MUSIC AND MEDICINE

Honors Senior Project

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INSPIRATION

- Pre-Med Student
- Trombone Player at WWU
- Bridge Interests

- The big question: How will I incorporate music into my future practice?

MUSIC: GOING DEEP

SOUND PATHWAY

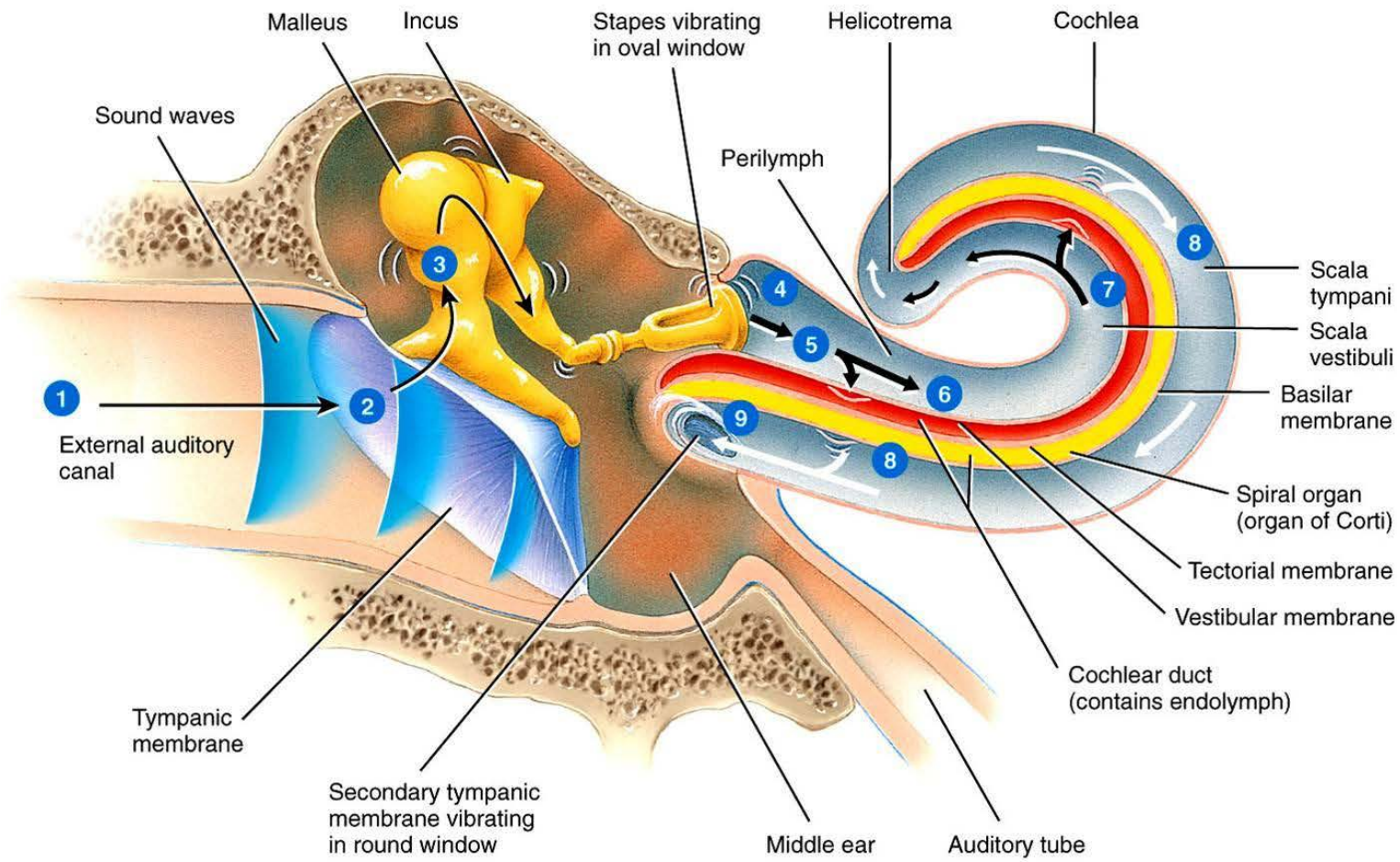
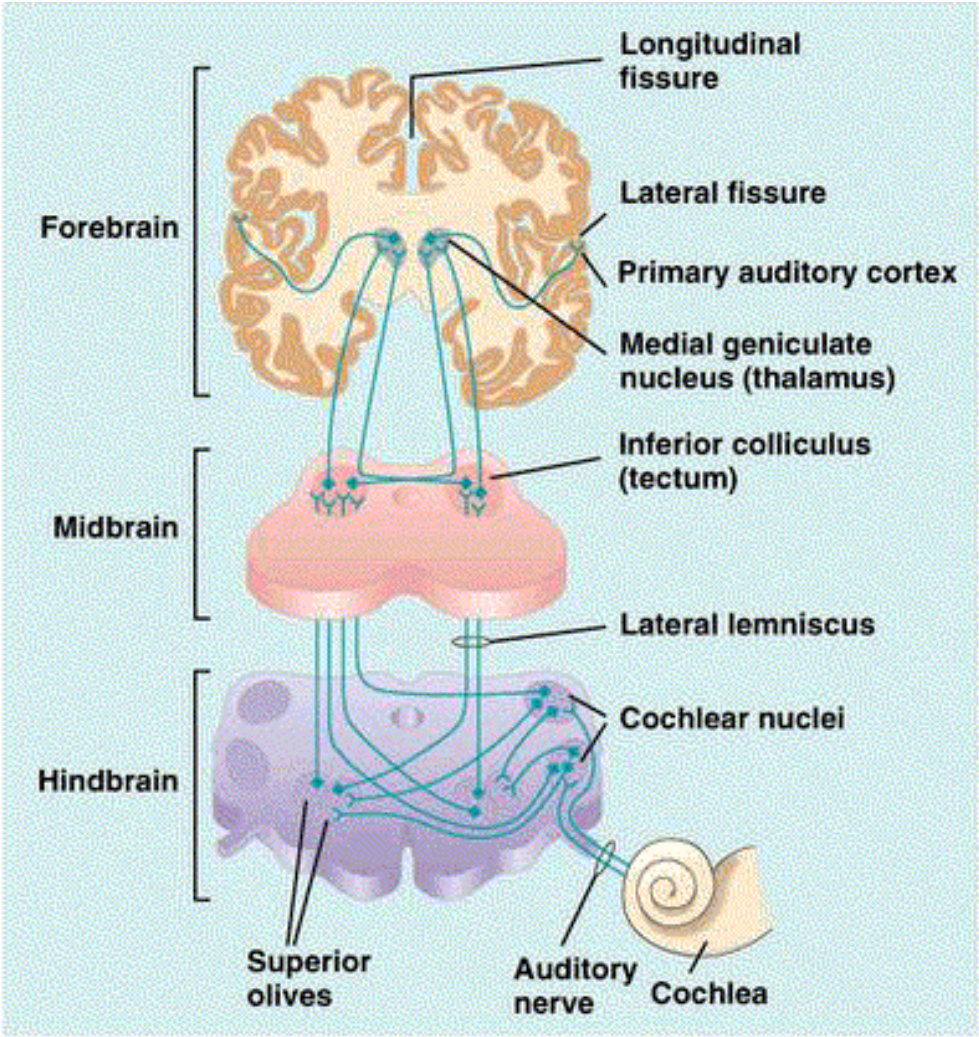
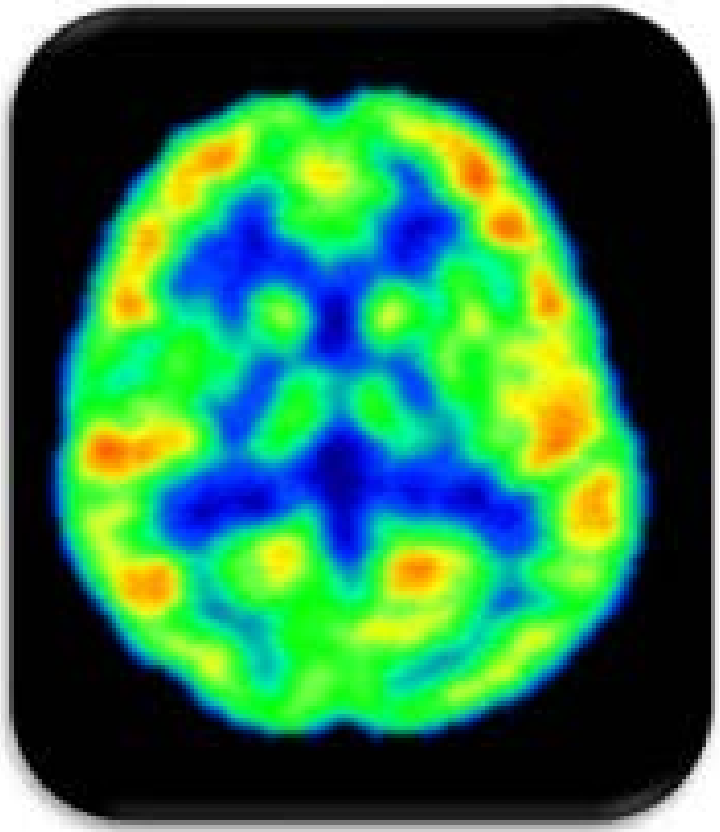


