

In the rehabilitation section of this edition we have chosen to focus on 'alternative' therapeutic approaches utilising music or animals. This reflects a growing interest in the importance of providing a stimulating therapeutic environment for patients as they undergo rehabilitation. There is evidence that patients undergoing inpatient rehabilitation are bored¹ and inactive.² Patients treated in 'enriched' environments show greater levels of physical activity, social interaction and cognitive activity.³

Importantly, in the current financial climate, this was achieved without increasing staffing numbers; it is a change in mindset and also having availability of resources to support these interactions. Environmental enrichment can include provision of equipment to enhance activity away from the bedside e.g. i-pads, books, puzzles, newspapers, games, music and magazines. It can also include provision of daily group sessions, with a varied focus,

for example: self-management education, emotional support, communication, physical activities. Some of the interventions in studies on stroke units may already be occurring on rehabilitation wards e.g. communal mealtimes, but there is still scope to look at relatively easy and cheap changes that could enhance a patient's rehabilitation journey and potentially improve rehabilitation outcomes and reduce length of stay. It is essential that rehabilitation environments enable people to continue to participate in meaningful activities and supporting interaction with family members as this can facilitate the transition to living with what is often a long term disability. Being hospitalised following an acquired brain injury entails many losses – loss of function, loss of independence, loss of role within family and society and a loss of identity. Physiological losses are compounded by a physical separation from family and also in some cases a virtual separation (the single most common complaint

on our ward used to be the lack of wifi signal). Loss of access to hobbies and cognitive stimulation from work often compounds the boredom. Hobbies and activities that interest people are intrinsically more rewarding and motivating than therapist-driven exercises. Diane Playford at the recent BSRM meeting spoke about the importance of 'play' or non-structured activity during rehabilitation and encouraged us to think of ways of incorporating more opportunities for play within our units. I hope these two articles will continue to stimulate that discussion.

Emily Thomas, Rehabilitation Editor.

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Why include music therapy in a neurorehabilitation team?

Abstract

Interdisciplinary neurorehabilitation programmes can be enhanced by including music therapy as music interventions can incorporate a patient's goals across behavioural domains. Neurologically, music is intrinsically motivating, drives motor function and elicits emotional responses. Incorporating live music delivered by trained and qualified professionals ensures interventions are tailored to patients' needs and goals, assisting with engagement and adherence to treatment. The evidence for the effects of music therapy in neurorehabilitation is reviewed, with reference to a recent Cochrane Review.

Summary

- Music therapy with neurological populations typically engages the patient in active music-making, with the therapist playing live music and adapting musical components moment-by-moment to both meet patient needs and to challenge the patient to reach goals.
- In neurorehabilitation, interventions range across song-writing to address psychosocial needs, singing and vocalising exercises to target communication goals, and playing instruments or moving to music to meet motor goals.
- Neurologically, music is intrinsically rewarding and motivating, activating neural networks

throughout the brain that influence non-musical behaviours, and resulting in changes to brain structures.

Music therapy: what is it and what is involved?

The rationale for including music therapy as part of an interdisciplinary rehabilitation programme may not be immediately obvious: unlike other professions that address function within a more clearly defined domain (e.g. physiotherapy for movement disorders; speech and language therapy for speech/language disorders; psychology for cognitive disorders) music therapy addresses function across domains. As defined, music therapy is the clinical and evidence-based use of music interventions to accomplish individualised goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy programme.¹ A common misconception is that music therapy is passive listening to recorded music. However, when delivered by a trained professional, music therapy typically actively engages the patient in live music-making, targeting active health goals, with the therapist adjusting musical parameters (tempo, dynamic, rhythm, pulse, melody, harmony) moment-by-moment in immediate response to the patient's functioning.

Internationally, professionals trained as music therapists are required to adhere to professional standards and codes of conduct: in the UK, music therapists are registered with the Health and Care Professions Council. Music therapy interventions are distinguishable from recreational activities, as they are individually tailored to the individual, goal directed and planned by a health professional. Interventions vary considerably, even when targeting goals within the one domain (i.e. motor; psychosocial; communication) but fall into two broad categories: active or receptive methods.² Active methods used in neurorehabilitation include: song-writing; music-making using acoustic or digital MIDI instruments; movement to music including gait training to rhythmic music or metronome; and singing or vocalising. Receptive methods include: music listening to live or recorded music; and imagery to music. Dosage for effective music interventions vary widely in terms of the number and frequency of contacts, the duration of individual contacts and course of therapy, and the mode of delivery (individual or group).² Dosage is dependent on the targeted outcome, stage of rehabilitation and setting, so standard recommendations cannot be made.

