Taichi Meets Motor Neuroscience

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An Inspiration for Contemporary Dance and Humanoid Robotics

By

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相看两不厌
只有敬亭山

We sit together, the mountain and me,
until only the mountain remains
Li Bai (701-762)
独坐敬亭山

Considerate la vostra semenza: fatti non
foste a viver come bruti ma per seguir
virtute e canoscenza

Consider your seed: you were not made
to live like brutes but to follow virtue
and knowledge
Dante Alighieri (1265-1321)
La Divina Commedia, Inferno, XXVI

¡Sólo queda en mi mano
la forma de su huída!

It only remains in my hand
the shape of its flight!
Juan Ramón Jiménez (1881-1958)
Mariposa de Luz

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PREFACE & COMMENTARIES

This book contributes to the "Belt and Road Book Series" conceived by Cambridge Scholars Publishing for investigating the multiple implications of China's recent 'Belt and Road' initiative (*yi dai yi lu*), a kind of 21st-century *Silk Road*. The original Silk Road, which started at the time of the Han Dynasty and continued for more than 15 centuries until the closure by the Ottoman Empire, linked the East with the West in many physical and material ways, but it was also a route for cultural trade, which is the main focus of this essay. In this reopening, cultural issues may play a long-lasting role, possibly with a smoothing effect on the economic and political relations likely to proceed anyway, but on rugged terrain.

Culture [1] is an umbrella term that encompasses the multifaceted distinguishing features of human civilizations: language, beliefs, philosophy, science, technology, religion, cuisine, social habits, arts, and so on. Although culture, as a human phenomenon, changes with time, its rate of change is surprisingly slow, and the basic traits are almost invariant over centuries. In this sense, we suggest that the Silk Road connected two areas of the world (China in the East and Europe in the West) which maintained their basic cultural features since the early times of the Roman Empire and the Han Dynasty into the twenty-first century.

The systematic analysis of the differences and similarities of the two cultural clusters are clearly beyond the scope of this book that chose a seemingly minor aspect of the Eastern culture, Tai Chi Chuan (太極拳), to address the issue. We used it as a master key to open a few communication "doors" between the two distant cultures, which are otherwise sharply different at first sight.

Tai Chi Chuan is known in the West mostly as a soft physical exercise that is beneficial, in particular, for elderly people; however, this is a dramatic underestimation of the width and depth of its influence on Chinese and more generally Eastern cultural values. Tai Chi Chuan, also defined as "meditation in motion", exemplifies fundamental characters of Chinese thinking. For example, the Taoistic view of the central role of Nature as a dynamic system in continuous transformation under the action of

[1] The word "culture" derives from the Latin "colĕre," which means to tend to the earth and grow, cultivate, and nurture what we need for living.

opposing/complementary forces (Yin and Yang), and the intrinsic unity of body and mind of each human being. Tai Chi sequences are the imitation and reproduction, on a micro-level, of the macroscopic dynamics of the natural world. Beyond the pure physical exercise, Tai Chi is primarily the expression of a philosophical attitude. Such Eastern "Naturalism", where nature holds the central stage and humans are junior actors, contrasts with Western "Humanism/Individualism", or the feeling that Man is entitled to subdue and master nature. Another contrast exists between the Eastern holistic view and Western reductionism in many areas, including science and medicine.

However, despite such contrasting cultural attitudes, there are signs of complementarity and convergence, where East and West can meet. This is metaphorically hinted at by the rationale of Tai Chi theory and practice. For example, Copernicus already shook the humanistic fundamentalism mentioned above, associated with a geocentric cosmology, at the cosmological level. He did this when he shifted humans to the side of the natural scene, and is being increasingly challenged by a growing understanding of environmental issues that put Nature again at the centre. On another level, scientific evidence put the mind-body dualism that dominated Western thinking since Greco-Roman times into a deep crisis. This is a result of neuroscience and neuropsychology, with particular emphasis on the recent developments of cognitive neuroscience. The emerging leading concept is Embodied Cognition, which enhances the deep integration and equivalence of coordinated bodily actions, skilled-prospective behaviour, and intellectual activities proper, which agree with the *meditation in motion* character of Tai Chi Chuan. Moreover, the Taoistic substrate of Tai Chi Chuan, which characterises the soft transitions posture to posture of a Tai Chi sequence in terms of a balanced interaction of the Yin/Yang forces, resonates with the Equilibrium Point Hypothesis. The Hypothesis was conceived for modelling synergy formation of whole-body actions, while elegantly solving one of the main problems faced by the brain, namely the degrees of freedom problem.

