*Athens Journal of Health and Medical Sciences 2026, 13: 1-20*
https://doi.org/10.30958/ajhms.X-Y-Z

# Bio-Connectivity in Tai Chi: Attunements and Mirrorings

*By Mauro Carboni**

*The concept of "bio-connectivity" is introduced to highlight the importance of an interdisciplinary framework for understanding the complex interactions and exchanges between living organisms and bio-inspired systems. It highlights the crucial role of species mobility and ecosystem connectivity in maintaining biodiversity and ecological resilience. By fostering collaboration across various fields, bio-connectivity aims to deepen the understanding of the dynamic interactions that sustain life and to guide the creation of sustainable systems that mimic natural processes. This paper examines the relationship between bio-connectivity and Tai Chi from neurocognitive and intersubjective perspectives, highlighting its potential to address fragmentation and promote a cohesive understanding of self. The practice of Tai Chi is internally structured into various levels and connective qualities; it exemplifies how mindful movement can generate a feedback loop between the mind, the nervous system, and muscular function, thereby enhancing proprioception and internal efficiency. Additionally, this paper explores parallels between natural phenomena and the Eight Trigrams of Tai Chi, suggesting that analyzing these connections may enhance understanding of balance, flow, and energy dynamics. This suggests that the intrinsic bio-connectivity of Tai Chi may offer a valuable framework for linking ecological science with somatic movement practices. Through this exploration, the paper aims to address gaps in existing research by integrating social, cultural, and philosophical dimensions with established clinical and neurophysiological studies.*

**Keywords:** *Tai Chi, bio-connectivity, bodily mirroring, attunements, social enaction*

## Introduction: The Tao of Bodily Bio-Connectivity

The concept of "Bio-Connectivity" provides an interdisciplinary framework for examining the interactions and exchanges of information, matter, and energy among living elements or bio-inspired systems. This definition draws parallels to the dynamic exchanges and interactions inherent in the practice of Tai Chi, as highlighted by Nathan et al. (2008).

Bio-connectivity refers to the degree to which organisms are able to move and interact within their ecosystems. It encompasses how landscapes support or hinder the movement of species, gene flow, and nutrient exchange across different habitats. This concept highlights the role of mobility in maintaining ecological health and biodiversity. The degree of movement observed among various species is intrinsically linked to the overall level of connectivity in a given habitat. This

*Professor, Conservatory of Music of Perugia, Italy.

relationship is both direct and interdependent, indicating that organisms' movement patterns can influence ecosystem connectivity, while connectivity levels can affect their movement capabilities (Crooks & Sanjayan 2006).

The "neurocognitive and intersubjective landscape" inherent in Tai Chi positions the practice as an ecosystem that fosters dynamics of adaptation and transformation, actively countering tendencies toward logical and hyper-rational fragmentation. Within Tai Chi, bio-connectivity enables individuals to perceive the body as an integrated network that engages with various systems. This concept is consistent with the classical principles of Tai Chi, which link internal physiological functions to martial arts techniques and energetic sensitivity (Yu et al. 2018).

The body is trained to move as a single, harmoniously unified structure, rather than as a collection of distinct, interconnected parts. Slow, continuous movements facilitate the release of tension throughout the body via the connective tissue. This ensures that the force generated from the ground is transmitted fluidly—passing through the legs, pelvis, and spine—until it reaches the hands. Mindful movement strengthens the feedback loop between the nervous system and the muscles, enhancing proprioception and internal efficiency.

Within traditional concepts, "Qi" (vital energy) is defined as the functional activity and communication between the body's various systems. Breath, intention ("Yi"), and physical alignment are reported to work together to maintain the openness and responsiveness of these internal pathways (Lehnertz et al. 2020, Gu et al. 2026).

Movement in nature manifests in various forms of energy, each with distinct characteristics and dynamics. Examples include the gradual shifting of soil due to erosion and tectonic activity, the unpredictable behavior of fire during consumption and transformation, the continuous flow of wind, and the dynamic rhythms of water in rivers and oceans. Additionally, the movement of flora and fauna exhibits intricate patterns, indicating agility and adaptability.

These natural phenomena can be likened to the principles of movement found in Tai Chi and Bagua (which precisely means *Eight Trigrams*), in which movement is often described using rich metaphors that reflect the essential transformative qualities of elemental forces of nature, showcasing how these movements can inspire and inform our understanding of balance, flow, and energy. In the practice of Tai Chi Chuan, there exists a profound relationship between the Eight Trigrams and the body's fundamental forces, known as *Jin*. These forces are essential for developing a nuanced understanding of movement and energy flow within the practice (Yang 2006).

Within this framework, we introduce the concept of *Bio-Connectivity as a systemic, integrative paradigm* that links ecological science and somatic movement practices. This paradigm emphasizes the interdependence of biological systems and the embodied experiences of individuals. By examining the connections between our physical bodies and the surrounding environment, Bio-Connectivity might offer valuable insights into holistic health and sustainable living practices.

Moreover, this systemic remodulation seeks to provide a theoretical and practical model that facilitates discussion of the challenges associated with the multimodal structure of the Tai Chi experience. Existing research has largely

concentrated on clinical or neurophysiological aspects, often overlooking the social, cultural, and philosophical dimensions of Tai Chi. This perspective suggests that all living organisms and natural elements are interconnected components of a single, fluid network. By establishing parallels between natural phenomena and the Eight Trigrams (Bagua) inherent in Tai Chi and Baguazhang, practitioners may translate external environmental dynamics into corresponding internal physical mechanics (Sun 2021).

Although Tai Chi is rooted in a rich philosophical and cultural tradition, today it is primarily recognized as a holistic practice that contributes significantly to both cognitive and motor development and enhances overall health and well-being (Peng 2026). The practice involves slow movements, coordinated breathing, and focused attention, which create conditions conducive to brain reorganization and the formation of new neural connections. Research has shown that sustained practice can increase grey matter volume in the insula, a brain region associated with interoception. Furthermore, maintaining attention to bodily sensations and balance may enhance the integration of sensory perception and cognition. This practice has been found to reduce mental distractions and promote self-awareness (Zhang et al. 2017, Hjortborg & Ravn 2020, Liu et al. 2025, Jin et al. 2026).

A substantial body of scientific research indicates a significant positive relationship between regular Tai Chi practice and changes in brain structure and function (Yue et al. 2026). Studies have demonstrated that consistent engagement in Tai Chi can increase gray matter volume and density in several critical brain regions. These anatomical changes are associated with various cognitive and emotional improvements, which may help clarify Tai Chi's contributions to physical well-being and mental and neurological health (Park et al. 2023).

