



## **An Objective Measure of Holistic Health Diagnosis: An HIP– Bioelectric Approach**

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### **Abstract**

The comparison of diagnostic approach between modern medicine and traditional holistic health care systems namely Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH) has been a subject of research interest. However, the precision and accuracy of physicians' diagnostic skill in AYUSH mainly acquired through clinical experience wherein, inter-rater reliability and consistency of same seems skeptical.

The present diagnostic research scenario of AYUSH reflects lack of consistency and reliability that hints for barring of physicians' diagnostic cognitive assessment. Therefore, this study advocates neuropsychological approach of Human Information Processing (HIP) model applicable to both physicians' cortical diagnostic cognition function and subjects' symptom generation. The study proposes modulation of bioelectrical activity on electro-neuro-physiological domain of physicians' cortical HIP function based on signal detection theory (SDT).

The traditional yoga and meditation practices would improve quality of physicians' diagnosis through electro cortical phase analysis to perceive subjects' whole body bioelectrical activity of symptom generation. Henceforth, the study concludes yoga and meditation practice modulates HIP-SDT axis to enhance physicians' diagnostic skill performance.

**Key words:** AYUSH, Yoga, Meditation, HIP, SDT

### **Introduction**

The Holistic health is an ideal state of health on physical, mental and spiritual plane that comprises traditional health care systems such as Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH). They deal with both invasive and non-invasive methods of diagnosis as well as treatment to restore health. The treatment modes as per AYUSH are akin to the principles of western medicine, having a basis of natural origin such as sunlight, magnetic field, metals, herbs etc. The role of physicians' statistical model of brain in possessing information is presumed to be of prime importance for diagnosis and health protection, by making sharp decision with available clinical data analyzed either through the instruments or direct

symptomatic aspects. However, the essential need for the physician towards ideal mode of diagnosis, particularly those of subjective in nature has not been dealt so far. Therefore, in order to address this aspect, there is a need to understand the physicians' neuropsychological basis of cognitive and cortical function in the context of ideal diagnosis.

### **Bio-Information Nature of HIP**

The key aspect of ideal health is reflected from the intra - inter bioelectrical cellular activity,<sup>[1]</sup> indicated as energy dynamics. The network of bio-molecular communication within and outside of each cell is integrated<sup>[2, 3]</sup> as numerous information processing pathways to represent at the body organ and systems level. The cellular information pathways would also work on both concrete and abstract functions of brain<sup>[4]</sup> to process the stimulus information. The concrete aspect of information pertains to mechanistic content of body functions such as feeding, self-care etc. while, abstract functions of brain involves higher mode of activities such as analytical and conceptualization, etc. Therefore, the body may have different information nodes or neural node hub assigned by the neural architecture.<sup>[5, 6]</sup> These are depicted as neural plexus and ganglia that collect information about activities of surrounding cells or tissues through different sub-regions of the brain, other than neurons. For, example, the respiratory motor impulses reach medulla and Pons to modulate breath activity according to the environmental conditions via Reticular Activating System (RAS) so as to communicate and integrate the whole body intra-inter cellular activity.<sup>[7]</sup>

According to thermodynamics viewpoint, the quantification of energy transfer could be defined as information bit.<sup>[8]</sup> Therefore, the cellular metabolic activity acts as a cross road for every information generated in regard to the health status of cell. Hence, the energy profile of the cell logically links to the molecular information content. The detection process by electrical behavior of molecular mobility would behave as Simple Detection function.<sup>[9, 10]</sup> This enables the Human Information Processing (HIP) pathway<sup>[11, 12]</sup> of the brain, to perform both concrete (day-to-day activities with self-care ability) and abstract nature (conceptual thinking) activities<sup>[4, 13]</sup> with its complex sub-routine levels of neural information processing ability.

### **Specifications and Limitations of AYUSH**

The traditional health care systems of AYUSH mainly focus on union of body, mind and soul that mainly depends on prevention of diseases and proper diagnosis by the physician. To improve the community health, traditional medicine is considered as a viable option.<sup>[14]</sup> However, the integration of AYUSH has a certain challenge to explore the potential of healthcare system, due to increased global health care cost and expenditure.<sup>[15]</sup> This could be due to industrialization of health care where, prime importance is given towards medical care than health protection.<sup>[16]</sup> Thus, as a result, the physicians are looking health epidemics as a profit making for income, rather than to keep people healthy.<sup>[17]</sup> This may undermine the intuitive quality endowed in diagnostic judgment of skilled physician. In present era, more emphasis is given on modern medicine, which has limitations towards the management of lifestyle disorders.<sup>[15]</sup> The physician plays a vital role for treating the disease<sup>[18]</sup> as well as for the health protection of community through his advice on healthy diet, lifestyle and medicines.<sup>[15]</sup> The recent research has recognized yoga practice as a health promoting lifestyle<sup>[19]</sup> to achieve balanced psycho-physiological health.

