The 8 Pillars of Metacognition

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Abstract—Metacognition constitutes the dominant competence of the 21st century. Despite the indisputable scientific interest, there are various unanswered questions concerning the identity of metacognition, its fundamental mechanisms and its limits. In this study, a holistic and multi-disciplinary approach is attempted by collecting and utilizing data from sciences such as cognitive psychology and neuropsychology, and philosophy. The research has led us to the 8 pillars that underpin metacognition. These pillars follow the model of the hierarchical organization of knowledge. According to this approach, cognitive and metacognitive skills evolve progressively depending on the effort an individual exerts. It is worth noting that some cognitive functions such as attention and working memory seem to surpass the rest, since they operate simultaneously as cognitive and metacognitive abilities, affecting the functioning of the pillars, other cognitive functions, and in particular the higher mental abilities. Among the conclusions of greatest importance, we can cite that the metacognition pillars are, like reality itself, a field of multiple readings. They contribute to the proper functioning of the cognitive and psychophysiological mechanism, the melioration of intelligence in all fields (physical, intellectual, emotional and spiritual), the emergence of consciousness and self-knowledge. In practical terms, the pillars of metacognition are the most valuable tool of self-learning, self-development, self-treatment and self-knowledge. Metacognition, also, constitutes a key factor in effective leadership, in medical and health professions. Lastly, the pillars of metacognition should be the cornerstone of general, special, vocational and academic education so as to promote holistic learning.

Keywords—Executive functions, intelligence, self-awareness, consciousness, self-remembrance, learning difficulties

1 Introduction

When Meno asked Socrates "How can we seek what we do not know?", Socrates claimed that man cannot seek what he does not know because then he does not know what to seek, but neither can he seek what he knows because he already knows it. Man learns nothing new, but he only becomes aware of what he already knows. Knowledge is a memory, so there is a memory within us [1]. When someone asked Heraclitus how he knew what he knew, he replied: "I search myself" [2]. In Charmides, a dialogue of Plato, Caritas supports the idea that knowing oneself is exactly

what self-control is. Self-knowledge and self-control are the same: they are the awareness about what we know and what we don't know, the awareness about the limits of our knowledge [3]. All of the above may seem philosophical. In fact, in the 21st century, they are not only fundamental issues for metacognition but for all sciences, such as neuroscience. The present paper attempts an alternative approach to metacognition that aspires to contribute to the aforementioned questions taking into account evidence from various scientific fields. We present the eight pillars of metacognition, with the aim of extending the horizons of metacognition and determining its role, not only in learning, but also in achieving the self-knowledge that is the main issue of most sciences in our century.

2 The 8 pillars of Metacognition

2.1 Academic & theoretical knowledge of cognition and cognitive abilities

Knowledge of cognition refers to the academic and theoretical knowledge we have to gain about our own cognition, its operations and abilities. What are our mental tools, how do they work, what disrupts them and what speeds them up? Without knowledge about our mental tools we are unable to use them appropriately. Cognition constitutes a dynamic and complex set of mental processes that contribute to the hierarchical organization and representation of knowledge [4]. Every aspect of intelligence unfolds as knowledge being organized and transformed through metacognition in hierarchically superior levels of consciousness. Intelligence coincides with the levels of self-organization or in other words with the levels of metacognitive development we have achieved [4,5]. More specifically, cognitive processes are involved in the identification, selection, recruitment, processing, storage, organization and transformation of the subject [4]. In other words, cognition integrates the mental processes that help us to perceive, attend, remember, think, categorize, reason, decide, even feel, because emotions are part of cognition as they guide the cognitive processes [6]. The theoretical knowledge about cognition and its functionality constitutes the first and indispensable step in order to train our metacognition by which we are capable of monitoring, regulating and adapting our cognitive mechanism consciously.

