

**APPLICATION OF *GUṆA*-IMPLICIT ASSOCIATION TEST TO  
STUDY SOCIAL DESIRABILITY IN EXPLICIT MEASURES OF  
*GUṆAS* IN YOGA STUDENTS**

Thesis submitted by  
**V. JUDU ILAVARASU**

Towards the partial fulfillment of  
**DOCTOR OF PHILOSOPHY (YOGA)**  
**NOVEMBER 2013**

**Submitted to**



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*Under the guidance of*  
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### Certificate

The Doctoral Committee confirms that this is an authentic approved copy of the thesis titled “Application of *Guṇa*-Implicit Association Test to study social desirability in explicit measures of *guṇas* in Yoga students”. The committee recommends the award of Ph.D. Degree.

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## DECLARATION

I, hereby declare that this study was conducted by me at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Bengaluru, under the guidance of Dr. Alex Hankey, Distinguished Professor of Division of Yoga and Physical Sciences, S-VYASA University Bengaluru and Dr. Sarasvati Mohan, Professor, Division of Yoga-Spirituality, S-VYASA University Bengaluru.

I also declare that the subject matter of my thesis entitled APPLICATION OF *GUNA*-IMPLICIT ASSOCIATION TEST TO STUDY SOCIAL DESIRABILITY IN EXPLICIT MEASURES OF *GUNAS* IN YOGA STUDENTS has not previously formed the basis of the award of any degree, diploma, associate-ship, fellowship or similar titles.

Date: 21<sup>th</sup> December, 2013

Place: Bengaluru

**V. Judu Ilavarasu**

(Candidate)

## A C K N O W L E D G E M E N T

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Date: 21<sup>th</sup> December, 2013  
Place: Bengaluru

**Judu Ilavarasu**

**STANDARD INTERNATIONAL TRANSLITERATION CODE USED TO  
TRANSLITERATE SANSKRIT WORDS**

a	=	अ	ña	=	ञ	pa	=	प
ā	=	आ	ca	=	च	pha	=	फ
i	=	इ	cha	=	छ	ba	=	ब
ī	=	ई	ja	=	ज	bha	=	भ
u	=	उ	jha	=	झ	ma	=	म
ū	=	ऊ	ñ	=	ञ	ya	=	य
ṛ	=	ऋ	ṭa	=	ट	ra	=	र
ṝ	=	ॠ	ṭha	=	ठ	la	=	ल
e	=	ए	ḍa	=	ड	va	=	व
ai	=	ऐ	ḍha	=	ढ	śa	=	श
o	=	ओ	ṇa	=	ण	ṣa	=	ष
au	=	औ	ta	=	त	sa	=	स
m̐	=	अं	tha	=	थ	ha	=	ह
ḥ	=	अः	da	=	द	kṣa	=	क्ष
ka	=	क	dha	=	ध	tra	=	त्र
kha	=	ख	na	=	न	jña	=	ज्ञ
ga	=	ग	gha	=	घ			

## DEFINITIONS OF TECHNICAL TERMS USED IN THE THESIS

**Schema:** An organized cluster of knowledge about a particular object or sequence of events.

**Implicit memory:** Type of memory apparent when retention is exhibited on a task that does not require intentional remembering.

**Explicit memory:** Intentional recollection of previous experiences.

**Triguṇa:** A personality concept according to eastern philosophy with three mutually dependent sub-domains namely, *satva*, *rajas*, and *tamas*.

**Satva:** Tendency of a person to express in terms of serenity, calmness, equipoise, purity, truthfulness, lively intelligence, etc.

**Rajas:** Characterized by activity, constant planning, attachment, etc.

**Tamas:** Characterized by dullness, ignorance, wrong understanding, etc.

**Association:** Mental categorization in terms of cognitive schemas.

**IAT:** Implicit Association Test, a computerized task used to assess a person's inherent or automatic preferences, attitude, or self-concept, evaluated using comparative reaction times. It is not a questionnaire.

