



HAL
open science

Dance and embodiment: therapeutic benefits on body-mind health

Norma Gomes, Sandrine Cochet, Alice Guyon

► **To cite this version:**

Norma Gomes, Sandrine Cochet, Alice Guyon. Dance and embodiment: therapeutic benefits on body-mind health. *Journal of Interdisciplinary Methodologies and Issues in Science*, 2021, Methods to assess the effects of sensory stimulations on wellness, 10.18713/JIMIS-02072021-9-4 . hal-03303576

HAL Id: hal-03303576

<https://hal.science/hal-03303576>

Submitted on 28 Jul 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Dance and embodiment: therapeutic benefits on body-mind health

Norma Gomes¹, Sandrine Cochet², Alice Guyon¹

¹ Université Côte d'Azur- CNRS UMR 7275- IPMC- Gérard Lambeau's Laboratory - 660 route des Lucioles-06560 Valbonne, France.

² Université Côte d'Azur- CHU de Nice. Hôpital L'Archet 1, 151, route Saint-Antoine de Ginestière, CS 23079 - 06202 Nice Cedex 3.

*Correspondance : alice.guyon@ipmc.cnrs.fr

DOI : [10.18713/JIMIS-02072021-9-4](https://doi.org/10.18713/JIMIS-02072021-9-4)

Submitted the 21 august 2020 – Accepted the 2 july 2021

Volume: 9 – Year: 2020

Volume title: **Methods to assess the effects of sensory stimulations on wellness**

Editors: *Martine Adrian-Scotto, Gabriel Gandolfo, Sandra Perez*

Abstract

Dance is a universal form of human expression that constitutes a physical activity and a body language that involves motor, cognitive, visuospatial, emotional and social engagement. This article is focusing on the therapeutic benefits of dance regarding body-mind health. After an introduction, we discuss the connection between body movements and the nervous system, highlighting the neuronal correlates of dance recently evidenced by new methods in neuroscience of dance, showing how dance can positively act on the brain and the nerves and opening a wide range of opportunities to deal with body-mind health based in therapeutic dance approaches. We then present a review of scientific studies addressing the therapeutic effects of different practices involving dance, which are very structured on the embodiment or body consciousness aspect of the dance. The last section illustrates some clinical psychological benefits of dance therapy in clinics, when used at the bedside, focusing on the psychological and emotional points of view. In conclusion, this article reviews how recent methods allow demonstrating the therapeutic benefits of different dance approaches, that appear closely related to the essential role of body consciousness promoted by dancing.

Keywords

dance therapy; embodiment; body-mind health; neuronal correlates; breath; present moment

I INTRODUCTION

Art is part of humanity and has been enchanting us through its diversity and richness, perceived by the bodily senses (like eyes and ears) and enjoyed through embodied feelings coming from the ongoing interoception process, which is defined as the brain's representation of all sensations from the internal organs and tissues, the hormones in the blood, and the immune system (Barret, 2017).

Indisputably, art is able to produce health effects and this article will focus on the art of dance and its therapeutic benefits regarding body-mind health. Dance is a universal form of human expression and it constitutes a pleasurable and captivating activity that involves motor, cognitive, visuospatial, social, and emotional engagement (Burzynska *et al.*, 2017). Currently, there is increasing interest in dance as a therapeutic intervention for various clinical groups ranging from neurological disorders, including schizophrenia (Martin *et al.*, 2016), depression (Karkou *et al.*

2019), neurodegenerative diseases such as Parkinson’s disease (McNeely *et al.*, 2015), to dementia prevention and management (Adam *et al.*, 2016). A vast literature concerning the functional and structural brain correlates of dance and their interactions with behavior, mainly regarding therapeutic effects of dance, highlighting the state of the art in neuroscience of dance and in dance therapy has emerged.

Dance is within straight connection with the new concept called “somaesthetics”, introduced by Shusterman in his book entitled “Body Consciousness: A Philosophy of Mindfulness and Somaesthetics” (Shusterman, 2008). Somaesthetics highlights and explores the soma -the living, sentient, purposive body- as the indispensable medium for all perception. He used the term “soma” (a less familiar expression deriving from the Greek word for body) to designate “embodiment” and to insist in the idea of a sentient lived body rather than merely a physical one (Shusterman, 2012).

The main point defended by somaesthetics is that enhanced skills of body consciousness can empower us toward better forms of self-knowledge and self-care (Mehling *et al.*, 2011). Interestingly, self-knowledge is an old issue in history, as illustrated by one of the most famous Greek maxims inscribed on Apollo’s ancient temple at Delphi: “Know thyself” (Figure 1). Moreover, ancient Asian traditions have long worked in self-knowledge subject by deploying body consciousness techniques, like meditation, embodied practices of Zen monastic everyday life, and yoga, which claim to deepen or "spiritualize" our senses and promote self-care. Indeed, recent studies in experimental psychology and neurophysiology have demonstrated that meditation training (including disciplines of self-examination, like body-scan) can effectively reduce symptoms of anxiety, depression, and panic (Saeed *et al.*, 2019). In modern philosophy, Friedrich Nietzsche¹ also honors the body as a great source of wisdom, by affirming the body as “an unknown sage” and urging people to “listen... to the voice of the healthy body”.



Figure 1 - Know Thyself - From the Apollo sanctuary in Delphi

Curiously, the term somaesthetics is also used in neuroscience, where the somaesthetic system refers most specifically to bodily senses other than those of sight, hearing, smell, and taste; that is, it designates feelings of skin (touch), proprioception, kinesthesia, bodily temperature, balance, and pain (Shusterman, 2012). Accordingly with (Poikonen *et al.*, 2018), over the decades, the focus of the neuroscientific studies has gone from ration to emotions – and recently ended up to “embodiment”, what is also named as “soma” by Shusterman (2012). Indeed, the processes of ration, emotion, social bonding and embodiment seem to be densely interwoven in the brain, as approached in the WiseMotion method (wisemotionco.com), developed by Poikonen.

This article contains three main sections. The first section will discuss the connection between body movements and the brain, highlighting the neural correlates of dance. After this overview of neuroscience of dance, the second section will present a list of scientific studies addressing the therapeutic effects of different practices involving dance, which are very structured on the embodiment or body consciousness aspect of the dance. The third section will give some

¹ Friedrich Nietzsche, *Thus Spoke Zarathustra*, in *The Portable Nietzsche*, trans. Walter Kaufmann (New York: Penguin, 1976), 145, 146-1 47.



examples of the beneficial effects of dance therapy in the patient, focusing on the psychological and emotional point of view.

II EMBODIMENT, DANCE AND THE BRAIN

The strong connection between body movement and the brain has been widely studied in terms of the brain sensorimotor system, but, indeed, this connection goes beyond motricity process. A research field known as “embodiment” or “somaesthetics” has emerged to better understand how body movements contribute to the cognitive and emotional processes in the brain. Somaesthetics theory claims that “penetrating beneath the skin surfaces and muscle fiber ... realign[s] our bones and better organize[s] the neural pathways through which we move, feel, and think” (Shusterman, 2008). Indeed, Shusterman’s theory speaks closely to Damasio’s theories related to cognitive neuroscience, which include the body in neurological processes. More specifically, Damasio refines the issues related to “the origin and nature of feelings and the mechanisms behind the construction of the self”, highlighting the importance of the brainstem as the origin of self, emotional and consciousness processes (Damasio, 2010).

The cerebellum, located just behind the brainstem, is another part of the brain which has been gaining research emphasis, based in the discovery relating cerebellum lesions not only with motor problems but also with cognitive and emotional anomalies, which is known as cerebellar cognitive affective syndrome (CCAS) or Schmahmann’s syndrome (Stoodley *et al.*, 2016). In 1996, the American scientist Jeremy Schmahmann already presented logical and anatomical arguments suggesting that the cerebellum performs the same computations for associative and paralimbic functions as it does for the sensorimotor system (Schmahmann, 1996). He predicted that “there are interactions between sensorimotor and cognitive/affective/autonomic afferents within the cerebellar cortex”, what may be interpreted as a cerebellar influence on the cognitive or affective component of movement or, in other words, a substrate for **embodiment**.

