Dosha brain-types: A neural model of individual differences

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ABSTRACT

This paper explores brain patterns associated with the three categories of regulatory principles of the body, mind, and behavior in Ayurveda, called Vata, Pitta, and Kapha dosha. A growing body of research has reported patterns of blood chemistry, genetic expression, physiological states, and chronic diseases associated with each dosha type. Since metabolic and growth factors are controlled by the nervous system, each dosha type should be associated with patterns of functioning of six major areas of the nervous system: The prefrontal cortex, the reticular activating system, the autonomic nervous system, the enteric nervous system, the limbic system, and the hypothalamus. For instance, the prefrontal cortex, which includes the anterior cingulate, ventral medial, and the dorsal lateral cortices, would exhibit a high range of functioning in the Vata brain-type leading to the possibility of being easily overstimulated. The Vata brain-type performs activity quickly. Learns quickly and forgets quickly. Their fast mind gives them an edge in creative problem solving. The Pitta brain-type reacts strongly to all challenges leading to purposeful and resolute actions. They never give up and are very dynamic and goal oriented. The Kapha brain-type is slow and steady leading to methodical thinking and action. They prefer routine and needs stimulation to get going. A model of dosha brain-types could provide a physiological foundation to understand individual differences. This model could help individualize treatment modalities to address different mental and physical dysfunctions. It also could explain differences in behavior seen in clinical as well as in normal populations.

Key words: Ayurveda, brain-types, Kapha, nervous system, Pitta, Vata

INTRODUCTION

Typologies have been delineated for body structure (ectomorph, mesomorph, and endomorph),[1] mental functioning (multiple intelligences),[2,3] emotional response (levels of emotional reactivity or sensation- seeking), social relationships (level of need for attachment), and behavioral tendencies (level of stress reactivity). Ayurveda, the traditional medical system of India, has delineated three categories of fundamental regulatory principles of the body, mind, and behavior. These three categories, called doshas, are named Vata, Pitta, and Kapha.[4] The category of Vata dosha includes processes responsible for cell division and cell signaling, movement at all levels of the physiology, excretion of wastes, and also cognition. Vata also regulates the activities of Kapha and Pitta. The category of Kapha dosha includes processes responsible for anabolism, growth and maintenance of structure, storage and stability. The category of Pitta dosha includes processes responsible for metabolism, thermo-regulation, energy homeostasis, pigmentation, vision, and attentional processes.[5] The physical, mental, and behavioral characteristic of each dosha are summarized in Table 1. Notice that the descriptions listed are primarily based on external observation of physiological characteristics and behavior [Table 1].

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Table 1: Description of doshas in Ayurveda

Vata dosha	Pitta dosha	Kapha dosha
Lean or delicate build, dry skin, and fine hair	Medium build, muscular	Solid frame and thick bones
Vibrant and energetic expression	Warm friends and fierce opponents	Calm, slow to act and react
Light of heart and quick to speak	Are strong willed, passionate leaders	Easy personality, and are loving and caring
Highly creative, and very changeable in mood, and flexible in decision making, and behavior	Tend to be direct and take charge	Move slowly and purposefully
		Are usually conservative

PHYSIOLOGICAL PATTERNS SUPPORT THE TRIDOSHIC THEORY

A body of research has grown, which explores patterns of blood chemistry, genetic expression, physiological states, and chronic diseases associated with each dosha type.[6] Triglycerides, total cholesterol, high low-density lipoprotein (LDL), and low high-DL (HDL) concentrations-all common risk factors for cardiovascular disease were reported to be higher in Kapha types compared to Pitta and Vata types. Hemoglobin and red blood count were higher in Pitta compared to other types. Serum prolactin was higher in Vata types.[5] Other research supports these findings that high levels of triglyceride, very LDL and LDL levels and lower levels of HDL cholesterol distinguish Kapha types from other types.[7]

Genetic expression also distinguishes dosha types. Genes in the immune response pathways were up-regulated in Pitta types, genes related to cell cycles were up-regulated in Vata types, and genes in the immune signaling pathways were up-regulated in Kapha types.[5] Inflammatory genes were up-regulated in Vata types, whereas up-regulation of oxidative stress pathway genes were observed in Pitta and Kapha types.[8] CD25 (activated B cells) and CD56 (natural killer cells) were higher in Kapha dosha types. CYP2C19 genotypes, a family of genes that help in detoxification and metabolism of certain drugs were down-regulated in Kapha types and up-regulated in Pitta types.[9,10]

