

Music Therapy in the Assessment and Rehabilitation of Prolonged Disorders of Consciousness: Lessons from Research

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Prolonged DOC (4 weeks+)

(Royal College Physicians Guidelines, 2013)

Table 1.2. Definitions of disorders of consciousness.

Coma (Absent wakefulness and absent awareness)	A state of unrousable unresponsiveness, lasting more than 6 hours in which a person: <ul style="list-style-type: none">• cannot be awakened• fails to respond normally to painful stimuli, light or sound• lacks a normal sleep–wake cycle, <i>and</i>• does not initiate voluntary actions.
Vegetative state (VS) (Wakefulness with absent awareness)	<p>A state of wakefulness without awareness in which there is preserved capacity for spontaneous or stimulus-induced arousal, evidenced by sleep–wake cycles and a range of reflexive and spontaneous behaviours.</p> <p>VS is characterised by complete absence of behavioural evidence for self- or environmental awareness.</p>
Minimally conscious state (MCS) (Wakefulness with minimal awareness)	<p>A state of severely altered consciousness in which minimal but clearly discernible behavioural evidence of self- or environmental awareness is demonstrated.⁵</p> <p>MCS is characterised by <i>inconsistent, but reproducible</i>, responses above the level of spontaneous or reflexive behaviour, which indicate some degree of interaction with their surroundings.</p>

PDOC: The Grey Areas

VS

41% (of n 103) rate of misdiagnosis in specialist units unchanged for 15 yrs (Schnackers et.al 2009)

Functional Locked in Syndrome (Owen et. Al 2006, Bruno et. al 2011)

35% sensory cortex & higher-order associative areas / 5% high level language processing (Celisia 2013)

PET study: in 13/41 'VS', 13 found to have MCS levels of activation. 9 regained consciousness within year (Stender et. al 2014)

MCS

Electroencephalogram (EEG)

Beta
(β)
13-30 Hz

alert, thinking & acting consciously, anxious
Cortically generated, associated with motor activity, attention and higher cortical functioning & **local processing**

Alpha (α)
8- 13 Hz

*relaxed, reflective, inhibitory control, creative visualisation. Important for **Widespread long-range** cortical functioning; level related to cortical activation, **consciousness**. Associated with specific perceptual, attention & memory functions*

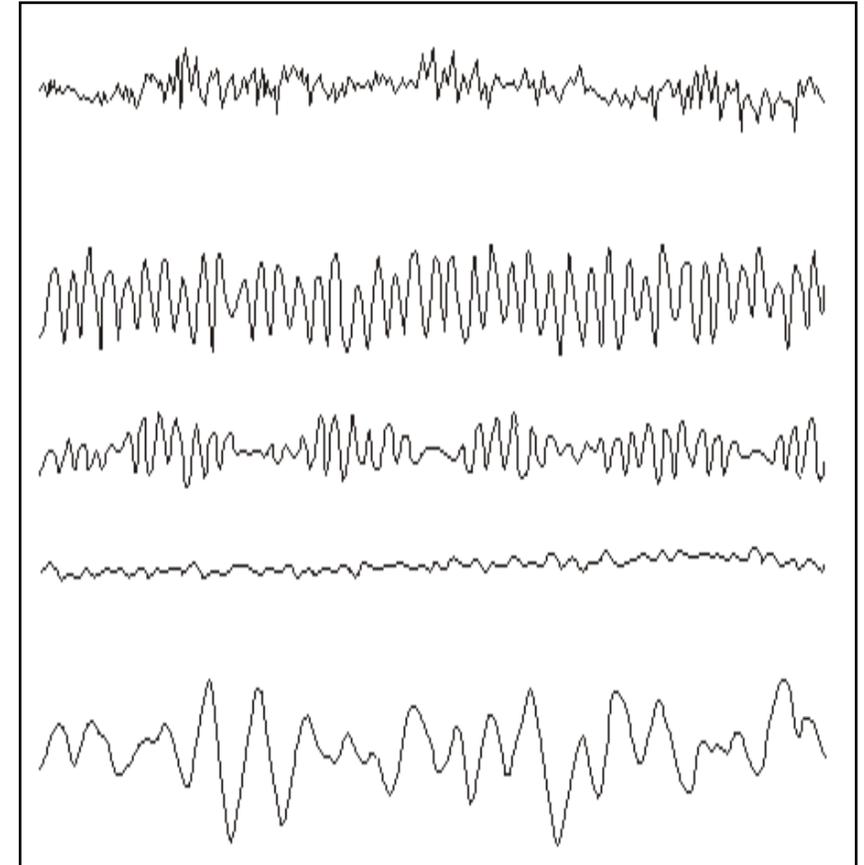
Theta(θ)
4-8 Hz:

If widespread: deep relaxation, meditation, drowsiness
Frontal midline theta (FMT) associated with hippocampal and anterior cingulate cortex regions emotion, concentration, and memory processes, -ve correlation with anxiety

[Mitchell et al., 2008; Aftanas & Golocheikine, 2001; Caplan et al., 2003; Ekstrom et al., 2005; Fachner et al., 2013; Sammler et al., 2007].

Delta
0-4 Hz:

Slow waves recorded in EEG
Mostly associated with sleep and anaesthesia phenomena



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THIS ARTICLE IS PART OF THE RESEARCH TOPIC

Music, Brain, and Rehabilitation: Emerging Therapeutic Applications and Potential Neural Mechanisms

ORIGINAL RESEARCH ARTICLE

Front. Hum. Neurosci., 25 December 2013 | <http://dx.doi.org/10.3389/fnhum.2013.00884>

Neurophysiological and behavioral responses to music therapy in vegetative and minimally conscious states

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Assessment of awareness for those with disorders of consciousness is a challenging undertaking. due to the



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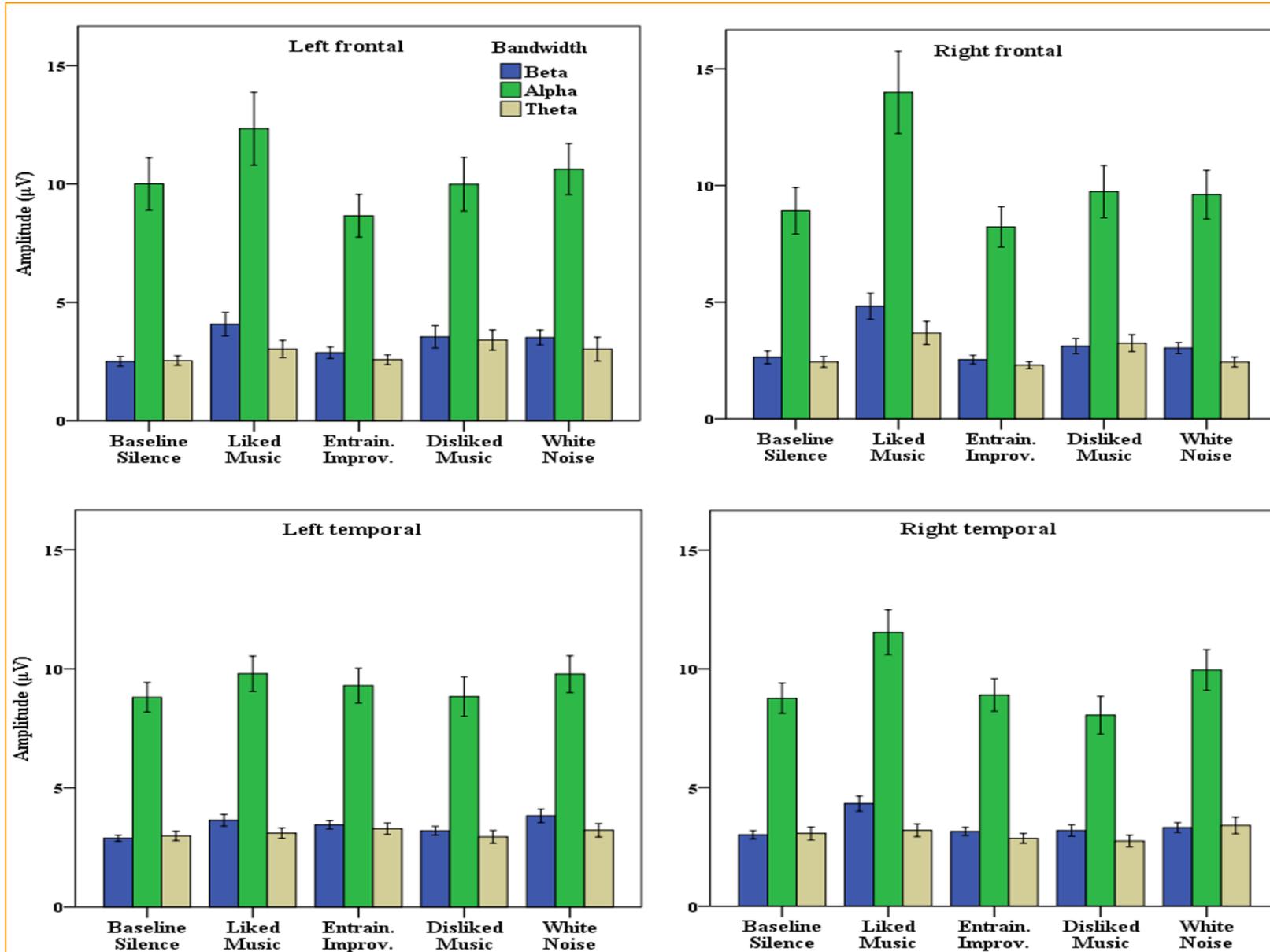
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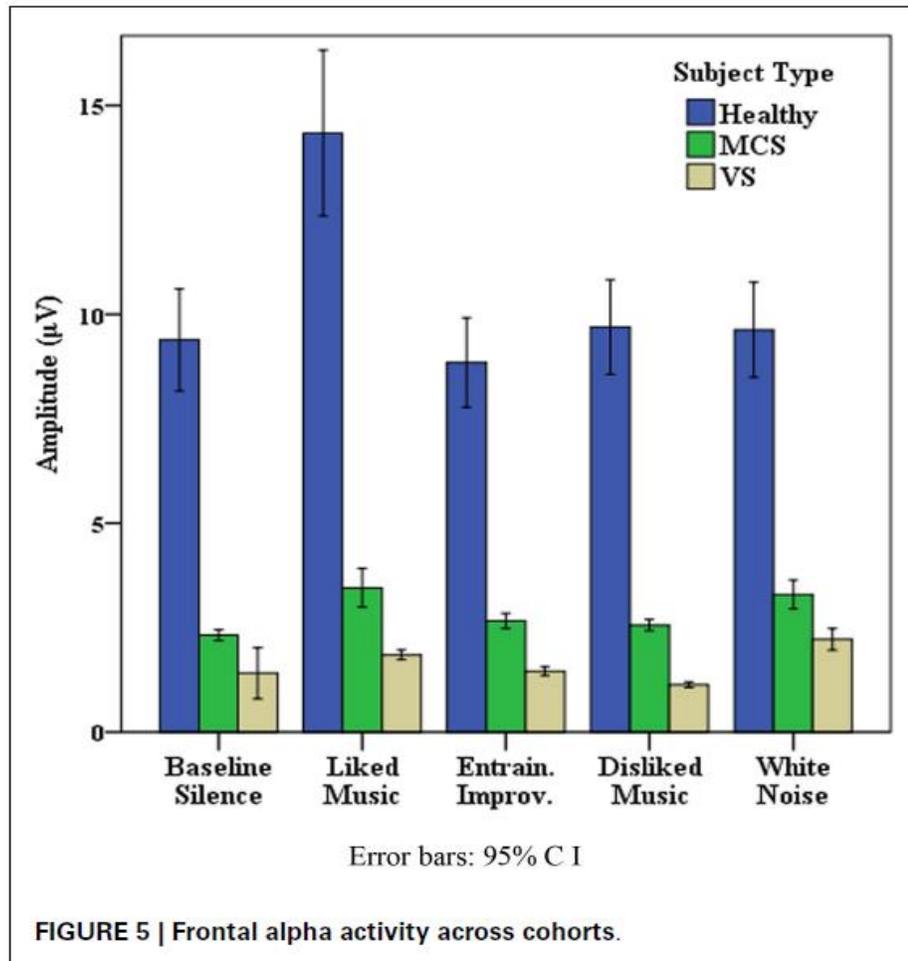
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Healthy frontal and temporal EEG responses to stimuli