Ultimately, the role of movement on emotional and cognitive functions are being confirmed. Regarding cognition, experiments developed to study the effects of physical activity on the learning process have shown, for example, that physical activity in children benefits brain structure, brain function, cognition, and school achievement (Chaddock-Heyman *et al.*, 2014), and that physically active academic lessons of moderate intensity improves overall performance on standardized tests of academic achievement (Donnelly and Lambourne, 2011). Regarding emotional functions, there is growing evidence linking motor skills and physical activity to self-regulation². (Robinson *et al.*, 2016) conducted an experiment to examine the efficacy of a motor skills intervention to assess impulsiveness and self-control in preschool age children (4-5 years old). They used “Delay of Gratification Snack Task”³ to measure self-regulation pre and post intervention and the results revealed that children in the intervention group maintained their self-regulation scores across time, while children in the control group scored significantly lower at the posttest. Besides self-regulation, the therapeutic role of movement on emotions has also been demonstrated, like in a study conducted to evaluate the effects of the practice of Authentic Movement⁴, largely used in dance therapy, on the emotional state (García-Díaz, 2018). The results of this study showed a decrease in self-reported subjective experience of anxiety and happiness, and an increase in melancholy and anger occurred, suggesting that this Authentic Movement

² Self-regulatory skills are broadly defined as the ability to manage emotions, focus attention, and inhibit some behaviors while activating others in accordance with social expectations. (Robinson *et al.*, 2016)

³ Delay of gratification is resisting a smaller more immediate reward in order to receive a larger reward later and is related to patience, impulse control, self-control, and willpower. (Robinson *et al.*, 2016)

⁴ Authentic Movement is a simple form of self-directed movement. It is usually done with eyes closed and attention directed inward, in the presence of at least one witness. Movers explore spontaneous gestures, movements, and stillness, following inner impulses in the present moment.



practice would provoke the awareness of repressed emotions, which were previously inhibited or avoided.

Therefore, the link predicted by (Schmahmann, 1996) between sensorimotor and cognitive and emotional systems has been well reinforced by a variety of neuro-psychological clinical trials. Moreover, newer understandings of the prominent role of the human cerebellum, with abundant imaging research, has found that the cerebellum is a master computational system for both motor and cognitive areas of the cerebral cortex (Akshoomoff *et al.*, 1997; Leggio and Molinari, 2015). Cerebellum is suggested to automate the manipulation of body movements (like for example, the automaticity of movement when handling a tennis ball) in the same way as it does with the manipulation of concepts, such as number information (Vandervert, 2017). The vermis region in the human cerebellum is known to connect the motor planning to the emotional and cognitive processes (Vincent, 2018).

Knowing about this cognitive and emotional component of movement, automated by the cerebellum, it makes clear that physical activity has strong benefits in brain functions, helping to deal with emotional diseases, like depression, and cognitive issues, like improving learning process. Still more interesting is the fact that a combination of physical activity with increased sensory, motor and cognitive demands, like in dance, has been suggested to have stronger and longer-lasting effects on the brain when compared to an ordinary physical activity (Kattenstroth *et al.*, 2013). Indeed, recent experiments have confirmed the achievement of better brain benefits in dance training program when compared, for example, to conventional fitness activities (Müller *et al.*, 2017, Rehfeld *et al.*, 2017).

Research on the neuroscience of dance can lead to a better understanding of brain-behavior relationships, since dance provides a unique opportunity to investigate brain plasticity and its interaction with behavior (Karpati *et al.*, 2015). Several researchers have investigated the role of mirror neuron system (MNS) in dance. MNS is a neural circuitry that is activated to a similar extent when an individual performs or simply observes an action. It is suggested that the brain areas involved in perception and production of movement overlap and are involved in the understanding of movement intention (Rizzolatti and Craighero, 2004). MNS activity during the observation or execution of emotional movement is thought to enhance activation in the limbic system, leading to a greater empathic response (McGarry and Russo, 2011). Indeed, previous studies had already shown that observation and imitation of emotion activated corresponding brain networks involving the MNS, as well as areas associated with emotion, such as the insula and amygdala (Carr *et al.*, 2003; Wicker *et al.*, 2003). These neural correlates of empathy, found in activation patterns of MNS, have been used to support the application of dance therapy to help persons with mimicry or MNS deficits, such as patients with autism, as will be seen in the next section.

Investigating the brain activity of dancers and nondancers while they observe dance performance is also an interesting approach to provide insight into how dance training may affect the MNS, also known as action observation network (AON). To this aim, different kind of experiments have been conducted, using (1) functional magnetic resonance imaging (fMRI) in the observation of different dance styles, such as capoeira (Calvo-Merino *et al.* 2005) and modern dance (Cross *et al.*, 2006), (2) electroencephalography (EEG) to measure event-related potentials in the observation of correctly and incorrectly executed tango steps (Amoruso *et al.* 2014) or (3) transcranial magnetic stimulation (TMS) to stimulate the primary motor cortex while recording the muscular response with electromyography (EMG) and comparing the observation of video-recorded versus live performances (Jola, Grosbras, 2013).

In sum, those experiments to study the action observation in dance have suggested that: (1) dancers show activation of the AON, particularly the premotor cortex, when observing dance,

likely because they have an enhanced motor representation of an observed movement; (2) functional differences in the AON of dancers are related to the degree of dance training; (3) short-term dance training is correlated with brain functional plasticity in nondancers, highlighting the importance of long-term dancing; and (4) observation of recorded versus live dance performance results in differential brain activity, which was enhanced when watching live compared to video-recorded dance. (Karpati *et al.*, 2015)

Although the studies of dance observation are very interesting, they are also limited, since the question about what happens in the brain while performing actual dance remains unaddressed. Despite technological and methodological challenges to get brain measurements while the body is moving, given the potential motion artifacts, the feasibility of conducting neuroimaging while dancing has been demonstrated, and several brain regions have been implicated in dance execution. Some researchers have created experimental paradigms that allow the study of some aspects of dance performance. For example, (Brown *et al.*, 2006) designed an apparatus allowing amateur tango dancers to perform tango steps (involving leg movements only) while in a positron emission tomography (PET) scanner, as illustrated in Figure 2. Results showed that the cerebellum was activated in the entrainment of dance steps to music, the putamen was involved in metric motion, and the superior parietal lobule was implicated in spatial guidance of leg movements (Karpati *et al.*, 2015). Unfortunately, this study may not be generalizable to more complex motor tasks or to real dancing.

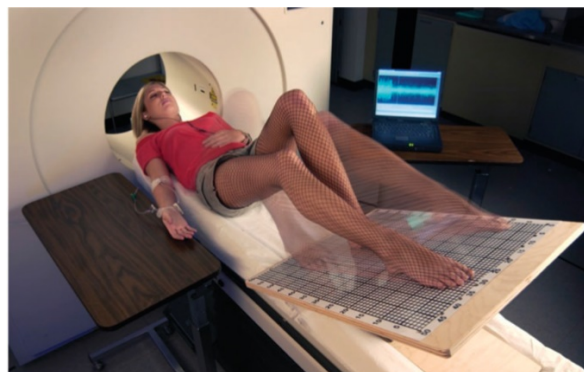


Figure 2 - A subject illustrating the tango dance task. Adapted from (Brown *et al.*, 2006)

In order to measure whole-body dance movement, (Tachibana *et al.*, 2011) used functional near-infrared spectroscopy (fNIRS), which has less motion sensitivity, to study brain activity in nondancers while they performed a dance video game. Additionally, (Cruz-Garza *et al.*, 2014) used a mobile EEG and inertial sensors in the body of dancers to extract information about expressive movements⁵ performed during dance. EEG was used as an input to a machine-learning algorithm that classified movements based on the thought or performed expression, demonstrating the feasibility of using EEG despite motion artifacts, which did not limit the movement classification. In sum, findings from these studies pointed to a network of brain regions implicated in various aspects of dance performance, in particular the superior temporal gyrus, superior parietal lobule, frontopolar cortex, and middle temporal gyrus (Karpati *et al.*, 2015).

The changes in brain function observed in expert dancers compared to non-expert could have a brain structure correlate. This was investigated in a few studies, like those conducted by (Karpati

⁵ Expressive movement occurs through shifts in thoughts or intentions and communicates something about the personal style of the mover. It differentiates from functional movement, which is task-oriented and mechanic, like cycling or walking, not communicating an attitude or expressing an emotion (Cruz-Garza & al., 2014).



et al., 2017) and (Giacosa *et al.*, 2016) using MRI to perform detailed gray- and white-matter analysis in expert dancers versus controls. Results from cortical thickness analyses showed that dancers have thicker gray matter (containing the soma of the neurons) than controls in the superior and middle temporal gyri and precentral gyrus. Regarding brain white matter (containing the axons of the neurons), results from diffusion tensor imaging (DTI) analyses showed that dancers have greater white-matter diffusivity in the corpus callosum, corticospinal tract, and superior longitudinal fasciculus. Therefore, the studies suggest that long-term dance training is associated with brain plasticity in both gray- and white-matter regions associated with motor and auditory functions (Karpati *et al.*, 2015).

To bring all this neuroscientific knowledge into practice, Dr. Hanna Poikonen, who is both neuroscientist and professional dancer, has developed the WiseMotion method, designed in workshop format, to improve physical abilities, self-awareness and social bonding through movement and neuroscience. The workshop is based on guided improvisation, neuroscientific explanation of the experience, and group conversation. Each workshop covers a topic such as Creative Process, Embodied Collaboration, Imagination and Reality, or Emotions in the Body and Mind. It is also applied for patients suffering from brain illnesses (such as dementia, Parkinson's disease, stroke) and to their family members and friends, where the exercises are designed to support the brain health and to enhance the emotional connection between the patient and the healthy participant (Poikonen, 2018).

