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REVIEW ARTICLE

Systematic review and effect of conscious breathing on adult attention and learning task

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Abstract

In recent years, the control of physiological processes has been strengthened, which show metabolic changes that can generate effects at a neuronal level. Our objective is to review what has been described as conscious breathing theory and how this can affect cognitive tasks, which have been described as very affected in adults and which reduce with age. However, we have begun to understand a new phenomenon of andragogic learning, which indicates that the task of learning must be understood differently, and that attention is something that must be understood as something that does not decrease with age but changes. It also seems that conscious breathing tasks can improve this type of task and that it can be beneficial. What has been published suggests that breathing, or at least conscious breathing exercise, improves certain cellular and neuronal capacities and that this can lead to real changes in cognitive tasks in adults.

Keywords: *Meditation. Learning. Breathing. Aging.*

Revisión sistemática, efecto de la respiración consciente en la atención de los adultos y tarea de aprendizaje

Resumen

En los últimos años se ha potenciado el control de los procesos fisiológicos, que muestran cambios metabólicos que pueden generar efectos a nivel neuronal. Nuestro objetivo es revisar lo que se ha descrito como teoría de la respiración consciente y cómo ésta puede afectar a las tareas cognitivas, que se han descrito como muy afectadas en los adultos y que se reducen con la edad. Sin embargo, hemos empezado a comprender un nuevo fenómeno de aprendizaje andragógico, que indica que la tarea de aprendizaje debe entenderse de forma diferente, y que la atención es algo que debe entenderse como algo que no disminuye con la edad, sino que cambia. También parece que las tareas de respiración consciente pueden mejorar este tipo de tareas y que pueden ser beneficiosas. Lo que se ha publicado sugiere que la respiración, o al menos el ejercicio de respiración consciente, mejora ciertas capacidades celulares y neuronales y que esto puede llevar a cambios reales en las tareas cognitivas en los adultos.

Palabras clave: *Meditación. Aprendizaje. Respiración. Envejecimiento.*

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General ideas

For several years, attempts have been made to reconcile meditation tasks and cognitive function. However, it has been difficult to reconcile esoteric definitions with the real scientific background; we can observe in this type of exercise[1]. Luckily, and driven by various researchers, more pragmatic study methods have recently been applied to this type of activity and we can indicate a relation between physiological balance states, secondary to conscious breathing activities, and beneficial effects with cognitive tasks[2]. This review aims to present psychological, physiological, and neurophysiological evidence of the advantage of conscious breathing practice on cognitive tasks, particularly learning in the adults.

The task of learning and the andragogy

Defining this activity is complex, with various viewpoints according to the professional area which studies it. These are all variables to respect, but I must agree on one to define it. A decision, we would like to construct, is that learning will be any stimulus generating a behavioral change which leads to survival[3]. These ideas have also been reinforced by the introduction of the concept of synaptic plasticity[4] and have been reviewed as an important and fundamental phenomenon for the task of learning[5]. Thus, this neurophysiological phenomenon will be a focus for observing adults when we consider the task of conscious breathing.

The history of definitions of education is long. Within it, pedagogy or teaching has been installed as education for children perpetuated in various models[6]. However, the concept of andragogy arose with strength in the 1960s, as a new identity for who was to be taught[7]. This model was taken as teaching adults, but neurobiological concepts let us redefine it as the process of educating a mature, full, and conscious brain, something which arises once this organ is already mature, and the ego emerges[8]. Learning in adults, andragogy recognizes the importance of tutor participation as an extrinsic motivator[7], which concurs with support in guided information searches[9]. It defines learning in context, which suggests that continuous learning exists, where in any moment; we can acquire new skills[10].

Attention as a complex task, description on adults

Within the task of learning, attention is a phenomenon to be studied[11] as we can define this concept in neurosciences. We can use the concept that attention is a form of feedback, of self-stimulating learning processes[12]. Thus, we can think of it as a part of learning and deem it important to develop to achieve better learning task performance[13].

Attention is a fundamental axis of the teaching-learning process, and in this way, we will consider it to be selective[14]. Furthermore, implicit learning modulates the assignation of attention in the first stages of the perceptive processing of learning and will become implicit only when attending to the relevant predictive information[15]. The information is redundant because its subjects can, in principle, select the right answer based on only one of these signs and ignore the others, so that consequently this signal is learned and the others are not[14]. This could basically be solved in adult individuals and is achieved in the selection of tasks which are known and to a lesser degree with new tasks. Subjects can also learn about stimuli which do not reach consciousness, particularly when they are near the perception threshold and are combined with a reward[16], a topic which becomes relevant in earlier stages of life. Attention, environment, and reward jointly determine how we learn and are some of the factors determining neuronal plasticity[17], which makes it even more important to investigate new learning environments and their determining factors, such as attentive breathing.