2.2 Operational knowledge about the functionality of cognitive abilities, their cognitive freedom degrees and cognitive constraints

How our mental tools work in practice when getting through a challenge? The most people underestimate or overestimate their cognitive abilities resulting, for instance, in improper decision making. In addition to theoretical training, at the second level, we must, in practice, know the functionality of cognitive abilities within ourselves through experience, in order to realize their scope and limitations. Human cognitive abilities are by nature limited, especially in people who do not exercise them systematically. Our perception is not only limited when we do not have access to the thing itself, it is very practically limited to the quality of processing and the general specifi-

cations of our perceptual system. Our acoustic sense, for instance, can register and process a very narrow band of frequencies [7]. While human capacity for information is very large, the amount of information that can be actively maintained and manipulated in memory is quite short. [8]. Moreover, we have at our disposal a limited pool of attentional resources so as to respond to high attentional demands [9]. We could mention dozens of restrictions. However, in this section, we underline the functionality of the basic cognitive abilities and how they relate to each other.

Attention is considered since the time of Aristotle as the gateway of human cognition, the prerequisite for awareness and consciousness. It is a mechanism that selects relevant information from our sense data and it is characterized by the remarkable property to voluntarily (top-down attention) and involuntarily (bottom-up attention) giving priority to some parts of the information [10]. According to the aforementioned point of view, researchers distinguish between external and internal attention. External attention focuses on the selection and modification of data coming through the senses, while internal attention includes cognitive control of the information that is already represented in the mind, recalled from long-term memory or being maintained in working memory [11]. The types of attention introduced in several models are: focused attention, sustained attention, selective attention, alternative and divided attention [12]. It is obvious that attention and memory cannot operate without each other. Attention determines what will be encoded in memory, while memory guides what should be attended. According to Chun et al. the distinction between attention and memory becomes unclear [13].

Memory comprises an array of interacting systems, each capable of encoding information, storing it, and making it available for retrieval [14]. It is the nervous system's capacity to acquire and retain usable skills and knowledge. Even our entire sense of self or self-identity is made up of what we know from memories [15]. Atkinson et al. [16] describe memory as a threefold system that involves sensory memory, short-term or working memory, and long-term memory.

Baddeley et al. [8] developed an influential model of an active memory system that they called working memory. Working memory is differentiated from short-term memory in that Short-term memory refers to the temporary storage of information, whereas working memory refers to both storage and manipulation of information. The components of working memory are the central executive and the three slave systems, the phonological loop, the visuospatial sketchpad and the episodic buffer. Working memory, a core executive function, stands at the crossroad between attention, perception and language. According to Broadway et al. [17] working memory "is not directly remembering per se, but instead reflects a more general ability to control attention and exert top-down control over cognition". The central executive, the master component of working memory is considered as an attentional controlling system. It is thought to be a function of the prefrontal cortex that controls the performance of other components by allocating a limited capacity of memory resource to each component based on its demands [18]. The Visuospatial sketch-pad and the phonological loop manipulate visual images and the auditory information respectively indicating an inevitable relation with the perception system [19]. Working memory impacts higher-level tasks such as reading, following instructions, incorporating new knowledge into

action plans, identifying relations and deriving general principles from particular observations [20].

Perception is the causal and informational foundation of our higher cognitive functions since it guides our thinking, believing and action planning [21]. It comprises a complex sequence of cognitive processes by which we identify, organize and interpret the detected signals of sensations that results in internal representations of the stimuli, forming a conscious experience of the world [15]. However, perception is not a passive receipt of signals, but it is shaped by learning, memory, expectations and attention [22]. In other words, perception involves "bottom-up" as well as "top-down" processes. "Bottom-up" processes transform low-level to higher level information, while "top-down" refers to a person's expectations (knowledge), and selective mechanisms (attention) that influence perception [23]. Among the most important theories are structuralism, the Gestalt theory, Gibson's theory, the ecological approach, the computational theories and the cognitive theories [24].