Figure 17.22 Tortora - PAP 12/e

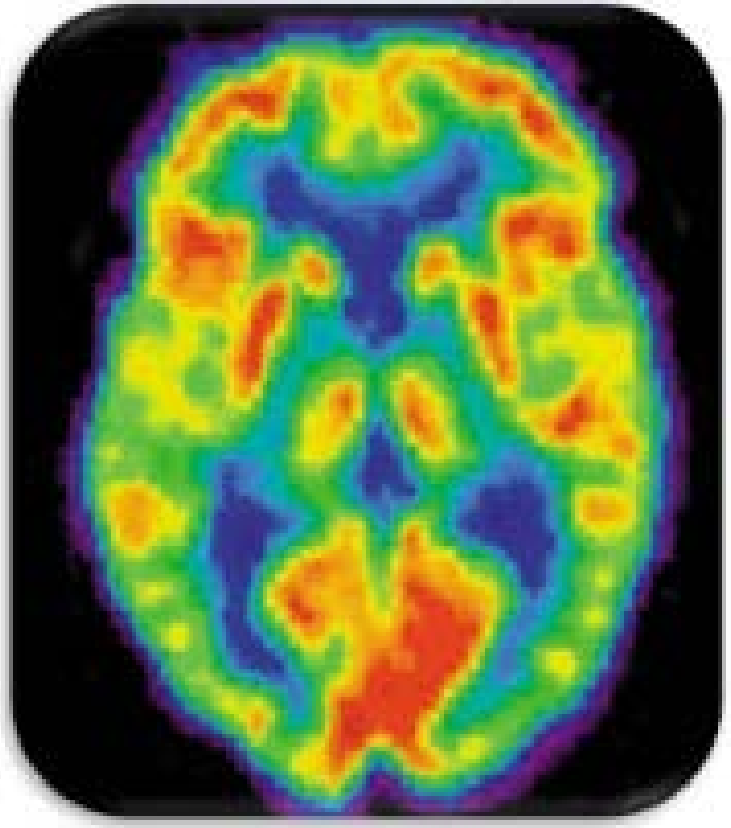


MUSIC AS A POSSIBLE MODALITY

The brain at rest



The brain's reaction to music



WIDELY ACCEPTED MEDICAL APPLICATIONS OF MUSIC

- Music Therapy
  - Uses music to help address individual therapeutic needs
  - Sing, create, listen
  - Music Therapist
- Dementia and TBI Rehabilitation
  - Alternate, unaffected pathways
  - Learning to speak again by singing
- Cognitive Disorders
  - Tomatis Method
    - Specific Resonant Frequencies Frequencies
    - Increased Cerebral Blood Flow
    - More nutrients and oxygen
    - Dendritic Branching
    - More Connections

WIDELY ACCEPTED **ASTERISK**

- Widely Accepted does not mean implemented in the clinic
- Ignored in Allopathic Medicine despite:
  - Wealth of Anecdotal Evidence
  - Proven music interventions
- Still termed alternative medicine
  - Bad connotation
- **Lack Of Empirical Evidence**

- Potential Benefits of Music using Music in the clinic
  - Synergistic effect with other therapies
  - Cheap, easy to access
  - **No side effects**
  - Less dependent on other drugs

MUSIC, PAIN, AND ANXIETY

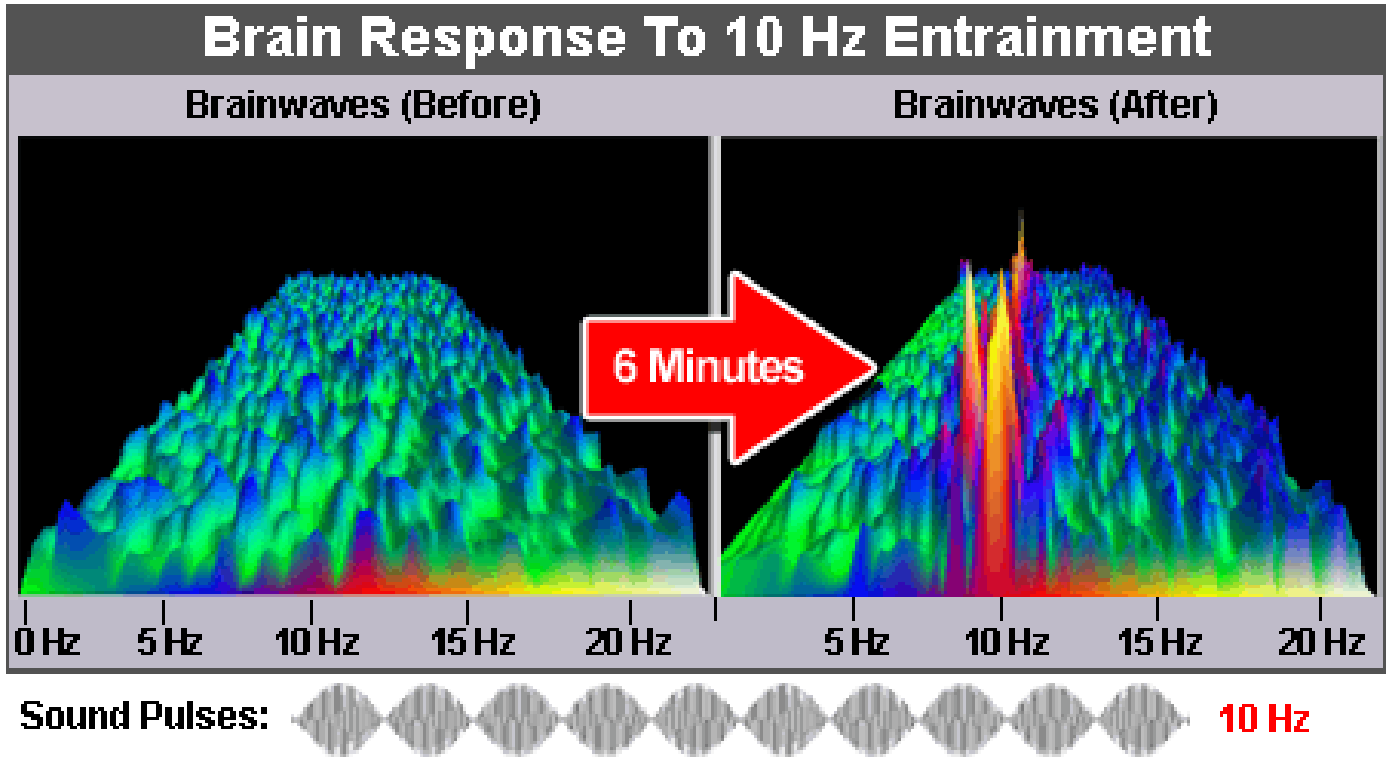
- Surgery (Pre/Intra/Post)
  - Anesthesiologists monitor vitals
  - Reduced analgesic and sedative requirements in music groups
    - Self administered pain medication
- Sympathetic vs Parasypathetic response
  - Music produced parasympathetic activation
    - Vagus nerve
  - ICU showed reduced HR, BP, RR with music
  - Retts Syndrome = “no bias”