Why include music therapy in a neurorehabilitation team?

The theoretical rationale for using music in neurorehabilitation centres upon music's innate competencies within humans, its cross-cultural purpose for social bonding across cultures, and its neurological capabilities in both healthy and neurologically damaged populations. Music is a universal phenomenon that exists in all known human societies and is considered distinctive to the human condition.³ Cross-culturally, humans engage in musical activity through singing and instrument playing as part of creative play and within ritual. So music is a familiar, meaningful activity with many inherent associations, even for those who are musically untrained. Music is also a social activity, a medium for engaging with others in meaningful collective practices⁴ and assists with managing social relationships.³ Thus, it facilitates social bonding and interaction as music-making is rarely a solitary activity. In western societies, music-making is realised through singing in choirs and ritual practices and playing instruments in bands and orchestras. Group singing is conducive to social bonding⁵ and has been found to be a stress-reducing activity as measured through reductions of adrenocorticotropic hormone,⁵ cortisol and cortisone.⁵

However, the strongest argument for including music therapy in neurorehabilitation lies in its neurological benefits. Neurologically, music is intrinsically rewarding as it activates brain regions involved in reward, motivation, emotion, and arousal.⁷ Cortical changes in brain damaged patients during music interventions indicate activation of bilateral networks across the frontal, temporal and parietal lobes, cerebellum and limbic areas, stimulating

cognitive, motor, and emotional processes.⁸⁻¹⁰ When integrated with repetitive rehabilitation exercises and drills, music that is tailored to an individual's performance can enhance the motivation to sustain engagement and may improve patient mood and enhance motivation.¹¹

Music therapy interventions in neurorehabilitation: practice and evidence

Music boosts cognition in the brain damaged patient, with reported effects on arousal, attention, orientation, memory, executive function, spatial neglect, and mental flexibility. For patients with Disorders of Consciousness (DOC), maintaining arousal is a significant problem and can interfere with optimal engagement in rehabilitation. Using music that is salient to the patient has been found to promote behaviours indicative of arousal and selective attention,¹² increase behavioural responses that indicate discrimination¹³ and awareness.¹⁴ Music therapy within interdisciplinary care may prime patient responsiveness in DOC,¹⁵ which is particularly useful when part of co-treatment: a music therapist will play live music that is personally salient to the patient, adjusting musical parameters to help the patient achieve and maintain an optimal state of arousal so as to engage in treatment sessions. Music has also been found to improve orientation for patients in post-traumatic amnesia.¹⁶ Following middle cerebral artery stroke, music interventions have been shown to be superior in enhancing cognitive recovery, more specifically verbal memory and focused attention, when compared to a language intervention (patient selected audio book listening) or a control condition (standard rehabilitation).⁸ Similar results have been found with mild traumatic brain injury patients, where music training in the form of eight weeks of piano tuition resulted in significantly improved results in executive functions related to attention, learning strategies and memory retrieval.¹⁷ Thus, music interventions have demonstrated positive effects across the spectrum of brain damage.

Of all behavioural domains with neurological populations, the strongest evidence for music interventions is with motor disorders. Motor regions within the cortex are sensitive to and driven by auditory stimuli as the auditory system processes temporal information rapidly and precisely, creating entrainment between a rhythmic signal and movement.¹⁸ In healthy subjects, movement to music results in superior physical performance: running for longer, lower perceived exertion, and slower exhaustion.¹⁹ These beneficial effects are increased when agency is incorporated into a workout, that is, that the physical movements result in musical sounds.²⁰ These observations support the growing body of research examining the influence of music with a strong beat on gait disorders and upper limb function in adults with stroke and acquired brain injury. A Cochrane Review examined the effects of rhythmic auditory stimulation (RAS) on gait velocity,

cadence, stride length, stride symmetry, gait and balance.² RAS is a therapeutic intervention using rhythmic pulse to improve gait or gait related aspects of movement. Using live music, the therapist can embed the rhythmic pulse into the music for the patient to move to, or a metronome alone can be used. Based on 10 randomised controlled studies (n=298) the meta-analysis found beneficial effects for RAS on gait velocity, stride length, gait cadence and general gait in people with stroke, although the degree of improvement across studies was inconsistent.² Subgroup analyses indicated that RAS interventions using live music with the beat embedded in the music may be more effective than using a metronome alone in addressing gait velocity and cadence. These findings highlight that although RAS can be implemented within interdisciplinary rehabilitation by non-music professionals using a metronome, the inclusion of a music therapist in the rehabilitation team using live music may enhance the intervention's benefits. Music provides an intrinsic motivational reward, and using live music enables components (such as tempo, dynamic tension, harmonic tension and resolution, melodic direction) to be adapted in the moment to the patient's movements, driving these movements to goal attainment.