Key regions demonstrating structural changes include the prefrontal cortex (PFC), which is crucial for complex cognitive processes such as decision-making and social behavior. The hippocampus plays a vital role in memory formation and spatial navigation, while the temporal lobes are integral to auditory processing and memory retention. Additionally, the fusiform gyrus, linked to facial recognition and visual processing, has undergone significant developments. These structural modifications in the brain are associated with enhancements in episodic memory, which involves recalling specific personal events or experiences. Moreover, notable improvements in cognitive functions, such as mental agility and memory retention, have been reported (Yue et al. 2020, Wang et al. 2025c, Yue et al. 2026).

Research has confirmed empirical observations regarding the benefits of regular Tai Chi practice for older adults, particularly for those with neurodegenerative diseases such as Parkinson's and Alzheimer's. Studies suggest that Tai Chi may enhance internal communication within specific brain networks and improve connectivity across them. This effect is especially prominent in key systems, including the Default Mode Network (DMN), which relates to resting-state activity and self-referential thought; the sensorimotor network, which integrates sensory and motor functions; and the executive control network, responsible for attention, problem-solving, and cognitive flexibility (Pan et al. 2018, Cerna et al. 2024).

The practice of Tai Chi is recognized as a valuable method for promoting both physical and cognitive development, enhancing intersubjective interactions—exchanges between individuals that foster understanding and empathy. Additionally, it has been linked to intrapersonal reprocessing, allowing practitioners to connect with their own thoughts and emotions. From a systemic biological perspective, such as bio-connectivity, Tai Chi may facilitate the reconfiguration of neural pathways, suggesting changes at various levels of cognition and experience. Research has provided maps illustrating the neural connectivity associated with these processes (Yu et al. 2018).

Thus, the relationship between Tai Chi practice and personal transformation can be understood as a cyclical process in which cognitive functions, physical movements, and changes in the brain's structure interconnect. Each session contributes to enhancements in physical well-being, mental clarity, and emotional resilience, which can ultimately lead to profound shifts in practitioners' self-perception and their view of the world around them.

At the macro level, this process organizes conscious and functional motor behaviors by activating complex brain networks in the hippocampus and prefrontal cortex. At the meso level, cognitive organization occurs during gross and fine motor learning, involving metacognitive and interpersonal dynamics. At the micro level, changes in neural activation can alter an individual's perception of themselves and others, indicating a relationship with "*Qi*", or internal energy. These changes may be associated with improvements in bodily, mental, and spiritual awareness. This indicates the potential effects of Tai Chi on executive functions, balance, motor control, and emotion regulation (Yu et al. 2026, Jin et al. 2026).

The relationship between physical activation, consistent study, cognitive processing, and participatory learning is complex. Regular practice of Tai Chi illustrates the role of mental control in balancing dualistic thinking with a holistic, embodied approach. According to Giovine (2021), Tai Chi is not just a physical discipline but also serves as a medium for self-exploration and holistic growth. Practitioners are encouraged to engage in critical reflection on their perceptions and the limitations that may affect their experiences. This reflective process promotes physical mastery and can facilitate a transformative learning experience, contributing to personal growth. Through this practice, individuals may achieve a deeper understanding of themselves while enhancing their physical capabilities.

After all, to paraphrase a well-known saying by Confucius, studying Tai Chi without ongoing self-reflection can render the practice superficial and devoid of meaning. On the other hand, theoretical or scientific exploration that lacks a substantial, personal connection to the practice may lead to misguided interpretations and potentially harmful consequences.

## Methodological Framework

### *Gestural Feedback and Empathetic Responsiveness*

Extensive research attests to the scientific validity of Tai Chi from neurophysiological perspectives, with insights from neuroscience suggesting potential avenues for further exploration (Wang et al. 2025). This study operates within established methodological frameworks and employs a conceptual analysis approach to synthesize contemporary literature. Its objective is to support the framework of "bio-connectivity", which refers to the integrated, bidirectional communication among neural, physiological, and somatic systems during mindful movement.

Tai Chi embodies an extensive array of relational competencies, prominently featuring adaptation and mutuality. Engaging in shared practice not only cultivates an empathic interchange between partners but also serves as a medium for self-discovery and the emergence of alternative identities that transcend individual experiences. This practice offers participants many opportunities to explore various aspects of themselves and their relationships with others, fostering a deeper sense of connection (Dillon et al. 2023).

The practice of martial arts offers a compelling dimension through partner exercises such as Tui Shou (Pushing Hands), which emphasize somatic listening and mutual awareness over physical strength. These activities can be viewed as a form of "physical dialogue" that facilitates an exchange focused on tactile and proprioceptive feedback. This engagement may enhance internal body awareness and contribute to interpersonal empathy, demonstrating how martial arts can serve as a medium for self-discovery and relational understanding (Shpak 2026).

Practitioners learn to "listen" through points of contact—a skill known as *Ting Jing*, or "listening energy"—by sensing shifts in weight, direction, and intention, even before a push or pull becomes visible. Rather than offering rigid resistance to an incoming force, practitioners neutralize it—a process called *Hua Jing*, or "neutralizing/deflecting energy"—by absorbing the force and redirecting it along the path of least resistance. The nervous system does more than map one's own internal alignment and balance; it also develops proprioceptive feedback—a shared spatial awareness of the partner's center of gravity. Because the practice requires cooperation to be carried out safely and effectively, the interaction evolves into relational empathy; it is no longer a confrontation aimed at dominating an opponent, but rather a continuous physical dialogue (Gomez-Lozano et al. 2023, Lin 2025).

In summary, Tai Chi serves as an embodied learning environment that cultivates both intrapersonal awareness and intersubjective relational dynamics. Through synchronized movement and continuous somatic feedback, practitioners build mutual empathy and shared understanding—deepening self-awareness while strengthening interpersonal partnerships within a bio-connective framework for personal growth (Larkey et al. 2009, Carboni 2013). Beyond the individual, coordinating movements and behaviors toward shared objectives enhances collective action. When group members align their efforts, they clarify roles, deepen cognitive engagement, and foster the shared understanding needed to develop coherent, innovative strategies. Relational mediation anchors this process

by prioritizing empathy and active awareness of others' actions, needs, and intentions (Allsop et al. 2016).

The engagement fostered by this interaction cultivates an environment in which action and observation alternate. A feedback loop within the group promotes continuous learning from both individual actions and others' responses. This cyclical process of action and reflection may enhance participants' learning outcomes and contribute to the group's overall development (Yue et al. 2026).

*Bodily Mirroring, Embodied Cognition, and Social Interaction*

In Tai Chi, coordination involves more than just physical movements. It serves as a critical aspect of a holistic approach, incorporating the internal organization of individual gestures as well as the sequence of collective movements performed with a partner or group. Practitioners are required to develop awareness of their own movements and those of their practice partners, necessitating attentiveness and interaction. This attentiveness fosters fluidity and harmony within the practice, thereby enhancing the overall experience and facilitating a deeper understanding of the sequence of postures and gestures (Wang et al. 2025a).