Pattern recognition can be considered as a perception process, which depends on knowledge and experience people already have. Generally, it refers to a process of inputting the stimulating (pattern) information, matching it with the information in long-term memory, and then recognizing the category, which the stimulation belongs to. Without involving individual knowledge and experience, people cannot understand the meanings of the stimulating information pattern inputted, neither possible to recognize the patterns, in other words to recognize the objects [25].

Perceptual speed refers to someone's speed in comparing visual patterns or identifying a visual pattern among distracting patterns, and it has been found to have a great impact on higher-level executive functions such as working memory. [26]

Action, according to the cognitive action theory, it represents our behavior as a product of a hierarchically organized network system. Behavior is organized at each level so we are capable of learning. Nodes at the lowest level, control patterns of muscular and neuroendocrine activity. Nodes at higher levels, represent abstractions of these behaviors that generalize over functionally equivalent specific patterns of movement. Nodes at the high levels represent plans, intentions, motivations, and so forth. Hence, emotion, cognition, action and movement all flow from the processing of information by specific mental network structure [27].

Mental imagery constitutes a multimodal cognitive simulation process that enables us to represent perceptual information in the absence of actual sensory input [28]. Mental imagery, voluntary or involuntary, can induce emotional experiences by triggering perceptual and memory system components of affective states leading, in some cases, to mental and emotional disorders such as anxiety. However, it is considered as a fundamental cognitive ability as it can modulate a range of mechanisms such as goal directed self-regulation [29]. Nuovo et al. [30] have shown that mental imagery improves the verbal comprehension, visual perceptual reasoning and working memory of the intellectually disabled individuals. Zhang et al. [31] found a relationship between mathematical giftedness and mental imagery. Specifically, gifted students demonstrated exceptional abilities in mental imagery in combination with logical reasoning, creative thinking and problem solving.

Problem Solving is one of the most fundamental human cognitive processes that interacts with other processes such as abstraction, decision-making, analysis and synthesis. It can be perceived as a search process in the memory space for finding a relationship between a set of solution goals and a set of alternative paths. [32]. According to Sternberg's triarchic theory of human intelligence [33], problem solving includes processes such as: recognizing the existence of a problem, defining the nature of the problem, allocating mental and physical resources to solving problems, deciding how to represent information about the problem, generating the set of steps needed to solve the problem, combining these steps into a workable strategy, monitoring the problem solving process while it is ongoing, evaluating the solution after problem solving is completed.

Language is one of the most intriguing notions in the study of mental processes and underlying brain mechanisms. Besides its obvious communicative function, it has a direct role to play in human cognition [34]. Language allows us to, variously and theoretically endlessly, combine meanings by constructing relational units and correlational networks. The aforementioned combinatorial power is impossible without the involvement of working memory. Conscious thinking requires deeper involvement of language and working memory, since it depends on processes such as the transformation of the object of thought and the production of new conscious experiences of earlier ones. Moreover, language specifically needs the semantic memory, which is involved when constructing temporal and spatial experiences [35]. Baddeley et al. [36] suggested that the primary function of the phonological loop is the processing of novel speech input supporting language learning and specifically vocabulary acquisition. Recent evidence suggests that attention mechanisms affect how humans process language [37]. Language structure itself seems to reflect aspects of human attention mechanisms. [38] Consequently, attention deficits often lead to delay in language development or impairments in language performance. [39].

Association is seen as a particular kind of process that causes connections between mental representations carrying us from one thought to another, built up by previous co-occurrences [40]. Association is at the root of metacognitive learning since it depends on our ability to connect previous to new knowledge. It is obvious that association of unrelated items is unattainable without memory. Associative learning is an experience where multiple exogenous signals are jointly acquired through sensory systems. Associative memory integrates and storages these associated signals in nerve cells, whose achievement can be proved by memory retrieval. After associative memory forms, one of these signals induces the recall of other associated signals, and these signals are retrieved reciprocally. Logical reasoning, associative thinking and integrative imagination to these stored exogenous associated signals generate their secondary integrations, which can be stored, recalled and represented. Secondary association memory is essential for comparison, computation, decision making and planned intention under the consciousness condition [41-42].

