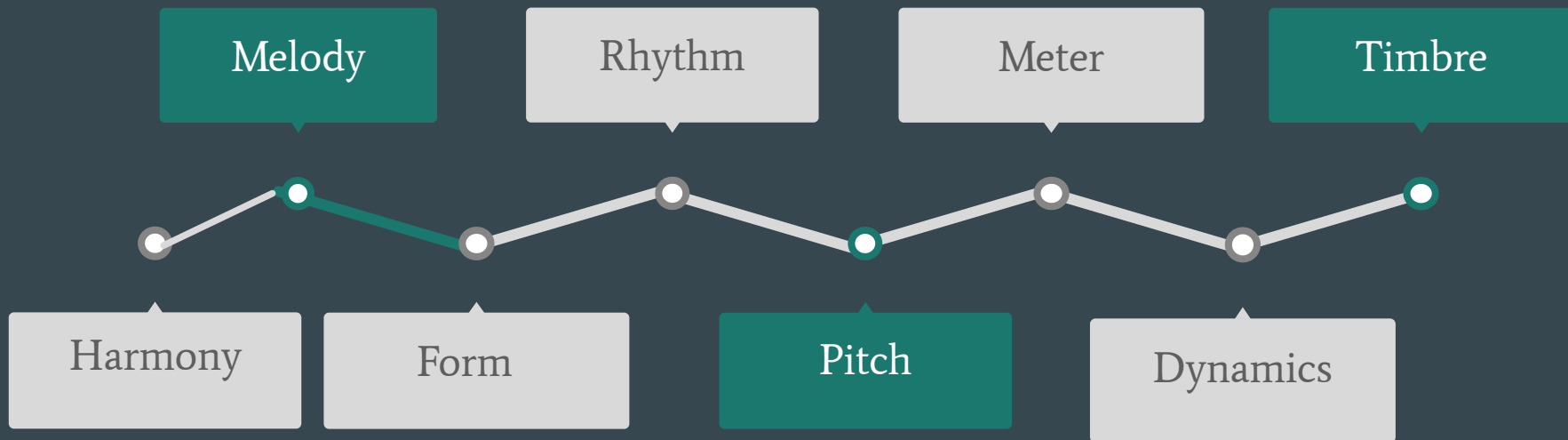


Music as Therapy:
Examining the Functional Use of Music in
Neurologic Music Therapy



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Elements of Music



Overview

1. Music and Neuroscience
2. Neurologic Music Therapy
3. Elements of Music in NMT
4. Examples of Application

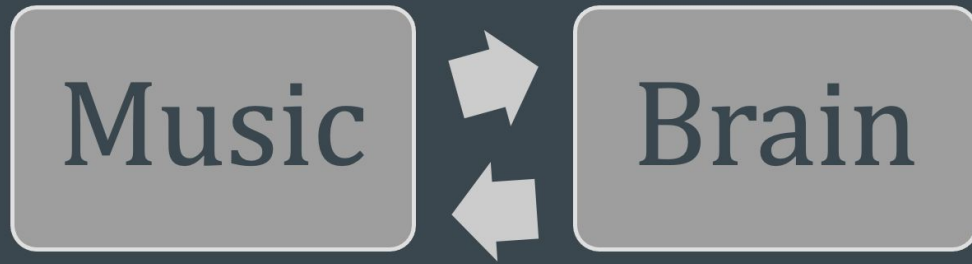
Music and Neuroscience

1990s- Advancement in Research Technology

- Led to a deeper understanding of the neurological and biological processes involved in how the brain processes music. (de l'Etiole and La Gasse, 2013; LaGasse and Thaut, 2012; Thaut and McIntosh, 2010.)

Music and Neuroscience

- Brain areas involved to process and respond to music are also involved in non-musical functions
- Music learning changes the brain - new neural pathways are formed (LaGasse & Thaut, 2012; Schlaug, Altenmuller & Thaut, 2010; Thaut & McIntosh, 2010)



What happens when the brain is engaged in music?

Rational Scientific Mediating Model (R-SMM)

1. Musical response models
2. Non-musical parallel models
3. Mediating models
4. Clinical research models

Rational Scientific Mediating Model (R-SMM)

Level 1: Musical Response Models

- There is an extensive amount of research that demonstrates overlaps between music processing and motor parts of the brain.
- Thaut and Abiru's (2010) study show that dense connections are formed between auditory and motor pathways in the brain on cortical, subcortical, spinal, and brain stem levels. These two systems run in parallel fashion, demonstrating that the auditory system can influence the motor system.