In addition to the brain plasticity, dance also largely affects the plasticity of the spinal cord and peripheral nerves throughout the rest of the body, although this field has been less studied in the literature. Practice of exercise, including dance, can help spinal cord and nerve recovery after injuries (Fu *et al.*, 2016; Gordon & English, 2016), via axon regeneration through mechanisms, involving neurotrophins (English *et al.*, 2014) although the effectiveness of exercise is humans in less clear than in rats (Gordon & English, 2016, van Meeteren *et al.* 1997, Armada-da-Silva *et al.* 2013). Exercise favors the neuromuscular junction formation (Nishimune *et al.*, 2013) and neuromuscular tissue health (Koutedakis *et al.*, 2008), improving motor skills. It can also favor recovery of peripheral neuromuscular fatigue (Caroll *et al.*, 2017). Finally, balance exercises also help reducing symptoms in patients with peripheral neuropathies (Streckmann *et al.*, 2014). The specific effectiveness of dance compared to other types of exercises remains to be studied.

This large overview of neuroscience of dance, showing how dance can positively act in the brain, opens a wide range of opportunities to deal with body-mind health based in therapeutic dance approaches, which will be addressed in the next section.

III PSYCHOPHYSIOLOGICAL BENEFITS OF THERAPEUTIC DANCE APPROACHES

Dance combines a physical activity with a rich sensorimotor and cognitive engagement, as well as other social and emotional stimuli (Kattenstroth *et al.*, 2010). Multiple studies have shed a positive light on the impact of dance related interventions to improve body-mind health in the cognitive, emotional and physical capacity domains. A big variety of dance practices, ranging from **Dance Movement Therapy** (DMT) to a combination of different dance styles, has been investigated with relevant benefits being demonstrated as illustrated in the following set of scientific studies.

DMT is a form of therapy which focuses on movement behavior as it emerges in the therapeutic relationship, in order to promote emotional, cognitive, physical, and social functioning (ADTA 2009). It is characterized by emphasis on the non-verbal, communicational aspect of dance (Karkou and Sanderson, 2006). In a pilot study with older people with dementia using circle dance, it was concluded that participants benefited emotionally, socially, and cognitively, as



following described:

“Circle dance provides an opportunity to engage in touching, holding, moving together gently, and to be part of a group; this promotes re-attachment and connection by overcoming communication difficulties through the use of non-verbal means” (Hamill *et al.*, 2011).

Regarding stress and depression, which are considered the largest causes of mental ill health worldwide, dance therapy has also shown its effectiveness. (Verreet, 2010) has confirmed a significant improvement in the symptoms of chronic stress and burnout, when evaluating the effects of DMT on emotional exhaustion of professional care workers in residential aged care services. In a meta-analysis about the effects of dance on health-related psychological outcomes, such as depression and anxiety, Koch *et al.* (2019) suggested that DMT decreases depression, anxiety, increases quality of life, and interpersonal and cognitive skills. In this analysis, follow-up data showed that on 22 weeks after the intervention, most effects remained stable or slightly increased.

Another interesting aspect of DMT is its capacity body consciousness, which is very useful in the treatment of psychiatric diseases. For example, several scientists understand schizophrenia as a form of disembodiment of the self, arguing that the approach of embodied therapies, such as DMT, may be more suitable to address its symptoms. Martin *et al.* (2016) conducted an experiment with patients with schizophrenia diagnosis and, after 20 sessions of treatment (DMT or TAU), patients receiving movement therapy had significantly lower negative symptom scores, with mean symptom reduction in the treatment group of 20.65%. They concluded that embodied therapies are highly effective in the treatment of patients with schizophrenia, strongly suggesting that DMT should be embedded in the daily clinical routine. Embodiment was also described by Beard & Koch (2016) as a relevant benefit, during an experiment with psychiatric patients using circle dance:

“The ritual and the circle are powerful entities, creating solidarity, a sense of community, inclusiveness, and equality. The circle acts as a container as well as being contained by the therapist: given that psychiatric patients often have a limited sense of their body boundaries, which may indicate a lack of differentiation between self and non-self, the circle dance, by creating boundaries, helps in the definition of the self.”

DMT using circle dances has also pointed out the role of touching in the therapeutic process, which deserves to be detailed as following. King (2014) designed a pilot study to examine the effects of Irish circle dances used as rituals during the beginning and end of DMT sessions in three experimental groups consisting of people with severe, predominantly psychotic, mental illness. The first group performed a dance with jump rhythms and holding hands, the second group performed the same dance without jump rhythms but holding hands, and the third performed it without holding hands but with jump rhythms; a control group did no movement at all. It was found that the most important aspect of the approach was the holding of hands, since the depressed affect decreased and the vitality increased most significantly in the group that danced with holding hands but without the jump step. Therefore, holding hands has an underlined significance as a nonverbal way of interacting, helping even the most withdrawn participants to be included, feel accepted, safely touch and be touched, while at the same time having bodily boundaries affirmed (Karampoula and Panhofer, 2018).

Another powerful process used in DMT is mirroring, also called as empathic reflection, which involves imitating qualities of movement to enhance emotional understanding between a therapist and client or among members of a group (McGarry and Russo, 2011). Accordingly, with (Berrol, 2006), mirroring in DMT may lead to shared activation in MNS networks between participants



and be responsible for reported enhancement of emotional connections following a DMT session. Indeed, in a dance movement approach, designed by (Behrends *et al.*, 2012), to foster empathy in people with autism, they suggested that conscious practice of the mirroring technique contributes to increased social integration and affiliation. In another study to evaluate the success of specific DMT therapy interventions, (Bräuninger, 2014) concluded that mirroring approach may strengthen the group members' self-confidence and physical resilience.

Regarding the practice of Dance Movement Therapy (DMT), we have to point that, despite the actual evidence of its benefits, current clinical guidelines still do not include DMT interventions in their recommendations mainly because of inconclusive results made with very few studies, like in the 2015 Cochrane review of DMT for depression (Meekums *et al.*, 2015). To address this perception of insufficient research evidence, recently, (Karkou *et al.*, 2019) made a systematic review with meta-analyses to evaluate the effectiveness of DMT to treat depression. In this review, 351 people with depression (mild to severe) participated, 192 of whom attended DMT groups while receiving treatment as usual (TAU) and 159 received TAU only. Analysis performed on depression scores before and 3 months after the completion of DMT groups suggested changes in favor of the DMT groups, and the highest effect size was found favoring DMT plus TAU, when compared to TAU only. Therefore, (Karkou *et al.*, 2019) concluded that DMT is an effective intervention in the treatment of adults with depression.

Besides the conventional DMT approaches, a variety of studies have applied different dance interventions to deal with body-mental health. Kattenstroth *et al.* (2013) investigated the effects of a 6-month dance class (1 h/week), with gradual increase of complexity, on a group of healthy elderly individuals compared to a matched control group. The results showed that dance intervention enhanced postural, sensorimotor, and cognitive performance in elderly without affecting cardio-respiratory functions. In a more recent study, Müller *et al.* (2017) applied a dance-training program stressing the constant learning of new movement patterns. They used five different genres (line dance, jazz dance, rock n roll and square dance) switched after every fourth session, to evaluate 22 healthy seniors (63–80 years), randomly assigned to either a dance or a sport group, for a period of 18-month study. After 6 months, they found a significant increase in gray matter volume in the left precentral gyrus in the dancers compared to controls (sport group), highlighting the potentiality of the dance to counteract age-related gray matter decline even when compared to sport activities. After 18 months, volume increases in the para-hippocampal region, a region involved in learning and memory where neurogenesis can occur, were also observed in the dancers.

Biodanza is another example of practice that combines dance, listening to music, social interaction and bodily expression. Chilean anthropologist Rolando Toro Araneda created Biodanza in the 1960s. It occurs in a group during sessions led by professors appointed facilitators who prepare exercises in advance. Several hundred exercises have been created. They are practiced individually, in pairs, in small groups, or with the whole group. Each exercise is performed on specific music, chosen by the facilitator. The first exercise in a session is often a simple round. Except for sharing at the start of the session, participants do not speak during the session. At the start of each exercise, the facilitator gives instructions, and can possibly demonstrate them. Often, the exercises involve a large part of free expression movements. The look, as well as, sometimes, the contact, can be put to contribution. Similar to DMT, there are some recent publications showing the benefits of Biodanza on health (Giannelli *et al.*, 2015), stress reduction and wellbeing (Stueck and Tofts, 2016) and in fibromyalgia (Carbonell-Baezan *et al.*, 2012).

Elderly people, including both healthy and those suffering with chronic diseases, such as Parkinson disease (PD), have shown to be benefited by dance interventions. Systematic reviews (Shanahan *et al.*, 2015, McNeely *et al.*, 2015) on dance effects in PD and older adults have been



done focusing on both motor and non-motor symptoms, such as mood dysfunction, impaired cognition, reduced participation, and lower quality of life (QoL). Tango was most frequently chosen to target impairments in PD including backward walking, turning, and changing speeds; besides tango, other dance styles, such as salsa, folklore, ballroom and contemporary dance, were chosen to address impairments in mood, cognition, participation, and QoL. The results, obtained from the studies included in these reviews, present evidences to support the potential for dance to improve both motor and non-motor impairments in PD and healthy older adults.