**G-IAT:** *Guṇas*-Implicit Association Test. IAT modified to study *Guṇas*.

**PG-IAT:** Personalized *Guṇas*-Implicit Association Test. In this test, the choice of words to be shown during the test is chosen by the subjects, unlike general IAT where the words to be presented are selected by the experimenter.

**D score:** Standardized score on the IAT measure obtained for each subject from the difference of latencies of two crucial blocks divided by their pooled standard deviation. The score ranges from -2 to +2 through zero. Positive D score means positive implicit preference/association and negative means the vice versa.

**Target:** The main concept which is evaluated in an IAT.

**Attribute:** The associated attribute with which the target concepts are evaluated for association in an IAT.

**Social desirability:** The tendency to present oneself more socially desirable.

**Implicit measure:** The term is used for the tool which assesses a person's automatic responses.

**Explicit measure:** The term is used for the tool which assesses a person's deliberate and evaluative responses.

**Mixed effects model:** A statistical procedure which is considered more versatile for analysis of repeated measures data especially when there are missing values and the design is not balance due to missing subjects at various conditions.

**Convergent Validity:** When two are more related measures show positive correlation for a given construct.

**Discriminant Validity:** When two unrelated measures show no correlation or when two opposite measures show negative correlation then discriminant validity is present.

# ABSTRACT

## INTRODUCTION

Assessment of personality through explicit self-report measures like questionnaires always suffers from the influence of social desirability, i.e., to respond to the instrument in a socially desirable manner. This distorts the actual assessment and obscures the inference and later the conclusion. In yoga, *triguṇa* is a personality concept, which may suffer the threat of social desirability; besides, self-report of one's *guṇas* through introspection may be difficult as the construct is very subtle and dynamic.

The Implicit Association Test (IAT), developed in the west by Greenwald et al. (1998), is well validated, understood and extensively used in psychology, and has the desirable qualities that make it a better complement to explicit measures. This tool, which was neither considered by the psychologists nor the yoga researchers till now in India, has been adapted for the implicit assessment of *guṇas*. This study examines the role of social desirability factor in self-assessment of *guṇas*.

## LITERARY REVIEW

Through review of literary works, a theoretical framework has been made and a set of guidelines for empirical research in *guṇas* is proposed. An attempt has also been made to understand the working of the IAT from a *shastric* (scriptural) perspective.

Review of scientific literature enumerates contributions and findings of various studies done in the personality domain using the IAT. A weaker implicit-explicit correlation is observed indicating an influence of social desirability factor.

Inspiration is also sought for the design of the current study, which has used multifactor IAT in which more than two targets or attributes are evaluated in a single study.

## **AIM**

The main aim of the study was to investigate the implicit and explicit expressions of *guṇas* using the Implicit Association Test (IAT) and explicit measures in yoga students.

## **OBJECTIVES**

The objectives were to find the influence of language on IAT scores in Indian population, to develop and examine validity and reliability of the *Guṇas* -IAT (G-IAT), to study the role of social desirability in explicit evaluation of *guṇas*, and apart from these, implicit preference towards yoga were also studied.

## **METHODS**

### **SUBJECTS**

There were four different studies. For the language IAT study, 54 bilinguals, 28 males and 26 females with a mean age of 23.3 were taken. For *Guṇas*-IAT study, 90 Yoga university students, 43 males and 47 females, with mean age 27.9 were chosen. For Personalized *Guṇas*-IAT, 77 participants, 32 males and 27 females, with mean age of 30.2 were taken who were undergoing a short term Yoga course. For Yoga-IAT study, five independent samples were taken amounting to 79, 27 males and 52 females, with a mean age of 27.2.

### **DESIGN**

Overall, survey design was adopted with one-time assessment. For test-retest reliability, pre-post design was adopted.