2.3 Self-monitoring (internal attention, the ability to watch and to perceive in real time the cognitive states and operations)

Self-monitoring is an executive process, activating and deactivating other processes, as a function of on-line evaluation of thought processes and products as they occur [43]. It refers to the ongoing process of seeking, integrating, and responding to both external and internal data and it requires motivation, attentiveness and cognitive flexibility. Self-monitoring allows for early recognition of cognitive biases, technical errors, emotional reactions and may facilitate realistic self-assessment and self-awareness. [44]. Working memory and especially the central executive, the attentional control mechanism, play a key role in monitoring information processes [18]. Highly socially and emotionally intelligent people are capable of better self-monitoring [45].

Human as an adaptive and goal-directed organism could be compared with an "open system" that is under the universal rule of the second law of thermodynamics, and particularly under the destructive influence of entropy. Entropy tends to disorganize every system that is lacking of energy input, leading it gradually and inevitably from disorder to "self-destruction". Equally, human cognition needs monitoring and control in order to achieve higher levels of the threefold of self-organization, self-knowledge and self-consciousness [4]. According to the aforementioned point of view, it is obvious that active monitoring of cognition is more than focusing on the cognitive processes when a task occurs. The road to self-knowledge cannot be traveled without uncovering our true selves. Thus, the first step is to acknowledge our blind spots, our implicit motives, to reflect on our thoughts, feelings and desires. Introspection and self-observation could be considered as the most efficient self-focused methods, in order to turn consciously our attention inward and neutrally describe what is happening inside us. Self-observation initially coincides with the detachment of an inner and objective observer that permits us to recognize and discriminate the illusions, the distorted forms of reality we have established in our mind leading to cognitive impairments and emotional disorders. During self-observation, one of the main obstacles is the excessive weight people place on their internal thoughts and feelings [46]. Moreover, according to Kant "even the observation itself alters and distorts the state of the object observed" (1786, AK IV:471). Open monitoring could minimize the aforementioned side-effects since it involves observation of the content of experience from moment to moment without any specific focus of attention [47]. It is worth to mention that self-knowledge is fostered not only through intrapersonal communication, but also through interpersonal communication. The feedback we receive from the observation of the other, about what others think of us, may be a fruitful source [46].

2.4 Self-regulation (The ability to change, to regulate and to fine tune via decisions the cognitive abilities themselves as well as the mental and emotional states)

Self-Regulation (SR) constitutes a set of ongoing, dynamic, and adaptive modulations by oneself on his or her internal state in cognitive, emotional and behavioral

level. A broad meaning of SR includes top-down and bottom-up processes that mutually influence one another altering emotion, behavior, or cognition in an attempt to enhance adaptation [48].

Recent researches suggest that there is a deep connection between self-regulation processes and executive functions, since both of them share the same brain regions such as the prefrontal cortex, that influence the functions of the higher-order mental abilities. Moreover, cognitive neuroscience research suggests that successful self-regulation, as well as executive functions, depend mainly on top-down control, from the prefrontal over the sub-cortical regions involved in reward system and emotion [49]. Specifically, working memory supports the active mental representation of self-regulatory goals, and the means by which these goals will be achieved. Moreover, it can help us redirect executive attention away from tempting stimulus, visual distractors, desire-related thoughts and emotions. Sustained attention resembles a "passive" inhibition control mechanism, which shields goals from other competing goals and distractors that entail automatic or impulsive responses [50]. Working memory capacity permits us to focus attention on goal-relevant information by regulating our thoughts and showing less mind wandering. Although the memory is viewed as a "cold" cognitive concept, it may be implicated in the regulation of negative emotions or other stressful thoughts. Active Inhibition constitutes a hallmark of successful self-regulation. This type of inhibition is characterized by a "Do not do X" frame by which habits and impulses are inhibited so as to prevent the expression of impulsive behaviors. Lastly, task-switching assists the self-regulatory mechanism by making us more flexible with "rigid" goals. On the one hand, high task-switching ability allows us to achieve the same goal, replacing sub-optimal means with alternative ones. On the other hand, it allows us to disengage from a short-term goal in favor of a long-term goal. [51]