(Error bars: 95% CI)



Frontal EEG response to stimuli across cohorts

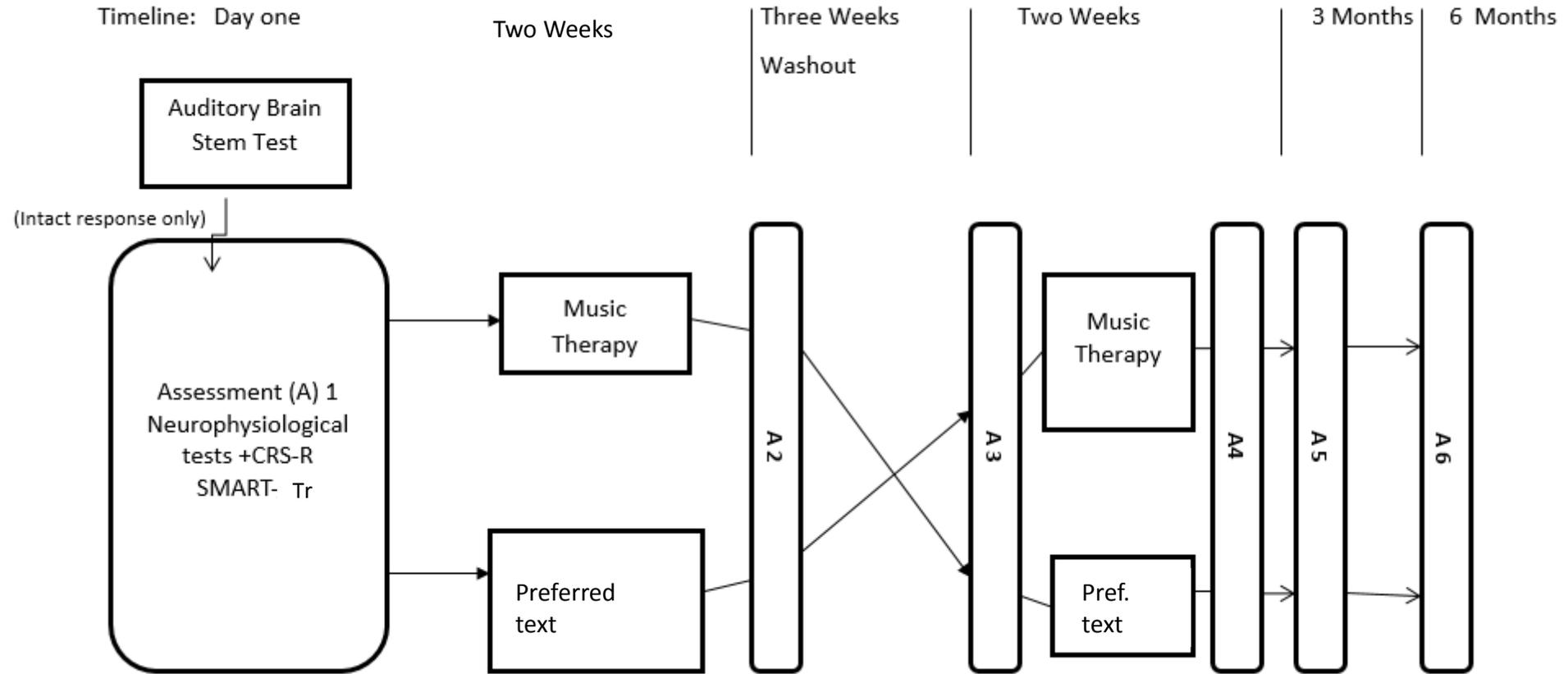


Liked Music has a similar effect of increasing cortical activity for MCS patients as controls albeit with less power

Music Therapy Rehabilitation with Disorders of Consciousness: A Neurophysiological and Behavioural Study

- Using behavioural, EEG and ANS measures to explore potential of music therapy to support the rehabilitation process for PDOC patients and provide prognostic indicators

Music Therapy Rehabilitation with PDOC: Neurophysiological and Behavioural Study



Measures

Neurophysiological

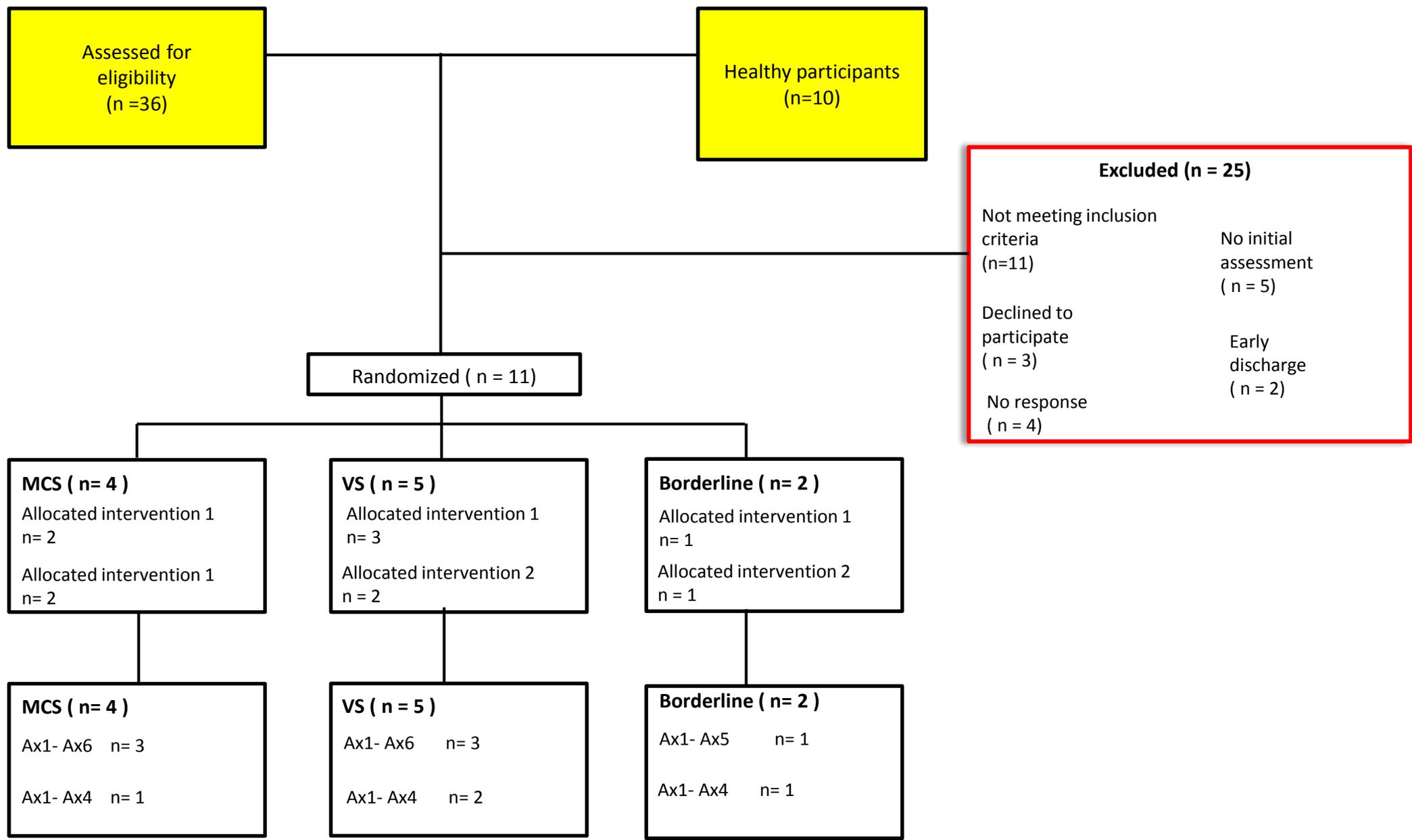
- EEG
- Respiration
- Heart Rate
- O2 saturation