So far, the application of neuropsychology aspect of HIP model<sup>[11]</sup> has not been done on the physicians' cortical basis of diagnostic component towards decision making process and evaluation of patients' somatic featured information. Further, this HIP aspect has not been dealt either to understand the somatic complaints through sensation of patients or physicians' ability to detect the same through efficient HIP pathway. Among holistic health care systems, the application of HIP for diagnosis requires thorough understanding of both subjective as well as objective features of symptoms and mode of cortical function adopted by the physician.

However, HIP function represents molecular basis of bio-electrical activity in the context to patient and physician, where synchronization of the same cannot be ruled out. With this view, it can be estimated that yoga or meditation practices will improve neuropsychological aspect of cognitive attention function of physician through the HIP pathway. This might improve the quality of diagnosis with precision and accuracy, which has not been dealt so far.

### **Principles of HIP in Diagnostic Skill**

The understanding of physicians' ability towards diagnosis mainly depends on three vital aspects such as: 1) Sensitivity of stimulus perception from the physical examination observed through tactile, visual or audible sources as triggered by the specific region of body. 2) To evaluate the feature of somatic stimulus transmission from both magnitude and duration wise. 3) Interpretation of perceived data by the Subject and Physician. The first two aspects depend upon the neurophysiologic basis and neuropsychological processing of stimulus information, while the last aspect involves decision making process that improves over experience.

The role of HIP seems vital to integrate the crux of each and every diagnostic component of holistic health care systems. In diagnosis, the elicitation as well as transmission of information between the patient and physician would arise from bio-molecules for the communication. This could be of non-interactive in nature, mostly from patients' side with one-way communication of cells responding to the environmental conditions of body such as emotions, metabolism, reflex action, endocrine secretions, altered states like wakefulness, sleep, etc. While from the physicians' side, it could be of interactive communication by modulating attention function. This could be possible through regulated psycho-physiological responses that lead to multiple choices for diagnosis. The attention is one of the neuropsychological ability of brain to perform interactive communication with- in and out of the body through the perceptual and cognitive process at cortical level. Therefore, virtue of interactive communication may interfere at will in the non-interactive communication pathway domain, which is evident through voluntary breathing.<sup>[20]</sup> This would be possible through two types of information processing such as Controlled and Automatic Attention Processing information to perform various tasks.<sup>[21,22]</sup> Therefore, the bio-molecular information processing occurs through attention function on both at sub-luminal perception and typical perception. Since, the typical attention function operates within complete awareness domain<sup>[21]</sup> hence, cortical information processing overlaps sensation, perception and attention function.<sup>[23]</sup> This aspect directs to look for the suitable variables with all modalities of HIP steps that include: a) *Detection*, b) *Discrimination*, c) *Decision*, d) *Memory*, and e) *Execution or Motor response*.<sup>[11]</sup> HIP covers the psychological (phenomenal), physiological (classical biological function), biochemical and psycho-physiological stimulus-response modalities. The underlying HIP mechanism extends from somatic cell to cortical neuron. This will address the mechanism similar to self-conscious process of information bits or conveying information about one's own status of body function.<sup>[24, 25]</sup>

The information content generated within the whole body cells and tissues can serve as the basis to distinguish the ideal health status of body – mind functions from ill-health. Therefore, evaluating different categories of HIP pertains to the specific state of health or ill health. This integrates all types of parameters to derive a global perspective of health status. As the communication in physical component of body is electrical in nature, the essential link for brain ability to evaluate the health status of self or other individual depends on electro-physiological function within the neural network algorithm.<sup>[26]</sup>