Dance has been used extensively for the treatment of gait and balance dysfunctions in individuals with PD, but such dysfunctions are largely observed in patients with stroke, multiple sclerosis, spinal cord injury, and Huntington's disease. To address this group, a recent systematic review (Patterson *et al.*, 2018) has revealed significant changes in balance, gait and functional mobility outcomes that were similar to or greater than those previously found in individuals with PD as reported in (Shanahan *et al.* 2015). Since the review included different dance types, it is suggested that the gains in mobility can be made with different forms of dance across different neurological conditions (Patterson *et al.*, 2018).

Besides promoting body-mind health, dance can be also a powerful tool to promote empathy among different cultures, fostering social inclusion, which is also an important aspect for mental health. A recent study applying capoeira (Afro-Brazilian dance) classes in a primary school, located at a regional city in Western Australia, was conducted by (Radicchi *et al.*, 2019). Since capoeira arose from and helped people rise above black oppression, the study purpose was promoting of mental health and preventing prejudice behaviors using an intercultural perspective in a school where nearly half the students are Aboriginal. The study has shown positive results with aspects of movement, joy, dance and music identified as important experiences, with empathy towards the new culture evidenced by many of the students.

Overall, the therapeutic benefits of different dance approaches are closely related to the essential role of body consciousness promoted by dancing. To go further in this physical body consciousness aspect, next section will give some concrete examples of the beneficial effects of dance therapy interventions in the context of the hospital, focusing on the psychological and emotional aspects.

IV CLINICAL PSYCHOLOGICAL BENEFITS OF DANCE THERAPY

Within the palliative care unit of the Nice hospital (France), an innovative practice of dance therapy has been set up with a dance therapist who offers a "Breath and movement" workshop. The simple idea of dance therapist in agreement with the multidisciplinary medical team is to bring movement and life to patients immobilized in the hospital. Patients in the Palliative Care Unit have serious and progressive illness and present with complex symptoms. They have very often experienced a long course of illness made up of successive hospitalizations. In addition to physical pain, there is often moral suffering linked to the loss of autonomy, immobility and the confinement imposed by the hospital. The dance therapy workshops have the therapeutic aim of opening up a space of creativity so that patients can once again connect to their inner but also outer life.

Dance therapy is a creative approach aimed at bringing back movement. Through this art of movement, she participates in restoring the identity of the person beyond their condition as a patient and the constraints imposed by serious illness. It is a form of bodily artistic expression that does not require the use of speech. This allows the participants to become aware of the path that exists between the emotions, the deepest sensations and the personality.



The body is the repository of each individual's experience and the dance makes it possible to reconnect with the history of the subject who can once again tell his story. We are no longer, there, in the obligatory discourse of speech, but in being through movement. Dance therapy exploits these aspects and tries to derive a therapeutic effect from them, by adding a psychological dimension for the patients.

Moreover, the physical dimension of dance adds to the awareness of sensations, the muscular and joint maintenance of the body. The aim is also to provide the patient with a feeling of physical well-being that awakens the living body, and no longer the body associated with the disease. "Dance, art, are modalities of being in the world... In dance therapy, we seek to restore or establish this implication and this intertwining of the subject with the world, through the mediation of the moving and sensitive body" (Lesage, 2006).

We have been able to observe to what extent this re-movement, however small it may be, allows patients to reconnect with pleasure and desire: no longer to be faced with a "suffered" body but to be aware of an active body. Breath and movement remain linked to life as it is; reactivating them is also being able to cope with anxieties and suffering. "Dance is what makes the breath visible" (Halprin, 2013). Dance therapy is an art of the living, it reconnects with the expressive force of the body. Before acquiring language through speech, we explore the world through our body, we experience through our senses and dancing is like telling something about your life. In her book "The Expressive Force of the Body", Daria Halprin, a dancer specializing in art therapy, explains the richness of a work based on the bodily dynamics of movement (Halprin, 2002). For her, this therapeutic work, which uses artistic expression based on movement, really takes into consideration that "our body contains the history of our life, exactly as it contains bones, muscles, organs, nerves and blood".

4.1 The conduct of a dance therapy session at the hospital

Let us first describe the setting of the session. To create a reassuring and enveloping setting with the patients and set up the dance therapy workshops, it is important to understand the institutional framework and the environment of the hospital service, its possibilities and constraints. The role of the dance therapist is to be able to adapt to its functioning to bring a new and creative dimension to the patients. How to offer a space for creativity in a standardized and codified system? How is the dance therapist located within the institution while knowing how to free himself from its social and functional codes? These questions are essential for setting up the therapeutic framework for dance therapy workshops. They are to be compared to the long works of Jean Oury on institutional psychotherapy and to the foundations of his practice. "The fundamental question, to always ask yourself, he said: 'What the hell am I doing here?' does not expect an answer that would be only circumstantial, conjunctural; it touches on existential and ontological dimensions. But by exposing himself to this permanent work of reconstruction, of creation, perhaps Jean Oury shows us a path to follow, in order to be able to stand, in the strong sense of the term, clinically, next to these existences that disease has destroyed." We actually like to think that there really are several dimensions of the framework and, in particular, the therapeutic framework in the face of the management of the disease as it is. The dimension of being and its place in existence is in our opinion essential and involves a presence in the moment and the encounter. The dance therapist is not only in an artistic dimension, it is also in a therapeutic link and this is what constitutes the framework of the workshops. The dance therapist goes on the proposal of the multidisciplinary team to meet the patient in his room. The first step of the work is to establish a meeting with the patient outside the framework of purely medical care



and to create from this meeting a relationship of trust between the patient and the therapist. During this meeting, the framework and the outlines of the workshop are set with the patient and the entourage if necessary. Depending on the wishes and possibilities of the patient, the session can take place either in a room or in an activity room, which is a room dedicated to artistic activities in the department or in the outdoor garden of the unit. The dance therapist offers a new space to the patient, whether physical, imaginary or sensory. It is a matter of the patient being able to hear this proposed space around dance therapy as an open space, and that takes time to learn. “What does ‘tame’ mean?” said the Little Prince.... It’s too much forgotten, said the fox. It means ‘to create links...’” (Saint Exupéry).

The time and content of the session is adapted to each patient, depending on their pathology and the limitations it imposes on the patient. In addition, the duration of the session can vary from a few minutes to over an hour depending on the desire and fatigue of each patient.

A dance therapy session in a palliative care unit is a unique encounter in a suspended space-time since the person’s vital prognosis is engaged. It is not in any case to present the course of the session to the patient but to offer him a space for artistic mediation that meets his needs and especially his availability in the present moment of the meeting. You have to listen to others to find the right time. So how do you create a link when time is suspended, or even reversed between a dying being and a living being? When the patient is aware of a body projected towards the end, how can the dance therapist bring the person back to a time of experiencing, of the sensory? Donatien Mallet, doctor of medicine and practical philosophy, responsible for the palliative care unit of Luynes-CHRU in Tours, developed very well this very particular question “Time of times in a palliative situation”. He breaks it down into three stages:

1 - Freedom of the moment: possibility of creating an event through the encounter that breaks with the functional and institutional rhythm. We are no longer in the lap of time to do something but we embody the moment to be free to express ourselves.

2- Kairos: the sense of time united with the tastes, the emotions, the experience and the uniqueness of each one, which makes it possible to be at the right time. The one who comes to break with the passage of time! The moment when acting becomes opportune and essential to allow the other to open up to a narrative identity.

3 - Existential time: experience of the duration of time in us, the one that values “here and now” to maintain an open future in a limited future. An ethical time that Donatien Mallet defines very nicely as “A continuous dance with a musical time.”

To create this moment of dance through musical time, you have to respect the times and the rhythm of the person. It is a work of listening and of right presence, where the clinch makes it possible to experience the duration so that the person is no longer in a deadly waiting time. “Movement is the principle of life” said Leonardo da Vinci, dance then punctuates the end of life and the time of death can be envisioned as a future that remains.

It is a question of interpreting the behavior, the movement as revealing of the patient’s expression. The therapist will forge links between spontaneous bodily manifestations and dance, gestures integrating rhythm, space and breathing. It is about identifying the behavior, the movement as revealing of the patient’s expression. “The body expresses the personality on the physical plane and movement makes the personality visible” (Halprin, 2002).



The body is there a source of narration and the vehicle of emotions: we will use the body as a path towards our own interiority and as a therapeutic support. As a dance therapist “There is a lot to observe and feel when we look at the movement, our own and that of others”. Through these observations of bodily movements, we can establish relationships between tensions and muscle tone. Through this work around the breath and the movement, we look to see if there is a presence and a level of tension and relaxation. We can notice the flow of the breath in relation to the movement. We carefully follow the mobility of the parts of the body in action. We are in bodily awareness facing the other in a present tense often punctuated by music. Being in consciousness brings us back to the fragility of the present time which means that no one can be an expert in the existence or the body of the other.