## **ASSESSMENT TOOLS**

Implicit Association Tests (IAT) were used for implicit assessment of *guṇas*, attitude towards Yoga, and relative preference for flowers or insects. For explicit measurements, various tools like Vedic Personality Inventory (VPI), Satisfaction With Life Scale (SWLS), Heartland Forgiveness Scale (HFS), State and Trait Anxiety Inventory (STAI), Active Procrastination Scale (APS), and Marlow-Crowne Social Desirability Scale (MC-SDS), and feeling thermometer (FT) were used, to find implicit-explicit congruence.

## **DATA EXTRACION AND ANALYSIS**

The data were collected using computers. All the tests including informed consent, questionnaires, demography data sheet, and IATs were administered through the stimulus presentation software, INQUISIT, version 3.0. R statistical package (R Development Core Team, 2012) and its linear mixed effects model analysis package, nlme were used. For data visualization and generating figures, ggplot2, manipulate, and ade4 packages were used. Correlation and regression procedures were used for statistical analyses for which car, psych, and psychometric packages were used.

## **RESULTS**

The results of four different studies can be summarized as:

- 1) Language of presentation of IAT does not significantly influence the IAT D scores in Indian population, especially those who use their native language and English equally.
- 2) Validity and reliability for *satva* were considered satisfactory while *rajas* and *tamas* were not found to be satisfactory.

- 3) Assessment of *guṇas* on students' population of yoga courses showed influence of social desirability factor.
- 4) The implicit-explicit correlations were weak for *guṇas*.
- 5) Test-retest reliability of G-IAT was relatively more stable after 17 days than 30 days.
- 6) Personalized G-IAT also revealed same trend as G-IAT, with improved implicit-explicit congruence for *rajas* and *tamas* domains compared to G-IAT.
- 7) Implicit tool to assess preference towards yoga showed moderate implicit preference on a yoga population.

## **DISCUSSION**

### **LANGUAGE IAT STUDY**

Despite the trend revealed by average error percentage and average latency, D score was not influenced, probably because of its robustness. In India, many schools introduce English in primary classes, so that despite the language being acquired in an instructed way, it may form a level of representation (LR) equally high as the native language.

### **GUNA-IAT STUDY & PERSONALIZED GUNA- IAT STUDY**

Implicit and explicit measures of *guṇas* are different and this difference is significantly moderated by social desirability factor. Explicit self-report measures' inter correlations were moderate to high and all in theoretically expected directions. However this study has strongly pointed out that relying on explicit measure alone may not give us a comprehensive picture of a person, and hence development and refinement of the implicit tool to access *guṇas* is essential.

## **YOGA- IAT STUDY**

The results showed moderate implicit preference towards yoga in this study sample. These preliminary results suggest that we can measure implicit preference towards yoga. 90% of the participants had shown various degrees of positive implicit preference towards yoga. The low correlation is an indication of possible extraneous influence through self-presentation biases, hence it is of interest to further study the influence of social desirability factors on implicit preference towards yoga. In the current study no measure of self-presentation bias was taken, so we could not evaluate the extent of its mediating effect.

## **CONCLUSIONS**

Implicit tools should be considered along with explicit measures to assess social desirable constructs in yoga like *guṇas*. Administration of IAT in Indian can be either in English or in native language, especially for those bilinguals who use their native language to the same extent as English. Reliability of G-IAT becomes weaker over 15 days. This new methodology to assess implicit attitudes and preferences can now be used in yoga research.

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**CHAPTER – 1.0**  
**INTRODUCTION**