From the artistic point of view, Tai Chi Chuan offers a chance for modern-contemporary dance to renovate itself, at the same time escaping from gymnastic-like virtuosity that enhances muscle activity while decreasing the attention of the dancer on his/her state of mind and expressive fluency; this means, among other things, to induce the dancer to focus on the sophisticated simplicity of soft motion and breathing flow, thus echoing the slow breathing patterns of nature on stage. Thus, Tai Chi Chuan may help to open another door of communication between East and West, this time in the artistic field, by suggesting matching Eastern *meditation in motion* of Tai Chi with the expressionist urge of Western modern dance. That urge

erupted at the beginning of the twentieth century as a rebellion to the over-coded virtuosity of classical ballet. In medicine, Tai Chi Chuan exemplifies the need to improve the link between the Eastern holistic vision focused on *maintaining health* as a complex and multifaceted equilibrium process, and the Western reductionist attitude, aiming at *defeating diseases* one at a time with the most recent and powerful techniques, frequently losing sight of the general consequences.

Finally, we suggest that issues like mind-body unity and the associated embodied cognitive framework, which underly the theory and practice of Tai Chi Chuan, may act as a powerful source of inspiration for the next generation of humanoid robots. The point is not to program/teach such robots to imitate Tai Chi movements, but to integrate doing with thinking. in the general cognitive sense. Actually, the technology of humanoid robots is still insufficiently mature because the underlying 'robotic cognitive neuroscience' remains a work in progress. One should not confuse this with the hype of artificial intelligence. Humanoid robots are likely to enter society at large quite soon and we may expect, as for all smart technologies, that their massive adoption will imply pros and cons beyond the scope of this short essay. We suggest that the main research challenge is developing a *Cogniware* that may match the state-of-the-art *Bodyware* that is currently available so as to allow humans and humanoid robots to interact symbiotically. Again, we believe that a deep understanding of the Tai Chi Chuan theory and practice can facilitate this challenge.

Regarding the issues of Opening Doors between Eastern and Western cultures through Tai Chi, the main audience that the authors of this book implicitly considered was Western, so as to communicate the feeling that inside and beyond this exotic gymnastic there is an ocean of meaning that can help one to better understand Eastern cultures. At the same time, the authors faced the urgent need to submit their working hypothesis to a "reality check" by Eastern scholars for whom the deep rationale of Tai Chi is part of their native language and culture. For this reason, we asked distinguished Eastern scholars, who are experienced in different aspects of the problem, to read the manuscript and freely express their opinions in a short commentary. We are greatly thankful and indebted to them for lending their ears, to use a Shakespearian quote, because there is nothing as precious as the gift of attention. Therefore, the last part of this preface includes five commentaries, provided by the following distinguished commentators:

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Commentary by Rainbow Tin Hung Ho

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From Wuji (no-thingness) to Tai Chi (supreme ultimate) and Yin Yang, the classic text of I Ching (the Book of Changes) gives the principle and an explanation for almost all phenomena in the universe. This principle transcends all levels, including but not limited to time and history, the universe, and the Earth, material and immaterial, the visible and invisible, and even cultures and philosophies. Tai Chi Meets Motor Neuroscience by Morasso and Morasso resembles this concept of all being in oneness. The book begins with the principle and nature of movement in Tai Chi Chuan, and particularly its dynamic equilibrium, its embodied cognition, and its mindful imagery. The book then radiates into novel extensions to different areas: the biomechanics of moving and dancing, the spatial-temporal perception of the movement, body schema, movement analysis, dances, mind-body connection, robot technology, and wellness. The work transverses the disciplines of art, sciences, and social sciences, and at the same time, intertwines with the fields of sports sciences, performance arts, biomedical engineering, neurosciences, psychotherapy, and health. The multi-layered discussions firmly connect to the core principle of Tai Chi: unity and oneness. It is neither a top-down nor a bottom-up discussion, but rather an aggregation of knowledge and wisdom from different fields and experiences, or as the authors describe: it is a process of "symbiosis" (p.72).