Behavioural

- Coma Recovery Scale- Revised
- Blink Rate
- Arousal Level
- Smart Tracker

Enrolment

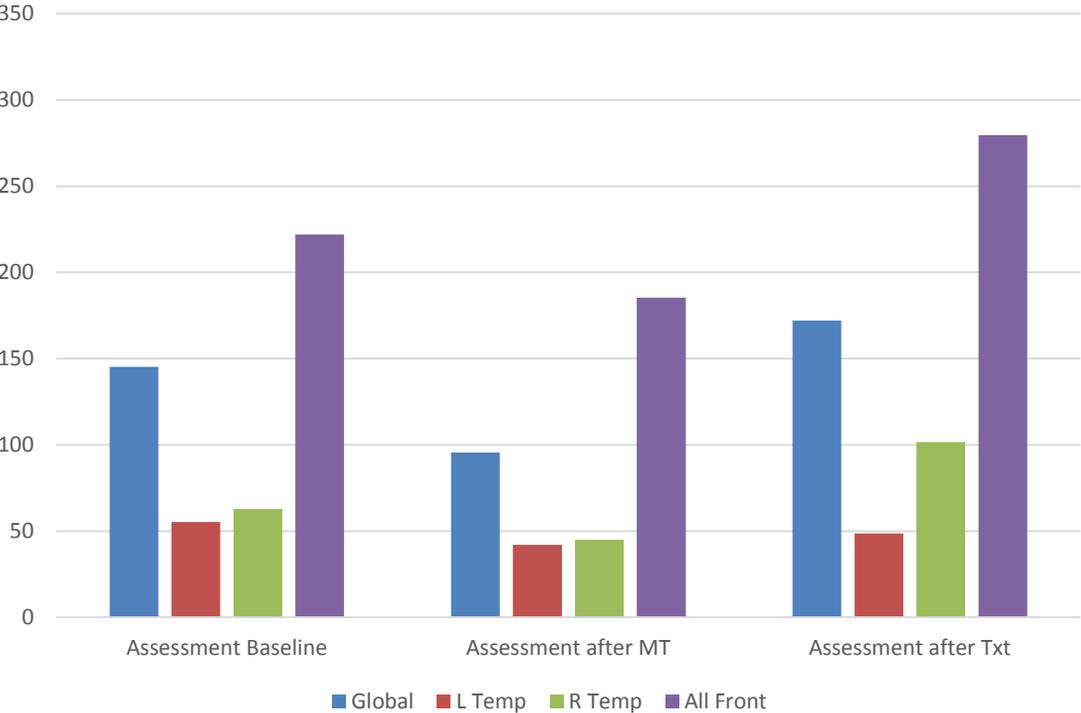
Allocation



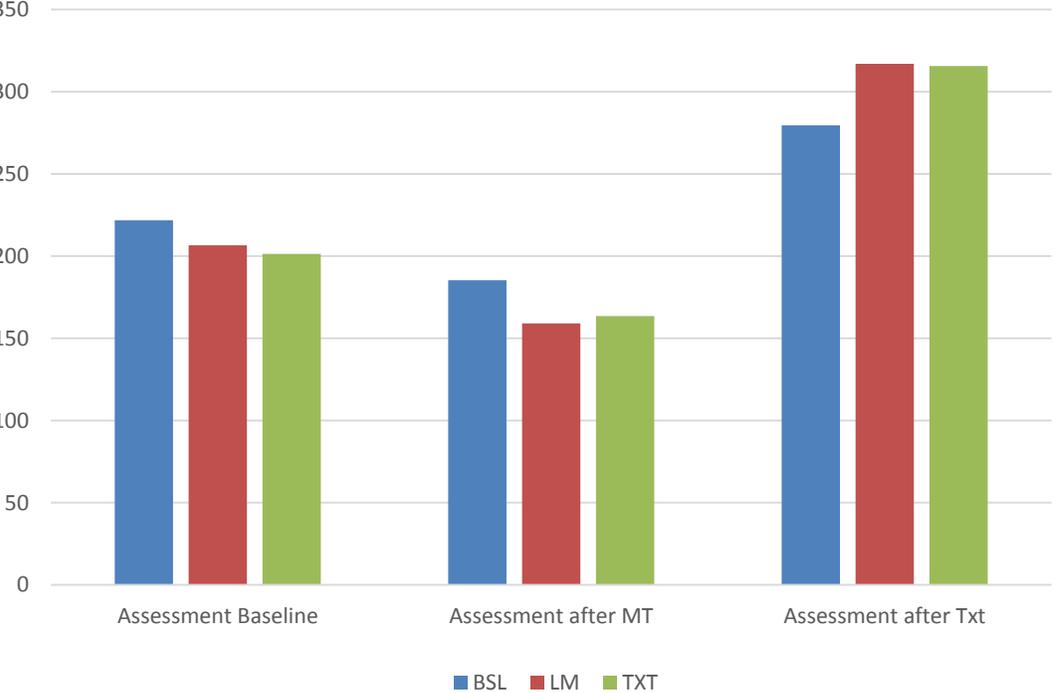


MCS Delta

MCS Baseline Changes: Delta

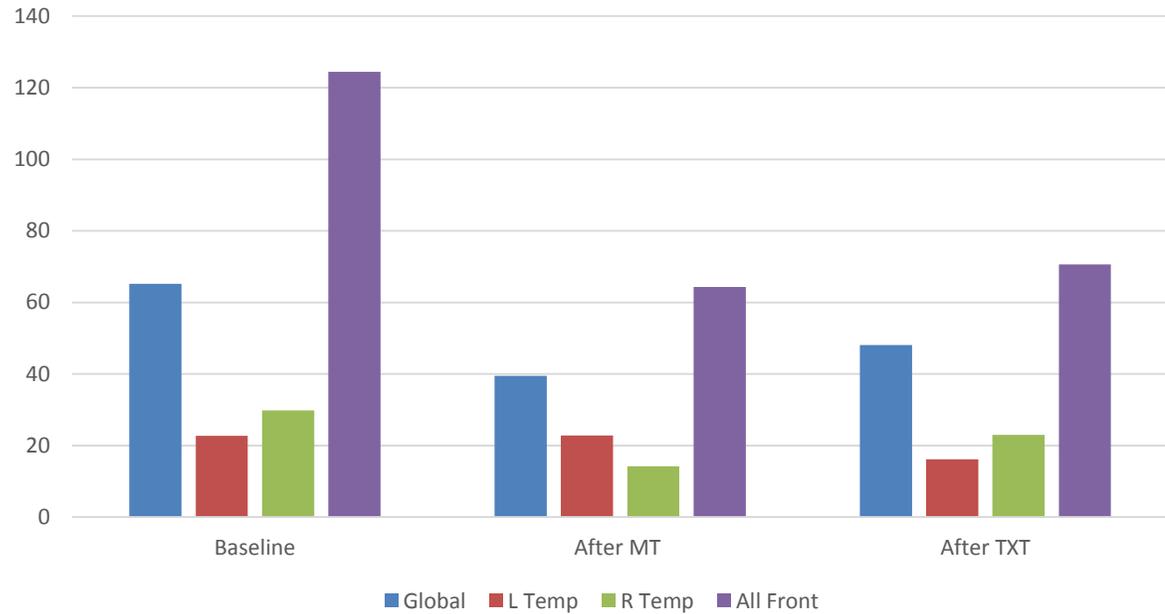


MCS Frontal Delta Conditions Compared