The intersubjective and intrapersonal dimensions of this practice differentiate it from being solely a form of physical exercise or meditation in motion. It is recognized as a sophisticated martial art that emphasizes collaboration, shared experiences, and the significance of relational context. This practice operates within a framework of shared bodily experiences and involves processes of interpersonal attunement and mirroring. These cognitive and emotional dynamics promote deep self-exploration, which occurs through both internal perspectives—such as awareness of one's own physical and emotional state—and external observations, where practitioners gain insights from the movements and reactions of their partners. This conceptual and experiential framework finds robust support in the research conducted by Rizzolatti et al. (2001), Jeannerod (2001), and Calvo-Merino et al. (2006), all of whom emphasize the critical roles of mirror neurons and embodied cognition in understanding movement and social interaction.

The harmonization of collective movement in Tai Chi serves as a significant experiential aspect, engaging participants at both individual and social levels. This process of extending a gesture—in both spatial and temporal dimensions—enhances neurofeedback loops, activating and maintaining the martial and energetic intentions associated with the practice.

Spatial and temporal expansion are key factors in transforming movement into a somatic listening process known as *Ting Jin*. The nervous system transitions from issuing motor commands to continuously receiving and interpreting sensory feedback. In Tai Chi practice, the role of intention, or *Yi*, is emphasized as it precedes physical action. This intentionality is considered a fundamental aspect of the practice, as it encourages slowing movement to allow for the conceptualization of an objective before the limb executes the action. This approach aims to prevent movements that are empty or purely mechanical.

The practice described involves cultivating internal energy, commonly referred to as Qi. Engaging slowly and expansively may help create movement

pathways that alleviate physical tension and enhance the flow of internal energy. This process demands coordination of mental focus, breath, and posture. Practitioners often report experiencing a harmonious flow of energy that unites the body and mind. Such experiences contribute to a deeper understanding of one's existence within the continuum of movement. As a result, the focus shifts from merely refining technical skills to fostering emotional regulation and relational awareness, and to developing resilient bio-connectivity between practitioners and their environment (Wang et al. 2025b). From an evolutionary perspective, this mechanism is considered a significant factor in enhancing mutual understanding and empathy among individuals (Fuchs 2002).

Central to the "as if" framework of simulation is a shared representation of the "self". This mechanism enables individuals to map observed behaviors onto their own experiences, creating a reciprocal process where actions are internally replicated rather than merely witnessed. Research suggests this internal simulation strengthens interpersonal bonds and enhances abstract thinking (Aziz-Zadeh & Damasio 2008). Consequently, empathy emerges directly from the interplay between observation and internal imitation. Exploring this dynamic further could clarify how shared mental representations drive social learning and cultural transmission.

Research indicates that Tai Chi significantly enhances multiple dimensions of well-being in older adults, including mood, self-perception, locomotor control, and balance. As an accessible and low-cost form of physical activity, it promotes a healthier lifestyle while fostering social interaction. Ultimately, participating in Tai Chi is linked to reduced social isolation, improved physical health, and a higher overall quality of life (Koren et al. 2021).

The bio-connective perspective conceptualizes Tai Chi practice as a co-evolutionary tool that impacts early childhood development through mechanisms of imitation and co-regulation. Motor mirroring, which is present in Tai Chi sequences, allows—for instance, in activities involving children—for the observation and replication of movements, thereby establishing a visuomotor correspondence. This process activates neural circuits involved in recognizing others' intentions, a critical aspect of social cognition.

The dynamics of emotional co-regulation during group Tai Chi practice can support healthy developmental trajectories into adolescence. Practicing in a group encourages participants to align with the rhythm and energy of an adult leader, enhancing their capacity for interpersonal attunement. Furthermore, sharing rhythmic and tonic movements fosters self-regulation and a heightened awareness of others' emotional states. This physical synchrony promotes individual well-being and helps practitioners internalize cultural values—such as patience, respect, and harmony—without relying on complex verbal instruction.

These dynamics are particularly valuable during adolescence, a developmental stage marked by heightened self-awareness and a strong focus on peer relationships. By engaging with shared mental representations during practice, adolescents can improve their perspective-taking abilities, which may help reduce social anxiety. Ultimately, these mechanisms highlight the multifaceted role Tai Chi can play in

cultivating foundational socio-emotional competencies (Riskowski & Almeheyawi 2019).

*Building Adaptive Mental Models*

The theoretical framework outlined here synthesizes key concepts to deepen our understanding of embodied practices, with a particular focus on Tai Chi. It integrates embodied cognition theory, which posits that bodily actions directly shape mental processes. This perspective is especially valuable for exploring how Tai Chi gestures foster mental representations and semantic processing through their intrinsic sensorimotor coupling and somatic connection.

The framework is grounded in Bandura's (1977) *social learning theory*, which emphasizes the role of observational learning and modeling. Within the practice of Tai Chi, this mechanism deepens interpersonal understanding; practitioners not only acquire techniques by observing physical movements, but also gain insight into group dynamics. Ultimately, this shared exploration of corporeality demonstrates how social interaction fosters personal growth and cultivates martial, meditative, and philosophical competencies within the Tai Chi community.

Integrating Carol Dweck's *growth mindset theory* brings resilience and self-regulation into focus, framing Tai Chi as a catalyst for adaptability and holistic—physical, cognitive, and emotional—development (Dweck 2006, 2017). Pairing this perspective with *embodied cognition* further illuminates the practice's "bottom-up" processes. Specifically, Tai Chi's slow, deliberate movements function not just as expressions of internal states, but as active mechanisms that reshape mental representations, heighten spatial awareness, and enhance semantic processing.

Bandura's social learning theory underscores the significance of interpersonal dynamics in Tai Chi, a practice rooted in communal engagement rather than isolation. The interplay of observational learning and modeling captures its relational nature, demonstrating how imitation and group synchronization foster mutual understanding among participants (Bandura 1988, 1993). Furthermore, integrating growth mindset theory clarifies the psychological mechanisms behind the long-term perseverance the discipline demands. Mastering complex forms requires not only patience but also resilience in the face of frustration and continual self-regulation—ultimately transforming physical discipline into emotional adaptability and holistic personal growth.

In the daily practice of Tai Chi, the interplay of these psychological theories becomes evident as practitioners engage with one another and their instructors. A core element of this dynamic is observational learning—rooted in Bandura's theory—which enhances motor simulation and facilitates embodied cognition. Mastering complex or unfamiliar movements also demands emotion regulation and sustained perseverance, principles that align closely with Dweck's research on growth mindset. Furthermore, these Western psychological constructs share compelling conceptual parallels with traditional Tai Chi principles, notably *Yi* (intention) and *Qi* (vital energy). Ultimately, bridging Eastern and Western frameworks highlights the holistic nature of learning and personal development within Tai Chi practice (Bao 2020).

