Neuromusicology and Combat-Induced Traumatic Brain Injury

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- General Overview of Conventional Traumatic Brain Injury
- Conventional vs. Combat-Induced Traumatic Brain Injury
- Blast-Related Traumatic Brain Injury
  - Types
  - Cognitive/Affective Outcomes
  - Physical/Motor Outcomes
- History of Music Therapy in Military Facilities
- Neuromusicology and Neurologic Music Therapy
- Current Music Therapy Practices in Military Facilities
- Conclusions
Traumatic Brain Injury

- Affects millions of Americans each year (directly and indirectly)

- Common Causes
  - Motor vehicle accidents
  - Falls
  - Violence
  - Sports-related incidents

- Improved medical support → fewer fatalities

- General Outcomes
  - Cognitive
  - Emotional
  - Behavioral
  - Physical
Classification of TBI

- Mild
- Moderate
- Severe
  - Penetrating
    - Entrance of foreign object into brain
    - More localized damage
  - Closed Head
    - Coup contrecoup injury
      - Rapid and forceful backward/forward movement
    - Diffuse axonal damage
    - Less localized damage

Conventional TBI vs. Combat-Induced TBI

- New focus on combat-induced TBI due to Global War on Terror
- “Signature injury” of this war
- Many combat-induced TBIs are blast-related
- Most prominent difference between civilian and military TBI
  - Context of injury acquirement

Types of Blast-Related TBI

- **Primary (barotrauma)**
  - Direct result of atmospheric pressure changes

- **Secondary (ballistic trauma)**
  - Hit with shrapnel or other objects put into motion as a result of blast forces

- **Tertiary**
  - Person is forced into motion from blast waves and thrown against solid objects

Prevalence

- Estimated 22% of wounded soldiers returning from Middle East have suffered from a TBI
  - Number may be larger due to lack of diagnosis
  - Number does not include all returning soldiers → only those who experienced additional injuries

Blast-Related TBI & Cognition/Affect

- General Cognitive/Affective Symptoms
  - Memory deficits
  - Attention deficits
  - Irritability
  - Anxiety
  - Depression
  - Personality Changes
  - Sleep disturbances
  - Headaches and/or dizziness

- Frequent comorbidity of TBI and PTSD
  - Evidence for correlational relationship

Blast-Related TBI & Cognition/Affect

- Research is limited → concern in this area is growing

- Scheibel et al. (2011)
  - Compared brain activation levels of soldiers who were deployed but not exposed to blast to the levels of soldiers who had been deployed and had been exposed to blast forces
  - Found generally increased levels of activation in soldiers who had been exposed to blast waves
    - Specific areas noted: Anterior cingulated gyrus, medial frontal cortex, and posterior cerebral areas
    - Accuracy did not differ
  - Increased activation levels result from inefficient processing → form of compensation, increased effort

Scheibel, R.S. et al. (2011). Altered brain activation in military personnel with one or more traumatic brain injuries following blast. Journal of the International Neuropsychological Society, 18(1), 89-100.
Blast-Related TBI & Motor Functioning

- General Motor Outcomes
  - Difficulty with ambulation (walking)
  - Impaired postural stability
  - Poor coordination
  - Muscle spasticity
  - Muscle weakness
  - Diminished executive functioning (motor planning)
<table>
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<tr>
<th>Area of the Brain</th>
<th>Type of Functional Motor Deficits</th>
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| Frontal Lobes    | • Loss of simple movements/paralysis  
                     • Inability to sequence complex movements |
| Parietal Lobes   | • Lack of awareness of certain body parts and/or surroundings |
| Brain Stem       | • Impaired balance and movement skills |
| Cerebellum       | • Inability to coordinate fine motor skills  
                     • Loss of functional walking skills  
                     • Inability to reach and grab objects  
                     • Inability to make rapid movements |

Fausti, Wilmington, Gallun, Myers, and Henry (2009)
- High rate of auditory damage
- Motor outcomes resulting from auditory damage
- Vestibular dysfunction → impaired balance
- Restoring gait is often primary goal of rehabilitation in returning soldiers (Scherer 2007)


Treatment of TBI

- Importance of interdisciplinary team
  - Wide spectrum of outcomes
  - Holistic approach \( \rightarrow \) may lead to more desirable treatment outcomes
  - Team members may include
    - Speech/Language Pathologists
    - Occupational Therapists
    - Physical Therapists
    - Psychologists
    - Physicians
    - Music Therapists

- Need for cost-effective treatments and interventions
Music introduced in treatment facilities between WWI and WWII
- Focused on influencing patients’ mood states
- Music “accompanied” other events (OT, anesthesia) or simply provided a more enjoyable environment

Goals of music-based activities expanded during WWII
- Included improving self esteem and social functioning
- Three main methods
  - Active participation: music making
  - Passive participation: listening and discussing
  - Audio-Reception: recreational music listening

First official research study involving the use of music in therapy

Experimental, exploratory study → Does music aid in working toward predetermined, nonmusical goals?