This book is both ground-breaking and ground-setting, or more accurately, it is a path to the ongoing process of ground-breaking and setting. It not only opens doors between the Eastern and Western cultures; it also creates channels for discussion and exploration between disciplines and ways to converge into the fundamental principle of unity. It is like the motor imagery (covert, Yin) of Tai Chi Chuan and its realization in real (overt, Yang) movement (p. 65-66), which leads to the synergy of the body and the mind before ultimately uniting in a state of "simplexity" (p.64) (Tai Chi) and Oneness (Wuji). Morasso and Morasso's work is inspiring for both choreography and performance in contemporary dance and classical dances, for understanding the philosophies of the East and West, and for comprehending cognitive and motor neurosciences. Their work also presents insight into human intelligence and "robotic intelligence" in humanoid robots, offering guidance toward achieving holistic wellness – the unity of the mind, the body, and the environment – a state of "the dynamic harmony of the man and nature" as in Tai Chi Chung.

Mental Health Contributions of Qigong & Taijiquan: A Commentary by Henry SR, Kao

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I. Application of Qigong in Mental Health and Disease Treatment

Qigong characteristics and principles

Qigong first appeared in the Jin Dynasty and has a history of thousands of years in China. In ancient times, it was called Qi Gong, Daoyin, or Exhalation. The names of sitting meditation and meditation were officially established in July 1979, when the State Council "National Qigong Reporting Conference" collectively referred to the various types and names of "Qigong" (Lin Housheng, 1999).

Traditional Chinese medicine practitioners believe that Qi not only represents the activity of life functions but also the life message from the body's internal organs (Li Shuncheng, 1992). The human body requires Qi to survive. When Qi gathers, it forms, and when Qi dissipates, it dies. The medical world believes that bioenergy is a physical wave generated by human organs. When the organ is affected, the potential difference between cells changes will affect the permeability of the cell membrane. Xu Wenhan (2005) used advanced science, technology, and calculations to measure how the fluid flow speed affects the flow of charged tissue fluid in the intercellular space to confirm the flow of air on the human body. Movement, the existence of the airway, established a model of qi-blood exchange.

Practicing Qigong refers to the practice of breathing exercises (Li Shuncheng, 1992; Chen Guohua, 1999) to dredge the collaterals and circulate the blood. Chinese medicine believes that as long as vitality is abundant and vigorous, the body's viscera functions can be vigorous, the body can be healthy, and foreign pathogens have difficulty invading. Exercising vitality can not only cure diseases but also make one strong without diseases (Guo Huigu, 1999).

Although there are many types of qigong sects, the basic training content can be divided into three types: breath regulation, mind regulation, and body regulation (Huang Qinyong, 1999). In qigong practice, mental activities include concentration, orientation, elimination of distracting thoughts, and emotional interference, and training similar to Zen meditation. Qigong training uses abdominal breathing combined with calming body rhythmic

movements, guiding qi and blood to run along the meridians; in doing so, one can calm down the mind and emotions, relieve the mind and body's tension, and promote re-coordination of body functions. This physiological state is called the qigong state (Li Sicen, 1991), which acts as a process of human physiology and biochemistry. In the best state, the central nervous system actively rests, providing favourable conditions for the body to rest, repair, and adjust. It is of great benefit to mental illness and mental health.

Qigong's influence on health and the moods

Qigong also has certain effects on mental health and emotions. Leung and Singhal (2004) conducted a test on 80 qigong masters and 76 people who were not engaged in qigong training. The results are indexed in Eysenck Personality Inventory (EPI) scores, the number of years of Qigong practice and neuroticism showed a significant negative correlation, and the scores of qigong masters on the neurotic dimension are significantly lower than those who have not engaged in qigong training. This indicates that qigong impacts the practitioner's personality traits.

Tsang, Cheung, and Lak (2002) treated 8 patients with chronic illnesses and age averaged at 68 for depression. After 12 weeks of Qigong training, these elderly people, originally having presented with depression, felt their physical and mental functions improved, and experiences increased physical as well as psychological benefits including relaxation, comfort, optimism, and sleep enhancement. The study proves that Qigong can improve symptoms for the elderly who are depressed and suffering from chronic diseases.

