MINDFULNESS AND MARTIAL ARTS: A COGNITIVE INVESTIGATION

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Review paper

Abstract
The objective of this paper is to highlight the link between Mindfulness practices and Neuroscience, through the concept of forms in martial arts. In the world of these arts, the term form indicates a series of codified movements that represent various combat techniques, so as to highlight their appropriate performance modalities. These technical sequences are inextricably linked to multiple cognitive aspects, such as attention and learning, management and control of emotions.

Key words: *martial arts, mindfulness, learning, neuroscience.*

Introduction

Mindfulness means focusing attention on the present moment in a non-judgmental way (Kabat-Zinn, 1994). According to Hanh (1987) it is a process that nurtures awareness and acceptance of the present moment. Therefore, the basic elements of Mindfulness are awareness and attention; according to these definitions, the goal is to understand and accept reality by working on one' s own mind. Mindfulness originally translates the Sanskrit term sati, which means mental presence. Sati, in the Buddhist tradition, is a faculty/attitude to be nurtured in order to obtain the right perception of human reality. Buddhist doctrine and meditation are probably the tradition that best embodies and makes explicit the theme of awareness. Among Buddha's teachings, we can find just a few factors allowing the individual to grasp the exact perception of each experience; these include aspiration, trust, attention, discrimination and, of course, awareness. To achieve this goal, Buddhist doctrine recommends a change in the individual at cognitive and emotional level. Therefore, mindfulness means being aware of what is happening in the phenomenological field. The development of this ability is obviously related to meditation practices. The practitioner must learn to anchor the mind to the present momentary experience, freeing himself/herself from the projections of thought. Most of the practices that nowadays go under the name of Mindfulness are the result of the studies carried out by Jon Kabat-Zinn, biologist and professor at the School of Medicine of the University of Massachusetts. Since 1979, he has been working to introduce the meditation on one's own awareness into clinical contexts. Kabat-Zinn believed that the practice of meditation had the power to transform the individual experience of suffering and stress. The relationship between mind and body, between thoughts and health, is a fundamental premise for understanding the nature and purpose of his research. He reinterpreted and modified Mindfulness with spiritual aspects, defining the object of his research as a focused, non-judgmental attention to the present moment.

Consciousness, Attention, Meditation

Consciousness can be defined as a particular state of mind in which one is aware of the existence of themselves and the environment, and consists of the subject's awareness of the external and internal stimuli. A prerequisite of consciousness is the concept of subjectivity, i.e. the experience of the exclusive and private (first-person) perspective of each of us. It is the center of gravity of ourselves, gives unity to our experience and attaches meaning to our identity.

Another prerequisite of consciousness (which, however, is not yet consciousness) is vigilance, which enables the mental representation of objects, the planning of what we intend to do, as well as the continuous monitoring and control of our actions.
First of all, consciousness consists in the ability to respond to the stimuli coming from the environment "here and now" (perceptual awareness). We are all aware of what is happening around and within ourselves. Consciousness, moreover, plays a function of confrontation, since it allows us to compare, instant by instant, the current state of things with the expected one, based on our experience, knowledge and expectations (cognitive awareness).

Furthermore, consciousness controls cognitive processes. It is a constant monitoring, allowing us to organize and plan our mental activities, as well as to begin, interrupt or modify them according to the continuous change in subjective and environmental conditions. As such, it performs the function of error detection system; if something goes wrong when performing an action, consciousness is capable of discovering the error and, if necessary, of stopping it, or can profoundly modify it according to the new conditions. Finally, consciousness is also self-reflective, thus it can be aware of itself in a theoretically endless process (meta-cognitive awareness). Not only do we know a number of things based on experience, but we are also aware of our knowledge.

We also know that we are aware of our knowledge in a theoretically infinite recursive process. Attention is the set of devices and mechanisms that allow us to concentrate and focus our mental resources on some information rather than on others, by selecting, from time to time, what is relevant to us and neglecting what is indifferent to us. In our daily experience, in many circumstances, we are guided by interests, needs, goals, and so on, when paying attention to what is happening around us; this is the endogenous attention, triggered by our personal needs, and implies a voluntary orientation towards a specific object or event in the environment. On other occasions, however, an unexpected event originating from the environment captures our attention, and immediately directs it towards itself; this, instead, is the exogenous attention, triggered by an external stimulus, and involves an automatic orientation of attention, characterized by the fact that it cannot be interrupted and distracts attention away from the task in progress.