Music interventions are used to rehabilitate upper limb function following stroke, measuring outcomes such as timing of movement, strength, hand function, manual dexterity, range of motion and elbow extension angle² and often in co-treatment with occupational therapists. Interventions typically involve the patient playing strategically placed musical instruments in live music making: the therapist commonly manipulates rhythm and tempo in the accompanying music to guide the patient's movements, but harmonic and melodic tensions are also used. A number of studies have examined neural reorganisation during these interventions, noting coupling between the motor and auditory cortices.¹¹ The benefits for involving music therapy in team treatment include motivation and adherence to treatment of motor disorders.²¹

Communication outcomes are frequently targeted with music following stroke and traumatic brain injury, as it has long been noted that people with severe non-fluent aphasia have greater success when singing lyrics than speaking the same words.¹⁰ Although speech and music are neurologically distinct, they share pitch, timing and timbre cues to convey information at an acoustic level and at a cognitive level both demand complex cognitive skills: memory, attention, and the ability to integrate acoustic events and perceive these according to rules of syntax are required by both.²² Music, like language, has structural rules for production suggesting a deep connection between the two within the brain. Intensive music interventions to address language production with people with severe non-fluent aphasia have resulted in neuroplastic changes to connections across brain regions.¹⁰ The acts of speech and singing additionally share musculature for

respiration, phonation, articulation and resonance.²³ Music therapy interventions address communication goals through singing and vocalising, often in co-treatment with speech and language therapists. Singing interventions address non-fluent aphasia, dysarthria, dyspraxia, dysprosody and dysphonia measuring outcomes such as words produced, speech intensity, naturalness and intelligibility, rate control, articulation, phonation and prosody.^{2,24} Melodic intonation therapy is an intervention frequently used to target language production in expressive aphasia, engaging right-hemispheric structures through tapping of the left hand and intoning words in a melodic contour that imitates speech prosody.¹⁰ Numerous case reports describe the benefits of a number of music interventions to improve communication, supported to some extent in research suggesting benefits to overall communication, naming and repetition.² Further research would consolidate these findings and improve the widely varying protocols that have been reported.

Lastly, music therapy interventions are reported to improve psychosocial functions such as behavioural outcomes, emotional needs, mood, well-being, social skills and quality of life.² Psychosocial sequelae are integrally related following brain injury: communication or behavioural difficulties impact upon social relationships, risking feelings of isolation and depressed mood, reducing quality of life. Music therapy can reduce agitation in patients with post-traumatic amnesia.¹⁶ The intersectional nature of psychosocial subdomains can be addressed through therapeutic music-making as a meaningful social experience that enhances social bonding³ and stimulates emotional experiences. Music therapy will typically use active music interventions such as song-writing, improvisation and song-singing to address mood, identity reconstruction and emotional expression in neurorehabilitation.² These can be powerful interventions when delivered in groups and may also incorporate members of the patient's social support network. Individually tailored

music listening programmes in the acute recovery phase post-stroke have resulted in less depressed and confused mood states than standard rehabilitation.⁸ More research is needed examining the effects of music interventions on all aspects of psychosocial functioning.

Conclusions

Music provides a familiar salient stimulus that activates widespread neural activity and has the potential to be harnessed to improve functioning across all the behavioural domains, including motor, cognition, communication and psychosocial. Thus, music therapy is well-placed as an intervention in neurorehabilitation. Music is also ubiquitous and easily accessible with the swipe of a screen, but its use is not without risk, particularly the possibility of triggering strong emotional reactions. The application of music interventions in neurorehabilitation thus requires planned and careful application with vulnerable populations by professionals trained in its use.

Music boosts cognition in the brain damaged patient, with reported effects on arousal, attention, orientation, memory, executive function, spatial neglect, and mental flexibility. For patients with Disorders of Consciousness (DOC), maintaining arousal is a significant problem and can interfere with optimal engagement in rehabilitation.

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