The dance therapist through her practice opens a dialogue; she seeks to understand the singularity of the situation, which is being lived in the present moment. She asks the person what they like to come up with music that is part of their story. It is part of a care practice where “The right presence at the right time makes it possible to meet the challenge of a unique healing art”. Walter Hesbeen, doctor of public health insists on the importance of the art of care: to dance is to be in this right presence. The person who accompanies the patient in a bodily way in order to provide therapeutic tools to the patient: to manage “meetings” and create a link, “to be a model-effector body” like a reflecting mirror by engaging in a bodily dialogue. The communication is infra-verbal via interactions between the creative gesture and the subject’s unconscious desire.

Below is the link for a video illustrating the clinical case of a patient:
https://www.linkedin.com/posts/sandrine-cochet-03090040_s%C3%A9ance-de-danse-th%C3%A9rapie-%C3%A0-lh%C3%B4pital-cette-activité-6754488910191071234-rixX.

This video illustrates a meeting of a dance therapist with the 63-year-old patient Josette. Here is the commentary of the dance therapist: “Josette is hospitalized at the Unit of Palliative Care in Nice for palliative management of dyspnea on pulmonary metastases in connection with the progressive continuation of thyroid cancer. When I am to meet Josette, psychologists tell me about a state of bewilderment. Josette elaborates little and she answers in the affirmative or the negative. Our first meeting will be to get to know each other: Josette speaks little to me but she manages to express herself on her areas of interest. She is very fond of children, everything that has to do with the world of childhood (she who has not known motherhood) and she is very fond of pop and variety music.

I take the time of this discussion to create links; I bring her books related to childhood topics. And I accept her negative answer to listen to music and I suggest that I come back next time, which she accepts. During this first exchange, I also introduce myself, I talk to her about dance, art and I suggest that in the hospital it is also possible to leave her room for her own creativity, to reinvest her body space. It is a proposal, an open space that she will take over our meetings. There are no reading grids but always a space where the patient shares what he or she felt during the session.

These are the words used by Josette: “When you are in bed, you can feel your body become stiff.” “When I dance I feel lighter and it makes me want to move.” “It brings back dynamism”, “I feel more Zen, calmer”. Josette speaks of dance as “energizing fatigue”. “It brings me back to memories with the music I used to listen to at home.” “This is the time when I could move when with illness I am Chaos.”

What are the psychological benefits of these sessions? Josette communicates more easily about what she feels and what she is experiencing. Josette was released from the hospital and even if

dance or art does not heal, this practice has reintroduced music and movement in her daily life, which improves the quality of her existence. She is always followed in dance therapy session in supportive care, in the mobile palliative care unit of the Hospital of Nice.”

Dance therapy in a palliative care unit is a dialogue through the movement, feelings and experiences of each person beyond any socio-cultural and intellectual representation. There is a natural chord that appears throughout the dance, a conversation that harmonizes the body in space and time to become with each other and the present moment. The dance embodies this suspended moment and reveals the being beyond the limits of body, space and time. Dare to dance to meet the invisible and feel that we exist! As a conclusion we can add this sublime quote from Martha Graham “Dance is the hidden language of the soul!”

4.2 Dance and mirror neurons: the transference



Figure 3 - The mirror effect.

As already exposed in part II, dance acts on many parts of the brain, including the cerebellum which is this crossroads that links movement to cognitive but also emotional processes (Vincent, 2018). Dancing in front of a patient also activates mirror neurons and the person can identify with himself, he can put himself in the other’s shoes. Dance Therapist creates a therapeutic link with the patient and sends him back through bodily movement a living image of himself. When the patient dances, there is a feeling of connection with oneself and at the same time with the other. Moving together in synchrony to the rhythm of the music makes it possible to embody the present moment and to be in total relational harmony. Our brain being programmed to imitate the gestures of the other, the patient understands that his gestures correspond to that of the dance-therapist, it is as if he perceived the other as a part of himself (Figure 3).

Carl Gustav Jung said: “In life, our mirror is the other. We see in others the thousand facets of ourselves” (Odoul, 2002). In the hospital, patients regularly evoke this feeling of being connected. Within this dance-therapy space they say they reconnect with their desire, their desire. They no longer identify with the disease but reconnect with their history, their experiences and their uniqueness. A patient expressed to the dance therapist that their meeting through movement has freed her from speaking. This term of “unblocking”, of freeing speech, is to be put in relation with the transference. In shapelessness and transference, Laurie Laufert (2005) speaks of psychic melee: in the dance, “it would be about moving the bodily space in order to move the psychic space.”

We can also speak of interaction in the relationship with the dance therapist, because in order to bring out the subject through his own creativity, the patient must be seen differently from what he may appear. In this dance-therapy space, the dance therapist meets the person to initiate a creative



process; it does not intervene in the medical field of the disease but rather on a musical song where the patient can write the score. The person no longer sees himself only as a patient but can again identify with a living and unique subject.

“There are two modes of relation to the other: recognition and identification (...) there is a double character of the relation to the other in a tension which organizes the relation to the same and to otherness and takes counts both drive and relationship.” (Freud, 1915). Through dance, the patient finds a form of vital impulse associated with the life drive. Movement is the very principle of life, whereas the word patient refers to a form of inertia associated with the death drive. When the dance therapist accompanies the patient, she matches the person’s movements and rhythm, creating a mirror effect and an interaction between gestures and gaze. The person establishes a bond of trust because he can assume his image through a sensitive look and the shaping of his gestures. It becomes a subject and no longer a body that is the object of the disease.

Dance allows you to enter the field of perception and motor language in response to the gestures of the other. The discovery of mirror neurons by Giacomo Rizzolatti in the 1990s was revolutionary in explaining that one can enter into communication and internal resonance with others. He explains that this mirror neural system is activated during the performance and observation of motor acts of the arm-hand or mouth pair as well as during the analysis of facial expression. The dance therapist is both in the observation and the execution of the gestures of the person whom it accompanies. We talk about mirror dance, which calls on this neural system to “facilitate the trans-modal representation of an action or a sensory perception, linking its causes to the details of its perception in order to flesh out its analysis and understanding.” (Bustany, 2015).

These mirror neurons also activate memories linked to the action of dancing or listening to music. The dance therapist can thus, by observing and imitating the gestures of his patient, be in an adapted response behavior while being in awareness of what is happening in his own body. Therefore, in dance we activate our brain through feelings and observation of the body: our own and that of the other. There is then this phenomenon of transfer and internal resonance that we project as a guide to understanding others with all the hazards that this can represent: all the feelings of our experience participate in it, hence the importance for dance- therapist to carry out personal and regular work in psychotherapy, to maintain a sufficient and sensitive distance with the patients.

Through the dance, the thoughts of the body are expressed. “We speak with the belly”. A patient told me. The dance therapist opens the field of communication with body language, which is obviously a revealer of our thoughts. The thought-movement interactions are rich and can go very far. And this is what is interesting in this practice of dance therapy. “Not only can you read someone’s mind by looking at their body, you can also change their brain processes by working on their body. The dance is therapeutic because it links movement and thought; it allows you to communicate your feelings beyond the ailments.

During dance therapy sessions, the issue of gaze and attention to the other is essential. The dance therapist is in a sensitive and aesthetic gaze, this is what will also allow the person to exist beyond their condition as a patient. “When I look, people see me, so I exist. I can then afford to look and see. I then look creatively, and what I perceive (apperception), I perceive as well” (Winnicott, 2002).

4.3 Dance and self-esteem: psychological well-being

Dance therapy works the body on movement and as part of palliative care support; it considers the body in its healthy part. It is about going to seek, through the dance movement, what goes well in



the sick person; the dance-therapist thus accompanies a non-autonomous person in his existential quality. By looking for everything that is pleasant, the dance therapist allows the person to find:

- Self-assertion through the incarnation of the body, the choice of movements and the determination of the musical tastes.
- Self-esteem through the possibility of living moments of shared happiness.
- Self-confidence in doing and doing something fun.

Based on the progress made in neurobiology, Lucy Vincent (2018), a neurobiologist, explains in her book the intelligence of the body, which acts on our brain, as also shown in part II of the present article. The dance would have a beneficial action on our mood, even it would have this capacity to be able to transform it. Many patients accompanied in dance therapy express very well this feeling of gaiety and joy experienced when they dance. In the act of dancing there is this process of releasing endorphins and oxytocin but above all there is a cerebral mechanism that links posture, environmental context and emotional state (Vincent, 2018).

Patients often evoke the sensation of lightness; the dance refers to the possibilities of infinite movements because even if the movement is tiny, the patient can imagine the movement, projecting himself into another space-time. A patient who moves in his bed and lets himself be carried away by the music, says “It’s like I’m really dancing!” As we have seen previously (Part II), imagining dancing would mobilize the same brain circuits as actually dancing. They feel the same pleasure and this sensation allows them temporarily shifting their focus from the suffering body. A patient said that the dance therapy session had allowed her no longer feeling her stiffened body. Moving to the beat and imagining yourself dancing as before is good for spirit. It expresses regaining dynamism and energy!