Physiological patterns also distinguish dosha type. Adenosine diphosphate-induced maximal platelet aggregation was the highest among Vata/Pitta types.[11] In diabetic patients, there were significant decreases in systolic blood pressure in Vata/Pitta, Pitta/Kapha, and Vata/Kapha types after walking (isotonic exercise). The Vata/Pitta types also showed significant decreases in mean diastolic blood pressure.[12] In terms of biochemistry, Kaphas had elevated digoxin levels, increased free radical production and reduced scavenging, increased tryptophan catabolites and reduced tyrosine catabolites, increased glycoconjugate levels, and increased cholesterol: Phospholipid ratio of red blood cell membranes. Pittas showed the opposite biochemical patterns. Vatas showed normal biochemical patterns.[13]

A study of basic cardiovascular responses reported that heart rate variability and arterial blood pressure during specific postural changes, exercise, and cold pressor test did not vary with constitutional type.[14] A more recent paper measuring cold pressor test, standing-to-lying ratio, and pupillary responses in light and dark reported that Kapha types have higher parasympathetic activity and lower sympathetic activity in terms of cardiovascular reactivity as compared to Pitta or Vata types.[15]

An open question in this discussion is how these genetic, metabolic, and physiological factors express themselves in terms of more expressed lifestyle and behavioral characteristics. Obviously, many genetic and metabolic factors are influenced by the nervous system, which not only controls metabolic and growth factors through the endocrine system but have an impact on the functioning of the immune, digestive, cardiovascular, and virtually every other system in the body. Further, it controls all our mental, emotional, and behavioral systems including attention, learning, memory, and sleep.

THEORY OF DOSHA BRAIN-TYPES

Brain functioning underlies and affects mental and behavior functioning. Thus, the dosha types which are based on observable mental and physical behavior and characteristics, should also be based on different patterns of brain and nervous system functioning. Thus, defining fundamental brain types may give a means to understand individual differences.

For instance, Vata dosha, which is highly variable in behavior and in response to the environment, would be associated with a greater range of functioning of the brain and nervous system. Pitta dosha, which is characterized by dynamism, would be associated with fast, passionate responses of the brain and nervous system to challenges in the environment. Kapha dosha, which is characterized by steadiness, would be associated with stabile activity patterns of the brain and nervous system.

These three different types of brain functioning can be seen as different patterns of functioning of six major systems of the nervous system. Table 2 presents an overview of this model.

The first system is the frontal executive system of the brain, which includes the anterior cingulate gyrus (attention switching and error detection), ventral medial

Table 2: Patterns of brain functioning for Vata, Pitta, and Kapha brain-types

Brain system	Vata brain-type	Pitta brain-type	Kapha brain-type
Prefrontal executive circuits	Easily overstimulated Acts quickly Learns quickly and forgets quickly Likes to multi-task	Strong reaction to challenges Purposeful learning Tenacious Goal oriented	Methodical thinking and action Learns slowly with high level of retention Prefers routine Needs stimulation to get going
Reticular activating system	Is alert but inconsistent Can lead to nervousness Hard to fall asleep and stay asleep	Strong dynamic responses to every situation Goal oriented behavior Can see impulsive behavior	Not easily provoked Easy going Easily falls asleep and stays asleep
Autonomic nervous system	The fight-and-flight response is frequently and easily triggered Limbs are generally cold and have poor circulation Sensitive to pain and cold	The fight-and-flight response turns on strongly to reach a goal, and then turns off Does not like heat Good peripheral circulation	The fight-or-flight response is not easily evoked High parasympathetic response Sensitive to cold and dampness
Enteric nervous system	Irregular appetite Irregular bowel movements, and frequent gas	Always hungry Irritable if miss a meal Loose and frequent bowels	Can easily miss a meal Regular daily bowel movements
Limbic system	Moods change quickly Fear and phobias can occur when in excess	Strong emotions Competitive and dynamic nature Irritable and angry when in excess	Calm and happy Rarely gets angry Shy and depressed when in excess
Hypothalamic control	Irregular appetite Bursts in activity Frequent snacking and drinking	Always hungry Strong response Higher metabolism Prefers cool foods and water	Can easily miss a meal Low and steady response Lower metabolism Tendency to gain weight

(emotional input), and the dorsal lateral prefrontal cortex (decision making). The Vata Brain-Type exhibits a high range of prefrontal functioning leading to the possibility of being easily overstimulated. They perform activity quickly. Learn quickly and forget quickly. They like to multi-task. Their fast mind gives them an edge in creative problem solving. The Pitta brain-type reacts strongly to all challenges leading to purposeful and resolute actions. They never give up and are very dynamic and goal oriented. The Kapha brain-type is slow and steady leading to methodical thinking and action. They prefer routine and needs stimulation to get going.