## 1.0 INTRODUCTION

The great Yoga master *Patañjalī* who brought out *Pātañjala yoga sūtra* classifies the modifications of mind as manifest (right knowledge, wrong knowledge and fancy imagination) and un-manifest (sleep and storehouse of all memories in the deep unconscious). In our wakeful phase of activity, the conscious mind is active, while asleep we are in our unconscious (un-manifest) phase of activity. Conscious activities can gradually modify the unconscious and change our personality. All techniques of yoga are essentially meant to modify the unconscious negative memory stores and transform them to a pure, transparent, and effulgent super-conscious state of bliss, harmony, peace, power, knowledge and gain mastery over the mind. The majority of people even in their wakeful state are governed by the tendencies in their deep unconscious mind, especially when they react spontaneously to a given external situation. Those moments are rare when in spite of demanding external situations majorly propelled by the unconscious mind that demands spontaneous and automatic response, people use their conscious faculty of discrimination. Behaviours emerging out of the unconscious are dominated by our emotions and hence are strongly influenced by *manomaya kośa*. On the other side, actions performed in a state of conscious inner awareness, with discrimination are influenced by *vijñānamaya kośa*. Being born as humans, it is the use of *vijñānamaya kośa* that qualifies humanhood. Unfortunately, this faculty of inner awareness is not consciously developed though it is potentially available. The goal of spiritual practice (*sādhana*) is to make it dynamically manifest. Swami Vivekananda said that each soul is potentially divine. The goal of *sādhana* is to make ourselves dynamically divine, to manifest the highest human potential.

During the initial phases of *sādhana*, a *sādhaka* (aspirant) undergoes a phase of conflict between his emotive mind influenced by his previous tendencies and his newly acquired higher values for rational discrimination. The general tendency is to easily follow the emotional mind. Effort is required to override this tendency and execute a different behaviour based on the newly acquired value system. Therefore, there is always a tug of war between conscious and unconscious mind leading to conflicts. To assess the progress of a yoga practitioner, it is helpful to know both the conscious and unconscious dimensions of influence. The challenge is to capture that domain of mind which is predominantly unconscious and less available for easy examination. In yoga research, will we be able to address this challenge?

In yoga, *triguṇa* is the predominant personality concept. *Triguṇa* is a set of three mutually interdependent personality concepts: its three domains are called *satva*, *rajas*, and *tamas*. They are defined by their characteristic features or modes of expression. In eastern philosophy *triguṇa* is considered a fundamental personality concept. However, this classification may not be known to many. This may not be a problem for explicit evaluation through a questionnaire. In academic yoga institutions, students are invariably introduced to the concept of *triguṇa* because yoga psychology is centered on it. The more they learn about the concept of *triguṇa*, the more they form associated schemas. When such students are assessed by *guṇa* questionnaires, they may tend to bias their responses due to prior knowledge of the concept. Hence the social desirability may obstruct proper assessment of *guṇas* in yoga students. As a person grows in the path of yoga, he gains more mental stability and inner equipoise, by virtue of which there is a greater congruence between what he thinks and what he reports. However, this is worth studying empirically.

In personality psychology, personality traits are often assessed using self-report measures like questionnaires. Subjects are asked to introspect in order to respond to items in the questionnaire. This is called explicit evaluation and such questionnaires are known as explicit measures. One problem in such self-report procedure is that subjects may present themselves more favorably. This is called self-presentation bias. One of the reasons for such bias is social desirability, i.e., a tendency to make oneself seem more socially desirable. Another problem with self-report measures is that, though subjects are willing to honestly self-report, but it may sometimes be difficult to introspect appropriately. Under such circumstances, explicit measures also face a serious threat to their accuracy. To overcome such limitations in self-report measures, implicit measures are used in psychology. They assess a person's preferences and attitudes without self-reporting them. One such popular tool is the Implicit Association Test, or IAT (Greenwald, McGhee & Schwartz, 1998).

Whenever we perceive something outside as well as inside, we do so with the help of our already available memory store, present in our cognitive system as associations. The following snippet from a recently published book, (Banaji & Greenwald, 2013) by the inventors of the IAT reveals a great deal about the workings of association in regular cognition.