Dance is also often inseparable from music. Through the choice of music, the patient also invests a sensory space. Listening to music has a very particular effect on the body, it affects our emotional brain, it can give goosebumps, revive childhood memories or special events: a meeting, a family event, a concert...

In the hospital, patients are able to relive sensations thanks to the music of the concerts they have attended. Anna, a 56-year-old patient with terminal breast cancer, dances as soon as she hears the first musical notes of songs she knows. Sitting on a medical chair, the dance therapist accompanies her outside her room. In the palliative care unit of the CHU de Nice, there is an outside garden reserved for patients and their families. Whenever possible, dance therapy sessions happen within this environment. In the garden, the patient is in an open, natural and living space.

The environmental context is also essential to allow the patient to be available for the session. His feeling of movement will not be the same depending on the physical space in which he is located. In the garden, she has the opportunity to listen to the music she loves in the open air. Thanks to a portable speaker, which is connected to a music application, the dance therapist can go and find the music and songs that the patient wishes to listen to. Anna is then a force for proposal, she is eager to listen to what will revive memories, her life story. The music instantly summons movement; she closes her eyes and begins to move to the rhythm of the music, which transports her to another space-time. She tells the dance therapist that she used to go to concerts. Being in a concert is listening “live” with thousands of people who share and experience an artistic event at the same time. A common energy and vibration create resonance and movement. In a concert the body perceives all these elements, the person is in an individual feeling at the same time as they dance, sing and listen to the music in unison.

4.4 Dance is a shared rhythm: social proximity



Dance is a tool for self-exploration but also a precious tool for bonding. Moving together and performing movements to the rhythm synchronously with others is a moment of communion that brings people together. Dance has been used for over 40,000 years to communicate and unite communities, in which it always refers to a mode of belonging to a group.

Since all time, “dance has had this essential and founding faculty of inviting men to share rhythm, images, sensory and sometimes sensual pleasure, drawing on individual and community memories. This immemorial anchoring in myths and in childhood makes it a dynamic source that can restart the subject ... step by step” (Lesage, 2006).

When a patient sings, dances, listens to music, he reinvests a rhythm, which is also his own. Some researchers link our affinity for rhythmic music to the existence of our own internal rhythms, in particular the heartbeat. It is also synchronous in sharing the rhythm with one another: many patients in the hospital have found the pleasure of moving again as they recall memories of singing and dancing together. Moreover, in French the word Choir (“Choeur”) has the same sound or even resonance as the word heart (“Coeur”). Anna at the end of the session expresses her feelings “Without music, life would be sad because if it touches you, the music penetrates your heart. When I dance I feel like a puppet but be careful, I am the one pulling the strings. Nothing is imposed on me! Music transports me and it makes me do what I want!”

Dance therapy is above all a meeting between one’s body and that of the other. In this meeting in motion, there is no expectation of oneself or the other; there is this movement, which interacts between oneself and the other (Figure 4). Besides, Anna uses the expression: “Music, it touches you” and indeed in dance, touch and contact are concrete. When we move to music together, especially in a nearby space, we are connected to each other. The dance therapist is close to Anna, she accompanies her movements synchronously, she sings with her. In events like concerts that Anna may have attended, people who move, sing and dance together end up as one. There is a very strong sense of belonging, of being connected to a whole and that is written in emotional memory. During the session, Anna comes to wake up all that, she comes back to life with her sensations and at the same time, her memories come to the surface. Rediscovering this social space through the creative movement is what allows Anna to break the isolation that comes with being sick. This is one of the therapeutic aims of dance therapy: it once again creates a link between oneself and the other, its memories and its pure desire. Anna can do and express what she wants; her cancer is no longer at the center of her life, she dances, and sings to release her creative energy. Margaret Newell H’Doublor created the first dance major at the University of Wisconsin and built her pedagogy and philosophy on “the true nature of dance”. She said: “Dance is an individual and social path for deep learning, to creatively express our emotional life and make our soul grow.”



Figure 4 - Henri Matisse. *La danse II*.



4.5 Dance therapy in healthcare: how dance therapy helps improve well-being and affects our health

A recent WHO report (2019) investigates the link between art and health. Any form of art like dancing can benefit your health, both physical and mental. This is one of the main findings of a new report from the WHO Regional Office for Europe, which analyzes evidence from more than 900 publications from around the world. It is the most comprehensive evidence-based study on the arts and health to date. “Bringing art into someone’s life through activities such as dancing, singing or going to museums and concerts gives us an additional key to improving our physical and mental health”, says Dr Piroška Östlin, WHO Regional Director for Europe ad interim. The examples of dance therapy sessions at the CHU de Nice join the examples cited in this unprecedented report. Dance therapy, like art therapy in general, considers the health and well-being of the patient in a broader societal and community context, and offers solutions where usual medical practice has so far failed to provide effective responses. The dance therapy sessions aim to work on the existential dimension of people. “Art is inherent in living” (Winnicott, 2002). We could also take this philosophical quote from Seneca “Life is not waiting for the storm to pass: it is learning to dance in the rain”.

These two sentences are a good illustration of the essential part that art occupies in life; art allows to shape our experience, our emotions, to resolve psychic conflicts but also to transform the difficulties of life. “Dancing in the rain” is to allow the patient to act on his illness, to shape his suffering, to transform his pain to express what he is deep within himself. The objective of our dance therapy project is to improve the management of the suffering of patients hospitalized in Palliative Care Unit by opening up a space for them to express themselves through the body. This body is no longer only supported in its physical and mental dimension but also in its sensitive, creative, emotional and spiritual dimension. This therapeutic approach of dance therapy aims to allow the patient to fully reinvest his place as subject by borrowing the creative process as the main mode of communication. Dance is a universal language that will create links and bring back a certain self-esteem. “Every human being has a dancer within him” (Laban, 2011). The patient is no longer just dependent on his illness; he becomes again a dancer and actor to face the pain.

V CONCLUSION

The importance of expression, communication and movement for bodily and mental well-being has become a central theme in contemporary Western discourse. The body is conceived not only as an extraordinary machine, or a means of communication with others, but also as a possibility of making us reborn in our deep unity on the bodily, mental and psychic levels. Dance and movement therapy began in the 1940s in the USA, initiated by contemporary dancers whose ambition was to evolve the world of classical dance towards an expressive-emotional dance. In 1966, was founded the American Association for Dance Therapy (AMDT). The proposed method is based on the assumption that the body and the psychic apparatus are linked, and therefore that each process is experienced both in the physical body and in the emotional body. In practice and in the clinic, this consists in the ability to mobilize the forces and tools of the physical apparatus to treat emotional pathologies. The dominant concept in this area is that the body keeps track of old experiences structured by muscle tension and has the means to tell its experiences like an autobiography, thus giving access, through the emotional-movement, to the history of the patient and/or his neurotic symptoms (Greilsammer, 2014).

Dance and movement therapy, at the crossroads of contemporary therapies, are both a recent practice and an old philosophical approach to the relationship of body and mind. By focusing on sign language and body expression as a way to expand emotional repertoire, it opens up the possibility for the therapist to learn about the patient’s individual story. The symbolic nature of movement makes it possible to remember, relive and experience emotional processes, while the integration



of physical and psychological aspects promotes integration at the verbal and non-verbal levels of the personality and encourages the translation of memories and sensations into words and thoughts. This approach is very valuable for treating patients suffering from severe mental pathologies or psychosomatic disorders for which the body becomes the vector of the psychic apparatus and sometimes the main tool of expression of communication and learning. Importantly, it has no adverse effects.

This study focused mainly on dance therapy and movement as a therapeutic method based on the understanding of the link between body and mind, by questioning movement at the crossroads of the relationship between body and mind. We considered mainly certain lines of theoretical-philosophical thought and took the occidental point of view, but we are aware that there are other theoretical paths, which are no less important (for instance oriental practices which have not been mentioned here, such as tai chi, qi gong and yoga).

Body-sign language operates as a mediator between the body, emotions and thought, and allows the patient to find a body-psyche balance. This discipline requires the therapist to have knowledge of the body, movement, analytical practice, and a subtle listening to the body-mind relationship through movement. Bringing the body and the mind together through the dance movement allows the patients expressing themselves in body-emotion-thought-spirit harmony. These processes respond to the patient's needs for an experience involving the whole being and offer him a tool to enter and act within himself, thus stimulating the patient's self-healing capacities.

Increasing methods in neuroscience and psychology have recently allowed to prove the benefits of dance therapy in both health prevention and care. Dance therapy works to improve the social skills, as well as relational dynamics among the participants to improve their quality of life. Through this form of therapy, participants gain a deeper sense of self-awareness through a meditative process that involves movement, motion, and realization of one's body. Compared to other forms of rehabilitative treatments, dance therapy has the advantage of allowing creative expression and being a holistic approach, involving mind, body, thoughts, emotions and spirit.