All this implies the never-ending exploration of the environment, aimed at acquiring the information useful to control the current situation in the best possible way. However, we do not investigate the environment as a whole at the same time, but we select a part of it towards which to direct attention: it is the spatial attention, in which there is usually a coincidence between the direction of our sight and that of our attention. However, we can separate these two processes; in fact, we can direct our sight towards an object in space, and our attention towards somewhere else (the phenomenon of "peripheral vision"). When detecting a stimulus, important factors concern both the time of execution and the degree of accuracy. In general, speed and accuracy in identifying a target are important indicators of mental effectiveness; they promote orientation and speed in the efficient performance of tasks, promote the timely recognition of any errors and the opportunity to make appropriate corrections.

We also have a significant increase in the speed and accuracy when detecting stimuli according to our interests. Stimuli that respond to central (primary) interests are detected much faster and more accurately than those associated with peripheral (secondary) interests. In particular, stimuli with greater emotional relevance capture attentional resources much earlier, and store them. The rapidity of the detection of stimuli assumes a fundamental value in case of emergency, since for a few fractions of a second, we can save our lives. In these seriously threatening situations, the subcortical pathway comes into action, which, by eluding the cortex, automatically allows to make the appropriate movements, albeit on the basis of coarse information. This is the case of the martial arts, which, born as a need for survival, teach how to automate a series of movements that can be carried out much more quicklyin case of danger. When detecting stimuli, both the processes of controlled and automatic processing come into operation. Even the activities guided by the controlled processing become (at least in part) automatic over time and through practice; just as for the activities guided by the automatic processing, however, it needs a trigger by the controlled processing. An example can always be provided by martial arts, where movements are slow and awkward at first, and then become faster, more accurate and automatic with the practice. Therefore, every action requires a certain degree of controlled and automatic processing. Meditation constitutes an altered state of consciousness due to the repetitive and sequential execution of certain mental exercises, usually performed in a quiet environment. It is a method of relaxation during which the subject, by directing his/her attention in a fixed and invariable way on a single stimulus, obtains a high degree of control in regulating breathing, and comes to greatly limit his/her field of attention and the receptivity of environmental stimuli. Meditation creates a pleasant sense of psychophysical well-being and harmony between oneself and the surrounding world. It also promotes the expansion of one's own consciousness.

The traditional forms of meditation are based on the practice of yoga (a system of thought exercises based on the Hindu religion) and Zen (which originates from Buddhism). Among these traditional forms it is worth mentioning the opening meditation and the concentration meditation. In the former, the subject, committed not to think about anything, frees his/her mind as much as possible to welcome new experiences, ideas and feelings. In the latter, on the other hand, the subject undertakes to concentrate all his/her attention and thought resources totally on a single object, idea or word, and excluding everything else. In turn, transcendental meditation consists in focusing attention on the mental repetition of a special sound (mantra) or on nasal breathing. This involves totally diverting attention away from normal external stimuli, and concentrating fully on a specific internal stimulus (the Zen principle of being totally present to be totally absent). Transcendental meditation is an effective technique to induce a deep state of relaxation, reduce physiological excitement and decrease stress conditions. As a matter of fact, it generates a significant lowering of the respiratory rhythm, a decrease in oxygen consumption and a lower elimination of carbon dioxide. Heart rate slows down, body temperature and blood pressure decrease, and blood flow stabilizes; likewise, there is a decrease in nervous excitement. At psychological level, it is useful to fight negative stress, overcome anxiety, improve mental efficiency and self-esteem.

Neuroscience and Learning

Neuroscience is based on the mutual recognition between distant disciplines, such as biology and psychology. Biology is the one that helps reflect on the concept of nature, and therefore on the interaction between man and environment. When faced with their biological insufficiency, human

beings can react with an impressive adaptability arising from the development of higher psychic processes (thought, memory, and language), and from their technical attitude allowing them to operate in the world, and thus to modify it. In this sense, the human species is the one that is most marked by the so-called learning phenomenon. These data offer, at pedagogical level, the evidence of three aspects related to the interaction between nature and technique, which deserve to be reflected upon:

1. human nature is characterized by technical ability;
2. human nature changes with respect to technique;
3. technique risks overwhelming the natural world.