Such engagement is essential for building adaptive mental models, resilience, and self-regulation. Research indicates that mindset shifts—often sparked by these experiential learning processes—can drive significant changes in behavior and broader life perspectives (Armor & Taylor 2003). Viewed through this framework, practices like Tai Chi emerge as particularly valuable contexts for personal development.

Beyond physical movement, Tai Chi embodies a rich process of participatory meaning-making, or sensemaking. Within this practice, participants engage in a dynamic process of mutual incorporation, where interactions are retroactive and circular rather than linear. This reciprocal dynamic deepens the integration of lived experiences and sharpens an individual's grasp of interpersonal relationships (Fuchs & De Jaegher 2009).

Ultimately, Tai Chi fosters not only physical well-being but also social resonance, expanding an individual's relational capacities. Social resonance thereby expands relational capacities.

*Bodily Postures and Mental States*

A continuous, bidirectional connection between physical posture and mental state is a key principle in Tai Chi. Structural alignment supports the body mechanically while influencing emotional and cognitive well-being; conversely, internal states affect outward physical expression (Osypiuk et al. 2018). Achieving biomechanical alignment cultivates eutonia, a state characterized by balanced muscle tone that enables practitioners to maintain an upright posture with minimal effort, avoiding both muscular rigidity and postural collapse. This balance depends on precise skeletal adjustments, such as suspending the crown of the head and sinking the hips. Aligning the skeleton in this manner transfers gravitational load onto the skeletal structure rather than straining the musculature (Sato et al. 2017).

A reciprocal relationship exists between bodily posture and mental states. Research by Osypiuk et al. (2018) indicates that maintaining upright posture both fosters specific psychological states and reflects an individual's engagement within them. This mind-body alignment suggests that physical bearing offers valuable insights into emotional well-being. Consequently, consciously adjusting one's posture can actively shape psychological experiences and overall mental health, underscoring the vital role of somatic awareness in cognitive and emotional regulation (Lin et al. 2026).

Rooted in shared physical intersubjectivity, nonverbal mutual understanding emerges directly through bodily presence. Drawing on enactive and phenomenological frameworks, the interplay between embodiment and cognition demonstrates that gestures and postures do not merely reflect inner states; rather, they actively construct our experiential reality and social understanding (De Jaegher et al. 2010, Galbusera & Fuchs 2013, Tanaka 2015). Within the practice of Tai Chi, this dynamic operates as a bidirectional loop between mind and body. Each posture expresses a practitioner's internal state while simultaneously shaping their perception and cognitive processing. Ultimately, this embodied dialogue extends

beyond the individual, transforming a shared physical space into a co-constructed reality forged through reciprocal movement and connection.

## Implications in Training and Teaching

### *Attunements and Mirrorings*

At the heart of every study lies a set of guiding questions that prompt deeper reflection. In this case, those questions are:

> *To what extent can the processes underlying neural mirroring and interpersonal attunement be understood as forms of bioconnective interaction?*
> *Do these adaptive mechanisms of physical and emotional co-regulation reflect the fundamental biological, neurological, and somatic capacities of living organisms to connect with and influence one another?*
> *How can mirroring and attunement be positioned along a continuum—where mirroring provides immediate kinesthetic and motor resonance, while attunement shapes that resonance into an integrated response that aligns bodies, autonomic systems, and minds within a unified relationship?*
> *Does the capacity to perceive and respond to another person's internal state, rhythm, energy, and nervous system rely strictly on physiological synchronization, or do complex modes of mental simulation and virtual sensorimotor representations also play a role?*

Over the years, various hypotheses in neuroscience and psychology have gained empirical support, while others have sparked new lines of inquiry. A central focus of this research is the interplay between the mirror neuron system, embodied simulation, and intersubjectivity. In parallel, studies on autonomic and endocrine synchronization have clarified how shared biological rhythms support emotional regulation and social bonding (Gallese et al. 2007, Bastos et al. 2025). Together, these findings underscore the complexity of human interaction and the biological foundations of social experience. Building on this foundation, the mirroring hypothesis posits that the neural systems responsible for executing our own actions also play a crucial role in understanding others' goals and intentions. By framing actions as inherently goal-directed, this model illustrates how mirroring mechanisms support social cognitive processes and bridges the gap between motor execution and social understanding (Woodward & Gerson 2014).

In the practice of Tai Chi, mind-body integration is not merely an abstract concept, but an ongoing empirical, theoretical, and philosophical pursuit essential to cultivating somatic awareness. Rather than treating movement as purely mechanical, the practice seeks to fundamentally transform how physical action is experienced—fostering a holistic understanding of the body as a cohesive unit, alongside an attuned sensitivity to others' movements.

Practitioners are encouraged to view their bodies not as disconnected parts but as an interconnected whole, in which every movement affects the entire structure. This perspective fosters a deeper awareness of physicality, linking the arms, legs,

and torso in a state of continuous interdependence. Consequently, each action in Tai Chi—whether it encompasses meditative exploration or martial technique—carries profound significance. Each movement embodies intention and awareness, reflecting essential principles of balance, flow, and harmony (Carboni 2015).

Attunements involve a responsiveness and reciprocity in communicative interactions, which are defined, in part, by an affective connection to lived experiences. This concept extends beyond mere verbal exchanges to include an emotional resonance with another's perspective. Ultimately, attunement promotes empathetic engagement, allowing individuals to connect with and validate each other's feelings and attitudes (Bolis et al. 2023).

On the other hand, mirroring processes encompass the ability to replicate fundamental bodily patterns, such as tonic-postural adjustments, proprioceptive awareness, and kinesthetic movements. These actions are deeply rooted in neurocognitive mechanisms that developed as adaptive systems and are vital to human social interaction. They allow individuals to synchronize with one another, fostering connections through shared physical and emotional states. Ultimately, embodying these patterns enhances mutual understanding and strengthens interpersonal bonds (Ammaniti & Ferrari 2013).

Research demonstrates the efficacy of Tai Chi as a method for neuromotor activation, highlighting its physical benefits more than the interpersonal interactions inherent to the practice. However, these interactions are precisely what cultivate a deeper understanding of essential concepts such as proprioception, posture, kinesthesia, and gesture. This awareness emerges through both spontaneous and imitative movements, which rely on the mirroring and attunement processes central to the discipline. As a result, Tai Chi provides a distinctive opportunity to explore empathetic dynamics—both among individuals and within group settings—within a shared learning context (Osypiuk et al. 2018).