A father and his son are in a car accident. The father dies at the scene and the son, badly injured, is rushed to the hospital. In the operating room, the surgeon looks at the boy and says, "I can't operate on this boy. He is my son". (p. 71)

The initial surprise that how is it possible for the father to die in an accident and later reach the operation theatre, is quite often felt by many. The reason for this

surprise is the strong association that we have in our mind, i.e., surgeon=male. This works first in judgmental process, then follows an error in judgment, i.e., delay or failure even in recognizing that the surgeon could be the boy's mother (Banaji & Greenwald, 2013). Whenever we evaluate something about others, outside situation, and even our own self, we tend to rely upon past experiences related to the context. The associated concepts are always mapped together and stored in our cognitive system. When we are involved in automatic processes, where less cognitive resource is required, we do not utilize deliberate thinking processes but in their place we tend to harness our capacity for mental associations. In the above example, the initial puzzle experienced by many people is due to strongly using the association surgeon = male. Similarly, we have many such patterns of mental concepts called cognitive schemas. A schema is an organized cluster of knowledge about a particular object or sequence of events (Weiten, 1998). This concept of association also applies to self-evaluation, i.e., what I think about myself; self-concept, what I consider I am. The various schemas that we have acquired are used to evaluate ourselves and others.

In psychology, we quite often use self-report measures to assess inner states of mind. They are, however, susceptible to self-presentation bias due to social desirability factors. Therefore, the quest for valid means of measurement has always been an important endeavor in psychometrics. The questionnaire may in fact be valid but its actual administration may pose various challenges. Implicit cognition is an area in psychology which attempts to throw light on these areas of the unconscious human mind. Implicit processes are characterized by the process which happens with lack of awareness, less cognitive resource, short times, and independence of the proximal goal (Houwer, Teige-mocigemba, Spruyt, & Moors, 2009). Here 'implicit' refers to the tool rather than the construct (Fazio & Olson,

2003). Hence what is measured using an implicit tool may not be unconscious constructs. Many times, subjects may not be unaware of the implicit preferences and attitudes, hence we cannot call the construct implicit. Recently, psychologists have devised a tool, the Implicit Association Test (IAT). The IAT is a well validated tool to measure implicit attitudes and implicit associations. Another use of IATs is for subjects finding self-report of certain constructs difficult. The test has also been widely used by western psychologists to study implicit social cognition including stereotyping and prejudices.

IATs' growing popularity can be estimated by their increasing use in various fields. They have been used in attitude as well as personality researches. IATs to measure shyness (Asendorpf, Banse, & Mücke, 2002), and the Big Five personality traits (Schmukle, Back, & Egloff, 2008), etc., are some examples.

### **Need for the study**

This work proposes to develop an IAT to measure *guṇā*, the personality construct from the Vedic sciences. Questionnaires are available to measure *guṇās* (Wolf, 1999; Das, 1991), but the construct is both elusive for self-report and prone to self-presentation bias, so development of an implicit tool to measure them is highly desirable, especially in the field of yoga which claims to change them.

*Guṇā* is an eastern concept of personality. Much less work has been done in this area in the west. The only well-validated test in the west is the Vedic Personality Inventory (VPI), developed by David Wolf, with 56 items (Wolf, 1999). Attempts to develop similar inventories were made earlier by Uma, Lakshmi and Parameswaran (1971), Singh (1971), Rao and Harigopal (1979), Mohan and Sandhu (1986), Das (1991), and Pathak, Bhatt and Sharma (1992). However, all may show the

limitations of self-report measures; the current study's focus is thus to develop an implicit measure.

### **Scope of the study**

The proposed study is unique in several senses. Little work has been carried out in the field of implicit cognition in India. This may even be the first Indian study employing IATs. As a field, yoga contains many constructs prone to self-presentation biases, and with levels of intricacy making them difficult to self-report. Hence reliable tools are needed to assess such constructs. *Triguṇā* has both the above problems embedded in it. Hence the outcome of this study could be far reaching and impact the whole field. It might even transform trends in the field of psychological measurements in India.

In this thesis, three major studies are presented. First one describes the influence of language on IAT scores, to decide whether the test should be administered in English or native language. Second, development and validation of *Guṇā* -IAT (G-IAT). As an extension work of the study, personalized *Guṇā* - IAT (PG-IAT) is also described in which selection of items to be delivered are selected by the subjects. The third one explores application of the IAT in yoga to assess a person's implicit preferences towards yoga. Through these studies, the role of self-presentation bias in explicit assessment of *guṇās* is evaluated.