The underlying bio-electrical principle at somatic level from Peripheral Nervous System (PNS) to Central Nervous System (CNS) is inferred through subjective and objective assessment of the whole body health status. This bio-electrical communication could be better dealt through the model of Shanon's information

theory,<sup>[27]</sup> Signal Detection Theory and Psycho-physics.<sup>[28]</sup> It would illustrate the underlying cellular communication of brain towards the outcome of subjective assessment. According to the neuropsychological view point, the understanding of energy dynamics in attention function and cellular perceptibility by the brain may be well described using the principles of Signal Detection Theory (SDT).<sup>[29]</sup> It implies a linear increase in the complexity of detecting the body function, such as psycho-somatic and psycho-social environment that may begin from conventional Simple Detection Experiment (SDE) and shift to Increment-in-Energy Detection (IED) or Envelope Detection (ED) model.<sup>[29]</sup> This complex signal detection process involved in IED may play a major role to understand Physicians' HIP towards accurate diagnosis.

### **Application of HIP in Holistic Health Diagnosis**

The diagnostic principle of Holistic Health is endowed with highly sensitive and decision oriented feature of physicians' HIP that would objectively detect the psycho-physiological changes occurring in the patient. This can be possible through the subtle and abstract features of instructions sensed by physician to develop specific subjective skills for accurate diagnosis. The underlying mechanism for this skill is based on complex neural network plasticity of signal processing ability among dorsal column-thalamus and cortical network to distinguish the perceived sensory cues of a normal subject in contrast to diseased one. Hence, improvement of the physicians' HIP towards diagnosis will be gained through repeated stimulus exposure with specific training and clinical experience without the aid of technical gadgets. This emphasizes internal cortical (mental) analysis for accurate diagnosis with precision. The specified neuro-plasticity in shaping physicians' cortical neural architecture is analogous to the Artificial Neural Network (ANN), a technical simulation of human brain neural network by means of software involving Algorithm or logical steps to perform specific type of analysis.<sup>[30, 31]</sup> This, mostly rely on the powerful mathematical tools to simulate neural signal processing function and is adopted for diagnostic programs of medical applications. It involves several rules of neural network in the form of deductive logic or Algorithms as per diagnostic outcome. The ANN would simulate human working neural network analysis of HIP function that seem to integrate and establish the accurate as well as precise judgment ability of physicians' brain towards diagnosis. The neural network of whole brain function mostly depends on the inter-link communication between specific harmonic (neural electrical impulse) waves that also depends on brain shape.<sup>[32]</sup>

With regard to the objective of diagnosis, each cell activity behaves as a unit detector that seems to monitor and assess health status. The information bit of each cell reflects underlying energy exchange<sup>[33]</sup> at molecular level. Therefore, detection as well as transfer of cellular information activity will occur through spending certain magnitude of energy equivalent to around 1 to 100 bits /sec to display self-conscious activity of the cell.<sup>[24, 25]</sup> This self-conscious activity may represent cells' ability to generate information regarding its health status and can employ earlier mentioned model of Simple Detection Experiment (SDE) function that later switch to IED or ED model.<sup>[29]</sup> The cellular energy of self-conscious function may reflect the fundamental state of whole body non-specific general activation or arousal<sup>[34]</sup> that represents awareness of whole body status. Thus, the initial simple detection function of cortex seems to be of watching the body function.

The complexity of cells' health status refers to a paradigm shift from SDE to IED function with its envelope (height) signal detection component and will enable to understand the cellular energy dynamics. This is mostly monitored by neurophysiological basis of two modes of attention function that links with cellular perceptibility aspect of psychophysics as per Signal Detection Theory (SDT) principles.<sup>[29]</sup> It also implies a linear increase in the complexity of detecting the cellular health status of body when subjected to psycho-somatic and psycho-social environment.

The operational concept of HIP would be to assess objectively the subjective approach of diagnosis (evaluation) performed by the physician. This seems to be a grey area that needs to be evaluated regarding individual health status. Therefore, there exists variability in the assessment of health status among physicians.

### **SDT Mechanism in Cortical function of HIP for Diagnosis:**

The brain has simultaneous capacity to observe the response elicited from target organ, monitoring through bio-molecular electrical activity. For example, phase angle correlates with the subjective assessment on pain experienced by the subject.<sup>[35]</sup> It suggests a synchronized co-existent role of bio-electrical phase angle component in brain to monitor the corresponding whole body bio-molecular electrical behavior. This helps to perceive the diseased state of somatic status information based on bio-electrical outcome as mentioned in past studies such as sensory perception of Pulse Pattern Variability,<sup>[1, 36]</sup> which can be equally perceived by the (physician) cortex particularly the Superior Colliculus routing sensory information of somato-sensory, visual and auditory<sup>[37]</sup> as well as visual and motor information to brain stem<sup>[38]</sup> on acquired data, may act as a basis for ideal diagnosis. This cortical aspect of diagnosis may be explained in terms of SDT models of detection function.