REFERENCES

- Adam D, Ramli A, Shahar S (2016) Effectiveness of a combined dance and relaxation intervention on reducing anxiety and depression and improving quality of life among the cognitively impaired elderly. *Sultan Qaboos Univ. Med. J.* 16 (1), e47–e53.
- ADTA. (2009) *American Dance Therapy Association*. Website: www.adta.org
- Akshoomoff N, Courchesne E, Townsend J (1997) Attention coordination and anticipatory control. *International Review of Neurobiology*, 41:575-598
- Amoruso L, Sedeño, L, Huepe D, Tomio A, Kamienskowski J, Hurtado E, Cardona JP, Álvarez González MA, Rieznik A, Sigman M, Manes F, Ibáñez A (2014) Time to tango: expertise and contextual anticipation during action observation. *NeuroImage* 98, 366–385.
- Armada-da-Silva PA, Pereira C, Amado S, Veloso AP (2013) Role of physical exercise for improving posttraumatic nerve regeneration. *Int Rev Neurobiol.* 109:125-49. doi: 10.1016/B978-0-12-420045-6.00006-7.
- Barret L F (2017) *How Emotions Are Made: The Secret Life of the Brain*. Boston: Houghton Mifflin Harcourt Publishing Company.
- Beard E K, Koch S C (2016) *A circle dance in a psychiatric setting: Can a circle dance intervention decrease levels of depressed affect among patients with mental health illnesses?* Barcelona, Spain: Unpublished thesis in partial fulfillment for the Master's in Dance Movement Therapy. Autonomous University Barcelona.
- Behrends A, Müller S, Dziobek I (2012) Moving in and out of synchrony: a concept for a new intervention fostering empathy through interactional movement and dance. *The Arts in Psychotherapy*, 39, 107–116.
- Berrol, C. (2006) Neuroscience meets Dance/Movement Therapy: Mirror neurons, the therapeutic process and empathy. *The Arts in Psychotherapy*, 33(4), 302–315.
- Bräuninger I (2014) Specific dance movement therapy interventions – Which are successful? : An intervention and correlation study. *The Arts in Psychotherapy*, 41, 445-457.
- Brown S, Martinez MJ, Parsons LM (2006) The neural basis of human dance. *Cereb Cortex.* 16(8), 1157–1167.
- Burzynska A, Fink, K, Taylor BK, Knecht, AM, Kramer, AF (2017) The Dancing Brain: Structural and Functional Signatures of Expert Dance Training. *Front. Hum. Neurosci.*, 11:566.
- Bustany, P. (2015) Les Neurones Miroirs. Dossier Sciences Psy N°1. Eds philippe Duval.
- Calvo-Merino B, Glaser DE, Grèzes J, Passingham RE, Haggard (2005) Action observation and acquired motor skills: an fMRI study with expert dancers. *Cereb. Cortex* 15, 1243–1249.
- Carbonell-Baezal A, Ruiz JR, Aparicio VA, Martins-Pereira CM, Gatto-Cardia MC, Martinez JM, Ortega FB, Delgado-Fernandez M (2012) Multidisciplinary and biodanza intervention for the management of fibromyalgia. *Acta Reumatol, Port*, 44(11):641-9. 231.
- Carr L, Iacoboni M, Dubeau MC, Mazziotta JC, Lenzi GL (2003) Neural mechanisms of empathy in humans: A relay from neural systems for imitation to limbic areas. *Proceedings of the National Academy of Sciences of the United States of America* 100(9): 5497-5502.
- Carroll TJ, Taylor JL, Gandevia SC (2017) Recovery of central and peripheral neuromuscular fatigue after exercise. *J Appl Physiol.* 122(5):1068-1076. doi: 10.1152/jappphysiol.00775.2016.
- Chaddock-Heyman L, Hillman CH, Cohen NJ, Kramer AF (2014) The importance of physical activity and aerobic fitness for cognitive control and memory in children. *Monogr Soc Res Child Dev.*, 79(4):25–50.
- Cross ES, de C Hamilton AF, Grafton ST (2006) Building a motor simulation de novo: observation of dance by dancers. *Neuroimage* 31(3), 1257–1267.
- Cruz-Garza JG, Hernandez ZR, Nepaul S, Bradley KK, Contreras-Vidal JL (2014) Neural decoding of expressive human movement from scalp electroencephalography (EEG). *Front Hum Neurosci.*, 8:188.
- Damasio A (2010) *Self Comes to Mind: Constructing the Conscious Brain*. New York: Pantheon Books.
- Donnelly J, Lambourne K (2011) Classroom-based physical activity, cognition, and academic achievement. *Prev Med.*, 52 Suppl 1:S36–S42.
- English AW, Wilhelm JC, Ward PJ (2014) Exercise, neurotrophins, and axon regeneration in the PNS. *Physiology (Bethesda)*. 29(6):437-45. doi: 10.1152/physiol.00028.2014.
- Freud S (1915) *Pulsions et destins des pulsions*. Petite Bibliothèque Payot 2018.



- Fu J, Wang H, Deng L, Li (2016) Exercise Training Promotes Functional Recovery after Spinal Cord Injury. *J.Neural Plast.* 2016:4039580. doi: 10.1155/2016/4039580.
- García-Díaz S (2018) The effect of the practice of Authentic Movement on the emotional state. *The Arts in Psychotherapy* 58, 17-26.
- Giacosa, C., Karpati FJ, Foster NEV, Penhune VB, Hyde KL (2016) Dance and music training have different effects on white matter diffusivity in sensorimotor pathways. *NeuroImage* 135:273-286.
- Giannelli MT, Giannino P, Mingarelli A (2015) Health effects derived from an annual course of Biodanza: an empirical study. *Psychology of Health Scientific Journal.* 1:84-107.
- Gordon T, English AW (2016) Strategies to promote peripheral nerve regeneration: electrical stimulation and/or exercise. *Eur J Neurosci.* 43(3):336-50. doi: 10.1111/ejn.13005.
- Greilsammer H (2014) « La Thérapie par la danse et le mouvement : entre corps, mouvement et parole ». Bulletin du Centre de recherche français à Jérusalem, 25. <http://bcfrfj.revues.org/7364>
- Halprin, A. (2013) *Le Souffle de la danse* – Film Documentaire Ruedi Gerber.
- Halprin, D (2002) *The Expressive Body in Life, Art, and Therapy: Working with Movement, Metaphor, and Meaning.* Jessica Kingsley Publishers.
- Hamill, M., Smith L, Röhrich F (2011) Dancing down memory lane. Circle dancing as a psychotherapeutic intervention in dementia—a pilot study. *Dementia, 11(6),* 709–724.
- Jola C-H, Grosbras H. (2013) In the here and now: enhanced motor corticospinal excitability in novices when watching live compared to video recorded dance. *Cogn. Neurosci.* 4, 90–98.
- Karampoula E, Panhofer H (2018) The circle in dance movement therapy: A literature review. *The Arts in Psychotherapy, Volume 58,* 27-32.
- Karkou V, Aithal S, Zubala A, Meekums B (2019) Effectiveness of Dance Movement Therapy in the Treatment of Adults With Depression: A Systematic Review With Meta-Analyses. *Front Psychol.,* 10:936.
- Karkou V, Sanderson P (2006) *Arts therapies. A research based map of the field.* London: Elsevier.
- Karpati FJ, Giacosa C, Foster NEV, Penhune VB, Hyde KL (2017) Dance and Music Share Gray Matter Structural Correlates. *Brain Research* 1657:62-73.
- Karpati FJ, Giacosa C, Foster NEV, Penhune VB, Hyde KL (2015) Dance and the brain: a review. *Ann. N.Y. Acad. Sci.* 1337, 140-146.
- Kattenstroth JC, Kalisch T, Holt S, Tegenthoff M, Dinse HR (2013) Six months of dance intervention enhances postural, sensorimotor, and cognitive performance in elderly without affecting cardio-respiratory functions. *Front. Aging Neurosci.,* 5:5.
- Kattenstroth JC, Kolankowska I, Kalisch T, Dinse HR (2010) Superior sensory, motor, and cognitive performance in elderly individuals with multi-year dancing activities. *Front. Aging Neurosci.,* 2.
- King E (2014) El baile en círculo en un entorno psiquiátrico. *Jornadas del 10o aniversario* (pp. 188–194). Barcelona: H. Panhofer, A. Ratés (Eds.).
- Koch SC, Riege RFF, Tisborn K, Biondo J, Martin L, Beelmann A (2019) Effects of Dance Movement Therapy and Dance on Health-Related Psychological Outcomes. A Meta-Analysis Update. *Front Psychol.,* 10:1806.
- Koutedakis Y, Owolabi EO, Apostolos M.J (2008) Dance biomechanics: a tool for controlling health, fitness, and training. *Dance Med Sci.* 12(3):83-90.
- Laban, R (2011) *The mastery of movement.* Dance Books Publications.
- Laufer L (2005) L'informe et le transfert. *Caïn Info* no 3 | pages 85 à 96.
- Leggio M, Molinari M (2015). Cerebellar sequencing: a trick for predicting the future. *Cerebellum,* 14:35–8.
- Lesage B (2006) *La danse dans le processus thérapeutique. Fondements, outils et clinique en danse thérapie.* Editions Eres, Collection l'ailleurs du corps.
- Martin LA, Koch SC, Hirjak D, Fuchs T (2016) Overcoming Disembodiment: The Effect of Movement Therapy on Negative Symptoms in Schizophrenia—A Multicenter Randomized Controlled Trial. *Front. Psychol.,* 7:483.
- McGarry LM, Russo FA (2011). Mirroring in Dance/Movement Therapy: Potential mechanisms behind empathy enhancement. *The Arts in Psychotherapy* 38, 178–184.



