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An Analysis upon Impact of Different Yogic Exercises on Executive Functions

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Abstract – Executive functioning (EF) is a multifaceted neuropsychological construct that can be defined as (1) forming, (2) maintaining, and (3) shifting mental sets, corresponding to the abilities to (1) reason and generate goals and plans, (2) maintain focus and motivation to follow through with goals and plans, and (3) flexibly alter goals and plans in response to changing contingencies.

Despite an increase in the prevalence of yoga exercise, research focusing on the relationship between yoga exercise and cognition is limited. The purpose of this study was to examine the effects of an acute yoga exercise session, relative to aerobic exercise, on cognitive performance.

Studies of the cognitive benefits of physical activity need to move beyond simple aerobic activities that require little thought (treadmill running, riding a stationary bicycle, or rapid walking) and resistance training. Many studies have looked at this in older adults, and the evidence points strongly to those activities having little or no cognitive benefit, certainly little or no improvement to the executive functions that depend on prefrontal cortex. There is encouraging evidence for other types of physical activity improving executive functions; however they have received far less study.

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INTRODUCTION

The relationship between exercise and cognitive performance is a highly topical area of scientific inquiry. Although the majority of this work examines the effects of chronic exercise participation on cognition, there has been an increasing interest in the potential transient effects of acute bouts of exercise. Several reviews and meta-analyses have suggested that participation in acute aerobic activity exerts a positive influence on cognitive function, and in particular, executive function.

Executive function refers to a subset of goal-directed processes (ie, planning, scheduling, working memory, task coordination, cognitive flexibility, abstract thinking, etc.) involved in the intentional component of environmental interaction. Both chronic physical activity and single acute bouts of exercise7 have been found to have positive influences on cognition, with disproportionately greater effects for tasks that require extensive amounts of executive control. In particular, one aspect of executive control that has garnered a great deal of interest is inhibitory control, which refers to the ability to manage and direct attention within the stimulus environment by ignoring irrelevant information and maintaining focus on relevant items. Hillman et al used a modified flanker task to manipulate inhibitory control, and demonstrated that adults are able to better engage and classify information in their stimulus environment and process this information more quickly following acute aerobic exercise. The majority of the acute exercise and cognition research has focused on aerobic exercise with relatively fewer studies investigating the effects of other modes of activity. It is difficult to compare or generalize the findings of these studies, given the different protocols and modes of exercise used, and various tasks used to assess unique aspects of cognition. Although there is growing interest in acute exercise and cognition research, the primary focus on aerobic exercise effects makes it difficult to generalize the findings to other nontraditional forms of exercise.

Accordingly researchers need to investigate the unique acute effects of other nontraditional modes of exercise such as yoga, tai-chi, and other forms of martial arts. It is known that the cardiovascular and metabolic demands of aerobic and resistance exercises are inherently different. Many of the nontraditional forms of exercise have mindbody components which may differently affect physical and mental processes.

Ross and Thomas 8 reviewed studies comparing the effects of yoga, a mind–body-based exercise; and aerobic exercise and concluded that in both healthy and diseased populations yoga may be as effective,

or better than, aerobic exercise at improving a variety of health-related outcome measures. Yoga is an ancient Indian science and way of life that includes the practice of specific postures, regulated breathing, and meditation. The technique involves an active attentional or mindfulness component but its potential benefits have not been thoroughly explored. Despite an increase in interest pertaining to the health benefits of yoga practice, research focusing on the relationship between yoga practice and cognition is limited. Sarang and Telles evaluated performance on a 6-letter cancellation task in males (age 18–48 years) immediately before and after 2 yoga-based relaxation techniques and a control session of equal duration. They used cyclic meditation and supine rest and found that the net scores were significantly higher after both practices.

In another study using the 6-letter cancellation task, Telles et al11 reported improvement in cancellation scores (either total errors or net scores) after engaging in a yoga breathing technique characterized by forceful exhalation and high-frequency breathing. Canter and Ernst conducted a systematic review of 10 randomized controlled trials to evaluate the effect of transcendental meditation on cognitive function. Four trials reported large positive effects on cognitive function; 4 provided only weak evidence for a positive effect and 2 showed no effect. Analogous to the aerobic literature, there is clearly mixed evidence regarding acute yoga benefits and cognitive function.