In detection function, energy dynamics is the indicator of HIP status and the same function performed by the cortex on working (target) cell could seem to operate on the basis of SDE.<sup>[39]</sup> This is the crux of biological awareness sensed by the patient or subject. However, the IED or Envelope Detection (ED) model<sup>[39]</sup> would reflect the complexity of cellular ill-health status, expressed as pain or other associated symptoms by the subject. With this view, it can be proposed that in physicians' diagnosis, the cortical analytical model of SDE or IED functions working on Ideal Detector Hypothesis (IDH)<sup>[39]</sup> can assess the health status in correlation with the complaints of subject or from the instrument. The evidence on diagnostic feature of bioelectrical signals measured as Phase Angle (PA) in both health and ill-health status would reflect the information gathered by physician for the assessment of health. The diagnostic basis of bio-electrical signals may be based on current-voltage phase relationships in response to incoming signals such as: different frequencies of alternating current (AC) bio-signals stimulation,<sup>[40]</sup> EEG phase coherence,<sup>[41]</sup> in sleep disorders<sup>[42]</sup> and in learning process due to enhanced coherence of sleep slow waves.<sup>[43]</sup> Further, it also suggests the relevance of phase shift or phase angle to assess the HIP function of different body systems.

### **Neural network: Whole body bioelectrical activity and Object of HIP diagnosis**

The bioelectrical basis of brain for diagnosis involves neural network signal processing that encompasses whole body electrical network covering all the body systems such as heart rate, blood pressure, sweat gland activity, endocrine, cortical EEG and evoked responses, etc. The body systems follow the basic electrical circuit principles to generate and compile the message of each bio-signal from respective source in terms of frequency, amplitude, phase shift or phase angle of bio-current, voltage onset timings and its amplitudes. The phase angle provides overall information regarding functioning status of all body systems for diagnosis.

The HIP is the pivotal pathway to represent all the underlying biological functions on Physical, Mental and Spiritual Planes. The five steps involved in HIP<sup>[11]</sup> are present in each of biological system and serve as Information Process Sub-Systems (IPSS). For example, the Sensory domain of IPSS would be relatively less active as compared to Cognitive and Spiritual dimensions. However, the initial stage of Holistic Health demands perfect and balanced IPSS of the HIP to monitor all the functions of body systems. The role of HIP aspect of detection function is defined from Energy Detection Model (EDM). It may be inferred through the revisit of the principles of Holistic Health Sciences. There are few scientific reports to explore the yoga practice effect on HIP like: Shavasana practice for resource conservation,<sup>[44]</sup> combating anxiety and

developing parallel vigilance<sup>[45, 46]</sup> that can be understood through EDM in the light of SDT.<sup>[39]</sup> The basic mechanism of HIP involving attention function and proposed psycho-neuro-immunological approach is evident from the past studies.<sup>[47, 48, 49]</sup> This aspect of HIP in resource conservation due to yoga practice may be objectively assessed through bioelectrical dynamics. It implies the role of Ideal Detector Hypothesis (IDH) operating through SDE and IED function as per SDT.<sup>[44, 47, 48]</sup> Therefore, there exist a co-relation between HIP steps and bioelectrical activity.

### **Bioelectrical Phase Angle and HIP: Diagnostic Communication**

The bioelectrical activity is the cross road of communication for both patients and physician to detect the symptoms. The vital parameter of bioelectrical activity is phase angle, which is the essence of bio-electrical communication. Basically, every aspect of biological function starts with molecular mobility to generate alternating cyclic impulse of electrical components namely current (I) and voltage (V),<sup>[50, 51]</sup> which can determine the detection function of diagnostic communication. The varying time responses of I or V depend upon the electrical properties of cell membrane such as resistance, capacitance, impedance and reactance.<sup>[52]</sup> The relation between I and V exist in three conditions. They are: - a) Current arrives after arrival of Voltage, referred as  $90^{\circ}$  negative phase angle. b) Cell voltage and current arrive in same time, so that both waves remain in same phase referred as  $90^{\circ}$  in – phase angle. c) The current arrives before Voltage appears referred as positive phase or  $90^{\circ}$  out of phase.<sup>[33]</sup> This would reflect the complexity diagnostic detection function of physicians' HIP varying from SDE to IED [Figure 1].