Therefore, it is useful to reflect on the integration and the balance between nature and technique. The contribution of the theory of evolution that interprets the biological world through the concepts of evolution, change and difference is fundamental for pedagogy. In fact, according to this theory, there is no immutable nature, and it rather emphasizes a continuous evolution; the human mind itself is a product of evolution, and it is an organization of brain structures closely related to the stimuli coming from the environment. If human nature is creative and consequently related to technique, and is simultaneously influenced by it, it is necessary to consider both them as interconnected. The brain is the result of millions of years of evolution, and is made up of billions of nerve cells establishing contacts with thousands of other cells, forming a complicated system of networks in continuous transformation. The brain is a unique unit by virtue of the variety of these contacts, which are influenced by the external environment and differ from subject to subject, because of the different genetic matrices and affective and cultural interactions with the environment.

This complex picture is very difficult to explain, and despite the progress made in the study of the brain, a number of questions remain unanswered. Two sciences in particular, as we have already mentioned and from different perspectives, try to answer some questions: on the one hand we have neuroscience, which deepens the physical structure of the brain in order to analyze the way it works, thus studying everything related to the nervous system in general; on the other hand, we have psychology, which deals with human behavior by analyzing mental processes through experimental research. It is worth mentioning also cognitive psychology, the young contribution of cybernetics and artificial intelligence. Therefore, neuroscience studies the central and peripheral nervous system with regard to its structure, function, development, biochemistry, physiology and pathology. This study is interdisciplinary and involves various aspects, from the molecular to the neuronal level up to the nervous system as a whole. At a higher level, the approaches of neuroscience are linked to cognitive sciences and to the philosophy of mind, so we can speak of cognitive neuroscience. The most important themes covered by neuroscience are the functioning of the neurotransmitters in the synapses, the functioning of the neuronal structures, the biological mechanisms underlying learning, and the structure and functioning of the complex neural circuits in perception, memory and language. On the other hand, cognitive psychology (or cognitivism) and the study of behavior and mental life is also characterized by an interdisciplinary approach, as it combines theoretical methods and frameworks, empirical data and different disciplines like psychology, linguistics and social sciences, neuroscience, and biological sciences in general. The objective of cognitive psychology is to establish a connection between the study of behavior and cognitive skills in humans and in the reproduction in artificial systems. Cognitive psychology is therefore one of the most important areas of contemporary psychology, according to which the human mind works by actively processing information that reaches it through the sensory organs, by analogy with cybernetic mechanisms. Unlike other previous models, cognitivism does not constitute an organized and coherent theoretical system, and its first theoretical formulation was carried out by the American psychologist Ullrich Nesler, at least 10 years after the development of the first experimental techniques that we could define as cognitivist. The difference in approach and scope led toneuroscience and psychology to work separately for a long time.

However, since the 1970s, when the mind/brain dualism was reconsidered, a breakthrough put neuroscience and psychology in dialogue and in connection with each other, trying to overcome the idea of an incommunicability between the biological level of the brain and the level linked to thought. Two factors have helped overcome the dualistic mind/brain conception; one is the emergence of complexity in the epistemological field, occurring when science embraces the idea that reality is made up of complex systems, and therefore mental life is something that belongs to the individual-system and cannot be reduced to physical components; the other is the use of simulative computer applications that make it possible to study complex systems, while traditional tools (such as the experimentation) are suited to the study of simple systems. Thanks to the paradigm of complexity, methodology, and simulation, it has been possible to overcome, or better to integrate, the idea according to which the mind is the software of the brain with the one according to whichit needs to start from the structure of the single components, of the neurophysiological apparatus, to understand it. It is no longer a matter of separating the study of the body and that of the mind, but of deepening the complex mind-body system. The outcome of the studies pursuing this perspective is that the way in which a thought is

determined depends on two elements, i.e. the genetically-determined brain structure and the cultural influence of the external environment. The experiences that the subject carries out in his/her natural and cultural environment are caused by a selection of some synaptic combinations over others. A synapse is a specialized junction between two nerve cells or between a nerve cell, and it is the peripheral organ of reaction. The advantage for man over other living beings lies precisely in this greater influence by the synapses, meaning that it is evolutionary advantageous for the brain to be less bound to its own formation. This leads to greater development of thought, enriched communication between individuals, enhanced social bonds and greater originality. Pedagogy must benefit from discoveries in this field by taking on the task of understanding and valuing the evolutionary capacity of the brain/mind; in this way, it is possible to plan an environmental training strategy in order to achieve the best development of the mental potential. It should be remembered that a fundamental contribution to neuroscience studies comes from the neurophysiology laboratory of the University of Parma, Italy, where important experiments were carried out in the 1990s thanks to a group of researchers coordinated by Giacomo Rizzolatti.

