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MEDITATION IN THE LABYRINTH: INTERACTION BETWEEN COGNITION AND PROPRIOCEPTION

MEDITAÇÃO NO LABIRINTO: INTERAÇÃO ENTRE COGNIÇÃO E PROPRIOCEPÇÃO

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ABSTRACT
In various parts of the world, work the maze theme as recreation and as an anti-stress resource for the troubled reality of large centers. Hospitals develop experiences with labyrinths as a tool to support the treatment of diseases. Henry Head proposed the term "body scheme", explaining that each individual constructs a model of himself, which constitutes a pattern in which postures and movements are composing themselves in a manner consistent with this pattern. It proposed the integrality between the different body perceptions and the influence of unconscious aspects in these experiences. Upon receiving sensory information, the CNS processes them in the context of previously learned responses and performs an automatic postural correction response, which is guided or expressed through the mechanical response that is supported. There are studies considering the contributions of various brain regions to adaptive behavior, and often conceptualize systems that govern brain-behavior relationships within separate and distinct domains. From a neurological point of view, behaviors can be differentiated between cognitive, attention/executive, language, visuospatial, learning and memory and sensory and motor domains.

KEYWORDS: Meditation. Labyrinth. Proprioception. Cognition

RESUMO
Em várias partes do mundo, trabalha-se o tema labirinto como recreação e como recurso antiestresse para a conturbada realidade dos grandes centros. Hospitais desenvolvem experiências com labirintos como ferramenta de apoio ao tratamento de doenças. Henry Head propôs o "esquema corporal", explicando que cada indivíduo modela de si mesmo, e constrói para si um padrão no qual posturas e movimentos vão se compondo de forma consistente. Ele propôs a integralidade entre as diferentes percepções corporais e a influência de aspectos inconscientes nessas experiências. Ao receber as informações sensoriais, o SNC as processa no contexto de respostas previamente aprendidas e realiza uma resposta automática de correção postural, que é guiada ou expressa através da resposta mecânica que é suportada. Existem estudos regionais que consideram as contribuições de vários cérebros para o comportamento adaptativo e muitas vezes conceituam sistemas que governam as relações cérebro-comportamento dentro de domínios separados e distintos. Do ponto de vista neurológico, os comportamentos podem ser diferenciados entre os domínios cognitivo, de atenção/executivo, de linguagem, visuoespacial, de aprendizagem e memória e sensorial e motor.

PALAVRAS-CHAVE: Meditação. Labirinto. Propriocepção. Cognição

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INTRODUCTION

The beginning of the 20th century was marked by the great interest of researchers in understanding the brain structure, its organization and functioning. Neurologists investigated the nature of the processes of organization of body perception and the brain structures responsible for maintaining an adequate pattern of these perceptions. From there, the idea of a body image was to meet clinical attempts to understand neuropathological forms of bodily experiences, including phenomena such as the phantom limb and anosognosia[1].

The research, at the time, was directed to investigate the relationship between distorted body perceptions and brain and/or body damage, but the psychological aspects involved in these relationships were still neglected [2].

In the first decade of the 20th century, Henry Head proposed the term "body scheme", explaining that each individual constructs a model of himself, which constitutes a pattern in which postures and movements are composing themselves in a manner consistent with this pattern. It proposed the integrality between the different body perceptions and the influence of unconscious aspects in these experiences. In the 1930s, Schilder approached body image in a systemic way, considering that there is, in addition to neurological and physiological factors, the fundamental role of psychological and sociocultural aspects in the construction of body image. He proposed body image as a multifaceted, complex, dynamic phenomenon experienced by any and all individuals. For him, the body image of an individual is the figuration of his body formed in his mind, that is, it is the way in which the body presents itself to him [1, 2.]