Two key aspects of Tai Chi demonstrate its broader impact on personal and social identity. First, it provides a pathway for understanding corporeal identity through shared experiences. Second, it promotes an internalized practice of mirroring and attunement, which arises from bodily interactions, relational insights, and the imitation of movement (Giovine 2021). Together, these elements emphasize the connection between physical practice and interpersonal empathy within the discipline.

Attention is directed toward complex internal bodily sensations, emphasizing the dynamics of shared space and time with others. Together, these interconnected dimensions establish balance and unity during physical practice. This proactive perception is particularly evident in the collective performance of Tai Chi sequences and in interactive exercises such as *Tui Shou* ("pushing hands"), where practitioners collaborate to harmonize their movements and energies. Through this process, participants cultivate gestural and postural awareness by continuously refining the transition between *Yin* and *Yang*. Ultimately, this practice transforms body perception, influencing both internal energy flow and kinesthetic ability while playing a vital role in revitalizing personal identity (Taylor-Piliae et al. 2006, Wang et al. 2010).

In settings dedicated to the care and support of individuals facing psychophysical challenges, this educational framework emphasizes developing motor skills while promoting personal autonomy and human potential. It fosters a supportive

environment based on intersubjectivity, where experiences and perceptions are shared and acknowledged. This approach encourages participants to engage actively in their own learning processes (Adolph & Hoch 2019).

This approach promotes interdependence among learners and acknowledges individual differences, suggesting that diversity enhances the collective experience. Within this framework, Tai Chi is highlighted as a holistic practice that connects cognitive processes with bodily expression. Research indicates that regular Tai Chi practice significantly improves multidimensional and hierarchical physical self-esteem in older adults (Li et al. 2002, 2026).

*Social Enaction in Tai Chi*

Reflecting on the enactive dimension of Tai Chi requires analyzing the conditions that govern interactions between an organism and its environment—specifically, between the practitioner and their community of practice and between a specific school and its broader sociocultural context. At its core, enaction involves the organism's proactive engagement with environmental contexts. This process establishes a dynamic, bidirectional relationship in which organism and environment mutually shape one another in a continuous feedback loop (McGann 2014).

This phenomenon corresponds with the concept of autopoiesis—self-generating processes that enhance an organism's self-awareness and facilitate goal-directed behavior. Within this framework, adaptation and evolution rely on developmental pathways that emerge in response to environmental stimuli. Scaling this biological mechanism to a broader systemic level bridges enactivism with Hutchins' (2010) framework of cognitive ecology, which situates human cognition not inside an isolated brain, but across an interdependent web of brain, body, cultural practices, and physical surroundings. Viewed through this synthesis, Tai Chi operates as a dynamic coupled system linking the practitioner and their environment. Through continuous sensorimotor loops—such as negotiating gravitational vectors, ground reaction forces, or a partner's kinetic energy—the practitioner's embodied actions and traditional somatic principles serve as cognitive scaffolds.

Enaction plays a crucial role in the concept of the embodied mind, establishing a connection between past experiences and cognitive processes. As highlighted by Stewart et al. (2010), enaction is not merely a product of prior experiences; it serves as a conceptual precursor that shapes cognitive functioning. This viewpoint challenges traditional cognitive frameworks by illustrating how individuals actively enact their worlds. By framing organisms as active participants rather than passive recipients of information, this approach fosters a more integrated understanding of human cognition and development.

The philosophical and social principles underlying internal martial arts (*Neijia*), such as Tai Chi, suggest that the self is not a fixed, independent entity. Rather, it is defined by interdependence and operates within a framework of ethical considerations and physical interactions with others and the environment (Giovine 2021). Through practice, individuals can recognize essential "enactive" constants, including shared attention and heightened body awareness. These elements evolve into social actions within a collective space of engagement, highlighting the

relational nature of existence. This demonstrates how individual practice can foster communal well-being and interconnectedness (González-Grandón et al. 2021).

The enaction experienced in Tai Chi extends beyond gestural and martial engagement, inscribing layers of meaning onto the body within broader social and cultural contexts. Through progressive practice, individuals cultivate a phenomenological sense of self and bodily awareness. By moving beyond traditional psychological models and analyses, Tai Chi sustains the dialectic between autonomous individuality and interdependence (Lee et al. 2026).

In this context, sense-making integrates sensorimotor and constructive processes—an approach that has sparked ongoing debate among scholars (Kimmel et al. 2024). This framework requires participants to align bodily attention and mental imagery with physical movement exploration. Refining motor skills and deepening engagement with cognitive imagery demands an introjective modality alongside rigorous metacognitive self-guidance to navigate complex tasks. Enhancing body perception is equally critical, as it bridges imaginative augmentations with physical presence. Consequently, facilitators often deliver instructions through diverse formats and layered metaphors to help learners construct a cohesive mental model. Ultimately, this process relies on an intricate network of cognitive, symbolic, intersubjective, and contextual operations, presupposing advanced internal, socialized, and semantic competencies to grasp deeper, connotative levels of meaning.

The relationship between individual experience and collective identity provides a framework for understanding the multifaceted nature of Tai Chi practice. Defined as a multidimensional bodily discipline, Tai Chi integrates various functional and interactive elements into a cohesive practice. This synthesis involves specific physical movements that enhance bodily awareness and coordination, as well as cognitive processes that improve mental clarity and focus. Additionally, its ritualistic aspects underscore its cultural significance and foster a sense of belonging within the community (Wayne & Kaptchuk 2008).

## Research Perspectives

This study explores *bio-connectivity* as a framework for understanding the structural and functional complexities of Tai Chi practice. Anchored in an integrative approach, this proposal synthesizes theories of Embodied Cognition, Social Learning, and Growth Mindset. Defining and integrating these complementary perspectives is crucial for effectively promoting cognitive and emotional engagement, addressing specific physiological demands, and enhancing self-regulation.

Tai Chi serves as a multimodal practice for learning and personal growth that engages regulatory systems within both the central and autonomic nervous systems. For instance, the Long Form (*Tao Lu*) comprises an intricate, continuous sequence of movements and weight-shifting transitions that demand sustained, fluid attention. This deliberate motor sequencing aligns with neurocognitive models of top-down attentional control, recruiting prefrontal-parietal executive networks to inhibit automatic postural habits, coordinate complex motor planning,

and sharpen proprioceptive integration in the sensorimotor cortex. Furthermore, Tai Chi's emphasis on breath regulation and somatic awareness mirrors mechanisms found in mindfulness-based interventions and contemplative neuroscience. Specifically, slow, diaphragmatic breathing paired with sustained interoceptive focus stimulates vagal afferent pathways, downregulating sympathetic arousal and promoting parasympathetic dominance (Gerritsen & Band 2018).