- Key Notes
  - Music Better than white noise, no conditioning effect = not placebo
  - Familiar, deactivating music was best
    - Slow = entrainment, calming
    - Familiar = emotional response
      - Limbic system is very powerfull!

= why I used *self selected* music under 120 bpm

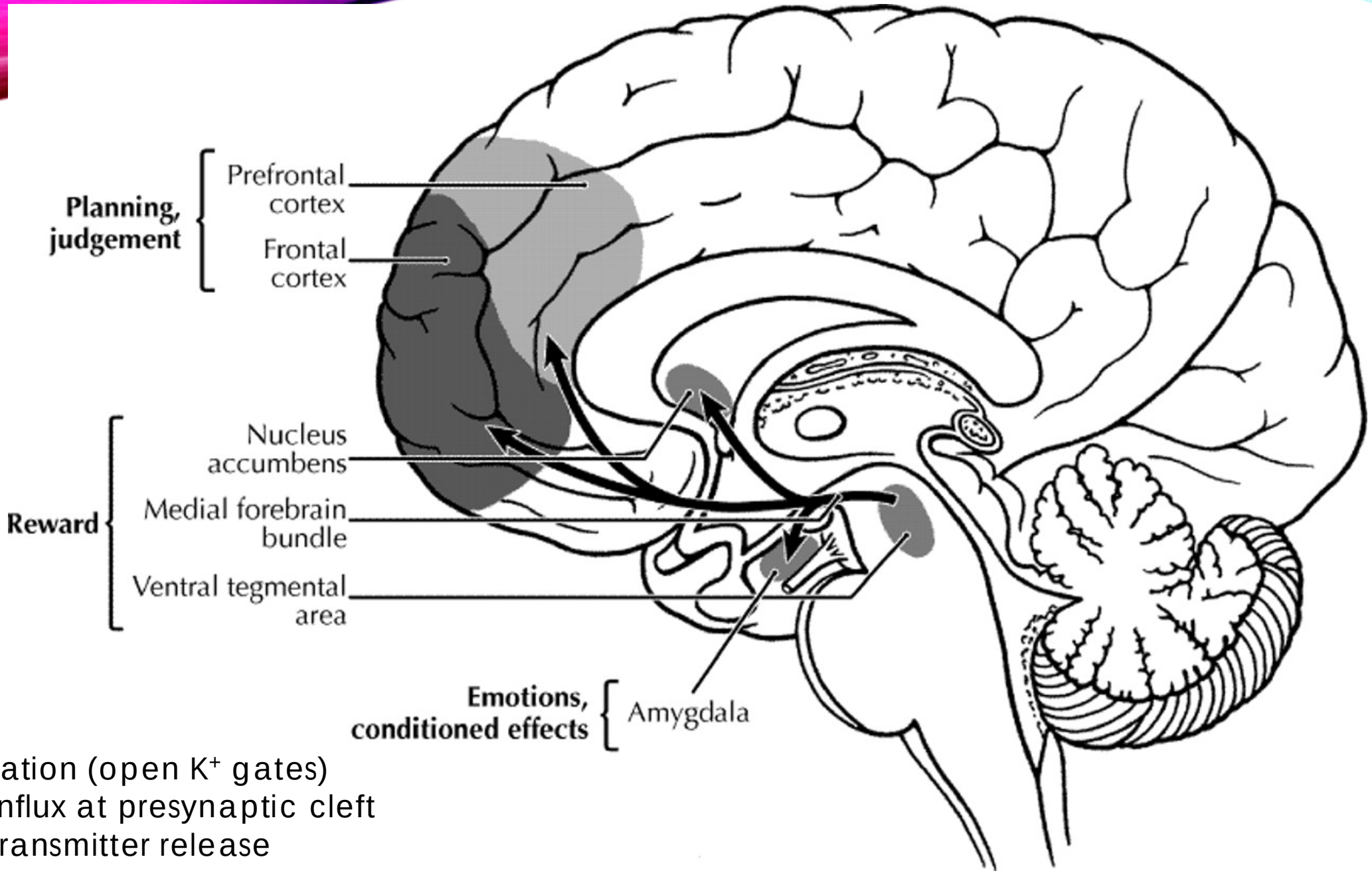
PHYSIOLOGY OF MUSIC

- Biological Entrainment
  - Tendency for body rhythms to synchronize to an external forcing function
  - Nerve Firing
  - Parkinson's
- Psychology
  - Evoke positive memories
  - Distraction
  - Positive emotions