Given the various forms and postures of yoga, it is not surprising that these results are equivocal. The primary focus of exercise and executive function studies has been inhibitory control. However, there is a need to explore other critical executive processes such as working memory. Pontifex et al showed that participants' reaction time on a modified Sternberg working memory task improved immediately and 30 minutes after acute aerobic exercise relative to the preexercise baseline. They observed no such effects after resistance exercise or seated rest. In the current study, we used the n-back task as a measure of working memory, one aspect of executive control that is responsible for continuous encoding, temporary storage and manipulation of information necessary to execute complex cognitive tasks.

The n-back task is one of the most popular experimental paradigms for cognition and functional neuroimaging studies of working memory. A modified flanker task was used in conjunction with the n-back as it has been used in acute exercise studies to manipulate inhibitory control.

To review the evidence on the benefits of physical activity for executive functions (EFs), it is necessary first to find all the studies that examined this and to exclude all studies whose experimental designs prohibit drawing a conclusion about whether the activity benefited EFs or not. For example, all purely correlational studies need to be excluded. Those studies compare the EFs of persons who happen to have engaged in Activity A versus the EFs of others who happen to have engaged in Activity B or at least not in Activity A. Factors which caused people to pick Activity A or not might account for any differences in EFs found; we have no way of knowing if the activity itself caused any benefit found. Second, studies with no comparison group (e.g., studies that looked only participants in Activity A) must be excluded because there is no way to tell if improvements might have been found even if participants had not done that activity. Third, I have excluded all studies that looked only at an acute effect right after one bout of exercise because I do not know what those results imply about effects that last more than 24 hours from an exercise program or regimen.

EXECUTIVE FUNCTIONING

Executive functioning (EF) is a multifaceted neuropsychological construct consisting of a set of higher-order neurocognitive processes that allow higher organisms to make choices and to engage in purposeful, goal-directed, and future-oriented behavior. EF confers an evolutionary advantage by freeing an organism from innate, hard-wired drives and reflexes, as well as from over-practiced, overlearned, and prepotent responses. A moth, for example, will be drawn to a light bulb time and time again, no matter if it burns its wings each time. In contrast, as humans, we possess the most highly evolved EF of all species, which allows us the latitude of considering options and selecting a specific response to any given stimulus based on situational contexts, previously acquired knowledge, and long-term goals.

Because EF is a highly effortful and, from an energy consumption standpoint, a costly process, it remains "dormant" for much of our waking hours, coming "on line" only when the novelty and/or complexity of a given situation precludes an automatic, routine response. Put another way, a response that is automatic or routine is, by definition, not a reflection of EF. This latter notion is important and is invoked later when the concept of "skills" will be discussed.

In clinical neuropsychology, it has been understood for a number of decades that EF represents one of a handful of core neurocognitive domains. Outside of neuropsychology, the EF construct has entered the research arena relatively recently, representing a new and exciting area of interdisciplinary inquiry. Researchers tackling this new direction face a number of challenges, most notably difficulties with defining, operationalizing, and assessing the EF construct.

The present paper reviews these challenges and offers some general guidelines. Traditionally, EF has been described as being associated with the so-

called prefrontal cortex (PFC) of the brain, which includes all portions of the frontal lobes that are located anterior to motor and premotor cortices and the supplementary motor area. The prefrontal cortex can be divided into three main convexities: (a) the dorsolateral PFC, often described as the substrate of working memory; (b) the super medial PFC (which also includes the anterior cingulate gyrus), often described as the substrate for sustained attention, response selection, and motivation; and (c) the ventral (or inferior) PFC (which can be divided into orbitofrontal and ventromedial), often described as the substrate for inhibition, social appropriateness, and sensitivity to rewards and punishments. In recent years, the most anterior portions of the frontal lobes, known as the frontal pole (which includes anterior portions of the dorsolateral and ventral prefrontal cortices), have also received much attention due to their role in morality, empathy, and higher order integration of EF.