While current Tai Chi scholarship predominantly focuses on quantifiable physiological and neurocognitive outcomes—such as improved balance, cardiovascular health, and executive function—this narrow focus often leaves its broader psychosocial dimensions unexplored. Validating these somatic benefits provides a critical baseline, yet isolating mechanics overlooks how the practice functions as a holistic system in everyday life. Adopting a *systemic framework of bioconnectivity* offers a stimulating direction for the development of a subsequent wave of inquiry. Rather than treating the mind, body, and social environment as discrete variables, bio-connectivity views them as a continuous, reciprocal network. Through this lens, researchers can better evaluate how internal physiological shifts shape external social behaviors, reframing Tai Chi not merely as physical exercise, but as an integrated ecology of human well-being.

Interdisciplinary methodologies are necessary to analyze the cultural and affective dimensions of practice, particularly in the context of how individual identity is negotiated within shared narratives and social communities. Within this framework, Tai Chi can be understood not only as a physical exercise but also as a process of self-inquiry that may foster a connection with the intrinsic self. An examination of Tai Chi as a structured discipline of mindfulness and self-reflection may clarify the mechanisms through which practitioners explore their emotions, cognitions, and motivations, contributing to the development of a more comprehensive research paradigm.

a. This field of study benefits significantly from qualitative rather than quantitative approaches, relying on structured observation and action research as foundational tools of inquiry. These techniques uncover insights that numerical data often overlook, offering a deeper understanding of complex phenomena. By prioritizing context, lived experience, and underlying meaning, researchers can capture the nuances of human behavior and social interaction to reach more holistic conclusions.

To achieve a comprehensive understanding of participants' experiences, this research framework combines multiple data collection methods. Conducting in-depth, semi-structured interviews at the beginning, middle, and end of the process is a well-established practice that tracks how participants' motivations and identities evolve. Incorporating self-reflective journals further enriches this dataset; encouraging participants to regularly document their emotional and cognitive responses provides deeper insight into their personal journeys and lived experiences.

Furthermore, participant observation is essential to this inquiry. This approach enables researchers to capture non-verbal dynamics, collective body language, and the nuanced transmission of cultural narratives by instructors and masters in the

field. Ultimately, this observational data will enrich the analysis, offering deeper insight into the interplay between individual and collective experiences.

b. Balancing personal growth with community awareness fosters a deep sense of social responsibility, strengthening interpersonal bonds and collective ties. Understanding these complex dynamics requires examining the communal structures common to shared practices like Tai Chi. By combining sociological theories with insights from cultural anthropology, research can apply interdisciplinary frameworks to better understand how these group practices function and evolve.

To investigate how Tai Chi promotes social responsibility, collective bonds, and empathy, a convergent mixed-methods design can be employed. The initial phase may involve examining the structure of the "community of practice", focusing on how shared rituals, spatial organization, and group hierarchies influence social cohesion. In a subsequent phase of the research, it will then be possible to outline the transition from the individual to the collective level, identifying the conditions under which a practitioner's pursuit of inner balance translates into social responsibility toward others.

c. From a neurocognitive perspective, bio-connectivity research in Tai Chi requires an in-depth understanding of attunement and mirroring during practice. As bodily sensations evolve into complex sensory, perceptual, and cognitive awareness, it becomes essential to identify these physical activations and recognize the pivotal role of gesture (Wayne & Kaptchuk 2008, Liu et al. 2025).

A mixed-methods neuro-behavioral approach can translate this theoretical framework into a practical research design using either longitudinal or cross-sectional studies. A promising strategy is a two-arm randomized controlled trial (RCT) or a comparative study contrasting seasoned Tai Chi practitioners with beginners. Including an active control group—such as participants engaged in non-martial physical exercise—is essential for rigorous comparison.

This design primarily aims to quantify how Tai Chi integrates fragmented joint movements into cohesive, whole-body spatiotemporal patterns to enhance neuromotor coordination. Additionally, assessing "attunement" and "mirroring" at both intrapersonal and interpersonal levels through synchronized solo or paired movements—such as Tuishou ("pushing hands")—will offer deeper mechanistic insights.

## Conclusions

Human movement is an inherently social mechanism for sense-making, enabling individuals to engage through modes of mirroring—such as alternation, complementarity, symmetry, and integration. Within this framework, Tai Chi stands out as a formative practice that exemplifies bioconnectivity and participatory engagement, fostering innovative learning experiences that surpass those in less interactive settings. Central to Tai Chi is the concept of embodiment, which bridges the dual dimensions of human experience: the lived body (Leib) and the expressive, functional physical form (Körper). Together, these interconnected dimensions drive

personal transformation and reframe care as an ongoing, dynamic process rather than a fixed state.

From a social enaction perspective, this study raises several pertinent questions for future research. First, how does participating in a Tai Chi class—as a shared relational environment—shape individual emotional regulation? Second, at what specific moments during the "Form" do practitioners shift from automatic imitation to deliberate execution marked by "somatic listening" and intentional movement, and how does proprioceptive feedback sustain this conscious attention? Third, in what ways do group practice and paired exercises like Tui Shou (push hands) cultivate authentic somatic attunement and empathy? Finally, which experiential elements of long-term training best integrate cognitive awareness, emotional resilience, and social connection, and how do practitioners navigate the relationship between inner self-exploration and community belonging?

The interplay between observational learning and modeling illustrates how novices align their movements with instructors and peers, transforming individual motor imitation into a shared experience of kinesthetic empathy. Integrating this process with Dweck's concept of a growth mindset fosters an environment in which practitioners view physical balance and cognitive focus not as fixed traits but as malleable skills cultivated through sustained, mindful effort. Collectively, these insights elucidate how Tai Chi enables individuals to develop adaptive mental models that extend beyond practice, ultimately enhancing emotional regulation and resilience in daily life.

The relationship between body posture and mental states is a complex field encompassing biomechanics, psychological regulation, and enactive phenomenology. This framework indicates that posture may influence both physical efficiency and emotional well-being. Future research should examine the interactions between individual and social factors across experimental and training methods. Investigating how mental states shape postural tone and how posture affects mental states could provide insights into this reciprocal dynamic. This area of study has the potential to reveal how cognitive and emotional conditions are physically expressed, potentially leading to new educational and clinical interventions aimed at promoting mental well-being and improving overall quality of life.

## References

Adolph KE, Hoch JE (2019) Motor Development: Embodied, Embedded, Enculturated, and Enabling. *Annual Review of Psychology* 70(Sep): 141–164.

Allsop JS, Vaitkus T, Marie D, Miles LK (2016) Coordination and Collective Performance: Cooperative Goals Boost Interpersonal Synchrony and Task Outcomes. *Frontiers in Psychology* 7(Sep): 1462.

Ammaniti M, Ferrari P (2013) Vitality Affects in Daniel Stern's Thinking - A Psychological and Neurobiological Perspective. *Infant Mental Health Journal* 34(5): 367–375.