The "proprioception", a term used by Sherrington, around 1900, refers to *the ability to recognize the position of joints in space, the brain receives information about the angulation of the joints and, hence, the position of the body parts in space, which also leads the individual to build the image of his own body – the body scheme*

Thus, it is described as being the awareness of posture, movement and balance changes, which differentiate the position, weight and resistance of objects in relation to the body. The Proprioceptive System receives information from multiple sensors of our body such as the skin of the soles of the feet, muscles and joints, mucous membranes, tongue, visual system and auditory system of balance (labyrinth). This system integrates and compatibilises all this information and exudes the necessary orders for the muscle fibers of the whole body for them to perform a certain action. However, this modality is also essential in the prevention of injuries, since, through the structures that compose it, impulses are generated to the Central Nervous System (CNS), which inform about the deformations that occurred in the joint when the movement is performed [3.] A joint injury can cause direct or indirect changes in sensory information maintained by mechanoreceptors. Direct trauma can cause ligament and capsular injuries, which may rupture less resistant nerve fibers and decrease proprioception. Studies conducted in the joint capsule allowed the discovery of four different types of nerve endings: Ruffini corpuscles, Golgi receptors, Pacini corpuscles and free nerve endings, which

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are sensitive to different types of movement. However, in other studies, other deep receptors were discovered: muscle spindles, Golgi tendon organ and pressure and pain receptors. The muscle spindle is considered the 3rd most complex sensory organ, after the eye and ear, and innervated by both aferent and eferent fibers. Functionally they identify the length of the muscle and its rate of change [4,]. Finally, the last group capable of determining proprioceptive meaning is represented by cutaneous receptors. They are classified as mechanoreceptors (which respond to mechanical deformation), thermoreceptors (sensitive to temperature change) and nociceptors (respond to harmful stimuli and result in pain perception). It is a complex system that influences most of the functions of the organism. The maintenance of posture involves controlling the position of the body in the space with a double objective of stability and orientation. The postural establishment takes place through a balance between neuro-muscular synergies, sensory strategies, anticipatory and adaptive mechanisms, internal representations and peripheral components. Therefore, a complex integration between musculoskeletal system, such as the range of motion (ROM) of the joints, is required; flexibility of the column; muscle properties; biomechanical relationships between body segments; and neural properties, such as sensory, motor and integration processes [5].

Whenever the Proprioceptive System goes into dysfunction, the symptoms are multiple and may manifest in different ways, depending on the organism. We can simplify, didactically, this set of symptoms by referring to the most frequent ones and integrating them into groups: Pain, imbalance, and spatial localization errors [6].

In order to maintain balance, sensory systems must act in such a way as to conduct specific information related to the positioning of the body in space, with the central nervous system (CNS) organizing them and controlling body posture both static and dynamic. Upon receiving sensory information, the CNS processes them in the context of previously learned responses and performs an automatic postural correction response, which is guided or expressed through the mechanical response that is supported [7].

The predominant models that guide the understanding of behavior and cognition within certain clinical fields such as neuropsychology, psychiatry, neurology and physiotherapy are "top down" or corticocentric in nature. By emphasizing cortical function, these fields cannot consider the substantial roles that subcortical structures that other branches of neuroscience have increasingly recognized as critical for adaptation [8].

There are studies considering the contributions of various brain regions to adaptive behavior, and often conceptualize systems that govern brain-behavior relationships within separate and distinct domains.

From a neurological point of view, behaviors can be differentiated between cognitive, attention/executive, language, visuospatial, learning and memory and sensory and motor domains. However, we must remember that the brain operates as an integrated whole [9].

The cellular mechanisms underlying this benefit of physical activity is hardly known.

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Reduced levels of neurogenesis of the adult hippocampus in old age are strongly regulated after exposure to complex environments. This suggests that decreased resources for neurogenesis can still be recruited in old age, possibly when unexpected functional challenges occur, it is also known that prolonged exposure to environmental complexity keeps the neurogenesis of the adult hippocampus at a "younger" level [10].

This is not only of theoretical importance, but is also of practical importance, as it can facilitate our approaches to the treatment of patients [11].