Imaging changes in learning tasks

There is apparently an idea that learning new tasks become harder with aging, especially those tasks depending on the hippocampus and structures related to the medial temporal lobe to form episodic or declarative memories. It has even been suggested that age-related cognitive deficits begin at age 20[18]. Various studies suggest that not only are there changes in cerebral microstructure and volume manifesting in cognitive function shifts[19] but also metabolic changes[20]. Decreased cerebral mass and diminished cognitive function are often seen with advanced age[20]. Therefore, it is important to distinguish between metabolic changes in the brain caused by healthy aging and pathological states[21].

Conscious breathing, physiology and molecular changes

The term meditation covers a wide range of mental training practices varying between cultures and traditions. They go from techniques for promoting physical health, relaxation, or improved concentration, developing an improved sensation of well-being and cultivating altruistic behavior[22]. Meditation is generally associated with a concurrent state of greater waking consciousness and lower metabolic activity, leading to better physical health, psychological balance, and emotional stability[23]. Mindfulness meditation is a promising basis for interventions, with particular potential relevance for psychiatric comorbidity. The successes and challenges of researching mindfulness meditation are based on the interactions between contemplative traditions and clinical psychological science[24]. The conclusions of these studies determined that attention is the fundamental process strengthened in these interventions[25]. To understand this, we can investigate that evidence exists supporting mindfulness-based cognitive therapy for treating depression[26] and obsessive-compulsive disorder. At present, there are studies about its efficacy on chronic and terminal diseases. This marks it as effective technique which can help cultivate positive mental health in normal individuals[27] and be an effective instrument regarding preventive medicine and public health.

Studies suggest that long-term meditation practice can reduce stress reactions, a fall in reduction-oxidation metabolic conditions and could be therapeutically beneficial in chronic inflammatory conditions characterized by neurogenic inflammation[28]. The cumulative effects of regular mediation practice may, in the long run, help improve the physiochemical conditions where synapses occur and could represent a useful preventive strategy for age-related chronic diseases[29]. Even so, there is still much to study given the technical limitations and molecular changes which mindfulness practice and conscious breathing could induce, but we may directly infer that metabolic changes improve synaptic tasks and that this improves the task of learning. Meditation and conscious breathing measurements suggest that this metabolic change occurs and that we can infer cognitive improvement.

Conscious breathing and cognitive effects

Studies suggest that mental training, meditation, and other similar tasks may be used as tools in neuroscientific studies of the brain and cognitive plasticity[30]. The brain changes as a function of experience or learning, dependent on stimuli, creating changes in neuronal pathways,[31] and deeper molecular remodeling giving evidence of the phenomenon of metaplasticity[32]. Therefore, some authors mention in their publications that some cognitive processes and executive functions can be improved with meditation, secondary to synaptic changes. A study was done on adolescents where the participants (N = 198 adolescents) were randomly assigned to mindfulness meditation, hatha yoga, or a control group. The mindfulness meditation group participants showed significant improvements in their working memory, unlike the control and hatha yoga groups[33]. Other short-term meditation studies show that meditation improves executive functions, including attention and working memory processes. However, they argue that it is unclear how much contextual effects contribute to these improvements[34], although we can suggest metabolic changes related to improved synaptic function.

Consequently, meditation training improves performance on tasks evaluating attention, control, and memory function[35]. To explain these effects, current theoretical models emphasize attention as the central component influenced by meditation[36]. However, can it impact adult learning enough to be used within teaching-learning processes? Apparently, studies confirm that these individuals improve performance related to sequence repetition, allowing for the implementation of response-based planning, and generating benefits from learning them[37].

There is evidence suggesting positive physical and psychological clinical results from meditation. These studies show relief for clinical disorders, including anxiety and depression[38], eating disorders, addictions and disorders caused by psychoactive drug use[39], stress normalization, arterial pressure and cholesterol levels, and cardiovascular disease prevention[40], of how it could improve metabolic states, diminishing reduction-oxidation balance, which has been suggested to modulate synaptic function, with effects on what we consider the base of learning, metaplasticity[41]. It has also been suggested that its effect is achieved by lowering the intensity of emotional excitement; therefore, the task of meditation not only allows us to infer an improved physicochemical environment where synapses occur, but also to achieve better balance in the autonomous system, allowing us to indicate an improved learning environment. For this reason, since 1996, Varela has spoken about neurophenomenology, regarding consciousness studies where subjective experience and brain dynamics are integrated, allowing for simultaneous measurement of subjective experience (experiential correlations), phenomenological correlations, and neurophysiological correlations for the same time period or event[42]. In this, the state produces a change