PHYSIOLOGY OF MUSIC ANALGESIA

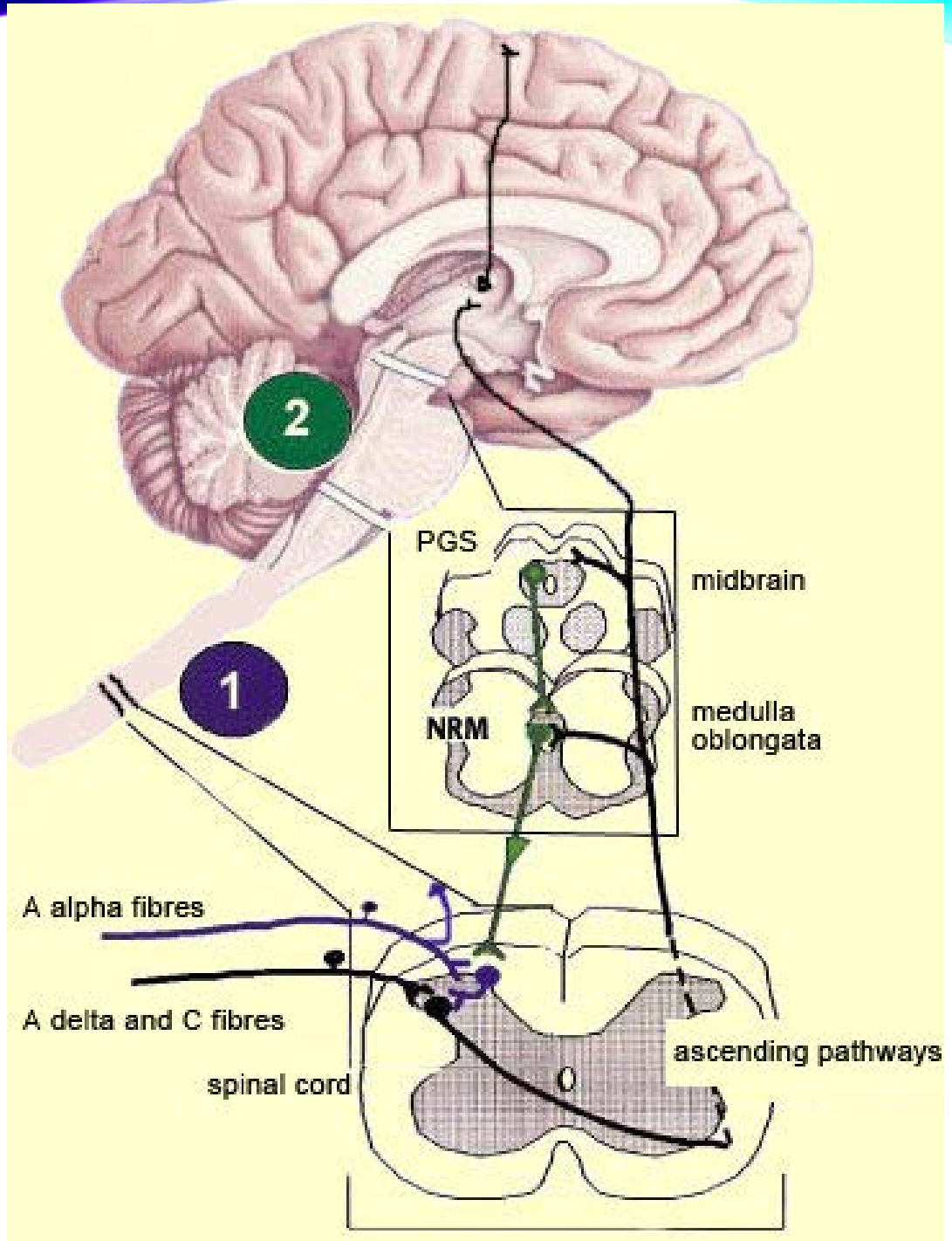
- Activation of the Limbic System
  - Limbic System Responsible for Emotional/Physiological Responses to Stimuli
    - i.e. fear and sympathetic activation
  - Would allow for excitation or relaxation based on type of music
  - Dopamine Release
    - Stim of VTA by LS
  - Endogenous Opioid Release
    - NA
    - endorphins
  - Inhibition of nociception
- Structures Affected
  - Thalamus
    - Switchboard of brain
  - Amygdala
    - Less active
    - Decreased negative reaction
  - Hypothalamus
    - Hypothalamic-hypophyseal axis
    - Endocrine system



Opioids

- Hyperpolarization (open K^+ gates)
- Inhibit Ca^{2+} influx at presynaptic cleft
- Block neurotransmitter release

- PAG modulates ascending nociceptive stimuli
- Opioids
  - Hyperpolarization (open K^+ gates)
  - Inhibit Ca^{2+} influx at presynaptic cleft
  - Block neurotransmitter release



MUSIC AND EXERCISE RECOVERY

- Similar Physiological Response to Stress and Exercise
  - Sympathetic Activation
  - Parasympathetic withdrawal
    - Increased BP, HR
  - Soreness
- Hypothesis: Music will expedite recovery of HR and BP after exercise and decrease perceived pain and fatigue.

- Supporting Literature:
  - **Desai, 2015:**
    - Significant greater decrease in HR, SBP, DBP after 3 min step test
  - **Savitha, 2005:**
    - Music improves recovery times of HR and BP after exercise
    - Slow music was more effective
  - **Eliakim, 2012:**
    - Fast Music improved lactate clearance, not HR recovery
    - Increased recovery activity, decreased RPE

PROTOCOL AND HUMAN SUBJECTS

- Required to complete NIH "Protecting Human Study Participants"
- Submit Protocol illustrating:
  - Methods
  - Safety
  - Risks/Benefits
  - Supporting Literature
  - Consent Form
  - Maintenance of Confidentiality
- Reviewed by IRB

- The take away:
  - Writing protocols
  - Experience with regulations
  - Submitting to IRB
  - NIH certification

  = Helpful for future job search or clinical research

METHODS

- Variables
  - HR, SBP, DBP, RPF, RPP
  - Pulse Oximeter, Automated BP Cuff
- Pre-Test
  - Consent
  - Resting Variables
  - Screened Music Selection
- Test
  - Run 600m as fast as possible
  - Measure variables every 2 min for 16 min
  - With or without music
    - Under 120 BPM, screened

ANALYSIS

- Mean Decrease from time $0 - t$
  - $MD = \frac{1}{n}\sum([x_0 - x_t]_1 + \cdots + [x_0 - x_t]_n)$
  - No Recovery Time
  - Not enough recovery
- Standard Error
  - $SE = \frac{SD}{\sqrt{n}}$
  - Error Bars
- ANOVA (single variable)
  - Statistical significance
  - Excel

RPF and RPF Rating Scales

Instructions: The following are scales that will be used to rate subjective levels of sensations during exercise recovery. You will rate your perception of fatigue and perception of pain periodically during the recovery period on 1-10 scales. The investigator will record your response in a separate data table.

Ratings of Perceived Fatigue

Please rate your level of fatigue using the following scale (exhaustion or tiredness).

0	1	2	3	4	5	6	7	8	9	10
Well rested/ Energized					Neutral					Extremely Exhausted

Ratings of Perceived Pain

Please rate your level of pain (including sensations of muscle soreness).