The plausible co-relation of phase angle and energy dynamics<sup>[53, 33]</sup> with respect to HIP function may be inferred as per the above mentioned three conditions such as: in condition (a) there is maximum energy consumption to process stimulus information in typical HIP, while in (b), yoga or meditation practice adopts only detection step that leads to minimum energy consumption and would help to enhance the detection component of diagnosis. Further, in condition (c) meditation or yoga practice leads to energy conservation.<sup>[44, 47]</sup> This aspect determines the magnitude of energy stored.<sup>[33, 1]</sup> The tangible outcome of bioelectrical cell parameters is a measure of Phase Angle as cross road to match all subjective and objective diagnostic areas of medical sciences,<sup>[54]</sup> in which relevance of phase angle could be a useful tool in yoga research<sup>[12]</sup> in all neurophysiological and neuropsychological diagnostic tools such as EEG, Evoked Potential, Magneto-encephalograph, Kirlian or Human Aura, ECG, EMG, Electro-Dermal Activity, etc. Therefore, all these tools reveal diagnostic performance of HIP steps.<sup>[11, 12]</sup>

### **Role of Yoga in HIP of diagnostics:**

In health care systems, there are very few reports to understand the fundamental concept of HIP in science of yoga. For example: Role of Yoga practice through the attention function would generate subjective experience and also modulates HIP of typical learning process through its catalytic action.<sup>[12]</sup> This may be the preceding stage of HIP applications of yoga towards improving precision and accuracy of physicians' diagnostic skills [Figure 2].

The HIP mechanisms consist of complex interactions of bio-information exchange right from cellular to whole body activity. This interaction is essentially a bioelectrical activity through bio molecules. The neuro-electro-physiological basis of cortical information processing is performed by bulk multi synaptic neuron interconnections. This neural network communication is the basis for cognitive functions. The basic brain abilities of this cognitive function such as perception, attention learning and motor responses form the basis for analytical functions. Thus, the analytical outcome in the cognitive information processing is reflected ultimately through evoked potential response<sup>[55]</sup> and high EEG coherence that indicates inter-hemispheric transfer of information.<sup>[42, 43]</sup> The whole brain bioelectrical activity such as ECG, EEG or cortical evoked

response represents Information Processing (IP) pathway functions across inter-hemispheric<sup>[56]</sup> connectivity. Therefore, the improvement in cognitive function with respect to physicians' diagnostic skill may be attributed by the enhanced HIP efficiency through yoga practice<sup>[11, 44, 47, 12]</sup> as it leads to resource conservation,<sup>[44]</sup> increased signal power as well as parallel vigilance<sup>[45, 46]</sup> that may enhance executive function of brain.<sup>[57]</sup> This implies plausible effects of yoga practice facilitating phase shift as indicated in a pilot study<sup>[58]</sup> that might be observed through the self-organizing behavior of cortical function<sup>[59]</sup> and could be objectively assessed through electrophysiological parameters. The mechanism behind physicians' cortical detection system may involve switching from SDE mode to I-D mode function of EDM<sup>[39]</sup> mostly through zero phase lag Vs network connection<sup>[60, 61]</sup> that can be measured through EEG coherence.<sup>[60]</sup> Among bioelectrical variables, PA with other accessory variables may be the indicator for an ideal diagnostic performance. The effect of Yoga and Meditation on HIP of diagnostic function is expected to operate by I-D paradigm with high Common Mode Rejection Ratio (CMRR)<sup>[62]</sup> and contributes to the better signal-noise resolution through enhanced Webber fraction<sup>[39]</sup> to filter out the noise, a confounding variable that leads to wrong diagnosis. Further, it infers that Yoga and Meditation practices would activate prefrontal cortex which is known to improve introspective accuracy for making precise decision<sup>[63, 64]</sup> as well yoga might improve learning processes through a mechanism similar to the observed slow wave sleep EEG coherence enhancement in learning process<sup>[43]</sup> in physicians' diagnostic performance. The physicians' electro-cortical activity and patients' symptom based bioelectrical activity might co-relate with physician's diagnostic HIP steps.