The functions of the prefrontal cortex can also be further subdivided by the two cerebral hemispheres, such that the left PFC is associated with initiation of responses, as well as processing of information that is verbal, concrete, or detail-oriented, whereas the right PFC is associated with inhibition of responses, as well as processing of information that is visual-spatial, abstract or connotative, and gestalt oriented.

However, it is now well understood that the PFC is not the only brain area involved in EF. Because the frontal lobes are richly connected to a variety of other brain regions, most EF processes depend on the integrity of complex networks rather than a single frontal lobe region. Thus, for example, working memory is dependent not only on the dorsolateral PFC but also on portions of the parietal lobe; response initiation is dependent not only on the left medial and ventral prefrontal cortices but also on the basal ganglia and the thalamus; sustained attention is dependent not only on the super medial PFC but also the integrity of many regions within the right hemisphere and the thalamus; and so on and so forth. In fact, virtually all EF components require the integrity of circuits involving portions of the PFC, the basal ganglia, the thalamus, and the cerebellum, as well as cortical areas outside of the frontal lobes. Clearly, the complexity of these networks is beyond the scope of this paper but suffice it to say that individual aspects of EF should not be viewed as easily localized.

IMPACT OF YOGIC EXERCISES ON BRAIN WAVE COHERENCE IN EXECUTIVES

Business executives' lives have become a never-ending race against time, technology, and targets. This race creates tension, which leads to dissatisfaction and frustration and eventually manifests itself as psychological and physiological stress with mental and emotional drain. This modern lifestyle intensifies the stress leading to 'Excessive Tension' and consequent deterioration in 'Executive Efficiency'. Yoga offers a holistic and integrated stress management program called Self-Management of Excessive Tension (SMET) to combat this modern lifestyle problem and thereby one can lead a holistic way of living in health, harmony and happiness. Previous work on stress management educational program, reported significant improvement in the subjective well-being inventory (SUBI) scores of the 77 subjects within a period of 10 days as compared to controls. These observations suggest that a short lifestyle modification and stress management educational program can make an appreciable contribution to primary prevention as well as management of lifestyle diseases. Previous work on SMET, reported decrease in occupational stress levels and baseline autonomic arousal in managers, suggesting significant reduction in sympathetic activity and better emotional well-being in the managers.

No previous investigation has directly evaluated the effect of SMET program on EEG. Hence, we have designed present study to assess the efficacy of five days SMET program, on corporate executives using EEG recordings. This study analyzes and discusses the neuro-physiological changes after SMET program.

THE IMPACT OF HATHA YOGA INTERVENTION ON EXECUTIVE FUNCTION IN OLDER ADULTS

Yoga is a commonly practiced, mind–body activity that has components centering on meditation, breathing, and postures. In recent U.S. surveys of adults, 7.5% reported having used yoga at least once in their lifetime and 3.8%–5.1% reported having used it in the previous 12 months. The use of yoga and other complementary and alternative medicine therapies is becoming increasingly popular, especially among older adult populations who use these alternative therapies for aging-related chronic conditions such as back pain, arthritis, anxiety, depression, and cancer. Although yoga practice involves physical postures that mimic stretching, balance, and strength exercises, which result in physical benefits, it also includes an active attentional component of breathing and meditation practice. Given the age-related declines in cognitive function, little is known about the potential of yoga in maintaining or enhancing cognitive function in older adults.

A considerable corpus of research exists that has extensively examined the effects of physical activity on cognition and executive functions. However, majority of these studies have examined the role of aerobic training. Colcombe and Kramer in their meta-analysis reviewed randomized controlled trials

(RCTs) conducted with sedentary healthy older adults and found that executive control processes (g = 0.68, $p < .05$) showed the largest benefit from aerobic fitness training. More recently, Smith and colleagues (10) conducted a meta-analysis to examine this relationship and reported that individuals randomly assigned to receive aerobic exercise training demonstrated modest improvements in executive function (g = 0.123, $p < .018$) and working memory (g = 0.128, $p < .026$). Regardless of the methodological differences, both these meta-analyses suggest that participation in aerobic physical activity can help improve cognitive function. However, compared with this extensive body of work on aerobic training and cognition, far fewer scientific studies or RCTs have examined movement-based embodied contemplative practices such as yoga or tai-chi. Oken and colleagues conducted a RCT examining the effects of yoga on cognition in healthy older adults, but found no relative improvements in cognitive function. The authors acknowledged two major reasons that explain these null findings: (i) recruitment of physically active seniors that may have resulted in a ceiling effect and (ii) the dose of exercise that was one session per week is lower compared with more frequent sessions employed in other successful RCTs. More recently, Hariprasad and colleagues conducted a 6-month RCT with residents of elderly homes and found significant cognitive improvements in attention and processing speed, verbal and visual memory, working memory, and inhibitory control.