Motor Learning

We can define learning as a relatively long-lasting and stable change in behavior, as a result of an experience that is usually repeated over time. The fundamental root of any kind of learning is therefore experience. If we do not experience something, we are not in the condition to learn it, so every kind of learning is experiential by definition. At this point, it is crucial to understand what kind of experience we are living, what kind of information is possible to process and how to get the information from the environment. As far as learning is concerned, therefore, the channels of information processing are those obviously linked to the five senses. To talk about learning it needs to recall the concept of consciousness and attention in the psychological and cognitive field; they are the foundations of most cognitive processes, and are of fundamental importance for the development of other skills such as perception, memory, emotions and even learning itself. Consciousness is the awareness of the subject's internal and external stimuli; attention consists in directing all psychic resources towards aspects which concern us and, in the psychological field, it is usually divided into spatial and selective visual. Consequently, the sense organs lead us to the very concept of sensory receptor, because the receptors linked to these five senses - sight, hearing, touch, and the proprioceptors (the organs of balance) - collect information from the environment, thus linking everything to the central nervous system. The information collected from the environment, sounds, light signals, and chemical signals in the form of nerve impulses are sent to the central nervous system which processes them; the processing taking place at cognitive level is called sensation. Consequently, in physical terms, the receptors put us in contact with the external world, the cognitive aspect related to it is the sensation that it is an immediate and simple subjective impression, corresponding to a certain intensity of the physical stimulus. So the cognitive process is at the basis of the chemical stimulus, and the first cognitive process is precisely that of sensations. This information, which is reaching and therefore travelling through the central nervous system, after being acquired by the sensory receptors, is collected by the analyzers; these work like filters that deal with the incoming sensory material and then turn the raw input into conscious information. The analyzers are complex functional systems that turn the information considered most important into conscious representation; this operation performed at blinding speed is called perception. The receptors are connected to sensation, just like the analyzers are connected to perception.

Therefore, what is perception? It can be understood as an immediate, dynamic and significant organization of the sensory information, which corresponds to a specific configuration of stimuli delimited in space and time. Thus our perceptual world is not an exact copy of reality, but is the result of a sequence of physiological, psychological and physical mediations. It is obvious and goes without saying that perception is mediated by a series of prerequisites. These prerequisites can be functional and structural, concern the integrity of the structure of the five senses and their functions. In the sports field, what are the analyzers? Theywork at optical, acoustic, tactile, kinesthetic, vestibular- labyrinthine level, and the selection of signals does not proceed with one information at a time, but in parallel, proportionally to the experience of the stimulus and that of the receiver. *The optical analyzer* obviously processes visual information coming from visual sensory receptors, and this information is of fundamental importance in all sports; especially in the initial phase of a learning process, the student builds a first image of the movement, thus the first model of the gesture is based on the teacher's demonstration. In this phase we can fine the first concept of motor image, and clearly the analyzers are located in the nerve cells of the eyes.

The acoustic analyzer, on the other hand, allows the student to perceive sounds/noises and the rhythm of a movement, and is of fundamental importance as it enables the transmission of verbal information, explanations and corrections. *The tactile analyzer* transmits information about the pressures exerted on the various parts of the body; this one is particularly significant for its contribution in activities where it is important to control small and big tools, or where there is a contact. It is located in the tactile organs. *The kinesthetic analyzer* is probably the most important one. It underpins motor perceptions and is essential for controlling and regulating movement. It is rooted in the muscle spindles and the Golgi tendon organs,

which are located in the muscle and tendons sending all the information about the tension, contraction, shortening and stretching of tendons and muscles to the central nervous system. It is therefore a very specific analyzer, the proprioceptors work on the so-called motor sensation and, subsequently, on motor perception. Finally, *the vestibular analyzer* is the basic structure to maintain the balance and control of the body in space; it processes information about all the accelerations of the body and the position of the head in space, and is of fundamental importance for what concerns the dynamic balance. It is clearly located in the nerve cells of the ear. What are sensory-perceptual patterns then?