Although we potentially have an impressive capacity of self-regulation, failures are common and result in losing control of our cognitive, emotional and behavioral operations in a variety of circumstances. Self-regulation collapse, in some forms, is related to most of mental disorders, learning disabilities, as well as underachievement in professional activity, such as attention deficit/hyperactive disorder, autism spectrum disorder, addiction, depression, bipolar disorder risk, schizophrenia, obsessive-compulsive disorder, habit disorders, eating disorders, some personality disorders, poor decision-making [48]. In the modern world, the threats to self-regulation mechanism are not only multifaceted but also interrelated. Every self-regulation failure gradually affects every aspect of our existence starting from our cells, the building blocks of material life and ending to our spiritual life.

Cognitive neuroscience research suggests that self-regulatory failure can occur because of insufficient top-down control and overwhelming bottom-up impulses. Most self-regulation and self-control failures derive from impairments in the prefrontal cortex, imbalance between the prefrontal and amygdala circuit or prefrontal and sub cortical regions, the dominance of mesolimbic reward system, the dysregulation of dopamine system, and the insula cortex. The aforementioned neural regions are matched with specific manifestations such as negative moods and emotions, anxiety, lapse-activated consumption, depletion of cognitive and

self-regulation functions [49]. For instance, when prefrontal cortex bridles amygdala, we are able to control emotions, anxiety, as well as attitudes and prejudice. Moreover, prefrontal cortex activity is associated with long-term decision-making, whereas sub cortical activity with impetuous decision-making. [52] Despite the variability in the neural regions that are engaged in different types of regulation, the nature of self-regulation is constant [53]. Moreover, it is noteworthy, that we might be unaware that stimuli from our environment activate implicitly cognitive processes that influence our behavior. [54].

Self-regulation as well as executive functions can be proved via repeated practice and training. For instance, attention can be trained as a metacognitive and conscious process. Mindfulness thinking exercises have been found to enhance internal attention towards negative cognitions and strong emotions [55]. Other researchers have shown that alpha oscillations improve inhibitory abilities [56]. Physical activity and aerobic exercises have been proven beneficial to brain structure function, cognition and school achievement. For instance, higher fit children have larger brain volumes in the basal ganglia and hippocampus, which relate to superior performance on tasks of cognitive control and memory [57].

According to the 8-layer model of intelligence, knowledge and consciousness, the process of acquiring knowledge is hierarchically structured. In essence, each higher level of the pyramid is a higher state of self-organization, self-awareness and self-consciousness [4]. It is obvious that the transition from one level of organization to another requires ever higher self-regulatory capacities. In the lower levels, we employ the regulatory processes by which the stimuli perceived through the senses are appropriately manipulated in order to obtain coherence and processability, in other words to become data. In turn, it is required to correlate and transform data to information, using the corresponding regulatory rules governed mainly by attention and memory. While we make efforts to transform information to knowledge, we are additionally confronted with our personal experiences, beliefs and values that critically influence the way we form the new knowledge and, as a consequence, the reality. In the aforementioned levels, our regulatory mechanism should function in a more flexible and refined way, so as to detect the false beliefs that inevitably lead us to the vicious circle of illusions. In the higher level of expertise, we should be able to overcome cognitive and emotional limitations, so as to creatively solve new problems, to "recognize" the stability of the true knowledge inside its eternal alterations and returns. Ascending the highest levels, we meet few people that dare to cross the "river" of remembrance, so as to "quench their thirst" for spiritual knowledge [5]. Specifically, at the level of self-actualization, we regulate society pressures imposing social masks on us, and we move to the Self we are capable of being and willing to be (Rogers, 1951 as cited in Drivas 2020) [5]. At the level of Universal Knowledge, self-regulation constitutes a tool in a master's hands enabling us to relate to the unrelated, to see what others don't (Wilber, 2001) [4]. Finally, reaching the first top of transcendence, self-regulatory mechanisms attain the forgetfulness of Self, as well as the absolute synchronization between Self and Others.