In various parts of the world, communities, churches, schools, parks, clubs, spas, spiritual retreats and even prisons work the maze theme as recreation and as an anti-stress resource for the troubled reality of large centers [12]. Hospitals develop experiences with labyrinths as a tool to support the treatment of diseases. The act of walking within a labyrinth, according to information from the Nursing Society for Oncology, awakens us to contemplation, reflection and transformation [13]. Psychoneuroimmunology is an area that seeks to study the correlation between these three areas. According to information available from this activity, walking through a labyrinth is a way to stimulate the correlation between the psychological, immunological and neurological fields of people [14]. This can be a component of an integrated approach to patient care. Labyrinths are a tool available to health professionals in the treatment and search for well-being, to help patients achieve a contemplative state.

One example is the labyrinth of *the Cecilio Cancer Center at Mid-Columbia Medical Center* in Oregon, which features a labyrinth used by patients and surgeons. Doctors practice walking which helps improve focus before a procedure. The stress that arises when undergoing (or administers) medical procedures is thus mitigated by the inclusion of the practice of walking meditation in the maze. Patients practice meditation to reduce anxiety [12,13,14].

Doctor Artress [14] refers to the Labyrinth as an archetypal figure for the human being, representative of paths and journeys of various symbolic meanings in life. Notes that the archetype of the labyrinth can be found in almost all religions in the world and represents a "universal pattern probably created in the human unconscious, born through the human psyche and passed through the ages. Research carried out in recent decades broadly support the statement that conscious meditation, practiced widely to reduce stress and promote health, exerts beneficial effects on physical and mental health and cognitive performance [15]. Labyrinth walking is a way to integrate cognitive and physical structure through walking meditation [16,17].

OBJECTIVES

Describe Meditation Walking in the Labyrinth and its reactions in proprioception and cognition, based on reports experienced of this activity in the participants of the practice.

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METHOD

This study uses the descriptive research method. In this study, we consider "Meditation Walking in the Labyrinth" a unique expression, which characterizes the activity developed by Phd. Lauren Artress (1995) from her study and application regarding the labyrinth image present on the floor of the Cathedral of Chartres, In France.

This activity we perform is similar to that performed by her in the USA, with some modifications introduced by us. We introduced the use of a mandala with a maze design, with a size of half a meter by half a meter, which is facing the maze. We also introduced appropriate texts that people read after walking. This activity requires no training (nor any kind of strenuous physical movement). Walking in the maze is the kind of meditation technique that anyone, regardless of previous experience or athletic ability, can participate in.

Since 2001, we started this activity in hospitals and sections linked to the Complex formed by the Federal University of São Paulo (Unifesp), Paulista School of Medicine (PSM) and Hospitals linked to the Society for the Development of Medicine.

Currently, Meditation Walking in the Labyrinth has taken place at the São Paulo Campus of Unifesp and is part of the Humanization Program in Health of the Unifesp-EPM-HSP Complex. For this activity we make use of songs of various themes, during the activity.

The labyrinth is designed, circular, two-dimensional, painted on a lonite fabric that usually varies from the classic standard of seven-circuit or 11-circuit labyrinth design, which leads from the outside, in and out wards and back to the outside again. This image has two dimensions with no walls. And both the entrance and the exit are one. As you walk through the maze, it winds up from side to side turning 180 degrees each time to enter the next circuit. Initially the person receives a brief explanation about Meditation walking in the Labyrinth. The shoes are removed, and disposable shoe covers are available.

Doctor Artress (1995), identifies three stages of walking in the labyrinth:

The first stage is *Preparation You* walk in the path of the labyrinth, at your own pace, slower or faster, until you reach the center. The second stage is *Enlightenment.* In the center the person can sit, or stand, or in the position in which they feel most comfortable, eyes open or closed, whether or not looking at the mandala. And finally, the third stage is the *Restoration.* As you leave the center, you walk back to the beginning. When leaving the labyrinth, the person receives two texts for reflection. After practice, participants received a text with a message to take home. Taking a text home aims to keep the memory about the walking activity in the labyrinth.