Lee, Kang, Lim, and Lee (2004) tested 32 healthy men and found that the anxiety state of the training group reduced by 26%, while the control group reduced by 9%. Furthermore, they pointed out that Qigong can promote mental health for the elderly with depression and anxiety, as well as improve sleep quality (Tang, 1994; Tang, & Wang, 1990). Lee et al. (2001) also found Qigong to be effective for treating chronic pain,

Depression can be improved (Tsang et al., 2003): 50 elderly people with chronic diseases were randomly divided into experimental and control groups. Compared with the control group, the experimental group participated in a 12-week Qigong training, and the control group received general treatment. The result is that the experimental group saw significant improvement in physical health, mental health, social relations, and self-conscious health scale scores.

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II. Application of Taijiquan in Mental Health and Disease Treatment

Characteristics and Principles of Tai Chi Action

Taijiquan is a well-known boxing technique in China. It originated in the Qing Dynasty according to Wang Zongyue's book of boxing. Taijiquan is a martial arts sport that combines consciousness, breathing, and movement (Ma Xiangjia, Lin Lingli, 1997; Xu Zhiyao, 2002). Conceptually, it integrates the Taoist principle of yin and yang coexistence and uses breathing and exhalation to move qi from the meridians. In Chinese boxing, Taijiquan is a kind of internal boxing that focuses on cultivating internal Qi and internal Qi training. The Qi of Taijiquan is not the breath of air, but vitality and true energy with a deeper meaning. It can also be regarded as a kind of inherent liquid phase pressure change, or a kind of biological energy (Lin Shichang, 2001).

The energy of qi originated from pubic acid, probably under the belly button. Dantian adjusts breathing and improves cardiopulmonary function and exercise. The diaphragm plays a vital role in strengthening visceral peristalsis. Those who follow traditional Chinese medicine believe that qi is the source of life. There is a theory that "If the qi gathers, it will be born, and if it dissipates, it will die." Qi circulates through the meridians, and thoughts guide the movement of Qi. The mind can guide breathing, increase lung capacity with abdominal breathing, and slowly send breath to the pubic area, according to Applied Psychology Research. The so-called Qi gathers dantian. Through this breathing method, breathing can be soft, long, and natural. Harmony, luck with the heart, luck with the body. This is dominated by the inner mind (Kang Gewu, 1991), as consciousness and body movements become one.

The movements of Taijiquan are mainly gentle and arc-shaped interactive spiral movements based on the concept of the circle (Liu Meizhu, 1994). The centre of the action's gravity exists in virtual and solid forms; the foot of the centre of gravity is solid, the other foot is virtual, and the waist is the axis. The two feet alternate between virtual and real, using virtual and real, opening and closing, flexion and extension, advance and retreat, up and down, and change to balance. The circular arc movement is endless, achieving a combination of integrated movement and stance (Lan Xiaoqin and Li Li, 2005; Dai Junqiang, 2002). In addition, the circular movement mode allows the human body to exert the maximum exercise benefit and the body does not move. While in motion, balance and coordination are always emphasized to achieve a state of harmony between Man and nature (Zhuang Hongyi, 2000). Zhang Sanfeng, a Wudang Taoist

priest during the Song Dynasty, created the Thirteen Forms of Taijiquan (Zhao Fangren, 1991): Walking, squeezing, pressing, picking, pressing, elbow, and lean, the footwork is forward, retreat, left looking, right looking, and remaining centred.

Empirical Studies of Taijiquan on Mental Health

In general, Tai Chi combines meditation, breathing adjustment, and muscle relaxation techniques to achieve spiritual unity of the body; moreover, it is an alternative to traditional medical treatment and physical and mental therapy (Chen, 2002; Luskin et al, 2000). It has also been used in healthy adults or patients for related psychological exploration.

Clinical studies have shown that Tai Chi can effectively relax muscles through deep breathing and relaxing movements (Koh, 1981). In addition, Tai Chi has meditation skills, which can improve one's mental state, achieve the effect of alertness and more concentration (Kutner et al., 1997). Liu, Mimura, and Ikuta (2003) monitored 20 healthy middle-aged women practicing 24-style Tai Chi. They divided the test subjects into an experienced group with an average boxing age of 16 years and a beginner group with an average boxing age of less than one year. The results show that the experienced group has a lower breathing rate than the beginner group, and more active beta waves appear during exercise. Circular shapes and more alpha wave patterns appear after movement. The research indicates that Tai Chi can effectively induce mental relaxation and concentration.