2.5 Adaptation (The ability to change the operational status of cognitive abilities, in order to adapt to the work, self or social demands and so as a result to be more productive, successive and happy)

In the 21st century, adaptability constitutes the most important skill, the factor for survival, achievement in academic and professional level, and well-being. Being adaptable translates to divergent thinking, creative problem solving, expertise, motivation. It also means behavioral flexibility, organization, decision making under time-pressure, adaptation to new task demands, innovation, equanimity, positive attitude, even respect of the environment [58,59]. Learning without adaptation is pointless. Metacognition without adaptation is unattainable.

At the core of metacognitive development, we place an evolutionary concept that is missing from most theories of metacognition; the concept of adaptation. According to the layer models of intelligence and consciousness [4,5,60], the construction of knowledge is subject to sequential processes of reorganization, transformation and unification through metacognition. Moreover, knowledge is structured hierarchically, reflecting ever higher levels of self-development, self-knowledge, and self-consciousness. Individuals who ascend from one layer to another, should be more adaptable with regard to the way they adapt their cognitive abilities, their emotions, their motivations, their goals. For instance, the degree of adaptability differs when we solve a simple problem, a creative and more complex problem, and a problem of meaning in life.

Neuroscientists have found that superior intelligence and giftedness depend on specific brain networks that are related to the ability of adaptation. For instance, they underline the important role of white matter in relation to speed adaptation and development of behavioral mastery. In addition, researchers highlight the cerebellum's critical role in behavioral refinement and expertise [61]. Specifically, without the contribution of cerebellum, prefrontal-cortical networks dysfunction. As a consequence, the individuals are unable to develop hierarchically organized behaviors, and to efficiently control and manage problem-solving in novel situations. Fine-tuned interactions between frontal-basal ganglia networks are associated with higher-order reasoning that is critical for adaptation [62]. Impairments in cortex, basal ganglia and cerebellum justify why people with autism are unable to function independently [61].

In cognitive neuroscience our ability to be adaptable depends on neuro-development. Neuroplasticity constitutes the "gift" of evolution, the mechanism of neuronal adaptation and reorganization. It denotes the ability of the brain to continuously adapt its functional and structural organization to external and internal changing requirements. In other words, it underlies the ability of the brain to learn, construct knowledge throughout its lifespan.[63]. Neuroplasticity depends on two distinct but interrelated phenomena that contribute to adaptation and life –long learning: neuro-genesis (and synaptogenesis) and brain rewiring. It has been found that new neurons in the hippocampus dentate gyrus contribute to cognition, emotional control, learning and memory, the core components of adaptation [64]. Consciousness influences brain adaptability both during wakefulness as well as during sleep in a top

down way. This means that consciousness really activates synaptic flow and changes brain structures and functional organization [65].

It is noteworthy that our ability to be adaptable is disrupted due to factors such as stress, inflammations, excessive intake of carbohydrates, mitochondria dysfunctions. Learning, physical exercise, sleep, balanced hormone levels, meditation and lower frequency oscillation (alpha, beta, gamma), mindfulness training as well as brain computer interfacing improve our ability to be adaptable [66].