It is summarized that HIP of diagnostic cognition efficiency could be possible through meditation practice that leads to enhanced cortical thickness<sup>[65]</sup> and also through whole body awareness and Neutral State of Attention (NSA) brought by the practice of Pranayama, Pratyahara and Dharana.<sup>[11]</sup> Therefore, yoga and meditation practices may act as a useful tool to improve attention function of physicians' diagnostic skill without cognitive errors, involving with least number of trials.

## Conclusion

The study concludes that holistic health care systems, diagnostic skills require fine-tuned Physicians' cortical detection function to process bio-signals sensed from the patient's body or symptoms. This aspect of improved quality of physicians' diagnostic skill with precision and accuracy is possible through Yoga and Meditation practices that may lead to modulation of NSA mediated neural network plasticity.

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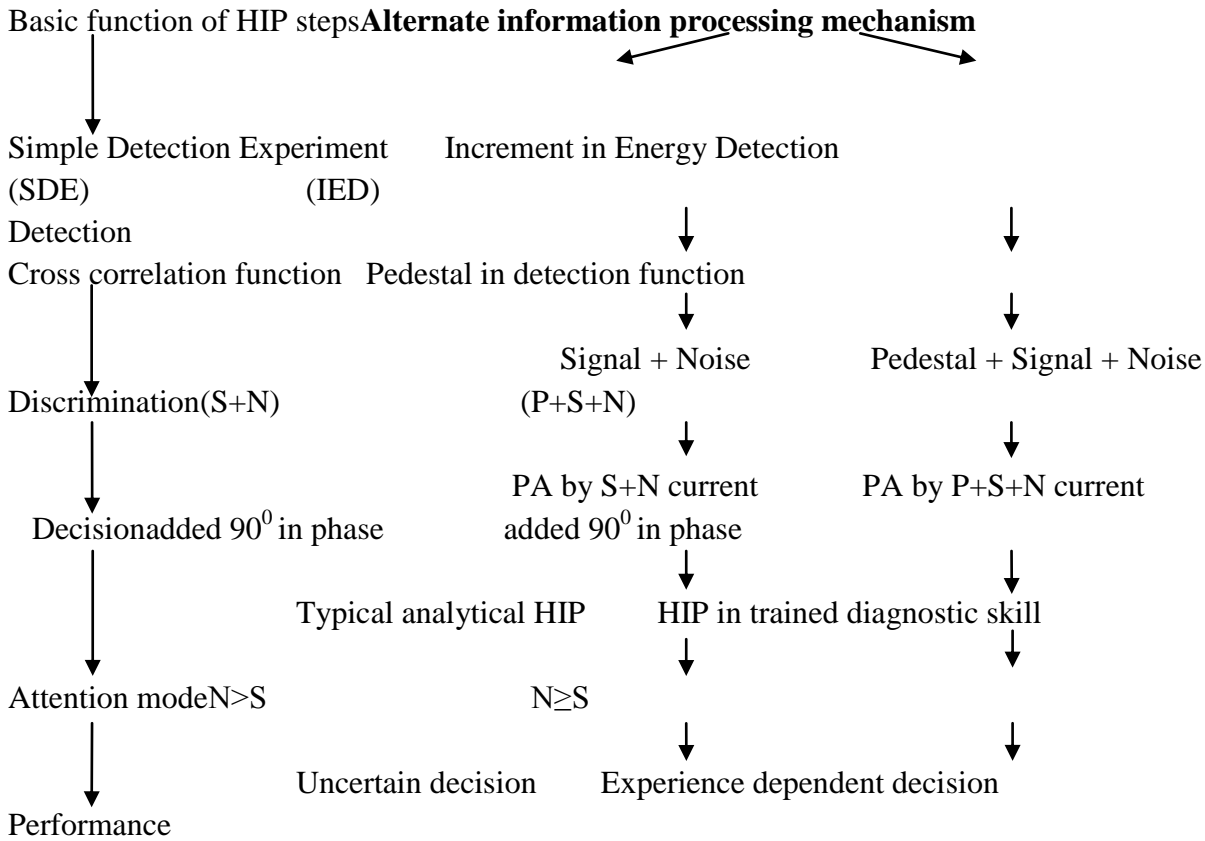
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**Human Information Processing (HIP)Signal Detection Theory (SDT)  
(Ideal Detector Hypothesis)**