In this study, the individual narrative listening of 18 participants was performed to better understand the answers after practicing the walk in the labyrinth. The narratives of these participants were analyzed, categorized and inserted into the results. For data analysis, IBM *SPSS* Statistics Base for Windows, 18.03 was used.

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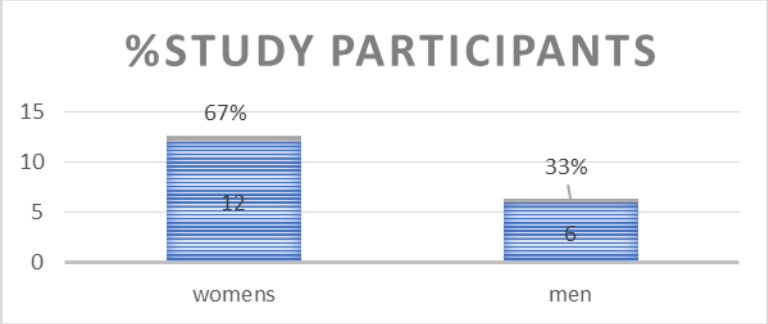
In this study, the majority of participants were women,67% and men 33%, the mean age was 42 years. Even with most women, no differences were observed in the results and the narratives were similar for both sexes.



The following graph shows the percentage at which these phrases appear during participants' narratives.

RESULTS

After practicing the walk in the Labyrinth, it was asked individually for each of the participants, if it was possible to describe the sensations that occurred during the practice. The most common answers were:

- ✓ Feeling of increased strength in the lower limbs as they advanced the path of the labyrinth;
- ✓ Greater sensation of contact with the ground;
- ✓ Improved balance during the execution of the curves of the course, reported this result saying that at the beginning of the course "they felt decreased balance in the first corners", but then improved a lot, felt "strength in the legs
- ✓ Improvement in hearing and interaction with music, all participants reported the sensation of increased sound during the walk (but did not hear changes in the volume of ambient music on the part of the researchers).
- ✓ Some mentioned improvement of muscle pain in the neck and lumbar spine;
- ✓ Feeling of warmth in the lower limbs during the return of the course;

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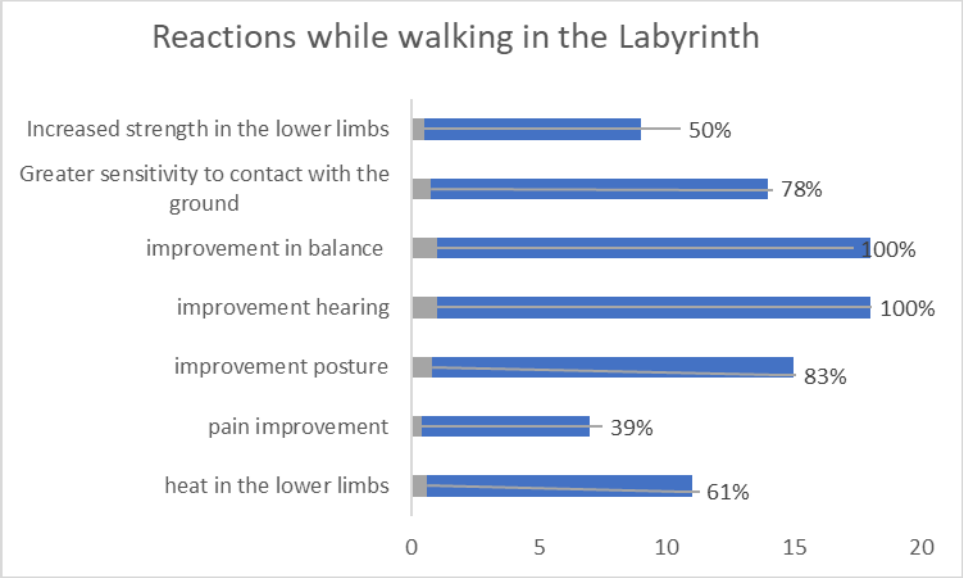
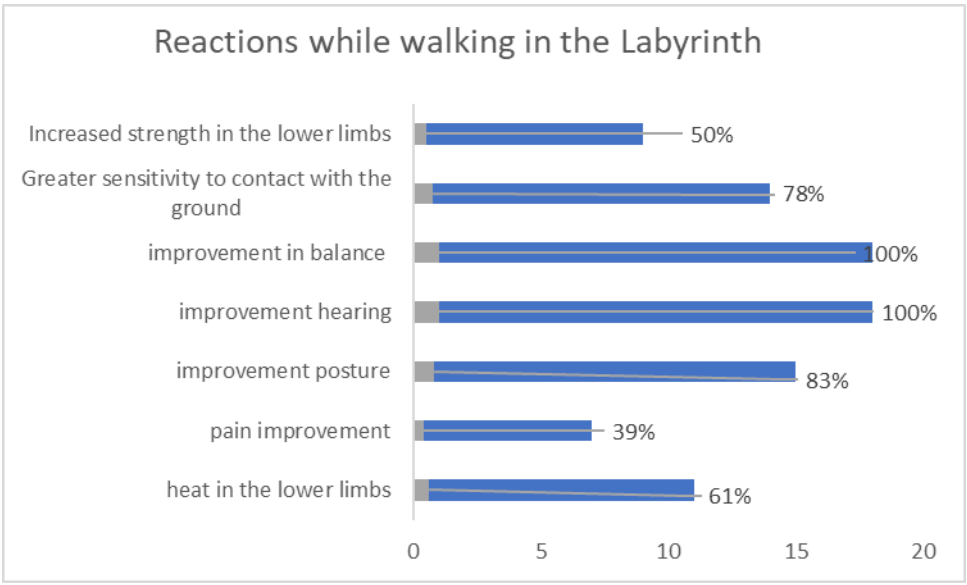