2.6 Recognition – Anagnorisis (To perceive the phenomena external and mostly internal states and operations in their full range and depth, the ability to see the cognitive operations and their motivations as well)

The level of self-knowledge, we are able to develop, is associated with the level of self–recognition we can achieve. According to Plato, recognition constitutes the turning point at which we are aware of our own ignorance or, in other words, our lack of knowledge. At this critical point, we initially realize that we were mistaken about things we were certain of. At the same time, the realization of our ignorance marks the beginning of the recognition of a deeper reality [3]. Taking into account, also, the four-layer model of consciousness, as well as the eight-layer model of knowledge, [4,60] we conclude that the transition from one layer to another represents a dynamic change from ignorance to knowledge which translates to a higher form of consciousness and awareness. Only when we proceed to a higher level, are we aware of the previous one. In the lower layers, we recognize the objects of the sense-perception, so we form our own perception of reality. We receive stimuli that are transformed in data and information, without being conscious aware about why they were selected and what is their meaning for us. Gradually, we recognize that all this information, we have gained, has a meaning for survival, personal and professional life. Striving to acquire more and more knowledge, we realize that we are able not only to simply know, but also to creatively manipulate the acquired knowledge, in order to solve new problems. In the higher levels of self-understanding, we recognize that sensory experience constitutes a deceptive illusion, and what we know is a blend of false beliefs and personal opinions. Higher mental abilities such us reasoning enable us to realize that our real self is not our social masks, neither our limits. Lastly, we understand that everybody, everything is under the universal rule of adjunction. From a practical point of view Recognition is the metacognitive ability to realize what is in front of you in physical, mental or emotional level, to be able to see, to perceive and understand the objects externals and internals, their relations, the correlations, the situations, the operations etc., and the structure of the phenomena and the reality in our struggle to follow the flow of the movements changes and variations that happens moment by moment.

2.7 Dicrimination – Diakrisis (The ability to filter and to make selections among various cognitive and emotional situations, and to make choices that are more helpful, positive, and supportive for your targets, success fulfillment and development)

Discrimination and recognition are complementary aspects of mnemosyne. Democritus, the Greek philosopher, distinguishes the "dark" cognition of the senses from the "genuine" cognition, governed by reasoning [67]. Plato describes sensory images as the shadows, which prevent us from envisioning the transcendental ideas [3]. Heraclitus claims that "although the truth is common, the many live as though they have a private way of thinking" [68]. According to Jung, the conscious mind is able to discriminate and synthesize the opposites in the personality, which are always inclined to merge. Without discrimination of the opposites, there is no consciousness [69]. Ascending the hierarchy of knowledge, our ultimate intention is to reach the level of unity [5,60]. However, the voyage is a long one. First and foremost, according to Heraclitus, we have to distinguish each thing according to its nature in order to "see' the big picture of the world, the way it really exists [68]. In this journey we constantly have to discern between ever deeper realities. In simple words, we should be able, for instance, to discern functional and dysfunctional thoughts, emotions and habits, real strengths and weaknesses, real and covered motives, social and deeper self, opinions and true knowledge, reality and appearances. The practical operations of discrimination are to filter, to help us to choose, what is the help and the obstacle, the facilitators and the inhibitors for our work or our targets. In a deeper level cooperates with Recognition to helps us to realize the correct from the false, reality from illusion, the existent from nonexistent [5].

2.8 Mnemosyne (The ability to be aware enough so as a result to remember that you have to apply self-monitoring, discrimination, recognition, regulation, adaptation, the ability of awareness, to apply metacognitive operations, the ability to remember the full range and depth of your abilities of who you really are)