Rational Scientific Mediating Model (R-SMM)

Level 2: Non-Musical Parallel Models

- The basal ganglia, cerebellum, and neocortex of the brain are involved in the production of rhythmic movements (Thaut & Demartin, 2008) and a major pathway for auditory-motor synchronization.
- On a brain stem level, auditory cues can help prime and coordinate the timing of motor responses through the audio-motor route via the spinal-reticular formation (Rossignol & Melvill, 1796).

Rational Scientific Mediating Model (R-SMM)

Level 3: Mediating Model

- Rhythmic auditory beats can be used to guide the scaling movement of time (Thaut, Kenyon, Schauer, & McIntosh, 1999).
- External cues such rhythmic temporal cues can provide information for the planning and initiation of movement (Thaut et al., 1999a).

Rational Scientific Mediating Model (R-SMM)

Level 3: Mediating Model

There are many elements in music that can facilitate and guide movements

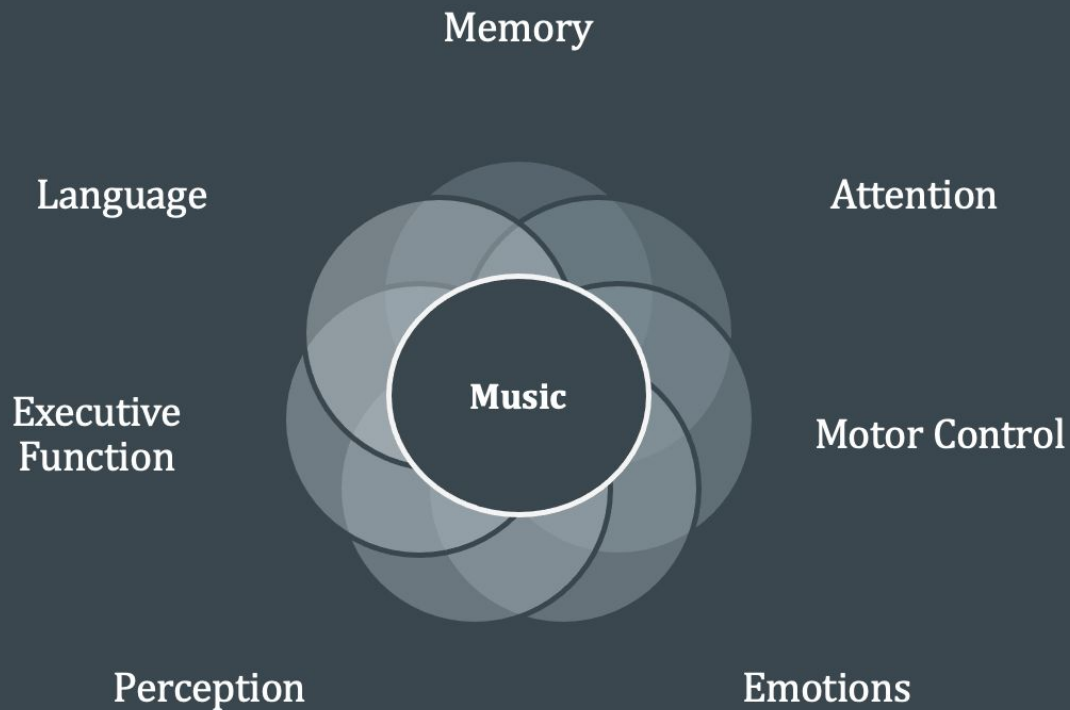


Neurologic Music Therapy

The therapeutic application of music to cognitive, sensory, language, and motor dysfunctions due to neurological disease or injury in the brain.

- Its techniques are based on neuroscientific models of music production, perception, and cognition to induce changes in non-musical brain behaviours and functions

Techniques



Types of Goals

- Rehabilitation
- Developmental
- Adaptive
- Wellness

Population

- Appropriate for anyone with neurological disorder or brain injury
- Techniques based on goal area and not population based

Rational Scientific Mediating Model (R-SMM)

Level 4: Clinical Research Models

- Studies by Freeman et al. (1993) and Georgiou et al. (1993) demonstrate the use of an rhythmic auditory stimulus with Patterned Sensory Enhancement technique to cue hand and arm movements showed significant improvement with patients with Parkinson's disease.
- Children with cerebral palsy showed increased strength with smoother and faster movement in their lower extremities when performing sit-to-stand exercise with guided music as a facilitating stimulus (Peng et al., 2001).