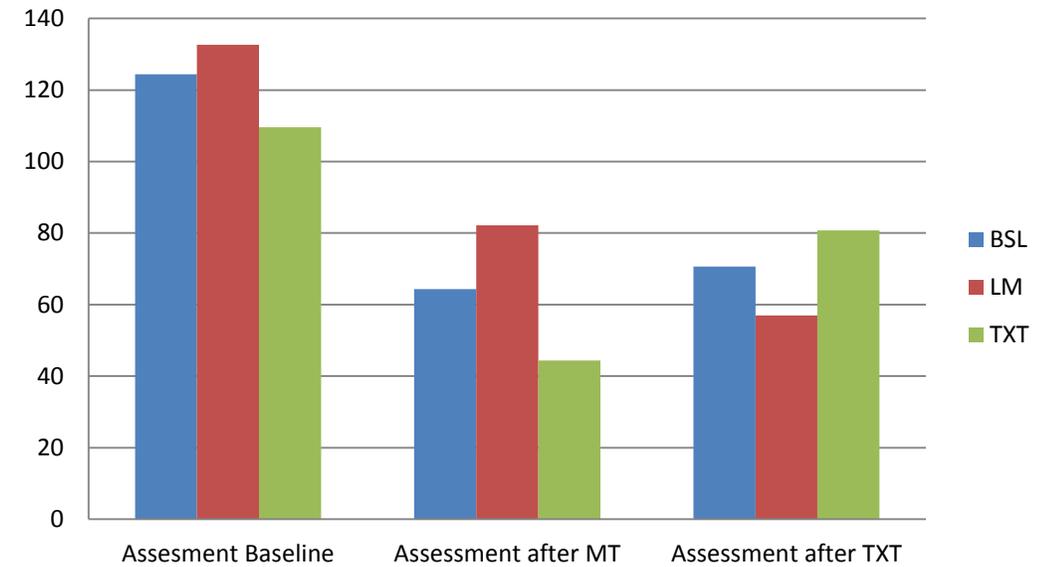


VS Delta

VS Baseline Changes: Delta

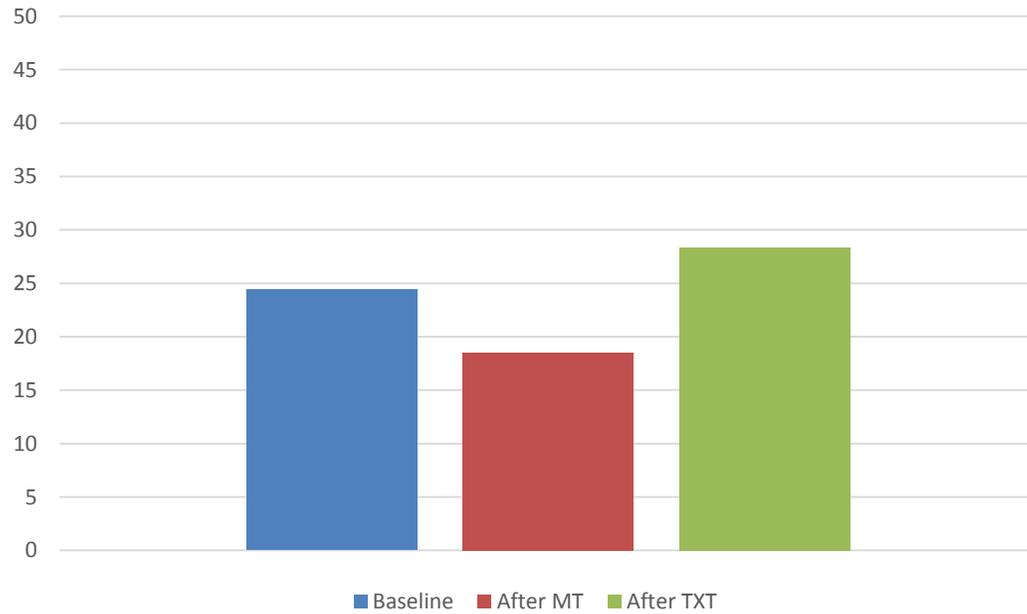


VS Frontal Delta Conditions Compared

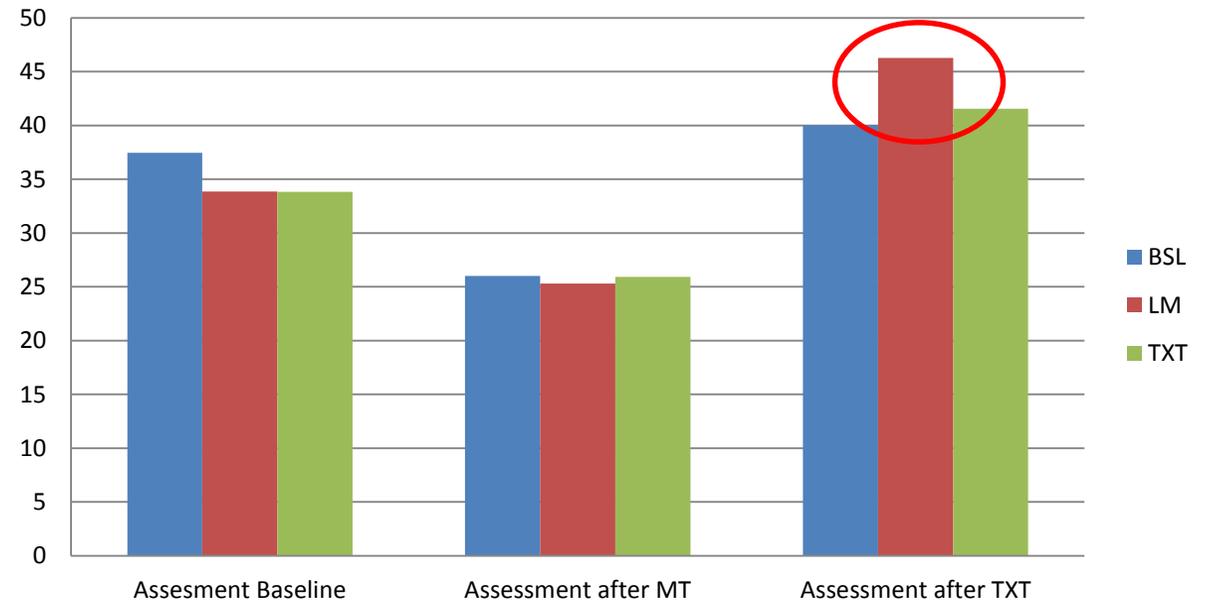


MCS Theta

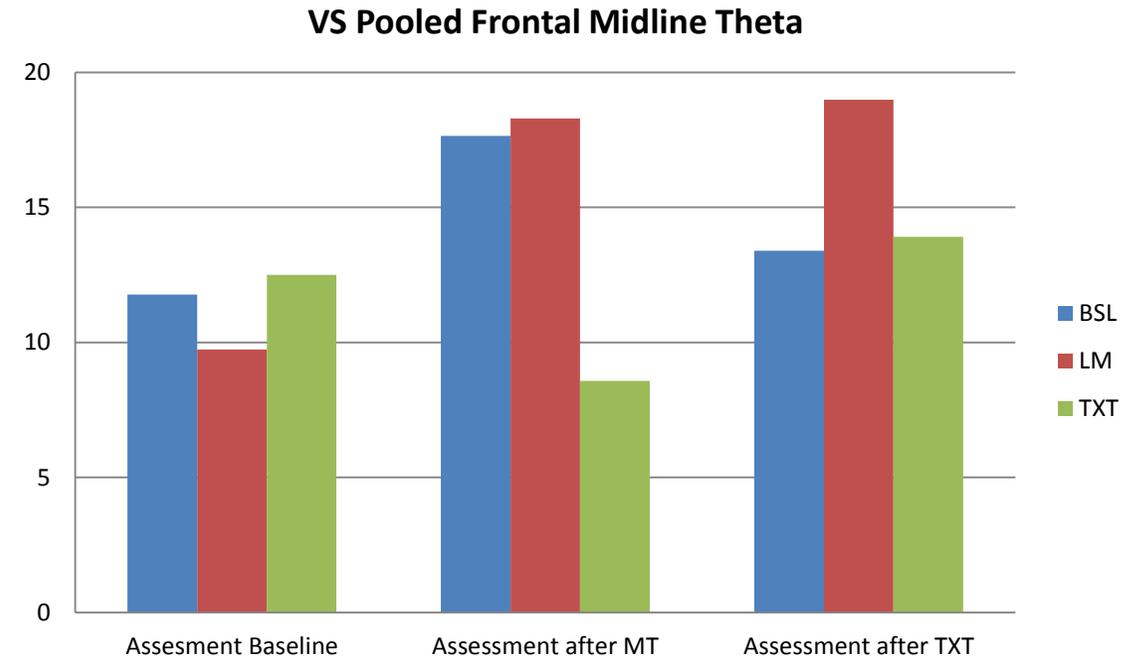
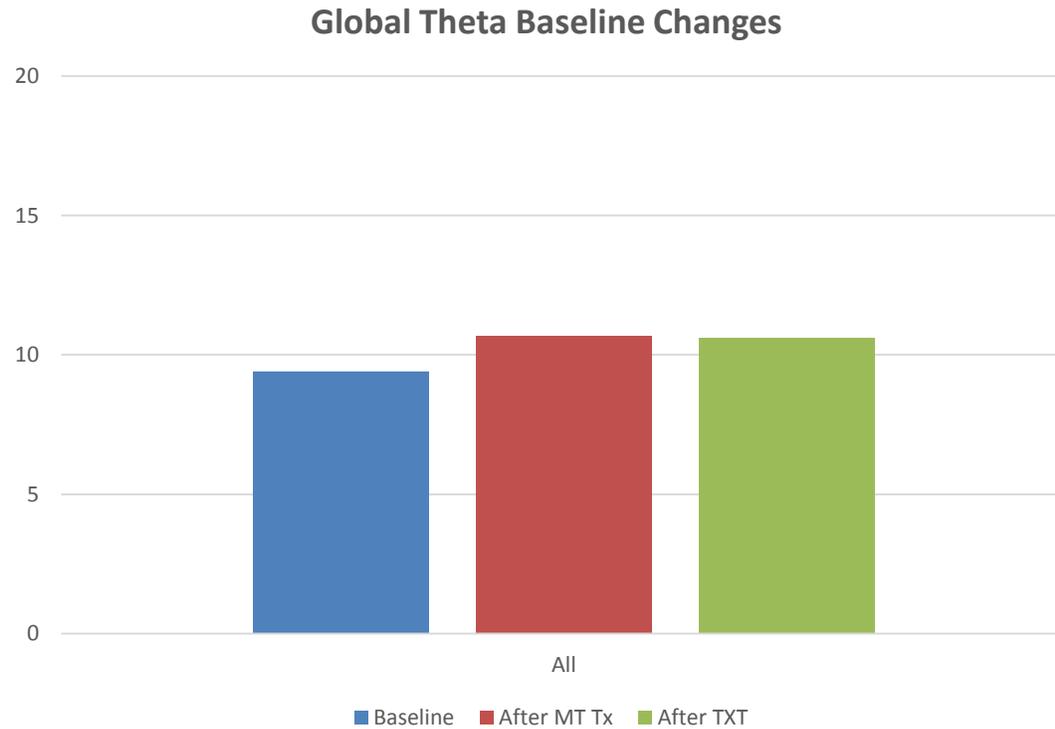
Global Theta Baseline Changes



