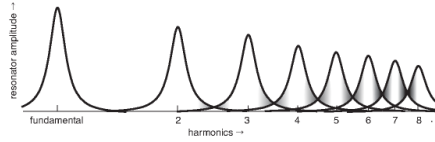
PERCEPTION





Harmony

- Happy Chords
- Sad Chords
- What makes a good chord?
- Consonance and the Measured tones Description.
 - Higher harmonics
 - Harmonic overlap



Harmony

- MT describes consonance in terms of harmonics.
- Lack of harmonics but similar notes or more overlap of harmonics is more consonance.
- What about real instruments?
- Don't real instruments sound nice when playing the same notes despite the harmonics?

Discuss



Emotion

- Low notes to high notes (the higher the happier).
- Intervals are learned as having emotional value



- Jazz is fundamentally based on the ii-V-I chord progression (minor-major-major) and it sounds hip and upbeat, not sad.
- "sad minors" and "happy majors" only sound that way in certain modes.



Emotion

What is happy or sad music?

Mafa Tribe in Northern Cameroon recognised happy music as happy and sad music as sad – Fritz (2009)



Emotion

Higher is happier



Rhythm

- Babies can detect the beat in music.
- Timing alterations detected by listeners
- Drummers swing tempos are not equal but are controlled over global timing of a piece.



Rhythm

- Internal meter
- Use of visual cues
- Tapping in time
 - Are drummers in time throughout a whole bar?
 - Do soloists stick to strict time?
- Group rhythm vs solo rhythm



Questions