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Neuroscience and the healing art of dance

Dr. Julia Stewart Clark, Consultant Clinical Neuropsychologist, outlines the fascinating science behind dance as a 'healing' art

I am a scientist and a clinician but for seventeen years I plied my profession as a neuropsychologist within a caring community in Scotland alongside art therapists and musicians. Without really thinking about their backgrounds and what it was they specifically did I took for granted the joy and fulfilment that followed in their wake. Around them people with severe physical, medical and mental problems blossomed, expressed joy and lived their lives to the full. Later, working in acute hospitals I witnessed the Artists in Hospitals help patients explore their most intimate feelings of loss when words were not sufficient. Now working in the community I have discovered yet another of the healing arts – dance.

We tend to forget that medicine itself is a healing art. It is no accident that the study of medicine is not taught in the Faculty of Science or that it is a vocational training. Once the would-be young doctors have acquired a basis in the pre-clinical sciences they then learn their craft on the wards, in the operating theatres, hospital clinics and GP surgeries. They serve an apprenticeship as surely as any master joiner will have done.

To protect us from Charlatans and to ensure that no harm comes to us, scientific method is applied to all therapies and treatments. In this way we attempt to distil the essence within holistic approaches and discover the simplified factor within that is most responsible for the healing properties. Serendipity, the fortuitous discovery of things one is not looking for, accounts for 90% of major medical advances. Medicine is littered with accidental discoveries from the action of Penicillin and Botox to Viagra. The chance observation that a drug treatment for tuberculosis also reduced the seizure rate in people with epilepsy led to the development of a whole arsenal of designer drugs to treat epilepsy in all its many manifestations. Creative use of the chance observation is what has taken medicine forward. The science comes later to ensure that the observation is correct and safe.

I became fascinated with the strong link between music, movement and emotion when my cousin, a robust rugby playing hulk of a guy, wept while listening to a symphony. In my line of work I am used to defending against the onslaught of emotions no matter what my patients have to tell me. But this defence, it appeared, only worked against words not against music or movement as I was unable to suppress my tearful response to the final scene in a dance about dementia. Was it possible that music, movement and emotion were closely entwined in the neural network of our brains?

I began to think about the evolution of movement and orienting behaviour throughout the animal kingdom, the swarming of bees, the migrating flocks of swallows and the communication of a pod of killer whales as it moved though the oceans. Not only was group movement coordinated by sound but it was also governed by emotion and the drive to survive. To dance requires the same intertwining of the neural processes of perception, movement and emotion that a bird uses to migrate by the visual guidance of stars and the auditory calls of the flock. The ubiquitous nature of dance across all cultures as part of group rituals, the use of the military cadence, the Maori Haka to engage both spirit and mind before entering into battle and the chants at a rugby match all testify to the unifying and social nature of music, movement and emotion. We are all hard wired in the same way and we know that it works but do we know how?

Functions such as these, studied by animal behaviourists and applied psychologists, have led to the

development and study of Tau Theory. This attempts to explain how we plan and carry out coordinated movement. It relies on our perception of the world and how our brains combine this information as a meaningful whole. Our movement is monitored by a series of tau guides for vision, sound, sensation and emotion. These individual tau guides within the brain have to be closely coupled together to allow purposeful and accurate movement. This coupling is done by an internal neural rhythm originating in the part of the brain closest to the spinal cord.

This Piper rhythm, first observed by a German scientist in the early 1900's and named after him, is what coordinates muscle movement. If this rhythm is lost or blocked we can no longer move. This is what happens in advanced cases of Parkinson's disease, when the neural circuits carrying this rhythm forward, to the areas at the front of the brain that serve movement, become too damaged to work. The internal tau guides can no longer be co-ordinated, the person's face remains blank and their movements are no longer under voluntary control.

Scientists became interested after chance observations that people with a form of dementia affecting movement, who could make only halting steps and hesitate many minutes before starting to move, could still dance as if unimpaired. Music and rhythm appeared to provide the missing impetus to move, thus allowing a woman with movement problems to dance in the arms of her husband and a man with a similar condition to get out of bed unaided when his radio alarm played music. These chance observations are now being actively researched.

Isobel Curren in 2006 demonstrated that the motor system in the brain was exquisitely sensitive to stimulation by sound and that patients were able to synchronise their movement to external sounds. Other investigations showed that musical taste and cultural variations in style did not influence this effect, the factor that was universal in the music was the rhythm. Serendipity and chance observations illustrated the remarkable properties of dance and Science took the information for its own purposes to fight Parkinson's disease which is principally a form of sub-cortical dementia. At the same time the Patents Office became inundated with plans for portable devises to provide sound signals to aid walking.

Entrainment of rhythm is not new to us, it is what we experience when an audience is clapping randomly and eventually starts to clap in unison. We are not surprised when our body rhythms match themselves to day length and we suffer the penalty when we cross too many time zones. We know that soldiers have to break rhythm when crossing a bridge or the resonance set up in the bridge may destroy it. An acoustic system absorbs energy if it is forced or driven at a frequency that matches its own frequency of vibration, the opera singer hits top C and the wine glass shatters.

But theories are all very well. What do we actually know about what happens within out brains when we dance. Brain scanning machines are huge and you have to remain very still while your brain is scanned. Amazingly scientists have devised a way to investigate the Tango using Positron Emission Tomography (PET) imaging of the neural processes underlying the playing of music and dance. Not only do these scans show which areas of the brain are activated when doing these tasks but also that the same areas light up when we watch the actions thus bringing new meaning to the term audience participation. In fact there is such a strong link between seeing and doing that even imagining the actions causes the same areas to light up and it hasn't taken the sports scientists long to latch on to this idea either.

Professor Larry Parsons and co-workers used PET imaging of the brains of tango dancers each lying in turn with their head in the a scanner while performing cyclically repeated tango steps outside the scanner on a sloping surface. By analysing the scans he was able to pinpoint the brain areas used by the dancers to follow planned tango steps. In the same way he isolated two other brain circuits, one responsible for moving through the dance without looking at one's own feet and one for synchronising dance movement to the musical rhythm.

Entrainment of the dance steps to music was contrasted with self-pacing of the movements and the scans were compared. The signal of one scan was subtracted from that of the other to reveal which area of brain was specifically activated by the coarsely processed beat. 100 years after the identification of the Piper rhythm we now have the technology to visualise it.

By exploring the neuro-scientific hypotheses of movement in the context of dance, the arts and the natural sciences can meet and support each other. We have to beware of unscientific and unevaluated concepts and strive to carry out research to bridge the gap between the approaches of these different disciplines. There are many challenges when moving from brain scan to dance and from there to therapy for such conditions as dementia. We have to draw together three types of evidence – biological, social and experiential and to cross disciplines. This requires the co-construction of concepts and a vocabulary in which words have different meanings for terms used in everyday language and in different disciplines. We need a common language and then a dialogue involving the different perspectives.

It is time to turn to the scientists to validate what the dancers already know. Dance like medicine is one of the healing arts.

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References

Brown, S, Martinez M.J. and Parsons L.M. 2006, The Neural Basis of Human Dance, Cerebral Cortex Vol 16: 1157-1167

Curren I. 2006, Can Tau-guided auditory cues help control movement in Parkinson's disease patients? Edinburgh University Dissertation