MCS Frontal Midline Theta Conditions Compared

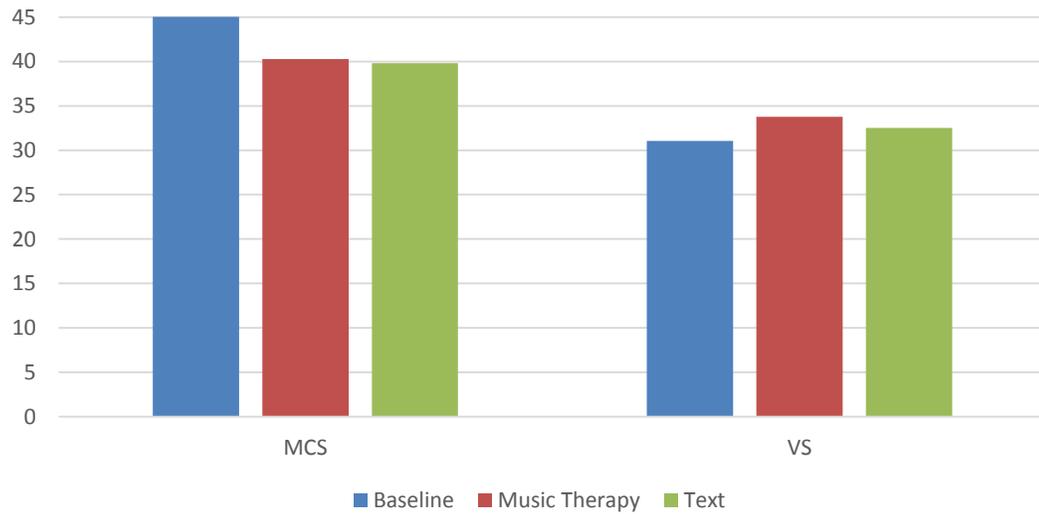


VS Theta

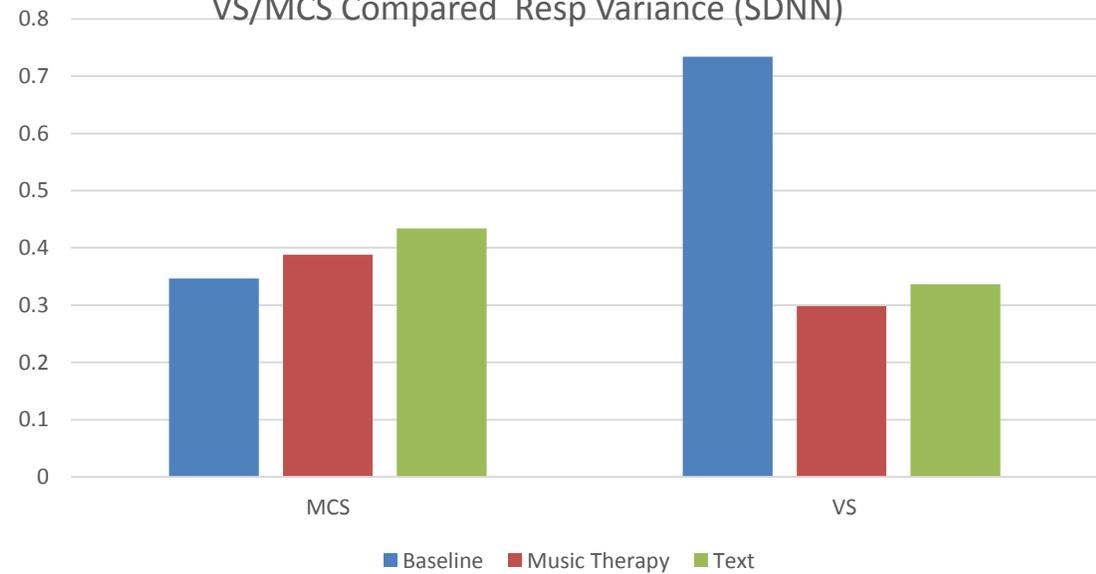


MCS/VS Respiration

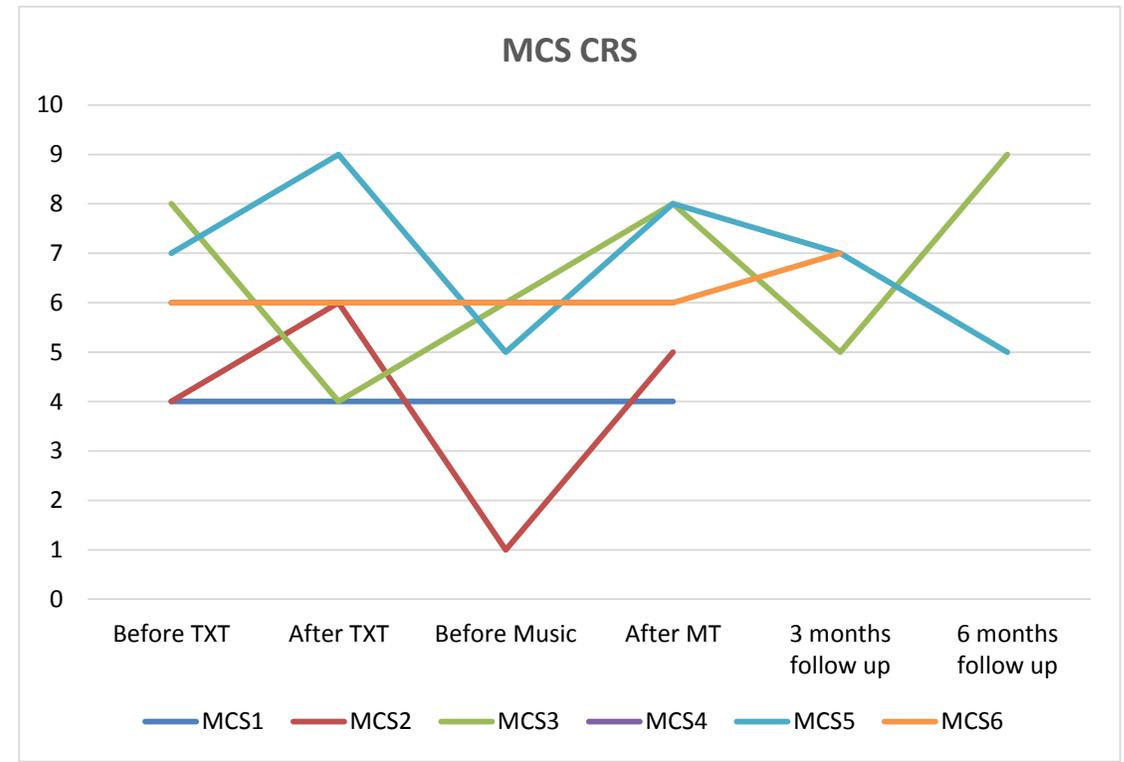
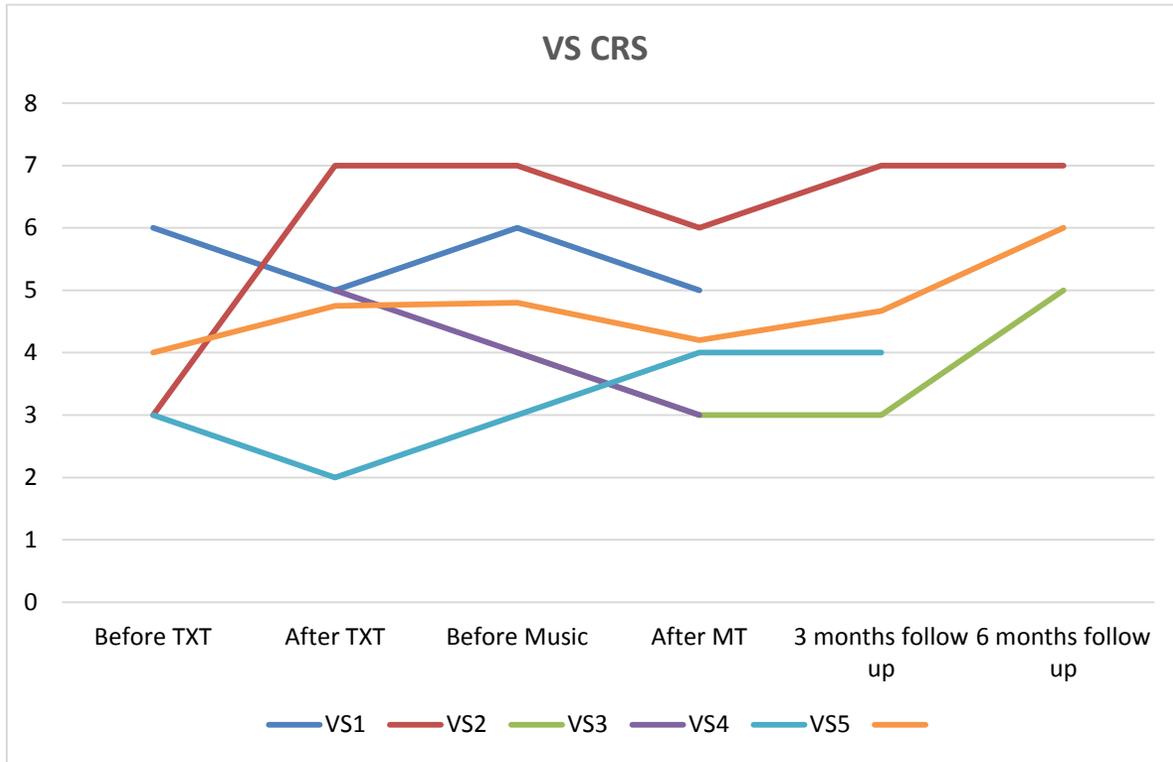
MCS/VS Rep Rate Compared