Elements of Music in NMT

Rhythm

Rhythmic Auditory Stimulation (RAS)



Auditory Perception Training (APT)



Rhythmic Speech Cuing

- The use of rhythmic cuing to control the initiation and rate of speech through cuing and pacing

Melody

Oral Motor Respiratory Exercises (OMREX)



Multiple Elements

Melodic Intonation Therapy (MIT)

- Uses the melodic and rhythmic elements of singing to help speech recovery for persons with aphasia
 - Speech production and singing uses different parts of the brain

Musical Attention Control Training (MACT)

- “Provides structured active or receptive musical exercises involving precomposed performance or improvisation in which musical elements cue different musical responses to practice...attention functions” (Thaut, 2005, p.196)

Different levels of attention

- Sustained
- Selective
- Alternating

Examples of Application

Transformational Design Model (TDM)

- Provides a systematic step by step guideline to designing, implementing, and evaluating NMT exercises

Steps:

1. Assessment
2. Goals & Objectives
3. Non-musical exercise/stimulus
4. Therapeutic Music Exercise
5. Reassessments

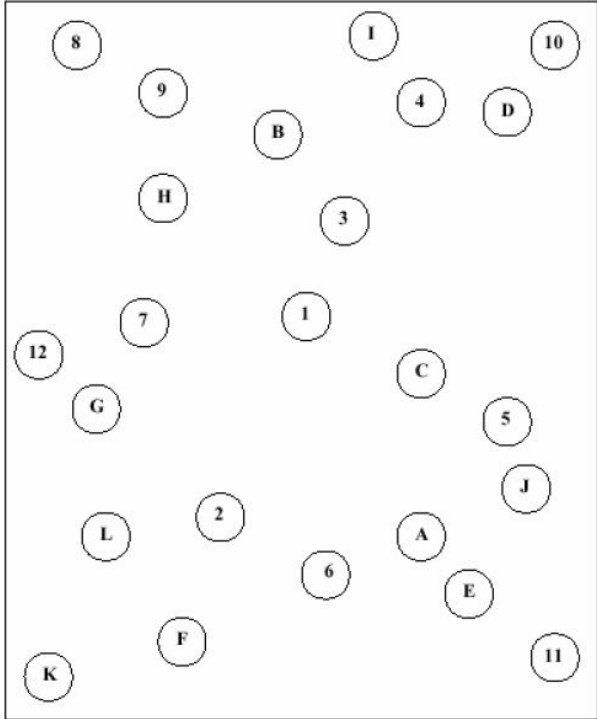
Transformational Design Model (TDM)

- 1) Diagnostic & functional assessment
 - Standardized assessments
 - 10-meter walk

Executive Function

Trail Making Test Part B

Patient's Name: _____ Date: _____



The grid contains 18 circles with the following labels: 8, 9, B, I, 10, 4, D, H, 3, 7, 1, 12, G, C, 5, J, L, 2, A, 6, E, F, K, 11.

The Trail Making Test Part B is a neuropsychological test used to assess executive functions, specifically visual attention, working memory, and cognitive flexibility. It consists of a grid of 18 circles, each containing a number or a letter. The test requires the participant to connect the circles in a specific sequence: starting with 1, then 2, then 3, then 4, then 5, then 6, then 7, then 8, then 9, then 10, then 11, then 12, then A, then B, then C, then D, then E, then F, then G, then H, then I, then J, then K, then L. The sequence is a continuous path that alternates between numbers and letters, starting and ending with a number. The path must be continuous and cannot cross itself or visit any circle more than once.

D

Diagnostic & functional assessment

- Diagnosis of Parkinson's Disease
- Condition deteriorated with recurring falls
- Subdural hematoma and underwent surgery
 - Previous experiences with NMT prior to injury

Parkinson's Disease

- Motor changes
 - Tremour
 - “Masked” face
 - Slowing of movement
 - Impaired posture and balance
 - Rigid muscles
- Cognitive changes
 - Deficits in attention, executive functioning, slowed thinking
- Changes in speech
 - Quietness in voice
 - Slurred speech, monotone

Transformational Design Model (TDM)

2) Development of Therapeutic Goals & Objectives

- What does the participant want to achieve?
- Consult family and caregivers
- PD
 - Adaptive goals
 - Transferrable to client's daily living

Goal areas

- Gait
- Speech
- Cognitive

Motor

Goal/Objectives

- To increase safety during gait.
 1. With standby assistance while maintaining safety, participant will improve by 5% on a 10-meter walk in stride length by April 5, 2020.
 2. With standby assistance while maintaining safety, participant will improve by 5% on a 10-meter walk in cadence by April 5, 2020.