Metacognition primarily reflects an ongoing and effortful ascent, permitting us to regain our self-knowledge. Self-knowledge, according to Plato, constitutes a contemplation of the inner knowledge, an exercise of self-remembrance. The intellectual process of re-discovering our inner knowledge require a theoretical and practical attitude. Real wisdom is the awareness of what is purer, true and more beautiful in our lives. For this reason, in the highest levels of self-awareness, a movement of escapism of the soul away from the perceptions of the world is mandatory. In the ladder of self-awareness, every step we make, it leads us to a higher level of self-freedom. The real self is the rational soul and his freedom comes when it is able to develop properly [3]. The practical perspective of Mnemosyne is the remembering and to become aware, to awake, and to observe, to self-monitoring, internally and externally. To remember your target, your role in every situation and in your life. Another deeper dimension of Mnemosyne is to remember who you really

are from the metacognitive perspective, which means to know in real time operation, what are the real mental abilities that are available to you, and to remember to become, to be the real driver, the real guide of these cognitive and metacognitive available structures, replacing the autopilot movements, and to become the metacognitive Regulator, the metacognitive Charioteer. In a deeper level Mnemosyne is the remembering of your real holistic total Self and Identity [5].

3 Conclusion

The present study describes a holistic and multi-scientific approach to identify the basic pillars of metacognition. Our research resulted in the following 8 fundamental pillars of metacognition:

1. Deep theoretical knowledge on our cognition, in general, and our cognitive functions, in particular
2. Operational knowledge on the functionality of our cognitive functions in the level of scope and limitations
3. Self-monitoring – Internal Attention of our physical, intellectual and emotional processes in real time through self-observation
4. Self-regulation of our physical, cognitive and emotional operations through monitoring and control processes
5. Adaptation of our physical, emotional and cognitive functions to perform every task
6. Recognition of the object's externals and internals, their relations, the correlations, the situations, the operations
7. Discrimination between what is functional or not, what is the facilitator or not of our work or our targets
8. Mnemosyne: Be aware- recalling internalized knowledge as an exercise to self-remembering our real holistic total Self and Identity

The pillars are in absolute interdependence so as to achieve mindfulness. However, they have some degree of autonomy. Any improvement or malfunction in each pillar affects the metacognitive mechanism as a whole. In addition, there is greater interconnection between certain pillars. For example, self-monitoring depends directly on our ability to recognize and discriminate. Self-regulation and adaptation depend on our ability to monitor and control.

According to the pyramid of knowledge, metacognition should intervene to move from one level to a higher one [4]. Only in this way, can we proceed from data to information, from information to knowledge and from knowledge to wisdom. In essence, each higher level is a higher state of self-organization, self-awareness, self-consciousness. Metacognitive development and intelligence are proportional terms. By improving our metacognitive skills, we improve our physical, intellectual, emotional and spiritual intelligence. When metacognitive skills are not properly trained or harmed by our wrong choices, intelligence is degraded.

It is clear that metacognition and its pillars should apply to all areas of human life, as they provide us with all the survival, self-development and self-knowledge strategies. Initially, they contribute to the proper functioning of the cognitive and psychophysiological mechanism. In turn, they contribute to the development of higher mental abilities and the improvement of intelligence in all areas. Therefore, they guarantee personal, academic and professional success, emotional well-being, while at a social level, prosperity and peace.

Metacognitive pillars are considered crucial for the design and implementation of appropriate educational and intervention techniques. Unless we adequately tailor our metacognitive skills, we cannot solve any problem, simply because we cannot understand what the problem really is. Accordingly, if the educator does not practice his/her own metacognitive skills first, he/she will not be able to assist the students properly. Metacognition provides us with the mental tools to identify the deeper causes of phenomena. Most students with learning disabilities display severe attention and working memory deficits not only due to genetics but also due to environmental factors such as malnutrition, toxicity and stress, all of which disrupt the functioning of vitamins, hormones and neurotransmitters, inevitably resulting in cognitive impairments. Metacognition means daily practice and training to identify the non-operating established habits and replace them with more functional and useful ones, to achieve what is called self-accomplishment through brain rewiring and brain development. Finally, educators should deploy all the new digital tools which are appropriately designed for the training on cognitive and metacognitive skills.

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