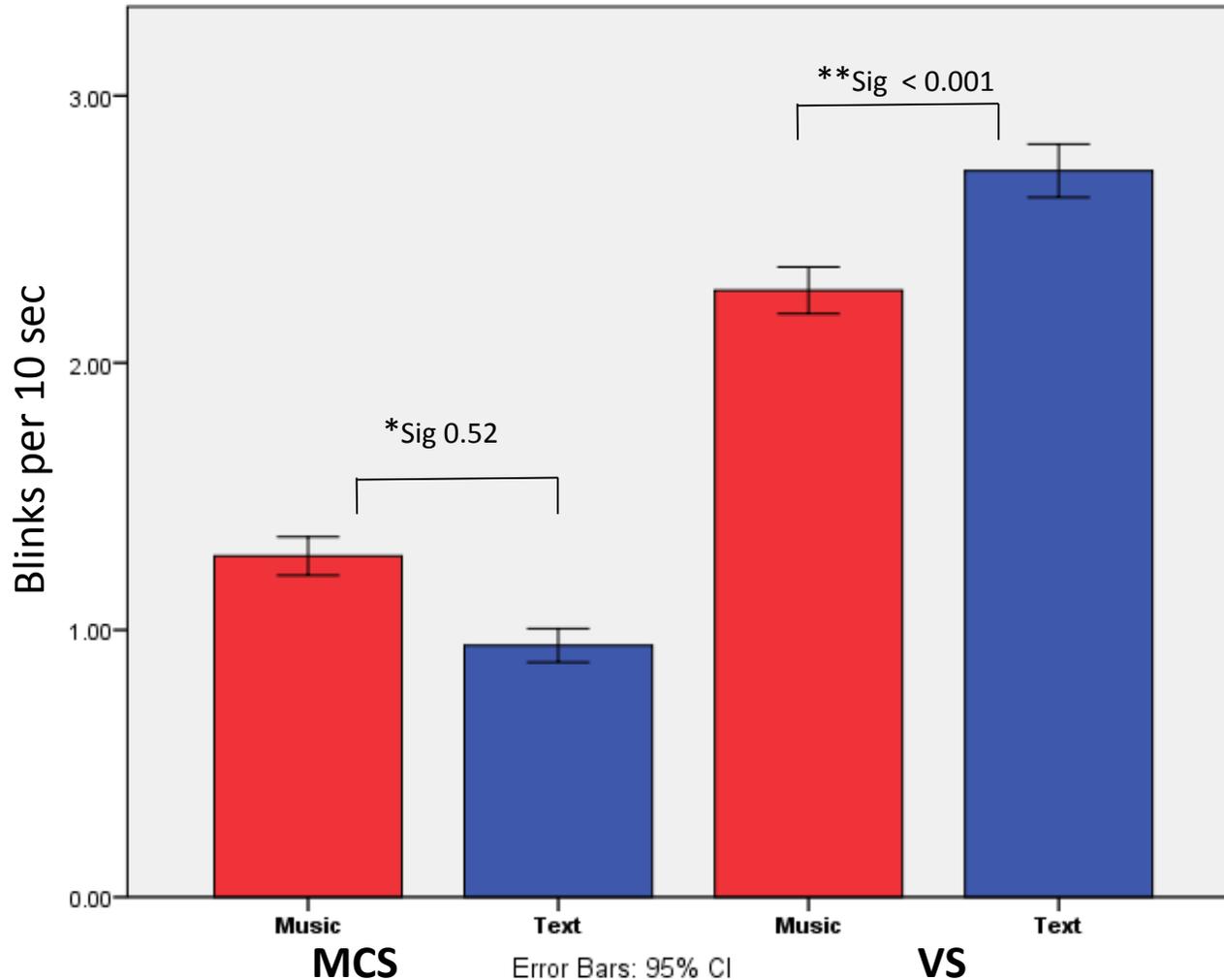
VS/MCS Compared Resp Variance (SDNN)



Coma Recovery Scale Scores



Blink Rate: MCS & VS Compared



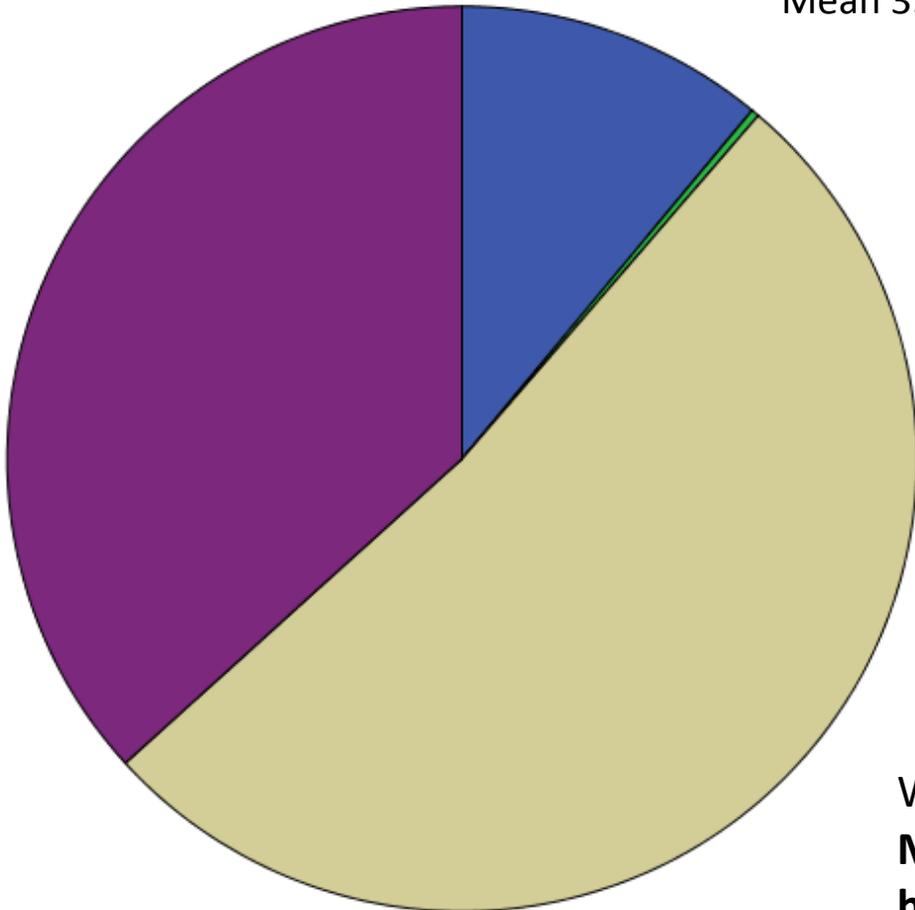
What does this mean?