The authors acknowledged the lack of an active control group, high dropout rate, and the need to examine effects of yoga on community-dwelling older adults. Given the paucity of yoga–cognition RCTs and to address limitations of previous studies, the purpose of this RCT was to examine the effects of an 8-week Hatha yoga intervention on executive function in community-dwelling older adults. We recruited sedentary healthy older adults and structured the dose of exercise to match the physical activity literature with training sessions held 3×/week. We also used three established measures of executive function that have been extensively used in physical activity research: the task switching paradigm, the n-back task, and the running memory span task. The primary outcomes were mean reaction time (RT) and accuracy (AC) scores on the three executive function measures. We hypothesized that regular, structured Hatha yoga practice, which included components of physical movements, breathing, and meditation, would lead to significant improvements on executive function measures following the 8-week trial in a sample of sedentary healthy community-dwelling older adults.

IMPACT OF SAHAJ YOGA ON NEURO-COGNITIVE FUNCTIONS

Major depressive disorder (Unipolar depression) is the most common mood disorder and is ranked fourth in the list of the most urgent health problems worldwide by W.H.O. with the life time prevalence of depressive disorders of around 10–25% for women and 5–12% for men. The associated cognitive deficits are frequently viewed as epiphenomena of the disorder and cognitive impairment is likely to be a key factor affecting the subject's ability to function.

Cognitive changes in depression span a range of functions, including deficiency in sustained attention, concentration, set maintenance, efficiency of information processing, verbal & non-verbal long term memory, short term retention, visuo-spatial skills and constructional ability.

The science of Yoga deals with a man holistically, as this is the only science, which takes into consideration both the 'psyche' and the 'soma' aspects of human framework. Study on the effects of Yoga on cognitive functions has shown improvement in memory, vigilance & anxiety. Sahaj Yoga is a form of "Kundalini Yoga" which describes a simple technique to arouse the latent potential of man by a simple meditative process. Sahaj Yoga has shown beneficial effect in the management of Hypertension, Bronchial asthma and epilepsy. Previous scientific studies on Sahaj Yoga have also demonstrated its role in reduction in anxiety levels, improvement in sensory-motor functioning, reaction time and better autonomic control in healthy practitioners.

However, executive functions have not been studied yet and there is paucity of data of the effects of Sahaj Yoga on cognitive functions in patients of Major Depression in whom these functions are affected.

THE IMPACT OF YOGA ON COGNITIVE DEVELOPMENT IN SCHOOL CHILDREN

Mental health is "a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community." It can also be defined as a state of emotional and psychological well-being in which an individual is able to use his or her cognitive and emotional capabilities, function in society, and meet the ordinary demands of everyday life.

Cognitive performance refers to a person's mental processes, including memory, attention, producing and understanding language, learning, problem solving, reasoning, and decision making. Cognitive development starts in early adolescence and is influenced by many factors such as postnatal psychosocial environment, poverty, malnutrition, family stressors, environmental stressors, and maternal depression. Adolescent rural children are more likely to be subjected to poor socioeconomic conditions as compared to urban adolescent children. Poor quality of home environment can adversely affect children's development, leading to cognitive deficits. Findings of one study suggested that the

experience of persistent economic hardship, as well as, very early poverty undermines cognitive functioning at five years of age. However, according to a recent experimental research, both acute and chronic aerobic exercise promotes children's executive function. Executive function refers to the cognitive processes necessary for goal-directed cognition and behaviour which develop across childhood and adolescence.