Graph 1: Types of sensations while walking in the Labyrinth.

Most participants reported the following cognitive sensations:

- ✓ General Relaxation Mind/Body;
- ✓ Emotions such as euphoria and fear altering the movements of the lower limbs during parts of the path;
- ✓ Mood Improvement;



Graph 2: Cognitive reactions during and after walking in the Labyrinth.

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DISCUSSION

In this study we observed that the most frequent reports were among people regarding the improvement of balance, attention, focus, general relaxation and interaction between emotions and movement execution. These results suggest that walking in the Labyrinth may be a way to integrate the cognitive and proprioceptive structure through walking meditation.

With regard to data from other articles, currently, studies suggest that meditation can physically change the brain and body and, with this, can contribute to the improvement of physical and psychic health. In a 2012 study, researchers compared brain images of 50 meditating adults and 50 adults who do not meditate. The results suggested that people who practiced meditation for many years had more "folds" (gyrations) in the outer layer of the brain. It is assumed that this (called spinning) can increase the brain's ability to process information [13,18,19].

A 2013 review of three studies suggests that meditation may slow, block or even reverse changes that occur in the brain due to normal aging [13,19,20].

In the activity of Meditation in the Labyrinth, we have the union of meditative practice with active movement, since it can also be considered a physical activity [17]. Studies show that physical activity is good for the body and also seems to be good for the brain.

By assessing memory performance after a sports session, neuroscientists at the University of Geneva demonstrated that an intensive physical exercise session of only 15 minutes improves memory, including the acquisition of new motor skills. This would happen through the action of endocannabinoids, molecules known to increase synaptic plasticity. Programs and strategies aimed at reducing the effects of neurodegeneration and memory decline can benefit from this [21]. Currently behavioral and neurophysiological disorders have shown that meditation improves not only attention, but also physical and psychological responses [18,19,20]. The various forms of meditation have in common the possibility of promoting a variable degree of relaxation, variability that is often more dependent on certain individual conditions specific to each person, than necessarily in relation to the characteristics of the meditation method, so it can also occur with meditation walking in the labyrinth [13,17].