- McNeely ME, Duncan RP, Earhart GM (2015) Impacts of dance on non-motor symptoms, participation, and quality of life in Parkinson disease and healthy older adults. *Maturitas* 82, 336–341.
- Mehling, W.E., Wrubel, J., Daubenmier, J.J., Price, C.J., Kerr, C.E., Silow, T., Gopisetty, V., & Stewart, A.L. (2011) Body Awareness: a phenomenological inquiry into the common ground of mind-body therapies. *Philos Ethics Humanit Med.* 6:6. doi: 10.1186/1747-5341-6-6.
- Meekums B, Karkou V, Nelson EA (2015) Dance movement therapy for depression. *Cochrane Database Syst. Rev.* CD009895.
- Müller, P., Rehfeld, Schmicker M, Hökelmann A, Dordevic M, Lessmann V, Brigadski T, Kaufmann J, Müller NG (2017) Evolution of Neuroplasticity in Response to Physical Activity in Old Age: The Case for Dancing. *Front Aging Neurosci.*, 9:56.
- Nishimune H, Stanford JA, Mori Y (2014) Role of exercise in maintaining the integrity of the neuromuscular junction. *Muscle Nerve* 49(3):315-24. doi: 10.1002/mus.24095.
- Michel Odoul (2002) *Dis-moi ou tu as mal, je te dirai Pourquoi. Les cris du corps sont les messages de l'âme.* Editions Albin Michel.
- Patterson KK, Wong JS, Prout EC, Brooks D (2018) Dance for the rehabilitation of balance and gait in adults with neurological conditions other than Parkinson's disease: A systematic review. *Heliyon*, 4(3):e00584.
- Peck S, Corse G. Lu D-F (2017) Case Report: Energy Field Changes Approaching and During the Death Experience. *Integrative Medicine, Vol. 16, No. 6, December*, 36-42.
- Poikonen H (2018) *WiseMotion Community*. Fonte: <http://wisemotionco.com/portfolio/wisemotion-workshop-combining-dance-and-neuroscience/>
- Poikonen H, Toiviainen P, Tervaniemi M (2018) Dance on cortex: enhanced theta synchrony in experts when watching a dance piece. *Eur J Neurosci*, 47 (5), 433-445. doi:10.1111/ejn.13838
- Radicchi MR, Papertalk L, Thompson S (2019) "It made me feel Brazilian!": Addressing prejudice through Capoeira classes in a school in Western Australia. *Health Promot J Austr.* 30(3), 299-302.
- Rehfeld K, Müller P, Aye N, Schmicker M, Dordevic M, Kaufmann J, Hökelmann A, Müller NG (2017) Dancing or fitness sport? The effects of two training programs on hippocampal plasticity and balance abilities in healthy seniors. *Front Hum Neurosci.*, 11:305.
- Rizzolatti G, Craighero L (2004) The mirror-neuron system. *Annual Review of Neuroscience*, 27, 169–192.
- Robinson LE, Palmer KK, Bub KL (2016) Effect of the Children's Health Activity Motor Program on Motor Skills and Self-Regulation in Head Start Preschoolers: An Efficacy Trial. *Frontiers in public health*, 4, 173.
- Saeed S, Cunningham K, Bloch R (2019) Depression and Anxiety Disorders: Benefits of Exercise, Yoga, and Meditation. *Am Fam Physician* 99(10), 620-627.
- Schmahmann J (1996) From movement to thought: Anatomic substrates of the cerebellar contribution to cognitive processing. *Hum. Brain Mapp.*, 4:174-198.
- Schmahmann J (1997) *The cerebellum and cognition*. New York Academic Press. (pp. 575-98).
- Shanahan J, Morris ME, Bhriain ON, Saunders J, Clifford AM (2015) Dance for people with Parkinson disease: what is the evidence telling us? *Arch. Phys. Med. Rehabil.* 96 (1), 141-153.
- Shusterman R (2008) *Body Consciousness: A Philosophy of Mindfulness and Somaesthetics*. Cambridge: Cambridge University Press.
- Shusterman R (2012) *Thinking through the body: essays in somaesthetics*. Cambridge: Cambridge University Press.
- Stoodley CJ, MacMore JP, Makris N, Sherman JC, Schmahmann JD (2016) Location of lesion determines motor vs. cognitive consequences in patients with cerebellar stroke. *Neuroimage Clin.*, 12:765–775.
- Streckmann F, Zopf EM, Lehmann HC, May K, Rizza J, Zimmer P, Gollhofer A, Bloch W, Baumann FT (2014) Exercise intervention studies in patients with peripheral neuropathy: a systematic review. *Sports Med.* 44(9):1289-304. doi: 10.1007/s40279-014-0207-5.
- Stueck M, Tofts P (2016) Biodanza Effects on Stress Reduction and Well-Being-A Review of Study Quality and Outcome. *Signum Temporis* 8. DOI : 10.1515/sigtem-2016-0018.
- Tachibana A, Noah JA, Bronner S, Ono Y, Onozuka M (2011) Parietal and temporal activity during a multimodal dance video game: an fNIRS study. *Neurosci. Lett.* 503, 125–130.



- van Meeteren NL, Brakkee JH, Hamers FP, Helden PJ, Gispens WH. (1997) Exercise training improves functional recovery and motor nerve conduction velocity after sciatic nerve crush lesion in the rat. *Arch Phys Med Rehabil.* 78(1):70-7. doi: 10.1016/s0003-9993(97)90013-7.
- Vandervort L (2017) The Origin of Mathematics and Number Sense in the Cerebellum: with Implications for Finger Counting and Dyscalculia. *cerebellum ataxias* 4, 12.
- Verreet CK (2010) *Chronic stress and/or burnout & dance/movement therapy. A pilot study with professional carers in geriatric residencies.* Autonomous University of Barcelona: Unpublished Thesis for the Partial Fulfillment of the Master in Dance Movement Therapy.
- Vincent L (2018) *Faites danser votre cerveau!* Edts. Odile Jacob, Paris.
- WHO report (2019) Can you dance your way to better health and well being for the first time? *WHO studies the link between arts and health.* <https://www.euro.who.int/fr/media-centre/sections/press-releases/2019/can-you-dance-your-way-to-better-health-and-well-being-for-the-first-time,-who-studies-the-link-between-arts-and-health>
- Wicker B, Keysers C, Plailly J, Royet JP, Gallese V, Rizzolatti G (2003) Both of us disgusted in my insula: The common neural basis of seeing and feeling disgust. *Neuron*, 40(3), 655–664.
- Winnicott DW (2002) *Jeu et réalité.* Folio Essai, Gallimard.



A Acknowledgements

We thank Nancy Midol from Université Côte d'Azur- Laboratoire LapCos (Anthropologie, Psychologie cliniques, cognitives et Sociales), Campus Saint Jean d'Angely, SJA3, MSHS Sud-Est, Nice for her advices on the manuscript.

B Biography of the authors

Norma Gomes has background in Computer Science (Federal University of Goiás, Brazil) and a Master of Science in Modeling of Neuronal and Cognitive Systems (Côte d'Azur University, France). She is interested in researching the psychophysiological effects of dance and other relaxation techniques that help to promote body-mind health. Ultimately, her studies look for identifying therapeutic benefits in the joining of AfroBrazilian dances (capoeira and samba) and Yogic techniques (breathing patterns and meditation).

Sandrine Cochet is art-therapist at the University Hospital of Nice, France. She has clinical experience in palliative care unit which is attached to the Neurosciences Pole of the hospital l'Archet 1 Nice). Art therapy is a practice of care which is based on the therapeutic use of the artistic creation process. As a dancer and communication consultant, she followed a university training in the field of language, arts and performing sciences at the Sorbonne University (Paris 1), to then focus on art therapy with the University Diploma "Art-Psychotherapy Interaction" from the University of Nice. She sets up dance and art therapy workshops that meet the needs of people in institutions: nursing homes, medical educational institutes, but also associations specializing in supporting children in psychological suffering.

Alice Guyon is a former student of the École Normale Supérieure and has a PhD in Neuroscience. Teacher-researcher for ten years at the University of Paris 6, then researcher at the Institute of Molecular and Cellular Pharmacology (IPMC) in Sophia Antipolis, she currently holds a position of Research Director at the CNRS. She is interested in the interactions between the brain and the immune system under physiological and pathological conditions and in the clinical expertise of non-drug practices.