0	1	2	3	4	5	6	7	8	9	10
No Pain										Severe Pain

RPF AND RPP

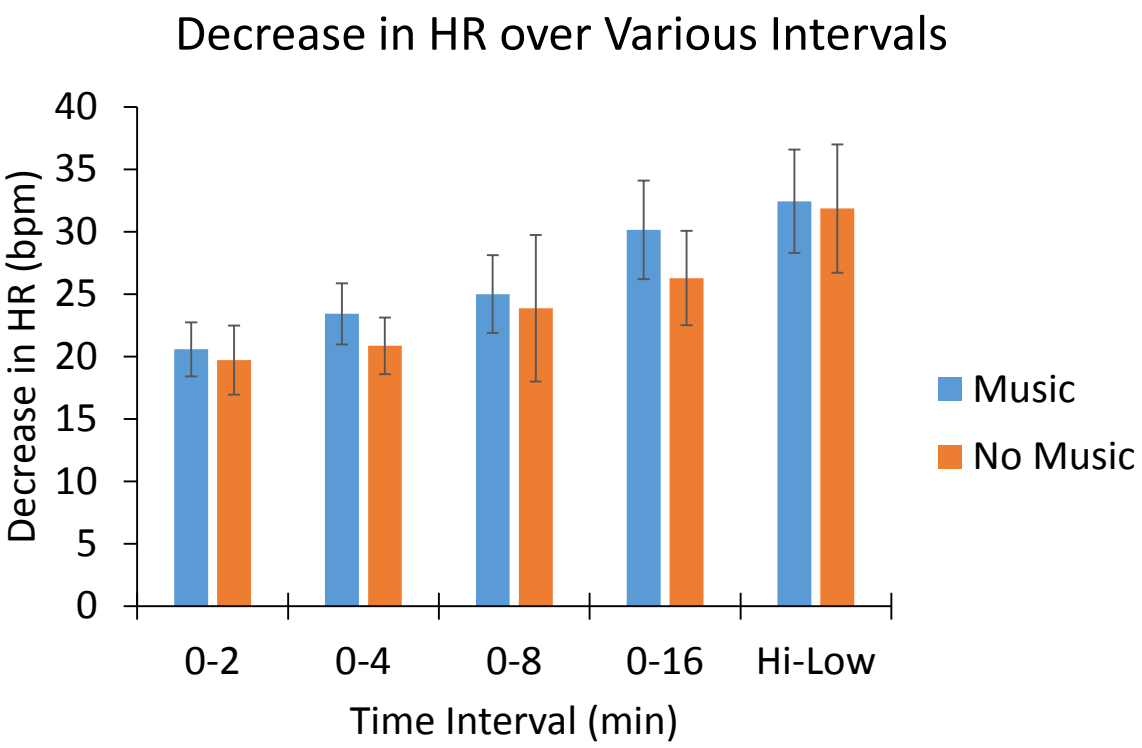
- RPF adapted from Borg's RPE
  - Recovery not exercise
  - 1-10 scale
- RPP on a 10 point scale is common

SUBJECTS

Table 1. Subject Characteristics	
Age (yrs)	21.3±1.8
Height (in)	69±2
Weight (lbs)	168±19
HR (bpm)	72.6±10.2
SBP (mmHg)	130±17
DBP (mmHg)	85±21
Run Time (sec)	144.1±21.8

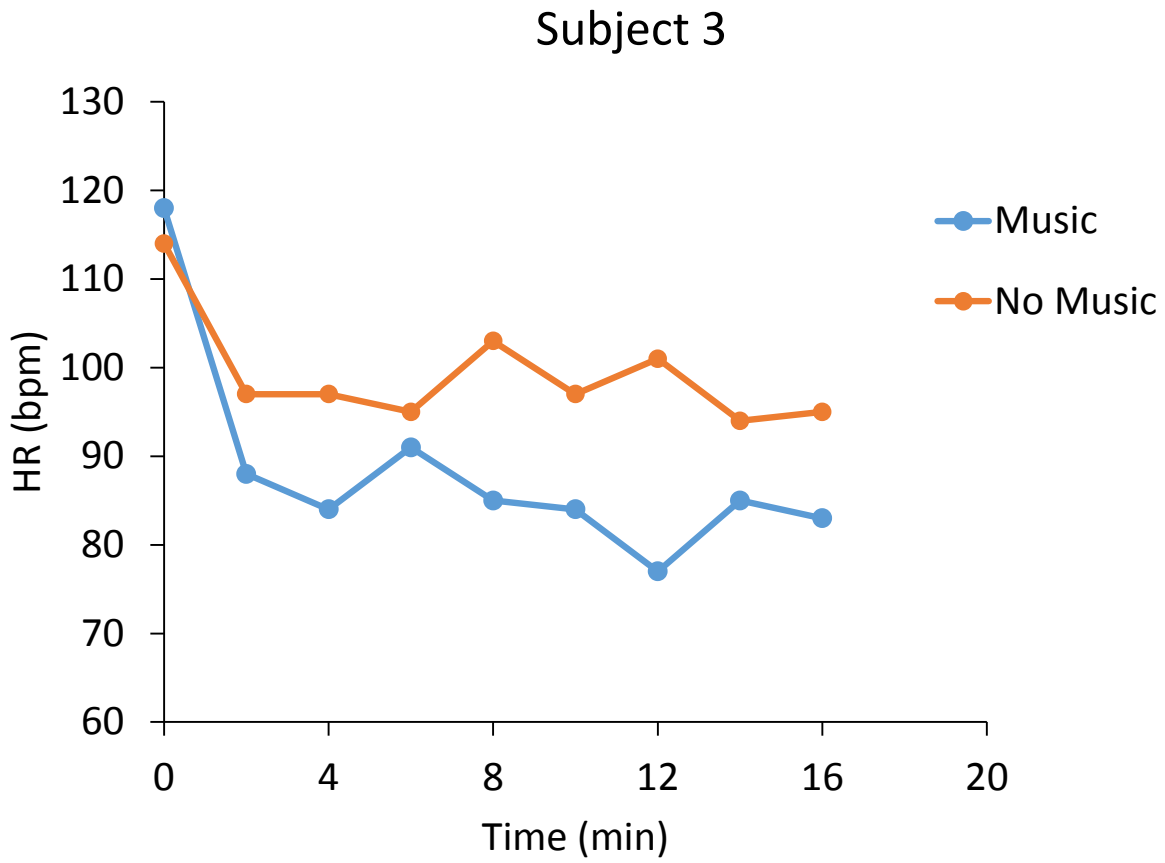
Table 2. Subject Demographics	
Subjects	7
Males	5
Females	2
Music Background	5
Physically Active	4

HEART RATE (PULSE)