In this study, the participants made reports that suggest activation of the proprioceptive system such as: to perceive the location, position and orientation of the body in space, to recognize the force exerted by the muscles and the movement of the joints, the movement of balance and posture during the execution of the curves of the course and sound interaction during the performance of the activity. Perhaps when working with the notion of body and space and with the unexpected path, as occurs during meditation practice walking in the labyrinth activate a body and spatial memory that can cause the walker to make reports of feeling in another space-time. This may be a process constructed from external stimuli that are less used to the individual [17].

Changes in gait movement caused by changes in emotions at the beginning of the walk and changing during the path were also reported. Other studies such as by Ackerley, reinforce the

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relationship of emotions with the proprioceptive system. We found that emotions greatly influence neural functions such as learning and memory [22,23].

It seems obvious that emotion is also capable of interfering with motor performance. But how does that happen? What would be the neurobiological explanations?

In a brief review of the functional anatomy of the basal ganglia and their relations with the thalamus-cortical system we can affirm that the basal ganglia, including the striatum, the pale, the subthalamic nucleus and the black substance, are involved in several parallel and functionally segregated subcortical circuits. These circuits support a wide range of sentient-motor, cognitive and emotional-motivational brain functions. One of the main functions of the basal ganglia is the learning and selection of the most appropriate motor or behavioral programs. The internal functional organization of the basal ganglia is very adequate for such selection mechanisms, both in development and in adulthood[23]. From the observation of some neuropsychiatric conditions, neuroscientists suspected a more direct influence of emotion on movement. In depression, for example, the reduction of physical movement is a typical symptom, almost always related to disturbed emotional processing and reduced motivation. Specifically, there is evidence that limbic information affects motor circuits probably by modulating the connection between the ventral striatum (base nucleus) and the motor cortex, through the nigrothalthalmic pathway [23, 24].

In another research, it was suggested that emotions are able to modulate feedback from our muscles, which implies direct consequences for our body awareness and readiness to react to emotional situations. In this case, sad emotions caused these spindles to respond differently to the movement. Motor exercises increased with the anticipation of positive effects, such as the visualization of rewards, represent a relevant way to enhance learning and performance in these activities [18,25].

Another interesting result was the sound reaction that the participants had during the activity, associated an interaction with ambient music and movement during meditation practice walking in the Labyrinth. Patel and Iversen proposed a theory of motor activation during musical perception called the ASAP (Action Simulation for Auditory Prediction) hypothesis. They suggested that the same neural bases involved in the simulation of body movements are used by the motor planning system to enter neural activation with musical beat. This would allow simulations to be used online during music listening as a predictive sensory signal for the upcoming musical beat. The simulation is not linked to a movement based on specific effectors, but a simulation of a timed rhythmic movement suggests the dorsal auditory flow as a potential neural pathway underlying this process [26,27].

Gordon conducted a meta-analysis, in which they found evidence of consistent activation of various regions of the brain during passive listening to music. The results showed activation in the primary and secondary auditory areas bilaterally. This is consistent with the existing literature, showing that these areas are the critical regions of the cortex for the processing of received auditory information. Other activated areas included the right primary motor cortex, right and left lateral

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premotor cortex, and left cerebellum. They concluded that motor planning activity serves not only to help us move but is recruited for musical perception even in the absence of movement [28].

After performing meditation by walking in the Labyrinth, participants reported improvement in mood. Physical activity, such as walking, has an impact on mood by reducing sympathetic nervous system activity and associated hypothalamic-pituitary-adrenal reactivity in the brain [13,29,30].

CONCLUSIONS

Walking Meditation in the Labyrinth, due to its characteristics of dealing with movement and the position of the body in the space of the labyrinth itself, seems to exert action on proprioception in addition to other factors that may be common with the more conventional forms of meditation. The practical activity of Meditation Walking in the Labyrinth seems to exert a beneficial relationship in proprioception and cognition and can be used as a support tool for motor sensory rehabilitation. Further research may be conducted in future studies to verify other experiences that may eventually manifest itself in other categories.

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