Tai Chi's effect on mood improvement is mainly to reduce anxiety, relieve stress, and stabilize emotions (Brown et al., 1995). In a study of 135 healthy middle-aged men and women, the average age of women was 54.8 years, and the average age of men was 50.6 years. The subjects were randomly assigned to the control group, medium-impact walking group, low-impact walking group, and low-impact walking group. There were also the degree walking plus relaxation exercise group and the Tai Chi group. After 16 weeks of training, the women in the Tai Chi group improved significantly in terms of their emotional states, tension relaxation, depression relief, anger reduction, less confusion, and anxiety relief. Women in the mid-impact walking group were more satisfied with their physical condition, while men experienced significantly more positive emotions. In addition to this, the other groups did not have emotional and physical functions. There are significant differences in self-efficacy. This study proposes that sports training involving cognitive thoughts is better than physical training.

Sports training can more effectively promote mental health. Jin (1992) focused on the effectiveness of Tai Chi on decompression. They conducted a comparative study and divided 96 adults (48 men and women each) who usually practice Tai Chi into groups. The group received the following training: Tai Chi, walking, meditation, and reading. It turns out that the four types of training are equally effective in reducing the stress response and restoring emotional distress, though the Taijiquan group recovered better than the reading group.

Tai Chi also positively affects self-efficacy and overall self-esteem. Li et al. (2001) conducted a randomized experimental study on 94 elderly people who usually exercise little, the average age of the elderly was 73 years old, and they were randomly assigned to the experimental group and the control group. The experimental group accepted the 24-style Yang-style Taijiquan training for six months, with two groups of barriers in the 12th week and 24th week (Barrier Scales and self-efficiency (self-efficiency) for testing. The results showed that, for the experimental group, performance rating had improved significantly, and the self-esteem rating had also improved. Six months of Tai Chi training can increase overall self-esteem, specific physical self-satisfaction, and other incidentals such as physical strength and physical condition, etc. Taylor and Froelicher (2004) conducted a cross-sectional comparative study on 18 patients with coronary artery disease. It also proved that practicing Tai Chi has a significant improvement in self-efficacy. Hartman et al. (2000) surveyed 33 community elders with an average age of 68. In the study, the subjects all suffered from lower limb osteoarthritis and had not received Tai Chi training before the experiment. The machine was assigned to the experimental group and the control group. The experimental group received 12 weeks of Tai Chi training, including two one-hour training sessions per week. The two groups were tested on three aspects of self-efficacy, quality of life, and physical function before and after the experiment. The results show that Tai Chi exercises can effectively increase the self-efficacy of patients, improve the quality of life and overall health satisfaction.

Tai Chi training also has significant effects when it comes to improving sleep quality. Li et al. (2004) conducted a study on 118 community elders who were 60 years or older. The study assigned them randomly to the Tai Chi group or the low-impact exercise group. Both groups received 24 weeks of Tai Chi Boxing or low-impact exercise training three times a week for one hour each session. Measurement items included Pittsburgh Sleep Quality Index (PSQI), physiological measurements (stand on one foot, stand five times, time-consuming test, 50-feet walking speed), and health survey status scale (Short-Form-12 Health Survey: SF-12). The results show that

Tai Chi's lower impact exercise poses both sleep quality and physiological improvements. The research suggests that Tai Chi can be used as a non-drug effective treatment.

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Commentary by Shu-Chen Li

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Being a person who grew up in Asia, I am somewhat familiar with the cultural and philosophical backgrounds of Tai Chi, although I haven't yet personally learned this form of martial art. As a researcher who investigates what are the implications of age differences in multisensory perception and action for technologies that serve human-machine interaction, the title of this book naturally attracts me. Furthermore, from the perspective of lifespan development, reciprocal sharing of knowledge and experiences between generations constitutes an enriched ground for lifelong learning. As a result, when this father-daughter pair of authors gave me the opportunity to read the preprint of their book, I most delightedly accepted the invitation.

