

## Why Music in Neurology?

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### Abstract :

In the last years we could find many uses of music in different clinical settings, also in the field of neurology. In this field empirical results, but also scientific studies, showed the efficacy of music interventions on psychological, cognitive and motor aspects. This is consistent with strong effects of music on brain areas. Music can stimulate and modulate/regulate cognitive functions, behaviors, movements and emotions. Music plays an important role also from a psychological point of view, increasing motivation and promoting relationships and communication. Literature has showed how music interventions can improve behavioral, cognitive, motor, psychological, relational and emotional outcomes in different neurological pathologies. Significant results are present in particular in dementia, stroke and Parkinson's disease. We can find also minor results and qualitative research approaches in multiple sclerosis and in other brain injury such as vegetative and minimally conscious state. More rigorous methodologies and criteria of research are needed to support and strengthen the therapeutic value of music.

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## Introduction :

Music has been a universal and natural way to communicate and to express emotions for individuals ever since. In the last years we could find many uses of music in different clinical settings, also in the field of neurology. Empirical results, but also scientific studies, showed the efficacy of music interventions on psychological, cognitive and motor aspects. This is consistent with strong effects of music on brain areas: auditory cortex, premotor, motor, limbic and paralimbic areas, but also frontal regions in the processing of more complex components of music.<sup>1-3</sup> Recent studies underlined also a strong link between sounds and mirror neuron system areas.<sup>4</sup> An intriguing hypothesis is that music, through its action on the brain, can stimulate and modulate/regulate cognitive functions, behaviors, movements and emotions.<sup>5,4</sup> Music plays an important role also from a psychological point of view, increasing motivation and promoting relationships and communication.<sup>6</sup> Literature has showed how music interventions can improve behavioral, cognitive, motor, relational and emotional outcomes in different neurological pathologies. Significant results and rigorous research methodology are present in the literature, mainly in dementia, stroke and Parkinson's disease, while it can find minor results and qualitative research approaches in multiple sclerosis and in other brain injury such as vegetative and minimally conscious state. Music interventions generally are defined as "music therapy" but are characterized by several contents, techniques and aims.<sup>7</sup> In the field of neurology we can mainly distinguish: rehabilitative music therapy approaches (for example, Neurologic Music Therapy, in particular Rhythmic Auditory Stimulation – RAS, or Melodic Intonation Therapy - MIT)<sup>8,9</sup> aimed to support motor and cognitive rehabilitation; listening to preferred and

individualized music<sup>10,11</sup> to improve behaviors, mood and to stimulate cognitive functions; relational music therapy approaches<sup>12</sup>, in particular active music therapy based on the direct interaction between patients and music therapist, to improve communication, relationships, emotional expression, behavioral and psychological aspects.<sup>13,14</sup>

Table 1 summarizes main studies describing clinical treatments with music carried out in the last decade in the field of neurology. From the Table the need of further clinical studies based on music interventions emerges. Reading literature it is possible to notice that more defined and systematic applicational criteria (kind of interventions, grounded theories, definition of clinical population and inclusion criteria to treatments, aims, settings, procedures, standardized assessment) and more rigorous methodologies and criteria of research are needed.

A bigger number of clinical studies (also multicentric studies to make the sample more representative) based on strong scientific criteria (Randomized Controlled Trials) could support and strengthen the therapeutic value of music, that can be considered as an inexpensive and without side effects non-pharmacological treatment.

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**Table 1.** Randomized Controlled and Clinical Controlled Trials (RCT, CCT) about clinical interventions with music in some of the main neurological pathologies found in PubMed (English language) from 2003 to 2013 using the following terms: "music", "rhythmic auditory stimulation" and "dementia", "stroke", "Parkinson", "multiple sclerosis", "brain injury".

Pathology	Music Intervention	Number of Studies	RCT/CCT	Outcomes
Dementia <sup>a</sup>	Music therapy techniques; rehabilitative music exercises; use of percussion instruments with familiar music; making music; singing; preferred music listening; Rhythmic Auditory Stimulation; group music with movement	25	21 RCT/4 CCT	Improvement in: behavioral and psychological symptoms (agitation, anxiety, delusions, apathy, depression; irritability, aberrant motor activity, night-time disturbances, aggressiveness); self-esteem; mood; stress; emotional functions; cognitive functions (general cognitive functioning, attention, prose memory skills, language, remote episodic and working memory, orientation, executive functions); physiological parameters (heart rate variability, systolic blood pressure, reduction of salivary Chromogranin A); motor functions (gait); reducing medications
Stroke <sup>b</sup>	Music therapy techniques; listening to music; music-supported training; Rhythmic Auditory Stimulation; Musical Motor Feedback	8	7 RCT/1 CCT	Improvement in: psychological symptoms (anxiety, depression, mood, frequency and quality of interpersonal relationships); cognitive functions (verbal memory, focused attention); fine and global motor skills (speed, precision and fluency, wider range of motion and flexibility, motor control in everyday activities, gait)
Parkinson's Disease <sup>c</sup>	Rhythmic Auditory Stimulation; Music relaxation; Rhythmic sound cues; Listening to drumming music	4	1 RCT/3 CCT	Improvement in: motor functions (functional gait and balance, gait timing, arm and finger movements); tremor; psychological symptoms (mood and anxiety); quality of life
Multiple Sclerosis <sup>d</sup>	Rhythmic Auditory Stimulation; rehabilitative music exercises; improvisational music therapy approach	3	2 RCT/1 CCT	Improvement in: motor functions (gait parameters); cognitive functions (memory learning); psychological symptoms (depression and anxiety); self-esteem
Brain Injury <sup>e</sup>	Neurological Music Therapy	1	1 CCT	Improvement in: cognitive functions (executive function) and psychological symptoms (depression and anxiety)

<sup>a</sup> Sarkamo et al., 2013; Chu et al., 2013; Ridder et al., 2013; Sakamoto et al., 2013; Vink et al., 2013; Raglio et al., 2013; Vink et al., 2012; Ceccato et al., 2012; Sung et al., 2012; 2010; 2006; Lin et al., 2011; Raglio et al., 2010a; 2010b; 2008; Cooke et al., 2010a; 2010b; Guétin et al., 2009; Choi et al., 2009; Bruer et al., 2007; Takahashi et al., 2006; Clair et al., 2006; Svansdottir et al., 2006; de Winckel et al., 2004; Suzuki et al., 2004.

<sup>b</sup> Kim et al., 2011; Särkämö et al., 2010; 2008; Altenmüller et al., 2009; Jeong et al., 2007; Schneider et al., 2007; Thaut et al., 2007; Schauer et al., 2003.

<sup>c</sup> Kadirvar et al., 2011; Craig et al., 2006; del Olmo et al., 2005; Bernatzky et al., 2004.

<sup>d</sup> Conklyn et al., 2010; Moore et al., 2008; Schmid et al., 2004.

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