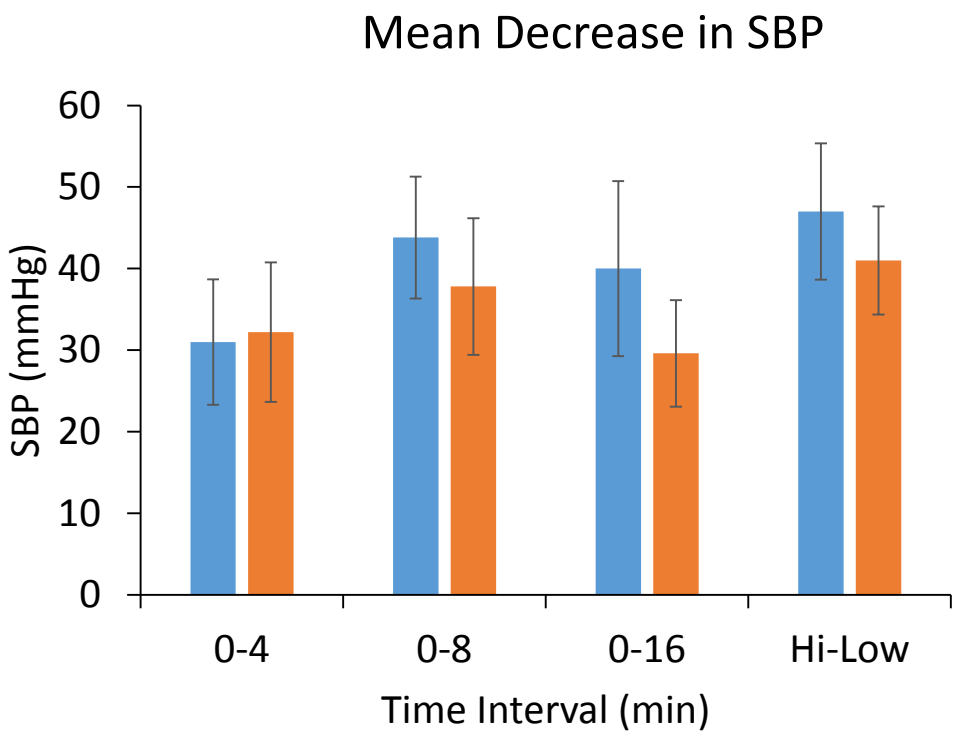


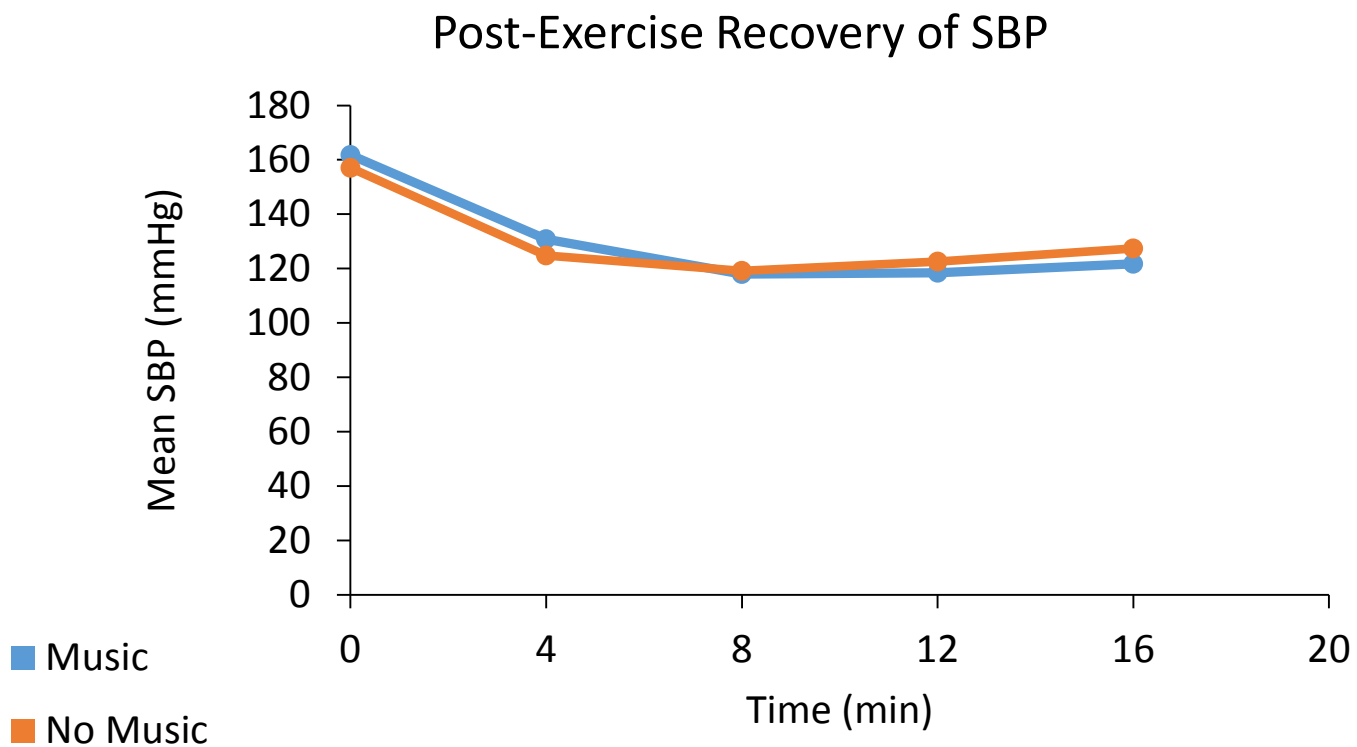
HR EXAMPLE


HR During Post-Exercise Recovery
Mean HR
130
120
110
100
90
80
0
5
10
15
20
Time (min)
Music
No Music


Subject 3
HR (bpm)
130
120
110
100
90
80
70
60
0
4
8
12
16
20
Time (min)
Music
No Music