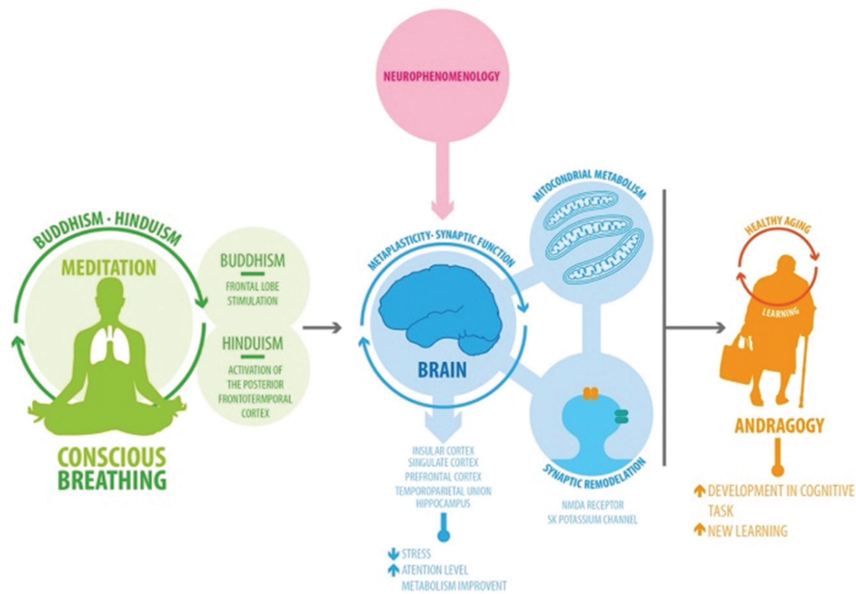

Figure 1. The figure is a summary model of our review, where we indicate that the use and development of conscious breathing improves cognitive tasks, enabling better behavior in adults. This can be explained by changes in the physiological conditions in which metaplastic phenomena occur and we can suggest that learning can be enhanced by this type of simple and easy to introduce activity.

in brain activity together with a phenomenological change according to the qualitative research done with people in hypnosis or meditation[43].

Electrophysiological and imaging evidence

In 2011, Hölzel, et al. analyzed magnetic resonance images and compared cortical density, before and after meditation training, and found structural changes which are secondary to increased synaptic connections in meditators. These changes are represented by an increased amount of grey matter in the left hippocampus, the posterior cingulate cortex, the temporoparietal union and the cerebellum, all areas involved in learning, memory processing, and emotional regulation[44]. The increased hippocampal structure may be secondary to the activation of the hippocampus. This change in function could be related to the consolidation of declarative memory long-term memory, such as the recovery of spatial information coding and autobiographical memory[45]. Researchers have also documented the effects of meditation on spatio-visual memory spatial memory recovery and recognition of objects and codification of distances between reference points[46] and the visualization of interior or exterior scenes representing a spatial design[47] including the imagination and representation of complex scenes[48], also activating the parahippocampal area, this latter effect being mainly due to structural changes, but which as mentioned are secondary to functional modulations.[49]

Conclusions

Figure 1 shows a summary of our idea, present now, in this review. We suggested some of the cellular efects of conscious breathing. Synaptic activity is modulable at the molecular level, due to a phenomenon known as metaplasticity. Recent evidence indicates that this is an ongoing phenomenon in the brain and accounts for learning in various models. This phenomenon also does not disappear, but rather changes its form of stimulation suggesting that it does not decline in age, but rather adapts to new conditions, Molecular changes occur in appropriate physiochemical conditions and with the right level of attention, especially regulating the autonomous system. The tasks of meditation and breathing have been described as affecting this type of process, improving metabolic parameters and regulating the autonomous system, thereby reducing stress. This could allow us to infer a mechanism carrying out structural changes in relevant brain areas for cognitive task development. These points could suggest that conscious breathing activities improve metabolic processes, allowing for improved synaptic function modulating remodeling culminating in changes in critical brain areas and improved cognitive function. This, in the framework of andragogic learning, could be a new paradigm for working on adult learning, where teaching conscious breathing may be helpful in adults for cognitive tasks in a context of new learning.

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Conflicts of interest

The authors declare that they have no conflict of interests.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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