- a basic arousal response where blink rate increases (VS Music), OR
- decreased spontaneous blink rate characterizes the early stages of conscious recovery (MCS overall & in favour of Text? Or more relaxed MCS for Music?). (Bonfiglio et al. 2005)

Behavioural Data: MCS

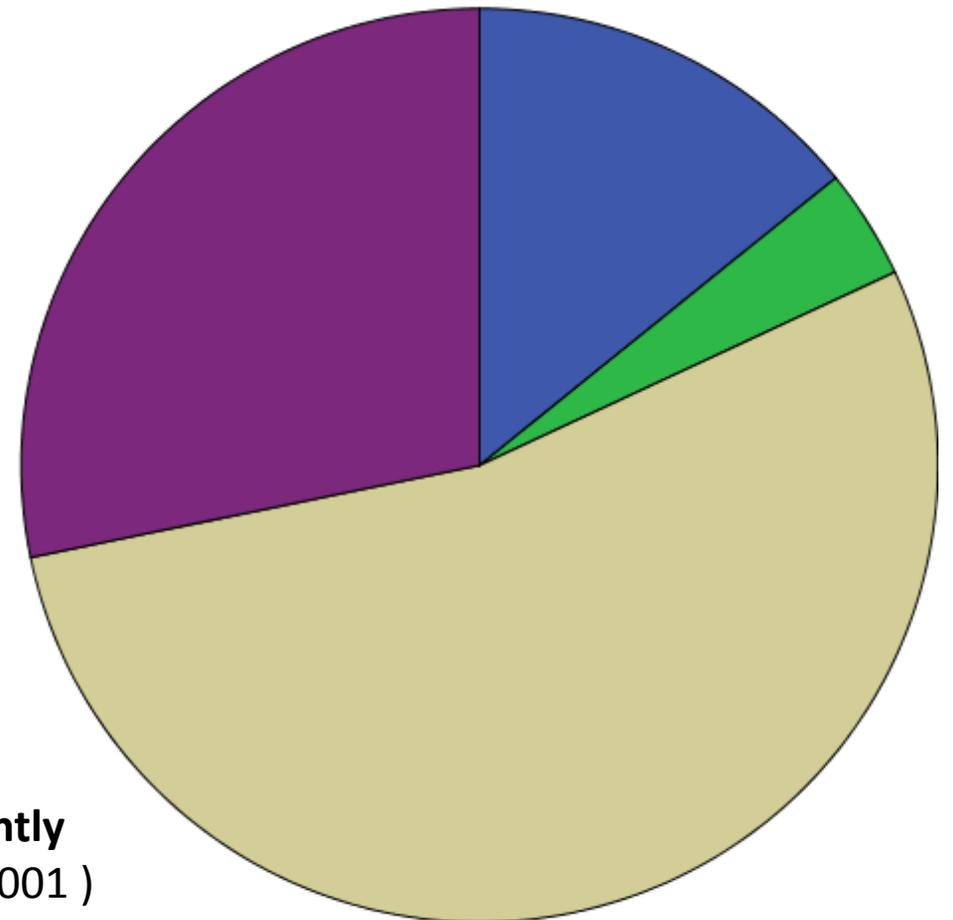
During Music

Mean 3.14 SD. 0.88



During Text Narration

Mean 2.9 SD SD. 0.94



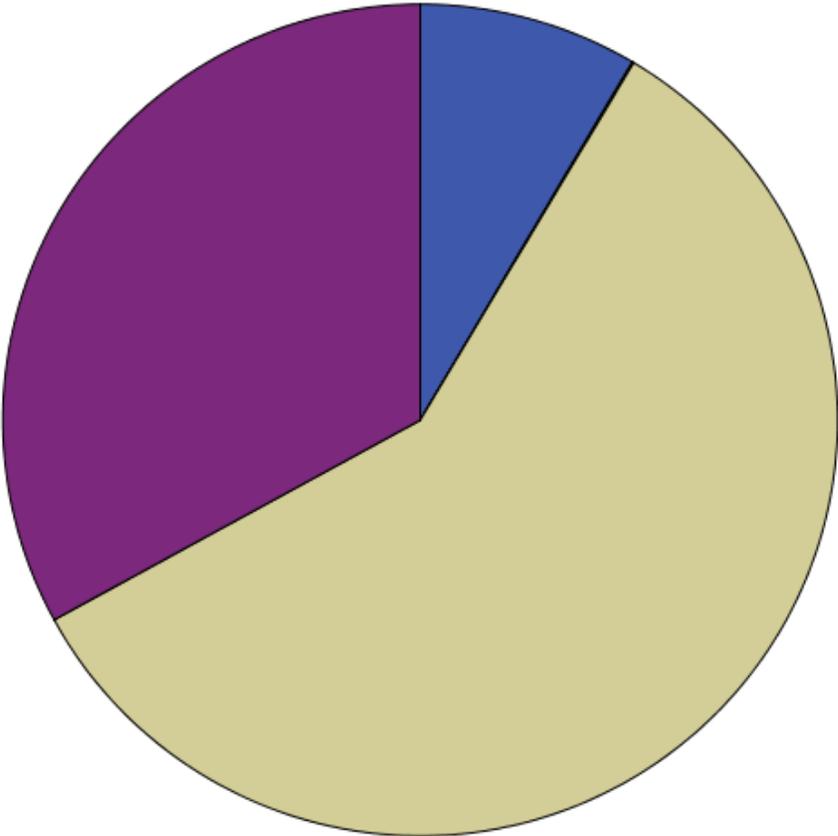
- eyes shut no body mov.
- eyes shut body mov
- eyes open no body mov
- eyes open body mov
- purposeful movement

Wilcoxon Signed Rank Test:
Music Arousal Level Significantly higher (z:-10 sig (2 tailed: < 0.001)

Behavioural Data: VS

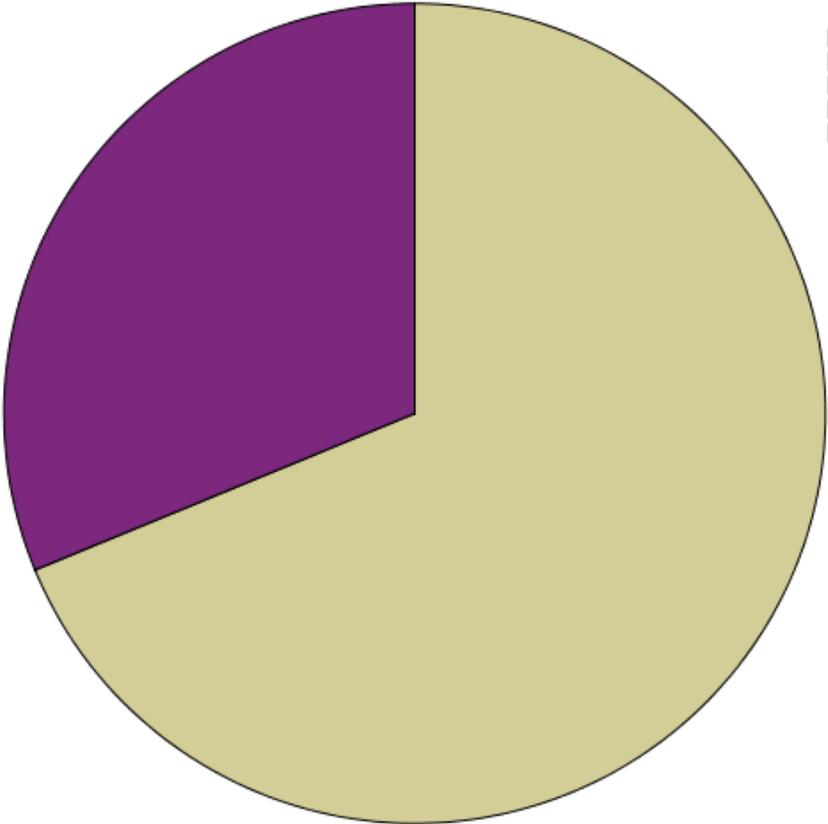
During Music

Mean 3.15 SD. 0.94



During Text Narration

Mean SD. 3.31 SD 0.8



- eyes shut no body mov.
- eyes shut body mov
- eyes open no body mov
- eyes open body mov
- purposeful movement

Wilcoxon Signed Rank Test:
Text Arousal Level Significantly higher
(z:-6.76 sig (2 tailed: < 0.001)

Case Study MCS

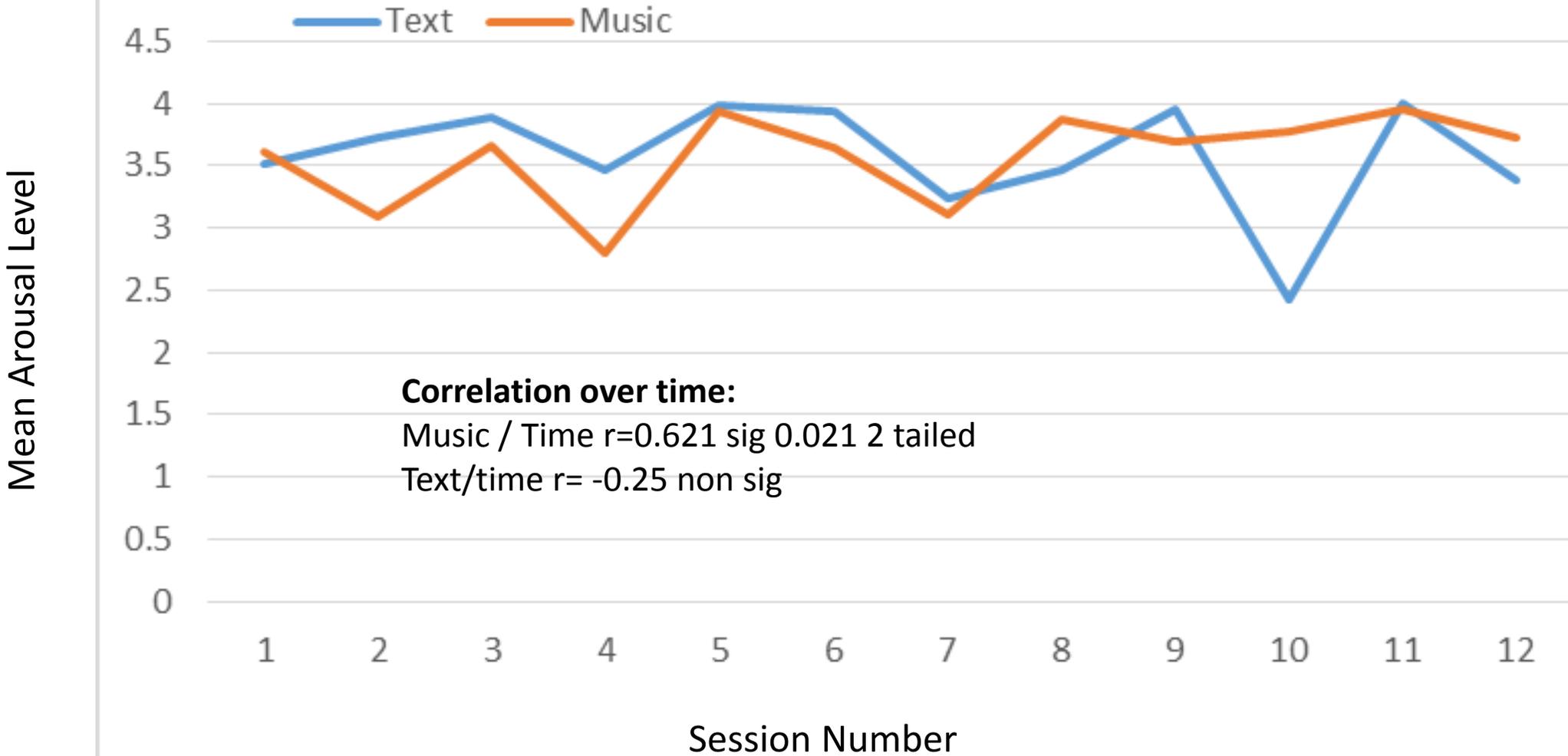
- Male patient, late 20s
- Traumatic brain injury following road traffic accident
- Admitted 3 months post injury
- Entered study approx. 4mths post injury