Tai Chi Chuan is one form of traditional Chinese martial arts with its philosophical root in Taoism. In a succinct and swift style, this book draws parallelisms between key principles of Tai Chi Chuan and modern concepts from the authors' own professional pursuits. Coming from the science of movement control and bioengineering, Pietro Morasso views principles of Tai Chi as the dynamic equilibrium of synchronized processes that generate a perceptive awareness space of directions and distances in one's peripersonal space for goal-directed movements. This interpretation is grounded in current neuroscientific knowledge about brain dynamics that underlie human posture and balance control, and it poses implications for designing movement sequences in dance and humanoid robots. Approaching the topic from the art and athletics of contemporary dance, Martina Morasso sees the mental representations of force flow and motor imagery practiced in Tai Chi Chuan to extend and broaden the geometric and sequential notations used in choreography. Both authors unite in their focuses on the concepts of embodiment of the human mind and animation of internal body schema to draw implications for their respective fields. Considering Tai Chi Chuan as "meditation in motion", the authors find health benefits in exercising covert and overt mechanisms for us to be more fully aware of our body and its relation to the physical environment. The balance in selecting and weaving together topics as broad as traditional Chinese martial arts, the modern science and technology of movement dynamics, as well as the art and sport of contemporary dance nicely illustrates the harmonious intergenerational exchange and cooperation between the authors.

Book review by Shu-Chen Li, Ph.D.

Shu-Chen Li is a Professor of Lifespan Developmental Neuroscience at Technische Universität Dresden, Germany. She is a faculty member in the faculty of Psychology as well as a principal investigator and co-speaker of the Centre of Tactile Internet with Human-in-the-Loop at the university.

A short commentary on Tai Chi meets Motor Neuroscience by Pietro Morasso and Martina Morasso by Toshio Tsuji

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This book is the first comprehensive discussion of Tai Chi and motor neuroscience together, and is set to inspire the future of contemporary dance and humanoid robotics.

The first author, Pietro Morasso, is recognized internationally as a leading scholar and thought leader in the field of motor neuroscience. He has investigated the neural control of movement, sensorimotor learning, rehabilitation engineering, anthropomorphic robotics and biological neural computation for over half a century. Importantly, he discovered the bell-shaped velocity profile in human reaching movements in 1981, stimulating numerous subsequent studies on the modelling of human movements.

The second author, Martina Morasso, is a choreographer and ballet master, teacher of performing arts, and university lecturer. She is the daughter of Pietro Morasso and Psiche Giannoni, a well-known Italian physiotherapist and the former director of the ART Rehabilitation and Educational Centre of Genoa, which is a school for post-graduate physiotherapists and medical doctors. Martina Morasso is well-versed in the performing arts of eastern cultures, including the Japanese arts of Butoh, Bunraku, and Noh.

As the starting point of this story, Martina Morasso adopted Tai Chi Chuan as a practice method around two decades ago. She later began to apply the practice for structuring choreographies and performances, in addition to training for herself and other professional dancers. Pietro Morasso told me that he initially considered this interest to be a fascination with a kind of "exotic flavour", considering the popularity of Eastern culture in many Western countries, including yoga, martial arts, acupuncture, reiki, and sushi. Later, he began to understand that Tai Chi is a serious and deep practice when taken seriously; it acts as a foundational pillar of many Eastern cultures.

The book consists of six parts, beginning with Prolegomenon. Prolegomenon provides an overview to the background of the book from a philosophical point of view. The Equilibrium chapter discusses still stances (Ding Shi) and transitions in Tai Chi Chuan, comparing them with equilibrium control in motor neuroscience. Next, the Motion chapter explores the simple transition of equilibrium to the passive motion

paradigm, including humanoid robotics and human-robot symbiosis. The Dance chapter proposes that Tai Chi Chuan has played a crucial role in rejuvenating and innovating contemporary and modern dance. The Health chapter describes wide-ranging evidence that the practices of Tai Chi and Qigong improve general wellness in elderly populations, and for a variety of specific pathological conditions of the body, discussing the basic "purification" of the mind-body linkage through increased awareness of the body. Finally, the Conclusion chapter summarizes five topics surrounding the Taijitu (the graphic symbol of Tai Chi) in which the authors investigate possible East-West points of contact and cross-inspiration: philosophy, neuroscience, robotics, dance, and health. The five elements may be a modern version of Yin-Yang Wu-Xing Thought, and the authors conclude that the choice of Tai Chi may provide a master key to open five different doors related to crucial aspects of culture.

