The Sounds of Music: Its Biological and Sociological Effects

Presented by Loretta Tang, Geoffrey Kong, and Lucy Wada

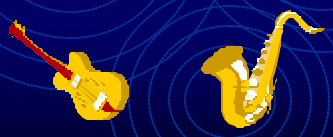
Introduction

- Sound and the Ear
- How Musical Instruments Work
  - Demonstration of a musical instrument
- Social Effects of Music
  - Skit
- Bibliography
- Question Period

Sound and The Anatomy of the Human Ear

What is sound?

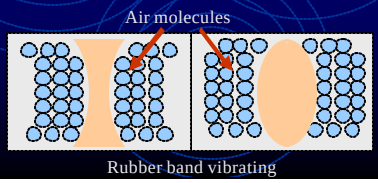
- What we refer to as sound are actually vibrations that travels through a medium (example: air)
- Vibrations occur when some entity is "...moved or caused to move back and forth rapidly…," such as the strings of a guitar, or the reeds in an saxophones' mouthpiece



- Okay, so sound is vibration, but why is a moving entity important in understanding sound?

The Rubber Band Example

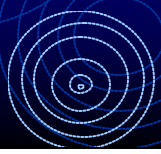
- Take a rubber band for example.
- When the rubber band is plucked, we can see that it is moving in an out (similar to when you inhale and exhale).
- However, the rubber band is not the only thing that is moving.
- As the rubber band moves, its surface pushes and pulls on the surrounding air molecules



Rubber band vibrating

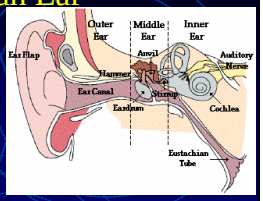
The Rubber Band Example

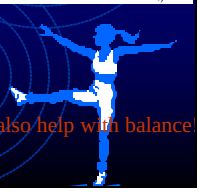
- The rubber band's movement will push and pull on the nearest set of air molecules.
- This movement will then cause the first set of molecules to disturb the next set of molecules. As this progresses, the result is something similar to a ripple effect.
- Like the ripple effect that is seen in water, these "waves" will continue to move outward (away from the source) and this is how sound is produced and carried.



The Human Ear

- The sense of hearing depends partly on a structure that we know of as the ear.
- The ear can be divided into three sections: the outer ear, middle ear, and inner ear
- Each section has its own function in the process that allows the brain to acknowledge and register a sound.

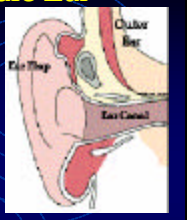




They also help with balance!

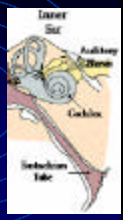
The Outer and Middle Ear

- The outer ear consists of:
  - Auricle (pinna)
  - Ear canal (external auditory meatus)
  - Eardrum (tympanic membrane)
- The middle ear contains the ossicles, which are three connected bones:
  - Hammer (malleus)
  - Anvil (incus)
  - Stirrup (stapes)
- This section is less than 2 cm in height and half a centimetre in width.



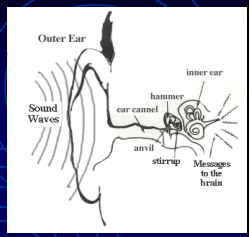
The Inner Ear

- The inner ear consists of:
  - A membrane that covers the opening between the middle and the inner ear.
  - A shell-like structure called the cochlea, which is filled with a fluid .
- If the cochlea were rolled out flat, it would be about 1 inch.



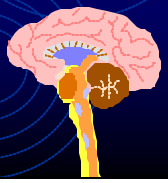
How do we hear with the ear?

- The outer portion of the ear directs the incoming sound waves into the ear towards the eardrum.
- The sound waves causes the eardrum to vibrates, and these vibrations are passed through the three bones of the ossicles.
- Before reaching the cochlea, the vibrations are then transmitted through a membrane in the inner ear.



How do we hear with the ear?

- Inside the cochlea is the organ of Corti, which consists of a basilar membrane that is implanted with hair-like structures with nerve endings.
- The vibrations that enter the cochlea produce waves in the fluid, and it is those nerve endings that “read” them.
- The waves creates electrochemical signals that are picked up by other nerves in the cochlea and are sent to the brain.
- The brain identifies the sound.