The second system is the reticular activating system (RAS) of the brain, which is responsible for arousal level. It determines if we are highly alert, relaxed, or asleep. The Vata brain-type exhibits a high range of arousal levels leading to a sense of over-reacting to the world. They have trouble sleeping soundly. The Pitta brain-type becomes easily aroused and maintains high level of focused arousal to get a task accomplished. The Kapha brain-type is not easily perturbed. They are calm and easy going and seldom get excited.

The third system is the autonomic nervous system that includes the sympathetic (fight-or-flight) and parasympathetic (tend-and-befriend) systems. Ninety percent of our responses to the environment are governed by the autonomic nervous system. This system automatically maintains an optimal level of arousal to deal with any situation from watching a sunset to running after a taxi. The fight-and-flight response is easily turned on in Vata brain-types and is variable in its level of response. The Vata brain-type is very sensitivity to pain and cold temperatures. Their limbs are generally cold and have poor circulation since high sympathetic activation reduces periphery blood flow. The fight-and-flight response turns on to a high level in Pitta brain-type and then return to resting levels again. Autonomic response is tied to purposeful goal oriented behavior it turns on to reach the goal and then turns off. The fight-or-flight response is not easily evoked in the Kapha brain-type. The parasympathetic response is generally high, and the person is very steady. They are sensitive to cold and dampness.

The fourth system is the enteric nervous system, which is responsible for digestion. The enteric nervous system interacts with the microbiome of the gut to modulate immune functioning and activity of the parasympathetic nervous system. The Vata brain-type exhibits a high range of digestive power leading to an irregular appetite, irregular bowel movements, and frequent gas. They are more affected by eating late at night or over eating. That would react more to new foods. The Pitta brain-type has a strong digestion. They are always hunger and can eat at any time and, seemingly, any food. They have loss and frequent bowel movements. The Kapha brain-type is not much affected by what or when they eat. They can easily skip a meal. The enteric nervous system interacts with satiety centers in the hypothalamus to govern feelings of hunger.

The fifth system is the limbic system, which is responsible for emotion. It includes many nuclei around the center of the brain: The amygdala for survival and fear response, the hippocampus for anger and spatial awareness, the nucleus accumbens for pleasure, the insula for saliency of experience and tie bodily states to emotions, and hypothalamus that integrates the activity of the autonomic nervous system. The limbic system is highly sensitive to changes in the environment in Vata brain-types. Their emotions are rich and highly variable. When over-activated, the Vata brain-type can have excessive fear and phobias. The limbic system provides the fire for the Pitta brain-type to react to the world. Their actions are competitive and dynamic. In excess, this can lead to irritability and angry. The Kapha Brain-Type is always smiling. They are seldom in a hurry. Nothing seems to make them angry.

The last system is the hypothalamus, which is responsible for homeostasis. It automatically controls our responses to challenges, freeing us from considering hunger, thirst, and arousal levels. The output of the limbic system feeds into the hypothalamus, which then will activate the autonomic nervous systems as needed and even activate the prefrontal cortex. The hypothalamus is intimately involved in the functioning of the other five brain areas. In Vata brain-types, the hypothalamus is constantly changing the state of mind and body. They will experience bursts of activity and rest, and will frequently snack and drink. In Pitta brain-types, the hypothalamus has a strong on and off switch. When turned on, the autonomic nervous system functions at its maximum to accomplish the goal. There is no half-way point. The hypothalamus maintains a higher core body temperature and dynamic mental and physical activity that leads to the preference for cool foods and drinks in this brain-type. In Kapha brain-types, the hypothalamus maintains a slower metabolism. This can lead to easily gaining weight. There is slower responsiveness to temperature and situations [Table 2].

This table has been created based on the organizing principles of the three doshas in Ayurveda. If these sub-categories of functioning of brain systems are valid, then other mental and physical typologies should also be explained by the patterns of nervous system functioning described in this table. The explanatory power of this proposed model is demonstrated in consideration of sensation-seeking.

Sensation-seeking in light of the three brain-types

Zuckerman defined the personality trait of sensation-seeking as the tendency to choose varied, complex, and intense sensations leading to increased risk. This trait is exhibited in a range of behaviors including substance use, gambling, and risky sexual practices.[16] High sensation-seekers orient more strongly to novel stimuli and show larger cortical activation patterns. Low sensation-seekers show defensive reactions to strong stimuli and show reduced or unresponsive cortical activation patterns to variations in stimulus intensity.[17]

Sensation-seeking is tied to dopamine levels, with higher dopamine leading to more risky behaviors. Dopamine appears to amplifier behavior when there is the chance for large gains, and decreases discrimination that the behavior may also yield large losses. This is seen in rats who press levels for food one yielding one pellet each time, the other leading 4 pellets from 12% to 80% of the time.[18] This was also seen with humans who were given a dopamine agonist, cabergoline, which increases the effect of dopamine in the brain. During conditions with cabergoline compared to placebo, subjects selected the high-risk condition (60–40) when there was the chance for high gains.[19] This effect in humans was only seen in subjects with low levels of sensation-seeking at baseline.