Speech

Goal/Objectives

- To increase volume and endurance in sound
 - Participant will increase 3% in volume measured by the Decibel X App compared to pre-test when sustaining a note for 4 seconds on the melodica by April 5, 2020
 - Participant will sustain a note with a 3% increase in duration measured by the Decibel X App compared to baseline by April 5, 2020

Non-musical therapeutically meaningful real-life experience (transfer):

- To be able to communicate with others at an audible level

Transformational Design Model (TDM)

3) Design functional, non-musical therapeutic exercises

- Focus on the functional behaviour

D:

- Heel-to-toe rocking (dorsi flexion/planter flexion) in chair then standing
- Sustaining sounds for prolonged exhalation - to support diaphragmatic breathing

Transformational Design Model (TDM)

4) Therapeutic Music Exercises

- Translation of Step 3 into functional therapeutic music exercises
 - Therapeutic logic
 - Promotes functional outcome
 - Scientific logic
 - Design based on parallel processes between musical and non-musical experiences
 - Musical logic
 - Aesthetically pleasing to the ear

Therapeutic Music Exercises

- **Patterned Sensory Enhancement**
 - A technique in which music acts as a facilitating stimulus to cue movements to address goals such as physical strength and endurance, balance and posture, range of motion.
- **Rhythmic Auditory Stimulation**
 - a technique that uses external rhythmic stimuli—eg. the beat of the metronome—to facilitate intrinsically rhythmic movements such as walking.
- **Oral Motor Respiratory Exercises**
 - A technique used to improve articulatory control, increase respiratory strength, and speech mainly through vocal exercises and instrumental playing

Transformational Design Model (TDM)

5) Reassessment

- Goal: Transfer of therapeutic learning into functional, nonmusical, real world applications
- Data collection
 - Quantitative
 - Qualitative