Musical Instruments

Musical Instruments

- Percussion
- Keyboard
- Strings
- Woodwind
- Brass

Differences in instrument group

- Tone-colour
- Compass
- Method of playing
- Sizes of instruments

Percussion

- Drums, cymbals, xylophones
- Percussion instruments usually have no pitch, but some of them can be tuned
- Many people think that percussion instruments are easy to play

Blue Man Group

Frequency =pitch

F=v/λ (frequency is equal to velocity over wavelength)

Therefore: the higher the velocity, the higher the frequency (pitch)

Keyboard instruments

- Piano
- Sounds are emitted from strings inside the piano
  - Keys control the small hammers that hit the strings, producing the sound

Stringed instruments

- <u>The violin</u>
- The violin's bow is made of a strong and flexible wood (eg. Rosewood, pernambuco wood, snake wood), and 200 hairs from a horse's tail
- The strings of a violin were once made of twisted strips of sheep gut

- <u>Two main groups of strings</u>
- Those played with a bow (violin family)
- Those played by plucking the strings with fingers, or a plectrum

•<u>Intonation</u>

•Tone can be varied using the bow

•Violins are tuned by tightening the strings

Woodwind instruments

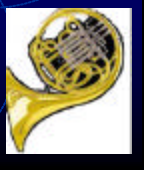
- Flute, clarinet, saxophone
- Notes are made by blowing air into it, causing the air inside the tube to vibrate
- Range of notes are made by cutting small holes at specific places in the tube
- Woodwind instruments are reed instruments, except for those in the flute family

Embouchure

- The way that the lips are applied to the mouthpiece of an instrument
- Demonstration of embouchure and a performance provided by Loretta Tang.
- Embouchure for the flute
  - The flute's mouth-hole is placed just under the flute player's bottom lip
  - As Loretta's breath leaves her mouth, the air is directed in a thin stream against the far side of a mouth-hole
  - Small whirlpools form inside the tube, fluttering rapidly and causing the air in the flute to vibrate, thus sounding a note

Brass instruments

- Trumpet, horn, trombone
- Sound is made by making the air inside the tube vibrate
- The embouchure for brass instruments is different from the embouchure for woodwinds
- It is possible for any brass instrument to play a range of 16 notes
- Brass groups have crooks and valves

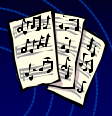


The Difference between brass and woodwind instruments

- Length of tube and width of bore
- Main difference is the way they are played, not the material they are made from

Social Effects of Music

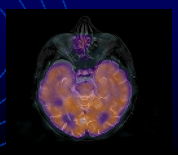
Sound/Music Therapy



- Technique
  - Music recorded through device, Electronic Ear, invented by Dr. A. A. Tomatis
  - Music function as conditioned stimulus
  - Music has potential as distraction or attention-focusing stimulus

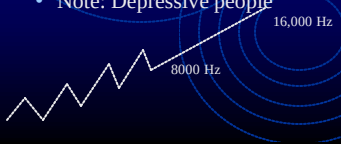
How Does Music Therapy Work?

- Brain uses energy
- Central grey nuclei of cortex is the "battery"
- But requires recharging through external input – via the ear
- Sound therapy can exercise the middle ear muscles, and stimulate cilia



Electronic Ear

- It has two filter systems
- Music goes through one filter system or channel at a time, creating a rocking effect
- When listening and recognizing tension and relaxation pattern of sounds becomes habitual, charge of energy to brain from music is distributed throughout nervous system
- Note: Depressive people



What are some effects of music therapy?

- Soothes the insomniac to sleep
- Uplifts people from depressive mood
- Protects, improves, and restores hearing
  - Deteriorates when…
- Relieves anxiety and stress

Music – Anxiety level - Pregnancy

- Instruct women in positing, breathing, muscular control and relaxation techniques (*Lamaze)*
- Select music used for labour and delivery
  - Qualities affect degree of intrusiveness
  - Classical music
- Introduce music to relaxation and breathing techniques
- Practice and become familiar

⇒ Assists in relaxation - Music - conditioned stimulus
⇒ Diverts attention from pain and hospital sounds - focus

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