In this context, ancient traditional practice of yoga might be helpful in improving mental health and thus cognitive development. The Sanskrit term yoga means "the union of the individual self (Jiva-atman) with transcendental self (Parama-atman)". The word 'Yoga' is derived from the Sanskrit root verb "Yuj" means bind, make union, control. Patanjali defines yoga as the "restriction of the wheels of consciousness and paths of ecstatic self-transcendence or methodical transmutation of consciousness to the point of liberation from the spell of ego personality". Yoga has multiple physical, mental and spiritual benefits and holds that the influence of the mind on body is far more powerful than the influence of body on mind. Yoga helps in gentle and automatic massaging of internal organs and thus helps in enhancing functioning of digestive system, circulatory system, respiratory system, endocrine system, nervous system, and excretory system. According to a study conducted in a secondary school, preliminary results suggest that yoga has the potential of playing a protective or preventive role in maintaining mental health.

There are scientific evidence that yogic practices enhance mental health, muscle strength, flexibility, respiratory system, cardiovascular system, promote recovery from addiction and its treatment, reduce stress, anxiety, depression, relieve chronic pain, improve sleep patterns and enhance overall well-being and quality of life. Earlier findings suggest that yoga reduces stress in school children which enhances their academic performance.

CONCLUSION

The purpose of this study was to compare the immediate effects of an acute bout of yoga and aerobic exercise on executive function tests of inhibition and working memory. The current findings indicated that the reaction times were shorter and the accuracy was significantly greater after an acute bout of yoga for tasks requiring greater amounts of executive control, indicating improvements in inhibition and working memory.

Yoga is a commonly practiced mind-body approach that has components centering on meditation, breathing, and activity or postures. There appear to be at least 2 mechanisms by which the practice of yoga or exercise improves cognitive ability. Lowered mood is associated with declines in cognitive function and Hatha yoga has been reported to produce improvements in mood comparable to aerobic exercise.

The present study has demonstrated that yoga training probably has affected primary cognitive processes such as attention, perception and observation. Yoga, being a simple and inexpensive health regimen, can be incorporated as an effective adjuvant therapy.

REFERENCES

Brisswalter J, Collardeau M, Rene´ A. (2002). Effects of acute physical exercise characteristics on cognitive performance. *Sports Med*. 32: pp. 555–566.

Canter PH, Ernst E. (2003). The cumulative effects of Transcendental Meditation on cognitive function–a systematic review of randomized controlled trials. *Wien Klin Wochenschr*. 115 (21–22): pp. 758–766.

Colcombe S, Kramer AF. (2003). Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychol Sci*. 14: pp. 125–130. doi:10.1111/1467-9280.t01-1-01430

Diamond A. (2013). Executive functions. Annu Rev Psychol. 64: pp. 135- 168.

Hillman CH, Snook EM, Jerome GJ. (2003). Acute cardiovascular exercise and executive control function. *Int J Psychophysiol*. 48: pp. 307–314.

Laude M. (1999). Assessment of nutritional status, cognitive development, and mother-child interaction in Central American refugee children. *Rev Panam Salud Publica.* 6: pp. 164-71.

Logue SF & Gould TJ. (2014). The neural and genetic basis of executive function: Attention, cognitive flexibility, and response inhibition. Pharmacol Biochem Behav. 123: pp. 45-54.

McMorris T, Tomporowski P, Audiffren M. (2009). *Exercise and cognitive function*. Michigan: Wiley- Blackwell.

Moritz S, Birkner C, Kloss M, et al. (2002). Executive functioning in obsessive compulsive disorder, unipolar depression and schizophrenia. Arch Clin Neuropsychol.; 17: pp. 477–483.

Pontifex MB, Hillman CH, Fernhall B, Thompson KM, Valentini TA. (2009). The effect of acute

aerobic and resistance exercise on working memory. *Med Sci Exerc Sport*. 41(4): pp. 927–934.

Sarang SP, Telles S. (2007). Immediate effect of two yoga-based relaxation techniques on performance in a letter-cancellation task. *Percept Mot Skills*. 105: pp. 379–385.

Sharma R, Gupta N, Bijlani RL. (2008). Effect of yoga based lifestyle intervention on subjective wellbeing. Indian J Physiol Pharmacol; 52: pp. 123–31.

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