Armor D, Taylor S (2003) The Effects of Mindset on Behavior: Self-Regulation in Deliberative and Implemental Frames of Mind. *Personality and Social Psychology Bulletin* 29(1): 86–95.

Aziz-Zadeh L, Damasio A (2008) Embodied semantics for actions: findings from functional brain imaging. *Journal of Physiology-Paris* 102(1–3): 35–39.

Bandura A (1977) *Social learning theory*. Prentice-Hall.

Bandura A (1988) *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ; Prentice-Hall.

Bandura A (1993) Perceived Self-Efficacy in Cognitive Development and Functioning. *Educational Psychologist* 28(2): 117–148.

Bao GC (2020) The idealist and pragmatist view of qi in tai chi and qigong: A narrative commentary and review. *Journal of Integrative Medicine* 18(5): 363–368.

Bastos MAV Jr, Braz DF, Porto ALM, Cordeiro KSDS, Portella RB, Granger DA (2025) Physiological attunement and flourishing: understanding the influence of relationships on health. *Frontiers in Psychiatry* 16(Aug): 1614379.

Bolis D, Dumas G, Schilbach L (2023) Interpersonal attunement in social interactions: from collective psychophysiology to inter-personalized psychiatry and beyond. *Philosophical Transactions of the Royal Society B: Biological Sciences* 378(1870): 20210365.

Calvo-Merino B, Grèzes J, Glaser DE, Passingham RE, Haggard P (2006) Seeing or Doing? Influence of Visual and Motor Familiarity in Action Observation. *Current Biology* 16(19): 1905–1910.

Carboni M (2013) Taiji as Shared Bodily Experience. *Yang-Sheng (Nurturing Life)* 3(2): 26–33.

Carboni M (2015) The Care of Person in Tai Chi as Educative Mutuality. *Yang-Sheng (Nurturing Life)* 6(3): 24–27.

Cerna J, Gupta P, He M, Ziegelman L, Hu Y, Hernandez ME (2024) Tai Chi Practice Buffers Aging Effects in Functional Brain Connectivity. *Brain Sciences* 14(9): 901.

Crooks KR, Sanjayan M (2006) *Connectivity Conservation*. Cambridge University Press.

De Jaegher H, Di Paolo E, Gallagher S (2010) Can social interaction constitute social cognition? *Trends in Cognitive Sciences* 14(10): 441–447.

Dillon JL, Gorman AG, Williams KN, Herlache-Pretzer E, Webster S (2023) Impacts of Tai Chi on Empathy Levels in Healthcare Professionals: A Quasi-Experimental Study. *Journal of Complementary and Alternative Medical Research* 24(4): 1–8.

Dweck CS (2006) *Mindset: The new psychology of success*. New York, NY: Random House.

Dweck CS (2017) From needs to goals and representations: Foundations for a unified theory of motivation, personality, and development. *Psychological Review* 124(6): 689–719.

Fuchs T (2002) The Challenge of Neuroscience: Psychiatry and Phenomenology Today. *Psychopathology* 35(6): 319–326.

Fuchs T, De Jaegher H (2009) Enactive intersubjectivity: Participatory sense-making and mutual incorporation. *Phenomenology and the Cognitive Sciences* 8(Jul): 465–486.

Galbusera L, Fuchs T (2013) Embodied understanding: Discovering the body from cognitive science to psychotherapy. *In-Mind Italia* V: 1–6.

Gallese V, Eagle MN, Migone P (2007) Intentional Attunement: Mirror Neurons and the Neural Underpinnings of Interpersonal Relations. *Journal of the American Psychoanalytic Association* 55(1): 131–175.

Gerritsen RJS, Band GPH (2018) Breath of Life: The Respiratory Vagal Stimulation Model of Contemplative Activity. *Frontiers in Human Neuroscience* 12(Oct): 397.

Giovine V (2021) Embodying Daoist Internal Arts: Walking the Line between the Reification and the Instrumental Use of Cognition. *SAGE Open* 56(3).

Gomez-Lozano S, Miguel Barbera-Inocencio M, Kelly-Lahon C, Leon-Guzman K, Garcia-Sottile ME, Vargas-Macias A (2023) Non-competitive Tuishou, a modality of Chinese

Martial Arts applied to the field of Health and Wellbeing. *IDO MOVEMENT FOR CULTURE. Journal of Martial Arts Anthropology* 23(4): 68–78.

González-Grandón X, Falcón-Cortés A, Ramos-Fernández G (2021) Proprioception in Action: A Matter of Ecological and Social Interaction. *Frontiers in Psychology* 11(Jan): 569403.

Gu M, Kang J, Zhou Y, Lin L, Li C, Wu M, et al. (2026) Mind-body exercise as epigenetic modulators: Rewiring neural circuits for stress resilience and cognitive aging. *IBRO Neuroscience Reports* 20(Jun): 673–687.

Hjortborg SK, Ravn S (2020) Practicing bodily attention, cultivating bodily awareness – a phenomenological exploration of tai chi practices. *Qualitative Research in Sport* 12(5): 683–696.

Hutchins E (2010) Enaction, Imagination, and Insight. In J Stewart, O Gapenne, EA Di Paolo (eds.), *Enaction: Toward a New Paradigm for Cognitive Science,* 15: 425–450. Cambridge: The MIT Press.

Jeannerod M (2001) Neural simulation of action: A unifying mechanism for motor cognition, *Neuroimage* 14(1 Pt 2): S103–9.

Jin X, Chen J, Zhang X (2026) Tai Chi exercise and neuroplasticity: a narrative review according to neural mechanisms and clinical utilizations in brain health. *Frontiers in Neuroscience* 20(Feb): 1769779.

Kimmel M, Schneider SM, Fisher VJ (2024) "Introjecting" imagery: A process model of how minds and bodies are co-enacted. *Language Sciences* 102(Mar): 101602.

Koren Y, Leveille S, You T (2021) Tai Chi Interventions Promoting Social Support and Interaction Among Older Adults: A Systematic Review. *Research in Gerontological Nursing* 14(3): 126–137.

Larkey L, Jahnke R, Etnier J, Gonzalez J (2009) Meditative movement as a category of exercise: implications for research. *Journal of Physical Activity and Health* 6(2): 230–238.

Lee Y, Liao J, Kim J, Lee J, Chae J (2026) Listen to your inner body: embodied emotions in predictive neuroscience and traditional East Asian medicine. *Frontiers in Human Neuroscience* 20(Apr).

Lehnertz K, Bröhl T, Rings T (2020) The Human Organism as an Integrated Interaction Network: Recent Conceptual and Methodological Challenges. *Frontiers in Physiology* 11(Dec): 598694.

Li Y, Hu Y (2026) Relationship between Tai Chi and the mood states, self-esteem, and subjective well-being of middle-aged and older adults: a cross-sectional study from China. *Frontiers in Public Health* 14(Jan): 1686008.