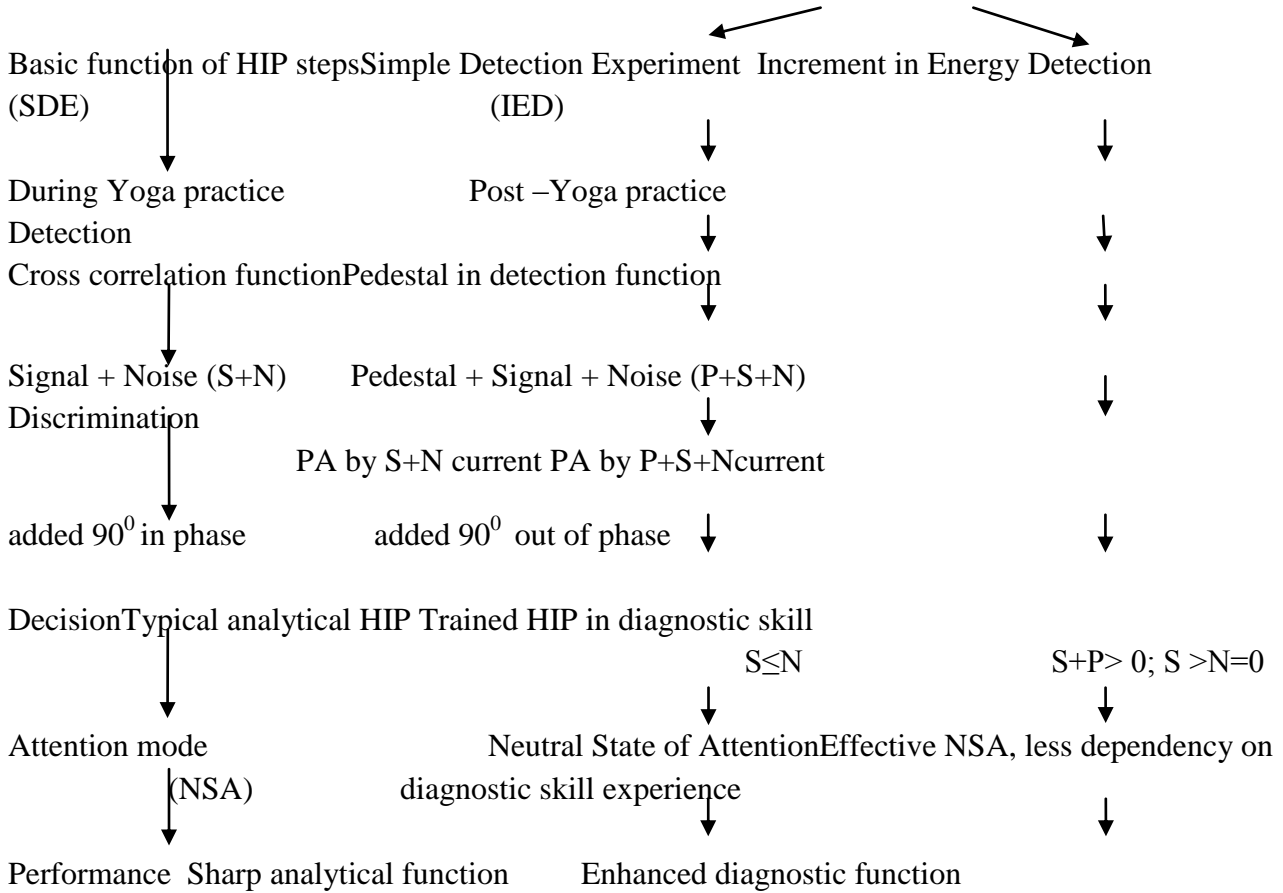


S= Signal, N=Noise, P=Pedestal, SDE=Simple Detection Experiment, IED=Increment in Energy Detection, PA=Phase Angle

**Figure 1:** Physicians’ cortical diagnostic function in holistic health measure: An HIP-SDT axis approach

**Human Information Processing (HIP)Signal Detection Theory (SDT)**

**(Idea detector hypothesis)**



S= Signal, N=Noise, P=Pedestal, SDE=Simple Detection Experiment, IED=Increment in Energy Detection, NSA= Neutral State of Attention, PA=Phase Angle.

**Figure 2:** Physicians’ cortical diagnostic performance through yoga practice: An HIP-SDT axis approach