The sensory-perceptual patterns are automatic data collection and signals selection systems that make it very quick to collect information and reduce energy expenditure, and are closely related to what psychology calls selective attention, as we mentioned earlier.Speaking of consciousness and attention, they guarantee the automatic processing of information, but the development of good sensory-perceptual skills is also closely linked to the development of coordination skills. At this point we have to speak of memory, because, until now, the incoming information has led to sensations, has been analyzed through an initial decoding leading us to perception, processed by the five specific analyzers, but our goal is learning and the latter is strongly linked to memory. Memory is the ability to preserve the information learned over time, and to retrieve it when needed in a relevant way. Memory is an ever-changing dynamic system, which is limited both in terms of quantity and duration. It is therefore connected with the oblivion represented by the phenomenon of physiological forgetfulness, is endowed with a multisystemic nature and is a sort of reconstruction of reality; the latter always implies a certain degree of distortion, meaning that our memories are not just as exact as reality itself and the way we remember it. Memory is a pattern of many processes and we have several mnemonic storages available, like a sensorial memory which is a receptor memory that lasts from 1 to 10 seconds, a short-term memory where there are temporary modifications of the synapses from 10 to 30 seconds, the so-called time to remember the sequence of a telephone number.

Finally, we have a long-term memory, which involves permanent modifications of the central nervous system, can last for years and has an almost unlimited capacity. Furthermore, learning is still linked to another cognitive factor, which is the activation of the central nervous system. The main theory of activation is the Inverted U theory, which correlates the level of activation with a high level of performance. Therefore, the concept of activation is very important for learning, and, pursuing this theory, it is evident that the peak performance (that is the best performance) is in a medium level of activation. Consequently, the optimal the level of activation, the better the level of the performance. Again, very important and still connected to learning is Fitts' law, referring to the relationship between the speed or accuracy of a gesture that goes one to the detriment of the other. This means that the speed of a motor gesture usually leads to less accuracy. But what are the conditions of learning? In general, they are the external and the internal ones. The external conditions include social environment and language; social environment refers to the methods by which and in which I learn. Language, according to the main theories of communication, is the feedback or the coincidence between intention and result. The internal conditions are those we have already mentioned, and correspond fundamentally to the functional and structural prerequisites. Moreover, the motivation to learn is another cognitive factor of fundamental importance in the concept of learning, as it supports learning itself. Among the structural factors we can find the physiological structure enabling movement (just think of disability, for example).

The functional factors are the structure of the body scheme, balance, laterality, breathing and general coordination. As we can see, all the characteristics are linked to the central nervous system. First of all, we need to classify the movement with a simplification, according to the methodology of human movement. Movement is usually reflex, i.e. if it is mediated by the spinal cord, can be voluntary if produced by the pyramidal path, and can be automated according to memory, when the gesture is conveyed from the short term to the long-term memory stores. Motor learning involves two processes: one implicit and one explicit. Consequently, our learning will be of implicit and explicit type. Implicit learners are characterized by a lack of awareness towards motor performance, postural and dynamic basic motor patterns are classic implicit learning types. The principles are written in our genetic code, it is in the heritage of the human being, and all children, unless there are the necessary prerequisites, perform them in a natural way. Explicit learners are a little more complex; this type of learning is characterized by conscious control of movement and gets acquired (therefore gets learned).

Motor skills give the possibility to switch from a motor skill to a motor ability, explicit learning becomes a motor habit when the gesture is automated and both are classified as secondary automatisms. To do this we must also clearly introduce the concept of motor coordination; it is nothing but the organization of the motor acts necessary to achieve a goal. According to the definition provided by Miner, coordination means nothing more than organizing the controllability of the entire motor apparatus, and this works on the basis of the central nervous system. All coordination activities depend on the central nervous system, and they can be general or special. Among the general activities we can find motor learning, motor control and movement adaptation and transformation. This means that motor learning is pure coordination.

Among the special activities we have movements combination and differentiation, space-time orientation, rhythm, reaction, anticipation, balance, imagination, and creativity. What are the forms of motor learning? They include learning by imitation, by trial and error, by understanding, by influence, and by insight. These learning forms obviously follow different strands of psychology. Learning by imitation is the most immediate and important form of learning, and is the one most used in the motor field. It is fundamental for the acquisition, and the construction of what is called motor image. This form of learning is based on the theory, and is influenced by the system of mirror neurons. What are these mirror neurons exactly? Mirror neurons are a class of specific neurons triggered when performing an action, or when observing someone else performing it.