High sensation-seeking is also tied to reduced attention to negative consequences of loss. A functional magnetic resonance imaging (fMRI) study compared blood flow in high and low sensation-seekers during a Wheel of Fortune type test. Both high and low sensation-seekers showed activation in bilateral insular and prefrontal cortical response to winning (activation). However, the high sensation-seekers showed deactivation in these structures to negative outcomes compared to the low group. Ignoring possible negative consequences of a decision may lead to maladaptive choices.[20]

High sensation-seekers orient more strongly to novel stimuli and they tend to ignore negative consequences. High sensation-seeking shares many characteristics of the Pitta brain-type with faster activation of the reticular activation that systemically increases arousal, activation of the amygdala that turns on the sympathetic nervous system to increase resource allocation, and activation of the anterior cingulate gyrus to turn your attention to the experience.

Low sensation-seekers have a defensive reaction to novel stimuli, cortical activation is lower, and they consider both positive and negative consequences of an action. Low sensation-seekers shares many characteristics of the Kapha brain-type with less reactivity overall-lower activation of the reticular activation, the amygdala, and the sympathetic nervous system.

The Vata brain-type may lead more to impulsivity rather than to sensation-seeking. Impulsivity is acting without consideration of the consequences of ones actions. Impulsivity and sensation-seeking have different trajectories of development from age 12 to 24.[21] The Vata brain-type is marked by variable response to external conditions that would lead to bursts in attention, in physical energy, and in autonomic response to situations. This type would probably be scored as neither as high nor as low sensation-seeker.

An important consideration in this discussion is that the sensation-seeking trait develops during adolescence. A 12 years longitudinal study of 7640 individuals, age 12 years at baseline, reports substantial variation in the magnitudes of developmental change in sensation-seeking. Some teenagers showing rapid changes in sensation-seeking as they matured and others maintaining relatively constant over the 12 years.[21] These differences could reflect predominance of Vata, Pitta or Kapha brain-types.

A research program to explore physiological correlates of dosha brain-types

A research program using physiological and cortical measures could explore the utility of dosha brain-types. Levels of this research program are presented in Table 3. For instance, resting state networks have become a recent focus in neural imaging research. Resting state networks are large-scale cortical circuits that dynamically interact to process experiences a salience network, involving the anterior insula and cingulate gyrus, deactivates the default mode network and activates the central executive network.[22] The salience network could be more variable in Vata brain-types, less reactive in Kapha brain-types, and function more decisively in Pitta brain-types more quickly shutting down the default mode and turning on the central executive network. fMRI could also be used to assess emotional responses to the International Affective Picture System. Pitta brain-types should respond me strongly to stressful pictures. This research program could investigate sympathetic/parasympathetic balance as measured by heart rate variability, which is sensitive to anxiety levels and level of emotional stress.[23] It could also measure cytokine and c-reactive proteins to assess immune functioning in the different brain-types. A focused analysis of brain-types would build the neural basis to understand dosha types [Table 3].

Table 3: Research program to explore physiological, neural, psychological, and behavioral correlates of dosha types

Measures	Sample research
Neural imaging	fMRI of resting networks
	fMRI viewing IAPS
	fMRI during a 2-back task, which measures frontal executive functioning
EEG	EEG power and coherence patterns
	ERP during a 2-back task (gives time and functional information)
Autonomic measures	Sympathetic/parasympathetic balance (heart rate variability)
Physiological measures	Immune functioning - cytokine and C-reactive proteins
	Sympathetic reactivity to a speech challenge (cortisol)
Psychological measures	Profile of mood states
	Emotional intelligence
	Cog state: A computerized test of many cognitive measures
Behavioral measures	Reaction time
	Psychomotor vigilance task

EEG=Electroencephalography, ERP=Event-related potential, fMRI=Functional magnetic resonance imaging, IAPS=International Affective Picture System

CONCLUSION

This brain-type model makes specific predictions about patterns of frontal executive functioning, RAS activation, and patterns of autonomic and limbic functioning. These variables can be assessed by standard physiological and electrophysiological measures. Future research will investigate the relation of dosha type to electroencephalographyEEG patterns, autonomic activation and autonomic balance, stress reactivity and behavior to support the proposed model. This line of research could help clarify variable response to drugs and lifestyle modifications in normal and clinical populations and so help target health promotion at all levels of life.

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Conflicts of interest

There are no conflicts of interest.

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