What was done?
- Soldiers provided with live music performance by professional musicians and an opportunity to discuss the experience
- Music chosen based on soldiers’ mood states
  - More stimulating or relaxing music was played based on soldiers’ needs (iso principle)
  - Detailed musical and behavioral data recorded each session

Found that 74% of the 50 soldiers included in the published report displayed noteworthy improvements

Neuromusicology

- Study of biological responses of the brain and nervous system to musical stimuli
  - Music processing
  - Neurotransmitter processes
    - Increases and decreases in levels of neurotransmitters in response to musical stimuli

- Clinical application of neuromusicology
  - Neurologic Music Therapy
Neurologic Music Therapy

- NMT is the “therapeutic application of music to cognitive, sensory, and motor dysfunctions due to neurologic disease of the human nervous system” (Thaut, 2005, p. 126)

- Rationale behind NMT involves scientific models of music perception, production, and influence of music on nonmusical functioning

- Evidence-based therapeutic music interventions applied in clinical setting → work toward nonmusical goals and objectives

- Practiced by trained and certified music therapists

NMT: Motor Interventions

- Role of music
  - Arousing/priming motor areas of brain
    - Enhances, promotes, and/or elicits movement
  - Provide temporal structure
    - Cues for elements of movement: Time, space, and force
  - Motivation

- Interventions
  - Rhythmic Auditory Stimulation (RAS)
  - Patterned Sensory Enhancement (PSE)
  - Therapeutic Instrumental Music Performance (TIMP)
NMT: Speech/Language Interventions

- http://www.youtube.com/watch?v=tiJ9X_wLSWM

Role of music
- Music = processed in both hemispheres of brain
- Speech/Language primarily processed in the left hemisphere
- Strengths in undamaged areas of the brain aid in improving areas of deficit

Interventions
- Rhythmic Speech Cuing (RSC)
- Musical Speech Stimulation (MUSTIM)
- Oral Motor and Respiratory Exercises (OMREX)
NMT: Cognitive Interventions

- Role of Music
  - Similar to Motor and Speech/Language Interventions
  - Musical structure aids in information processing, provides motivation

- Interventions
  - Music Mnemonics Training (MMT)
  - Music Executive Function Training (MEFT)
  - Music Psychotherapy and Counseling (MPC)
Current Research: MT in Military Facilities

- Very limited published literature

- Bensimon, Amir, & Wolf (2008)
  - Drumming with soldiers experiencing PTSD
    - Participants
    - Methods
    - Data collection
    - Results

Current Research: Soldiers’ Reactions

- “Once you beat the drum, although you don’t know anyone, it gives a feeling of togetherness…”

- Participant B: “Maybe a drum . . . bom bom bom bom bom bom can remind me of the trauma . . . because the noise stresses me. That’s what happened there at the moment of the fire”

  Participant B led group instrumental improvisation (using drums).

  [After the group playing] Participant B: “It reminds me exactly the chaos that was there.”

  Participant C: “It was frightening, it reminds me of war”

- “It’s as if you’ll go naked in front of them. Yes! Exactly! As if they saw everything, so I can tell them all about myself. If I spoke about personal issues it’s only due to the group drumming which enabled us to open up”

Current Practices: MT in Military Facilities

- **Operation Oak Tree (Illinois)**
  - Mission Statement
    - Empower individual expression
    - Strengthen interpersonal connection between family members
    - Strengthen coping strategies for families
    - Encourage families to seek community support

- **Warrior Transition Wellness Program (Hawaii)**
  - Mission Statement
    - Provide comprehensive wellness program
    - Ease transition from deployment to civilian life
    - Provide coping mechanisms, recreational activities, minimize stress, anger management strategies

Robbins, D. (2009). FMWR and Tripler work together to provide wounded warrior programs.
Role of Music in the Lives of Soldiers

- High levels of appreciation for music and recognition of its positive effects
- Music in combat environments
  - Historical Uses
    - Drums on battlefield used to...
      - Signal commands
      - Maneuver troops
      - Inspire troops for combat
      - Intimidate the enemy

Role of Music in the Lives of Soldiers

- **Current Uses**
  - **Master Sgt. Isaac Alexis**
    - Performer, Songwriter
    - Performs for fellow comrades, hopes to convey positive message
    - Set personal goals involving the completion of a CD for his next deployment time
  - **Sgt 1st Class Ted Bentley**
    - Performs and teaches guitar lessons
    - Fort Sill Warrior Transition Unit in Oklahoma
    - Soldiers reported feeling therapeutic effects as a result of participating in the guitar lessons

Role of Music in the Lives of Soldiers

- Many soldiers listen to certain types of music prior to missions
  - Common genres
    - Rap, rock, and heavy metal → focus on lyrics, general sound characteristics
  - Effects of music listening
    - Helps soldiers to change mindset, set outside themselves
    - Provides adrenaline rush

Role of Music in the Lives of Soldiers

- 75th Ranger Regiment, 2nd Battalion
- “Glycerine” by Bush
  - “It’s not my time to wonder why”
  - “I’m never alone, I’m alone all the time”
  - “Should have been easier by three, Our old friend ‘Fear’ and you and me”
  - “Don’t let the days go by”
Conclusions

- Increasing need for effective yet cost-efficient treatment modalities for soldiers with TBI

- Research involving NMT and TBI suggests that music therapy may prove beneficial

- Soldiers have recognized music’s potential to affect their mental and emotional states

- More research is warranted involving the use of NMT specifically in military facilities
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Questions?


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