The observer's neurons therefore reflect the behavior of the observed person, as if he/she was performing the action himself/herself. What is the function of these neurons? They work by imitation, i.e. by understanding and imitating the actions of other human beings; they are important in the areas of emotions and empathy, language and communication, and are crucial to some clinical applications, like autism and post-stroke rehabilitation. Hence, the system of mirror neurons is decisive for the occurrence of common experiences, which gives rise to our ability to act as subjects both individually, and above all socially; therefore, learning, gestural and verbal communication, empathy and understanding of emotions are all reflected in Rizzolatti's theory of the mirror neurons. Then there is the learning by trial and error, thanks to which improving the motor mechanism of the sports gesture occurs by examining the evidence of the error evaluated during the performance of one's own gesture and thanks to the feedback; if any errors are detected, it will need to reduce them until they no longer persist in the following trials.

Through continuous repetitions, the discrepancies between what has been designed (the motor image) and the action performed should be identified. It is clear that the kinaesthetic analyzer, at this point, is the one that gives us the proprioception, the information about contraction and decontraction in parallel with all the other analyzers. Then we have the first test, the feedback and the error; correction after correction, test after test, and repetition after repetition, we can get to what we wish to learn. Moreover, we have the learning by understanding, which is a more sophisticated form of learning. The basic prerequisite for this form of learning is the development of abstract thinking. According to scientific studies, the development of abstract thinking is known not to occur before a certain age, but at a fairly advanced stage of adolescence. It is based on verbal descriptions and logical deductions, requires strong abstraction skills to turn words and verbal language into something else, into a mental image.

It is purely related to verbal communication and to the various forms of language. Obviously, for this type of learning, the main analyzer is the acoustic one, because it needs to listen to and also to verbalize what I am told. The learning by conditioning is based on a system of incentives leading the individual to choose/act on the right stimuli; in fact, one learns to receive a reward and to avoid punishment. According to Pavlov's classical conditioning experiments first, and to Skinner's experiments later, it would be necessary to understand whether the stimuli should be internal, i.e. linked to an intrinsic motivation, or external, thus rewards linked to an extrinsic motivation. Once again, we are on a higher level of cognition. Then there is the so-called learning by insight, which represents an instantaneous mode of learning, a sort of enlightenment. The subject gets to the solution of a task, and then suddenly to the realization of that movement, on the basis of the existing prerequisites that, favored by an open and tolerant climate, encourage creative solutions. Motor maps are probably linked to the phase of learning by intuition; the learning system in general in based from the latter, because the experience of the movement is clearly part of the learning process.

The structure of this learning process can be assimilated within a pre-existing motor structure, therefore related to the previously-acquired learning, and in a second case, it must urge the subject to search for new adaptations. In the first case, when it can be assimilated to an existing motor structure, it will be possible to have a constant improvement of the performance ability with the creation of motor maps known as rigid. In the second case, instead, by stimulating the subject to search for new adaptations, and consequently modifying the pre-existing structures, we could have a wider repertoire of action with elastic motor maps. This, for example, is the case of disciplines where the outcome depends on the effectiveness of a repeated exercise, such as jumping, throwing, high jump, and javelin. That of the elastic motor maps, instead, is useful for those sports activities where the outcome depends on the athlete's ability to perform actions appropriate to the context and the situation, as in the case of sports games. Therefore, learning implies that each training session aims to promote the learning of the students to whom it is addressed, without any consideration of the age group.

Learning does not mean acquiring a mechanism in a stereotypical way, but it rather means working on the development of an athlete's training comprehensively, the motor performance is closely related to it and always depends on the maturation and development processes. Therefore, by learning we mean an activity aimed at the acquisition and improvement of knowledge and skills related to the individual's cognitive processes. There are three phases of learning according to the so-called classical model worked out by Mainel & Shnabel. An individual can learn all the movements only on the

basis of those he/she already possesses, in addition to the motor maps; furthermore, knowing about the motor level one starts from, analyzing the succession of the various phases and determining one's own control leads to the three phases that we are now going to explain, namely those of raw coordination, consolidation and variable availability. The phase of raw coordination is the one related to being focused and oriented to the search for new forms of movement. Presented by the instructor, the performance level is low, due to the poor reception and processing of the information. At this stage there is a reduced ability to use strength, and a consequent difficulty in matching movements. The amplitude of movements is disproportionate.

