

Chapter 4

Neurobiology of Yoga Practice

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ABSTRACT

Although self-knowledge and behavior training have been substantial parts of Yoga for many centuries, neuroscience approach towards the effects of Yoga on cognition and brain functioning/structure is a pretty new field of research. As technology advances, new technical support is gained to investigate long ago experienced traditional Yoga practices. To the extent Yoga gains more supporters all over the world, growing interest arises from many laboratories and research centers in unraveling the “mysteries” surrounding its techniques, making this way a bridge between tradition and science.

INTRODUCTION

Self-knowledge and behavior training have been substantial parts of Yoga for many centuries. The neuroscience approach towards the effects of Yoga on cognition and brain function/structure is a relatively new field of research. As technology advances, new technical support is gained to investigate long ago experienced traditional Yoga practices. To the extent Yoga gains more supporters all over the world, many researchers become interested in unraveling the “mysteries” surrounding its techniques, and thus, creating connection and a contemporaneous approach for traditional Yoga through the modern understanding of science.

The role of a researcher is to methodically observe and describe phenomena. Similarly, the practice of yoga leads the practitioner to meticulously observe his/her thoughts and feelings. In the absence of instruments to explain such events, the sages of the past have explained some psychological and physiological phenomena based on myths, stories and symbols (Campbell, 1991). The definition of Yoga

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by Patanjali: “*Yoga’s citta vrtti nirodhah*” (Yoga is the silencing of the modifications of the mind) can now be better understood from a neuroscientific perspective. In this ancient text, the author reveals the existence of obstacles (*kleśāḥ*) that prevent the human being from living a joyful life. The psychological distress caused by *kleśāḥ* is based on ignorance, which is understood in the philosophy of Yoga as confounding the Self with mental activity. In modern language, one could say that stress, depression and anxiety are some of these obstacles. Such obstacles affect circuitries in the central nervous system, which are strengthened at each and every access. The same way, specific components of yoga may positively influence cognitive, emotional, behavioral, and autonomic modulation of the human being, through an emphasis on interoception and bottom-up input, resulting in physical and psychological health, as well as through a top-down regulation during meditation, quieting mind and body. According to some authors, yoga is formed by a vast group of synergistic tools, which aim at integrating high and low-level brain systems, and creates a self-feeding process of afferent and re-afferent inputs, such as somatosensory, viscerosensory, and chemosensory ones (Gard, Noggle, Park, Vago, & Wilson, 2014a).

Patañjali has not talked about brain networks or synapses; however, he developed concepts such as “*samskāra*” (mental impression) or “*vāsanā*” (latent dispositions) which are related to compulsive behaviors and also that in which one always uses the same neural pathways and synapses. *Vāsanā* and *samskāra* have a very similar meaning, and both refer to a tendency towards influencing a present behavior. According to Patanjali, people are constantly influenced by these phenomena (*vāsanā* and *samskāra*), which keep the mind negatively conditioned. Compulsive behaviors are easily noted and diagnosed in Obsessive Compulsive Disorder (OCD), or in addiction to alcohol and drugs; the sages, however, suggested yoga as a path to free humans from these constraints, even when those behaviors were mild or moderate. In OCD one is trapped by a pattern of repetitive thoughts and behaviors and has no way out of it, and the activity in the orbitofrontal cortex is reduced. This part of the brain cortex is related to cognitive flexibility, which allows changes in behavior, adequate to one’s needs. There are some authors who investigated the effects of Yoga on OCD, and found improvements of symptoms in subjects who practiced Yoga or meditation (Hertenstein et al., 2012; Hanstede, Gidron, & Nyklicek, 2008; Shannahoff-Khalsa et al., 1999). Besides, Hernandez et al. (2016) found larger gray matter volume in some regions of the brain as the orbitofrontal cortex of healthy practitioners of *Sahaja Yoga* (a spiritual technique founded by Nirmala Srivastava) as compared to non-practitioners. Although studies with OCD patients have not analyzed neurotransmitters nor used neuroimaging techniques, this improvement of symptoms may have happened along with changes in brain function or in the levels of neurotransmitters, which are altered in psychiatric disorders. Similarly, addiction may also be associated to *vāsanā* and *samskāra*. In the addicted behavior the reward system of the brain and some dopaminergic pathways are mostly activated and “strengthened”. There is an impairment of the orbitofrontal cortex, which also impairs cognitive flexibility. Thus, the addicted patient adopts a recurrent behavior through which he/she searches pleasure and tries to avoid discomforts, that might happen during abstinence; changes in behavior become very difficult. Yadav et al. (2012) reported an increase in β -endorphins, related to wellbeing, in volunteers who practiced yoga, while Shahab et al. (2013) found reduction in craving through yogic breathing. Thus, the cited works support the hypothesis in which Yoga can help subjects who suffer such chemical subordinations. However, these conditionings are not restricted to drug addiction or OCD. When Patañjali addresses these subjects, he certainly refers to something more subtle, common to all human beings. At the beginning of his text (the *Yogasutras*), in Chapter 1, Verses II, III and IV, he states that when the practitioner (*yogin*) reaches the Yoga state, he/she contemplates his/her very nature; the state in which there is no conditioning. In modern and scientific terms, when one is

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