SMART - MCS

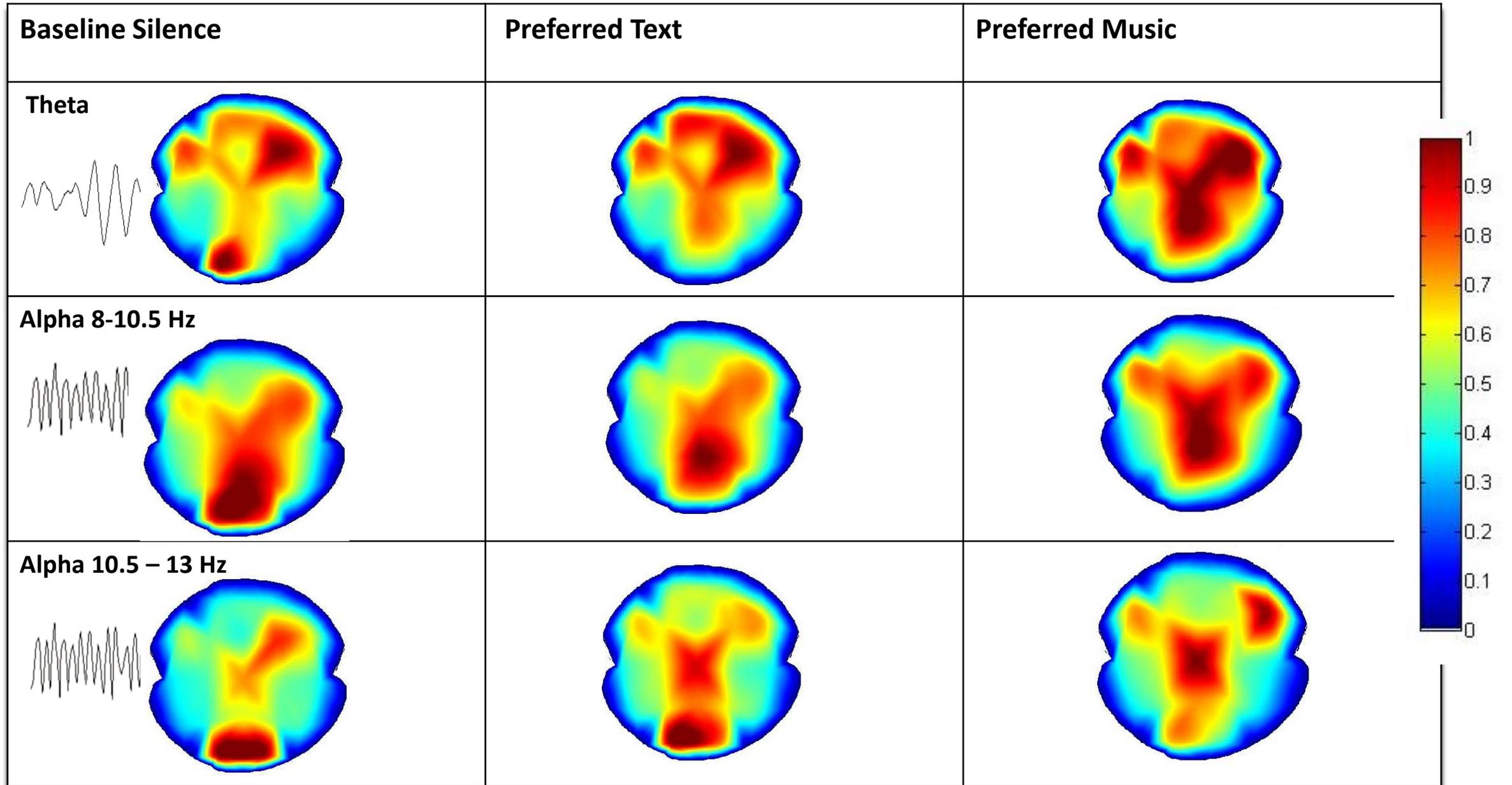
MATADOC – borderline VS/ MCS

CRS-R – initial score 5 (indicative of MCS due to high score in visual scale)

Arousal level over time

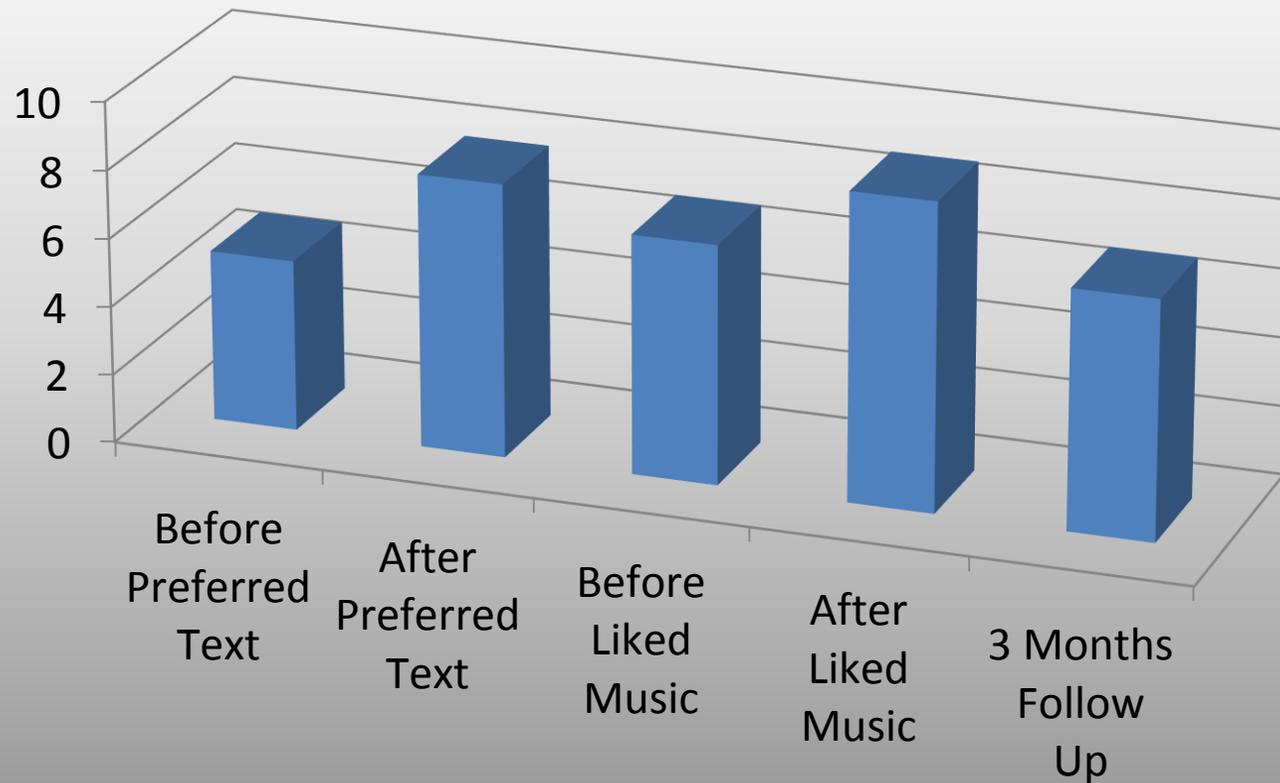


Normalised EEG Power Changes after MT Treatment Block



Case study: Coma Recovery Scale Scores

CRS-R Scoring



- Most Responsive Domain – Visual Scale
- Highest Score After Music Therapy Treatment (9) – Due to Higher Score in Motor Function Scale

Conclusions & Implications

- Preliminary findings support hypothesis that Music Therapy has advantages as a non verbal, salient stimuli capable of optimising arousal to support the rehabilitation process
- More data needed to support hypothesis of a link between music therapy < neuroplasticity correlating with clinical improvements

This presentation is a combined effort of Julian O'Kelly, PhD and S Rappich



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