Data

Pre RAS



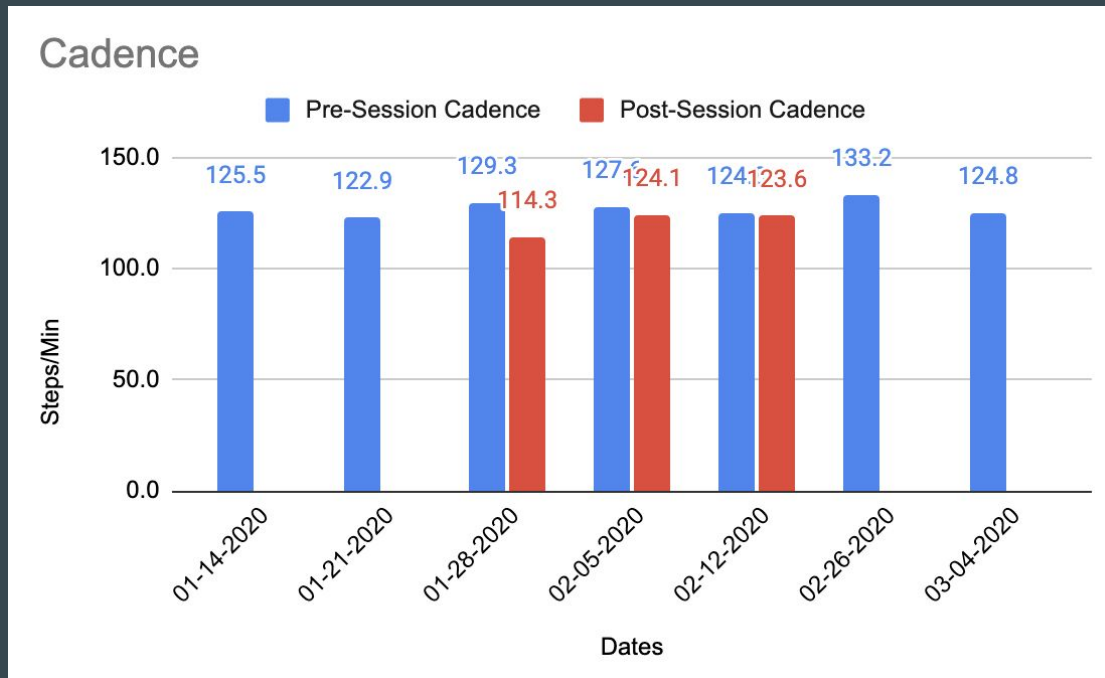
Data

Post RAS



Data Collection

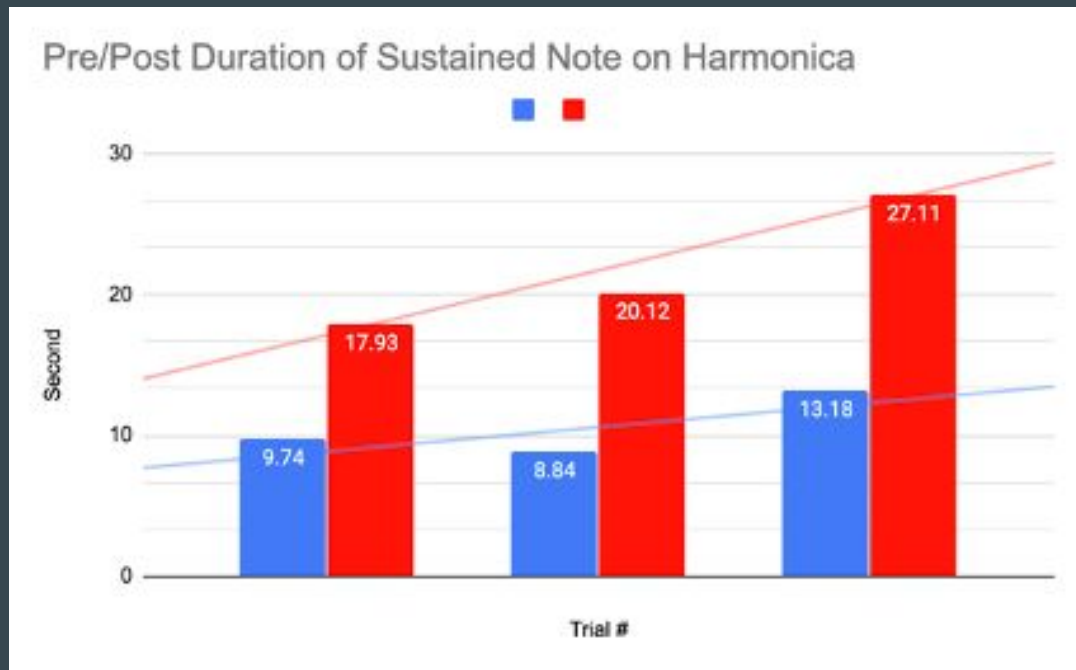
Motor



Data Collection

Speech

- Changes within a session

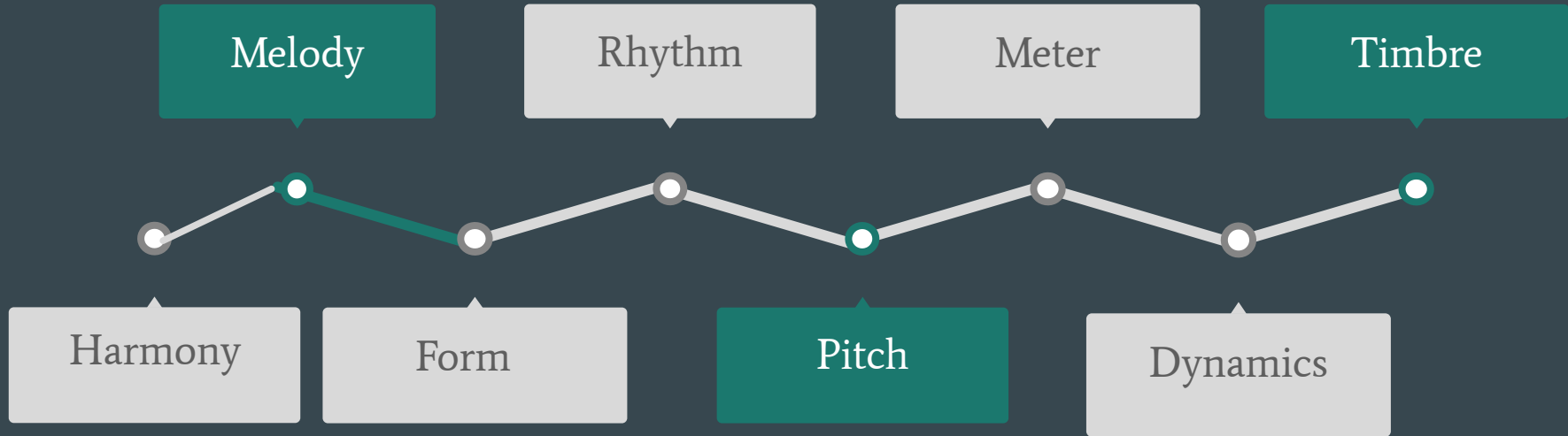


Functional

Musical

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Elements of Music



Questions

Thank you!

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