Li F, Harmer P, Chaumeton NR, Duncan TE, Duncan SC (2002) Tai Chi as a Means to Enhance Self-Esteem: A Randomized Controlled Trial. *Journal of Applied Gerontology* 21(1): 70–89.

Lin HC (2025) Embodied strategy: The value of push-hands in life. *Working Paper – Preprints*. ResearchGate.

Lin P, Tien Y, Kang L, Hsu L (2026) Stand tall, think bright: How embodied experience unlocks the power of posture in emotion regulation. *Acta Psychologica* 263(Mar): 106351.

Liu D, Zhou B, Wen Z, Zhang Y (2025) From healing and martial roots to global health practice: reimagining Tai Chi (Taijiquan) in the modern public fitness movement. *Frontiers in Public Health* 13(Sep): 1677470.

McGann M (2014) Enacting a social ecology: radically embodied intersubjectivity. *Frontiers in Psychology* 5(Nov): 1321.

Nathan R, Getz WM, Revilla E, Holyoak M, Kadmon R, Saltz D, et al. (2008) A movement ecology paradigm for unifying organismal movement research. *Proceedings of the National Academy of Sciences* 105(49): 19052–19059.

Osypiuk K, Thompson E, Wayne PM (2018) Can Tai Chi and Qigong Postures Shape Our Mood? Toward an Embodied Cognition Framework for Mind-Body Research. *Frontiers in Human Neuroscience* 12(May): 174.

Pan Z, Su X, Fang Q, Hou L, Lee Y, Chen CC, et al. (2018). The Effects of Tai Chi Intervention on Healthy Elderly by Means of Neuroimaging and EEG: A Systematic Review. *Frontiers in Aging Neuroscience* 10(Apr): 110.

Park M, Song R, Ju K, Shin JC, Seo J, Fan X, et al. (2023) Effects of Tai Chi and Qigong on cognitive and physical functions in older adults: systematic review, meta-analysis, and meta-regression of randomized clinical trials. *BMC Geriatrics* 23(1): 352.

Peng B (2026) Embodying the Cosmos: Taoism Bodily Philosophy, Chinese Medicine, and Relational Body. *Recherches & Educations* 30–31.

Riskowski JL, Almeheyawi R (2019) Effects of Tai Chi and Qigong in Children and Adolescents: A Systematic Review of Trials. *Adolescent Research Review* 4(Sep): 73–91.

Rizzolatti G, Fogassi L, Gallese V (2001) Neurophysiological mechanisms underlying the understanding and imitation of action. *Neuroscience* 2(Sep).

Sato Y, Sato Y, Sato Y (2017) Standing sagittal alignment of the whole axial skeleton with reference to the gravity line in humans. *Journal of Orthopaedic Science* 22(5).

Shpak G (2026) Neurophysiological mechanisms of embodied empathy in martial arts. *Frontiers in Psychology* 17(Mar): 1782703.

Stewart J, Gapenne O, Di Paolo E A (Eds.) (2010) *Enaction: Toward a new paradigm for cognitive science*. Cambridge: The MIT Press.

Sun C (2021) My understanding and application of Tai Chi diagram. *New York Science Journal* 14(7): 21–41.

Tanaka S (2015) Intercorporeality as a theory of social cognition. *Theory & Psychology* 25(4): 455–472.

Taylor-Piliae RE, Haskell WL, Waters CM, Froelicher ES (2006) Change in perceived psychosocial status following a 12-week Tai Chi exercise program. *Journal of Advanced Nursing* 54 (3): 313–329.

Wang C, Bannuru R, Ramel J, Kupelnick B, Scott T, Schmid CH (2010) Tai Chi on psychological well-being: systematic review and meta-analysis. *BMC Complementary and Alternative Medicine* 10: 23.

Wang G, Liu X, Cai Y, Wang J, Gao Y, Liu J (2025) Cortical adaptations in Tai Chi practitioners during sensory conflict: an EEG-based effective connectivity analysis of postural control. *Journal of Neuroengineering and Rehabilitation* 22(1): 120.

Wang Y, Bai X, Wang T (2025a) The Effect of Multimodal Sensory Feedback in Tai Chi on Cognitive Function in Older Adults. *Journal of Aging and Physical Activity* 34(4): 463–472.

Wang S, Huang Y, Si X, Zhang H, Zhai M, Fan H, et al. (2025b) The impact of Tai Chi on emotional regulation efficacy and subjective wellbeing in the elderly and the mediating mechanism. *Frontiers in Psychology* 16(May): 1550174.

Wang H, Guo Y, Fan H, Chen Z, Liu S, Zhao L, et al. (2025c) The effects of an acute Tai Chi on emotional memory and prefrontal cortex activation: a fNIRS study. *Frontiers in Behavioral Neuroscience* 18(Jan): 1520508.

Wayne PM, Kaptchuk TJ (2008) Challenges Inherent to T'ai Chi Research: Part I—T'ai Chi as a Complex Multicomponent Intervention. *The Journal of Alternative and*

*Complementary Medicine: Paradigm, Practice, and Policy Advancing Integrative Health* 14(1): 95–102.

Woodward AL, Gerson SA (2014) Mirroring and the development of action understanding. *Philosophical Transactions Royal Society London B* 369(1644): 20130181.

Yang J-M (2006) *Neidan. Qigong Meditation Small Circulation*. Massachusetts, USA: YMAA Publication Center Boston.

Yu AP, Tam BT, Lai CW, Yu DS, Woo J, Chung K, et al. (2018) Revealing the Neural Mechanisms Underlying the Beneficial Effects of Tai Chi: A Neuroimaging Perspective. *American Journal of Chinese Medicine* 46(2): 231–259.

Yu Q, Zhang Z, Wang P, Raab M, Herold F, Heath M, et al. (2026) Neural and computational mechanisms of embodied learning: From brain–body interaction to translational applications. *Journal of Sport and Health Science* 15(Sep): 101177.

Yue C, Yu Q, Zhang Y, Herold F, Mei J, Kong Z, et al. (2020) Regular Tai Chi Practice is Associated with Improved Memory as Well as Structural and Functional Alterations of the Hippocampus in the Elderly. *Frontiers in Aging Neuroscience* 12(Oct): 586770.

Yue F, Chen N, He H, Zhang X, Pan C, Yang H (2026) Tai Chi, brain activity and psychological outcomes: a systematic scoping review. *Frontiers in Psychology* 17(Jun): 1865028.

Zhang Y, Zhang Y, Zhang Y, Zhang Y, Zhang Y, Zhang Y (2017) Tai Chi Chuan and Baduanjin increase grey matter volume in older adults: a brain imaging study. *Journal of Alzheimer's Disease* 60(2): 389–400.