Interestingly, the authors describe an analogy between the Taoistic "road" and the philosophical "river" evoked in the pánta rheî aphorism attributed to Heraclitus in Prolegomenon. Ancient Greek philosophers reached the limits of dualistic thinking, and were placed in a situation similar to postmodernism. Heraclitus' approach to transcending dichotomy can be linked to the concept of "deconstruction" against logocentrism in Derridean thought. Taijitu does not mean dualism of yin and yang. Rather, its visual representation combines black and white magatama (comma-shaped beads). In China, the representation of this concept is likened to the shape of two fish, called yin-yang fish. The black fish represents yin, and means falling on the right side, whereas white represents yang, and means rising on the left. The expansion of the area from the fish tail to the fish head shows how each spirit is born and gradually becomes more active, and eventually the yin tries to swallow the yang and the yang tries to swallow the yin. The yin then changes into the yang, and the yang into the yin. A fisheye-like white dot in the centre of the yin indicates the yang in the yin. This means that no matter how strong the yin becomes, there is a yang in the yin, which then turns into the yang. The central point of the yang also indicates the yin in the yang; no matter how strong the yang becomes, there is a yin in the yang, which later turns into the yin. The Taijitu indicates that this process infinitely repeats. This concept of black and white fish may have useful future-oriented implications for race-related conflict occurring in the modern world. Black and white fish are intertwined with each other and form a perfect circle. There is no dichotomy, and the two fish behave like the front and back of the Mobius strip.

Tao is always present, and is called "do" in Japan. Almost all Japanese martial arts, including ju-do, ken-do, and karate-do, as well as performing

arts, such as sa-do (tea ceremony), ka-do (flower arrangement), and sho-do (calligraphy) include “do”. Tai Chi involves different properties of yin and yang while balancing. This book prompts the reader to consider that there is always Tai Chi in their body and mind, which can potentially affect human movement, dance and health.

When Tai Chi Meets Neuroscience: A Commentary by Min Zhu

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In the current period of emerging conflicts between Chinese and Western ideologies and uncertainties about the future, it has become imperative to strengthen the mutual understanding between China and the West. In addition to economic and trade cooperation, enhancing in-depth exchange between academic research and culture is one of the most effective ways to do this. Such is exactly the purpose of this academic research – Tai Chi meets Motor Neuroscience. Pietro Morasso and Martina Morasso start from the investigation of the traditional Chinese martial arts form Tai Chi and try to pave the pathway (dao) of dialogue by exploring and comparing embodied cognition, creative practice, motion and health respectively in Chinese and Western cultural contexts.

This research introduces the essentials of Tai Chi practice from the perspective of neuroscience, allowing indescribable or verifiable experience and knowledge about the Tai Chi that people thought to be obtained only through physical perception to be rationally verified and analysed. At the same time, readers will also notice that insightful thoughts and concepts embodied in the practice of Tai Chi, such as Yin and Yang forces, equilibrium, and the unity of body and mind, can inspire modern neuroscience research. Looking at the potential intersections of the two different research fields can therefore simultaneously deepen people's understanding of Tai Chi and neuroscience.

One of the fundamentals of Tai Chi is the interaction between body, mind, and environment, defined in this research as the notion of embodied cognition to understand the perception and action of a human, and this idea is further illustrated in the theme of dance. The understanding of body-mind in Tai Chi philosophy is a holistic system, which is opposite to traditional Cartesian dualism in the West, and the later has been gradually abandoned by contemporary dancers and artists under the influence of neuroscience and phenomenology study. In this research, Martina Morasso proposes an idea that Tai Chi Chuan can become a solid foundation for generating new forms of contemporary dance built based on modern expressionist dance traditions, owing to the simplicity and fluidity that Tai Chi practice stresses. Although incorporating Tai Chi movements into creative practice is not a fresh idea, Martina's suggestion is based on her rich experience of choreography and her understanding of the significant impact of energy

flow (qi) on the body and mind, rather than creating exotic visual effects or simple cross-cultural forms. The emphasis of the flow of qi within Tai Chi practice and integrating body and mind to produce a great effect with minimal effort will allow artists to surprise themselves with the freedom of movement and autotelic experience. Moreover, coordination and relaxation of joints rather than muscular tension emphasises continuity and enables the body to be alert, strong and awakened, reducing injury risk. Tai Chi Chuan can therefore be a training tool for attuning dancers' body and mind, enhancing one's sensory awareness and driving energy for expressive work.