The subsequent phase is that of fine coordination, which is an evolution of the first phase and lasts until no error is made. So, when making a gesture, thus when motor learning shows no errors, we are already in the second phase but in non-complex conditions. The external conditions are still stable; the better the intervention and differentiation of strength, the better the coupling of body segments. Furthermore, the amplitude of movement is close to the optimal range. The kinesthetic analyzer then begins to prevail. The last phase is that of stabilization, therefore of variable availability; in this phase the movements are performed with more confidence, and above all in variable and difficult environmental conditions. The athlete knows how to perform that technical gesture, can handle it even if his/her environmental condition is changed; it is the phase of perfection, of the automation of motor skills, and of the quality that can be used in competition contexts. The refinement of this phase is to be considered almost unlimited for the improvement of coordination and conditional skills. The athlete can only improve elements such as precision, rhythm, speed of movements and automation of movements themselves.

Conclusion

"Very few things, like forms, teach you how to be focused here and now".

"Forms are solitary rituals dedicated to achieving both physical and spiritual perfection. When the form is alive, awareness, body and mind become one" (Bolelli, 2015). But what is a "form"? In Eastern martial arts, the forms consist of a sequence of previously codified technical, defense and attack gestures, which imitate an imaginary fight against one or more opponents. The forms develop according to a pre-established pattern at the end of which the practitioner, if he/she has made no mistakes, returns exactly to the point from which he/she started. There are forms that last a few tens of seconds and others that are very long, some that take place "in slow motion", while decontracting or being backwards, thus emphasizing strength. Others are very quick and develop a fast impact strength, and others typically mix slow and fast passages, contractions and decontractions. The movements are all stylized and provide multiple interpretations of the various gestures, even apparently secondary. As a consequence, every little detail is carefully considered when refining a gesture. However, it is necessary to distinguish martial arts in the strictest sense from their modern sports derivations, like Judo fighting from Ju-jitsu, Karate sport, Full-contact from Muai-thay, and Olympic Taekwondo from the traditional one. Generally, the non-practicing audience completely confuses the two areas, but martial arts are something totally different. Born for self-defense, they encompass a many techniques which are too dangerous to be practiced in a free combat, and can be trained together with one or more partners only in a controlled environment. For this reason, despite the first impression, this sort of strange gymnastic sequences, representing the forms of martial arts, are often the only practical way to learn these techniques, together with controlled training with one or more partners of the single contexts. In the classical tradition of martial arts teaching, teachers used to deepen their knowledge of an art exclusively by practicing the forms. Like today, they could also learn and practice many different forms, many times a day for the rest of their lives. In any case, whatever the form practiced, it was a common practice in a training session under the direction of a teacher to be repeated several times in a training session.

The goal of this type of training was to automate the movements, to such an extent that the practitioner would perform that form in a kind of trance state, where conscious thought would disappear completely. A martial form, therefore, is first of all body-oriented. In a first sense, it is a kind of gymnastics, aimed at improving the body's ability. But in a second, much more important sense, it is aimed at educating the body, namely at making it learn unusual and almost not really instinctive movements, but nevertheless extremely effective in the combat. After a constant and tenacious practice of the forms, the movements, repetition after repetition, become a real conditioned reflex. The cognitive processes of sensation, perception and attention are trained in the constant repetition of the forms and in the complementary technical training. The forms of martial arts, as a result, are aimed at creating an automatic reflex; therefore, in a real combat situation, even emotions are literally eliminated.

Moreover, the role of a good teacher is in the ability to direct the practitioner's attention to certain martial aspects of what might otherwise remain a simple sequence of movements. With constant practice it may happen that, by analyzing certain movements of a form, a new meaning emerges among the sequences; the process of discovery fully embodies the characters of the insight (*learning by insight*). A form, in short, is simultaneously a complex and exhausting body gymnastics, a hidden conceptual knowledge and an art form.

It is a logical sequence, which, at the same time, strengthens the body and educates it to combat; a traditionally codified repetition of gestures, which produces both motor automatisms and moments of insight, in which combat strategies and certain aspects of the biomechanics of the human body are consciously understood. In such a practice, the separation body-mind fades away.

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