SYSTOLIC BLOOD PRESSURE

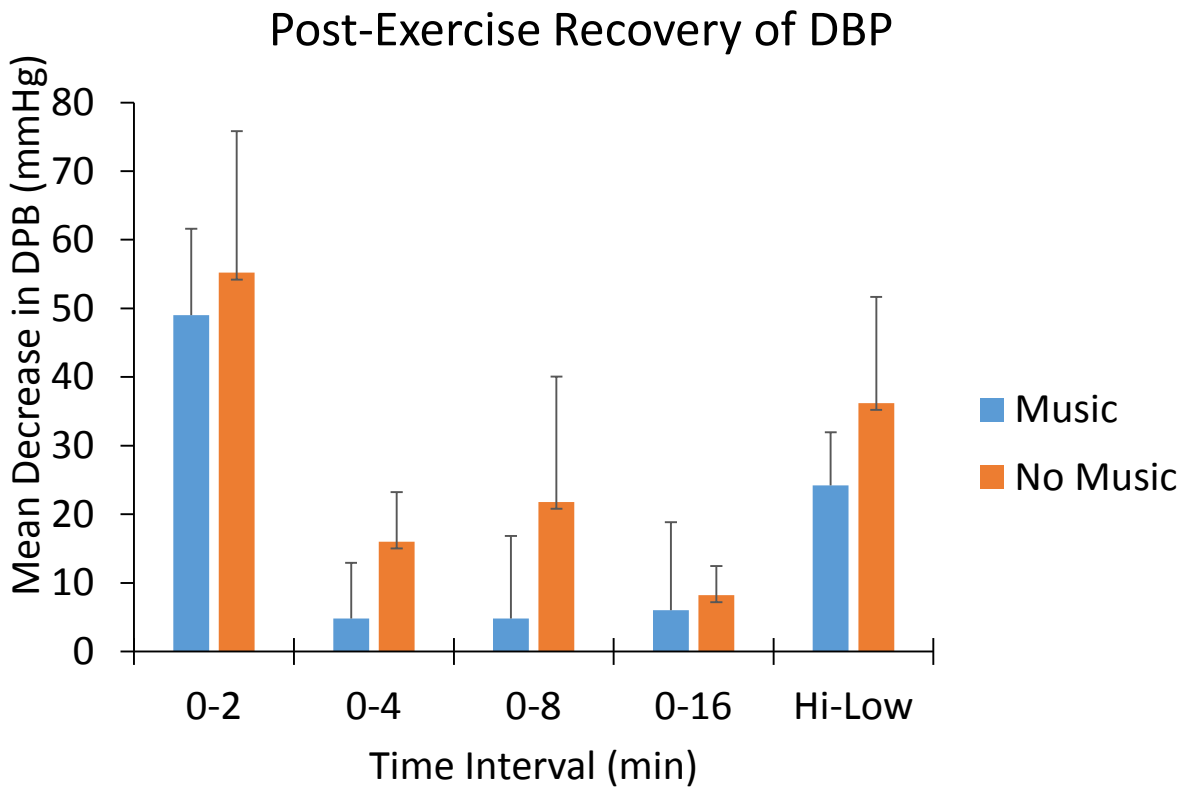


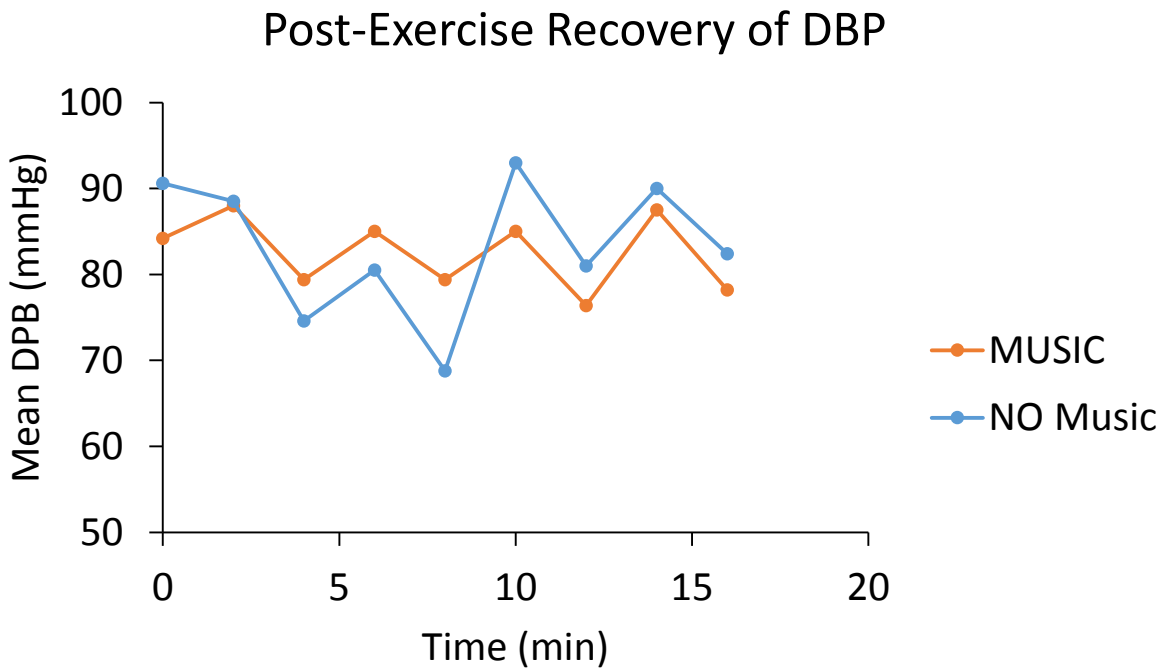


Music

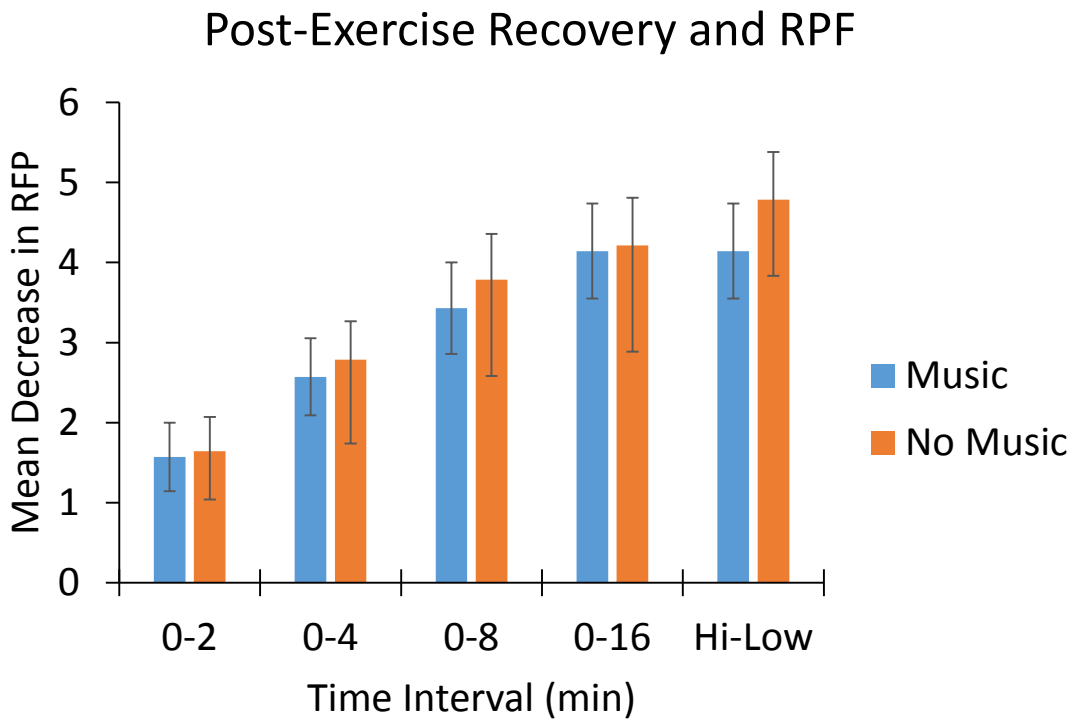
No Music

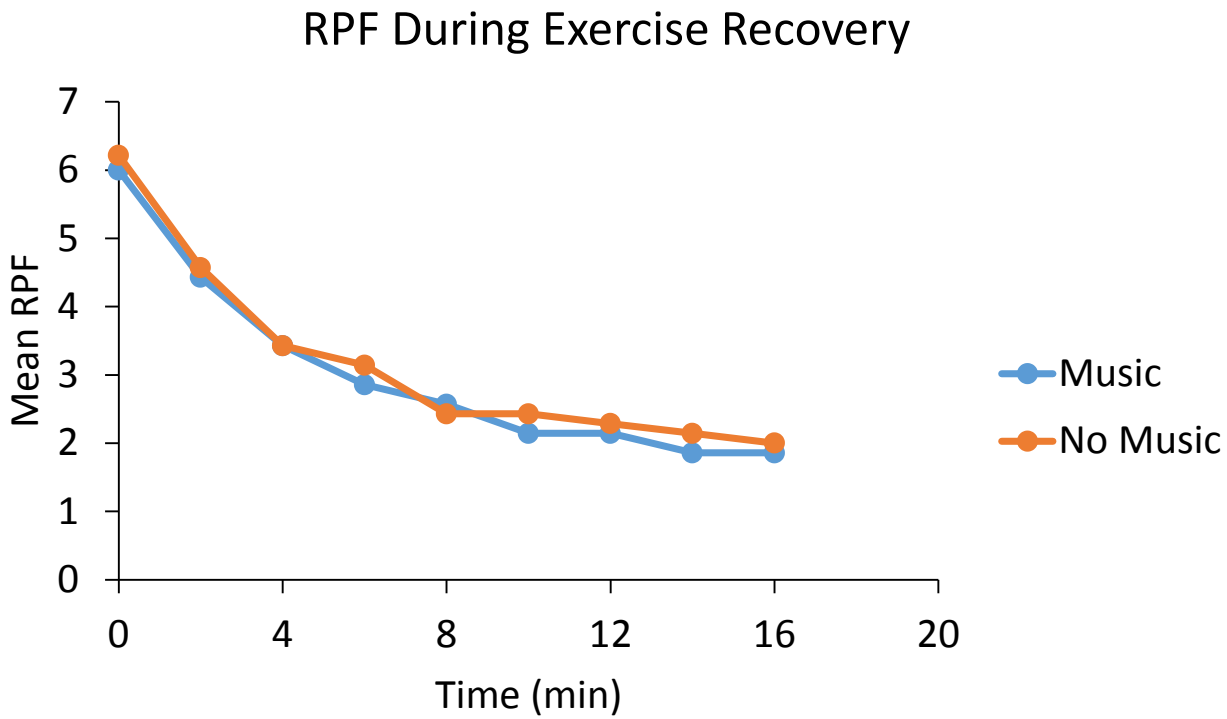
DIASTOLIC BLOOD PRESSURE



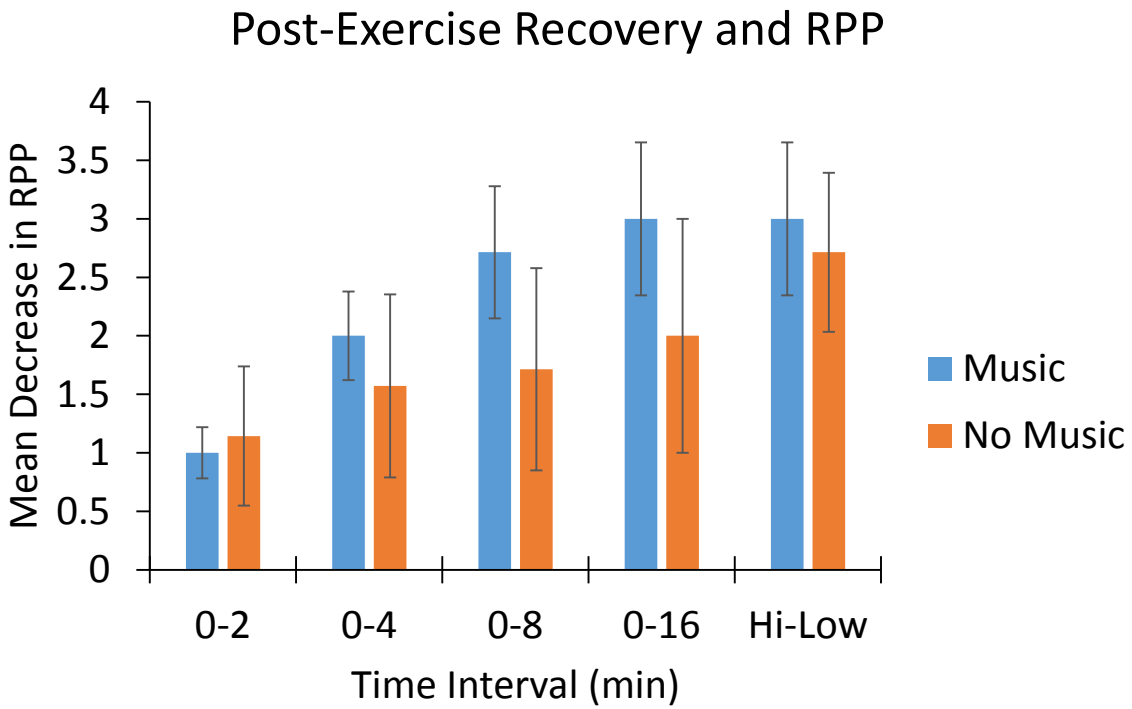


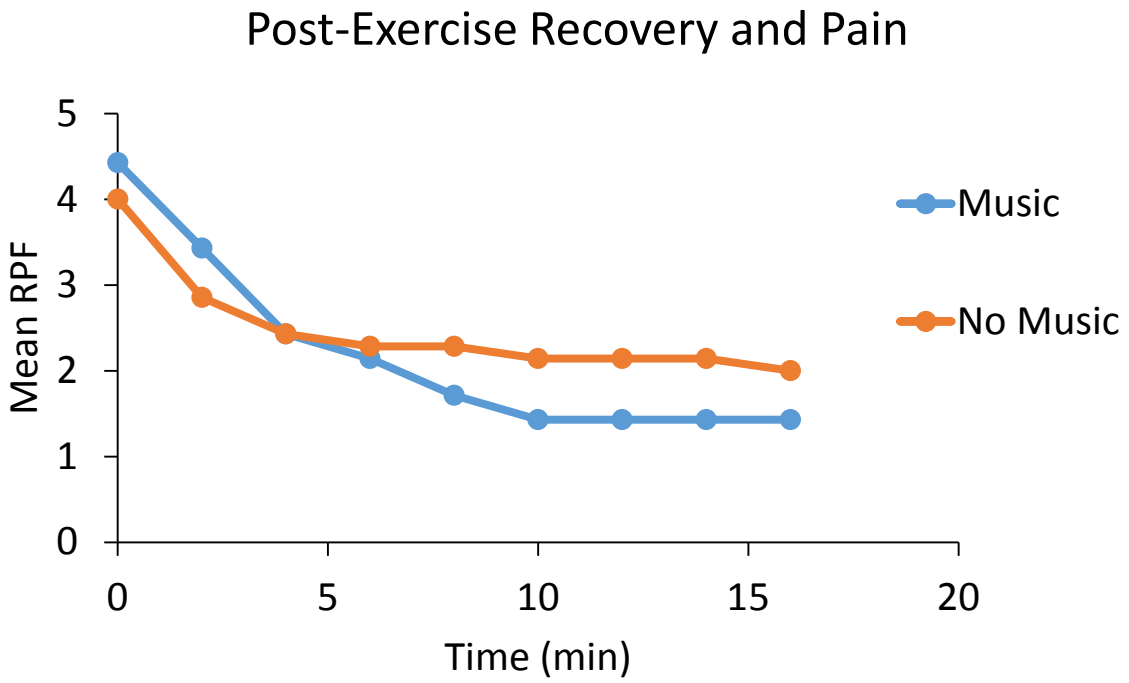
RATINGS OF PERCEIVED FATIGUE





RATINGS OF PERCEIVED PAIN





EXPLANATIONS

- Experimental Control
  - Motivation of subjects
  - Temperature
  - Speed
  - Music Selection
- Physiological
  - HR varies with age, temp, caffeine, emotions
  - Duration/Intensity of Test
- Subject Variability
  - Different amounts of exercise
    - PA and on test day
  - May have been more focused on pain when rating it than during interim time
  - Music may have made sleepy or “less energetic”
- Limitations
  - Sample Size
  - Equipment Sensitivity

LOOKING TO THE FUTURE

- **I will incorporate music into practice by:**
  - Using music in treatment of pain, anxiety, and cognitive disorders
  - Using pre/intra/post-operatively
    - Made my own Emergency Surgery Playlist
  - Continuing to play
    - Musicianship and laparoscopic technique
  - Continued Research
    - Music and the immune system
  - Using Music to connect with patients

- Experience has been invaluable!

THANKS!

Dr. Dudenbostel

Dr. Symons

Dr. Mariz

Dr. Moore

Dr. Yamamoto

Prof. Lapsansky

All Advisors

Parents

All Subjects!!!!

- Without advisement and help, my project would have never been possible.
- A special thanks to Adam's Honors Scholarship and an Honors Department Tuition Waiver!