Most importantly, Martina Morasso discusses contemporary Chinese dance: "*when comparing East-West contemporary choreutic activities, one should not jump from the preliminary observation that the modern dance revolution occurred earlier in the West than in the East to the conclusion that the role of West would be to assist East artists to 'modernize' their tradition*." Her idea provides an alternative means of understanding the evolvement of Chinese traditional dance and raises a question: how does one properly define Chinese modernity? Obviously, this issue is not within the scope of the book, and there is still much room for exploration in cultural exchanges between China and the West.

PROLEGOMENA

Taijitu: the graphic symbol of Taiji, representing both the monistic and dualistic aspects of Tao. Humans practicing Taijiquan must train from a state of movement towards a state of stillness so that taiji comes about through the balance of yin and yang: every movement of Taijiquan is based on circles, just like the shape of the Taijitu.

Many in the Western world know Tai Chi Chuan or Taijiquan as a form of physical training (TCC training), characterised by five main styles (Chen, Yang, Wu, Sun, and Hao) and articulated in series of well-defined movements or forms of different length. As a training technique, Tai Chi Chuan has been evaluated experimentally in several areas, including medicine, sport, and the performing arts. Generally, Tai Chi Chuan is an exercise that aims to strengthen, stretch, balance, coordinate, and integrate the different parts of the body, thereby linking the left and right halves, the upper and lower halves, and the external and inner parts. In medicine, TCC has beneficial effects on the stability of balance in elderly subjects, often decreasing the risk of falling (Jiménez-Martín et al., 2013; Guo et al., 2014). In many sports disciplines, athletes adopt TCC as a practice of cross-training, participating in a variety of activities in addition to their chosen sport so as to improve aerobic capacity (Ruth et al., 2004), prevent overuse injuries, and relieve the monotony of repeating the same training program. Regarding the performing arts, the practice of Tai Chi Chuan has much to teach dance professionals. In addition to the obvious positive influence on general choreographic qualities like balance, centeredness, and continuity of

motion, research has shown that Tai Chi Chuan can improve the main performance itself (Yu et al., 2018). It is also commonly known that TCC beneficially affects personal wellness, largely owing to the body movement forms involved. A practitioner coordinates these forms with rhythmic, conscious breathing, and in that way TCC recruits multiple cognitive and emotional components.

Unfortunately, the general effect of Tai Chi on wellness is more difficult to investigate in standard scientific, experimental methodologies. One should also consider that the rationale surrounding TCC training is rooted in traditional Chinese medicine, which holds the basic holistic principle that health and wellness are determined by the free, unencumbered circulation of Qi or Chi (i.e. vital energy). This concept is difficult to grasp directly in Western frameworks of thought. One must also consider the underlying philosophical substrate, namely Taoism, that views the universe (both at the macro and micro levels) as constantly changing under the action of two opposing but complementary forces: Yin and Yang. Tao indeed literally means 'way', 'path', 'route', or 'road', expressing a picture of the universe in unstoppable transformation: the 'road' does not lead to any final destination but only to intermediate 'resting areas' that are temporary bases for the next 'jump'. Although this view is apparently alien to the Western cosmological frame of mind, it is natural to find an analogy between the Taoist 'road' and the philosophical 'river' evoked in the *pánta rheî* (everything flows) aphorism attributed to the Greek philosopher Heraclitus: "No man ever steps in the same river twice, for it's not the same river and he's not the same man."

Heraclitus was focused on the philosophy of *becoming* as a process of continual evolution, in contrast to the philosophy of *being*, initiated by Parmenides: two antithetic points of view. The two frameworks represent the two opposite poles of Western thinking, from the 5th century B.C. to the current time, although there were many but never decisive attempts, from Plato to Hegel, to solve or mitigate the contradiction. In particular, a distinguishing character of Heraclitan thought was the pantheistic notion of *logos*, defined as the law of interdependence and inseparability of opposing entities or forces that shape and run the world through a perennial transformation: clearly, we may find an analogy between the *logos* of such opposing entities and the *yin/yang* antinomy/complementarity of Tao. In this framework, living is struggling and harmony is not achieved by settling into an absolute being but by an incessant flowing and becoming. Heraclitus did influence a line of thinking through the centuries, such as stoicism and epicureanism, well formulated in the De Rerum Natura by Lucretius (Lucretius, 1968). Many now consider him to be a kind of precursor of the