## **CHAPTER – 2.0**

# **LITERARY RESEARCH**

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## 2.0 LITERARY RESEARCH

### 2.1 AIM

To unearth the concept of *guṇās*, its origin, influence, and manifestation, from texts of yoga and spiritual lore.

### 2.2 OBJECTIVES

- 1) To understand the concept of implicit association from the perspective of ancient text.
- 2) To prepare a theoretical framework of *guṇās* and its functioning.

### 2.3 METHODOLOGY

The first step was to review works done earlier and reported in theses and dissertations. The second step was to search for the keyword *guṇā* from various scriptural texts for the current work. For this the multimedia database *Śāstrāṇi*, a reference manual for scriptures published by the Ramakrishna Mission Ashram was used (Shastrani, 2004). Various texts searched were: The 103 *Upaniṣads*, The *Gītā* (8 different kinds like *Aṣṭāvakra Gītā*, *Ġurugītā* etc.); *Śrī Śaṅkarācārya's* most important works (28 works including, *Pañcīkaraṇam*, *Pañcīkaraṇavārttikam* of *Śrī Sureśvarācārya*, *Vivekacuḍāmaṇi*, etc.); Vedanta *granthas* like *Brahmasūtra*, *Dṛgdrśyaviveka*, *Hastāmalaka Stotram*, *Naiṣkarmyasidhdi*, *Pañcadaśī*, *Sarvasāstrārthasaṅgraha*, and *Vedāntasāra*; Yoga texts includes, *Haṭha Yoga Pradīpikā*, *Pātañjala Yoga Sūtra*, and *Yogarahasya*; the *Mahābhārata*, the *Rāmāyaṇa* (*Adhyātma*, *Rāmacarita Mānasa*, *Vālmiki*); the *Bhāgavata Purāṇa*; *Manusmṛti*;

Grammatical treatise like *Amarakoṣa* and *Pāṇinī Aṣṭādhyāyī*, various stotras; and other texts like *Nārada Bhakti Sūtra*, *Śāṇḍilya Bhakti Sūtra*, *Tarkasaṅgraha*, etc. The search led to 3277 occurrences of the word *guṇās* in all the above mentioned texts. Apart from these texts, to seek references for clinical application of *guṇās*, *Āyurvedika* text, *Caraka Saṁhitā* was also referred.

**Inclusion criteria:** As the search results were large and texts were varied, we focused on verses that had *guṇā* explained as personality concepts (*satva*, *rajas*, and *tamas*), or as quality of *prakṛti*. The former describes characteristics in humans and the latter in inanimate nature. For this further search was performed with keywords as *satva*, *rajas*, and *tama*.

**Exclusion criteria:** Texts which have very few references of the word *guṇā* with the above meaning and where the information is redundant. We have excluded *mahābhārata*, *rāmāyaṇa*, *purāṇa*, various *strotras*, as they are considered as secondary source of information compared to *prasthānatraya* and other Vedānta *prakaraṇa granthas*. Though they supply a rich sources of information, for our current need restricting to other texts would serve the practical purpose.

## 2.4 WORKS DONE EARLIER

In a master's dissertation, the concept of *triguṇa*, and *tridoṣa* are compared to bring out an understanding of holistic health and the nature of psychosomatic diseases. Ayurvedic texts and other yoga texts like *Bhagavadgītā*, and *Sāṅkhya*

philosophy are analysed. The authors highlight that for a complete understanding of a person's nature, both *guṇa* and *doṣa* needs to be considered (Mallikarjun, 2004).

In this M.Sc. dissertation, attitude has been analysed using the concept of *guṇas*. Mainly, again *sāṅkhya* philosophy text and *Bhagavadgītā* were used. Various attributes of attitude were studied from the perspectives of *triguṇa*, so that a suitable attitudinal change could be designed (Mohan, 2008).

In an another M.Sc. dissertation, titled, "*Guṇas* According to Yoga and Ayurveda- A comparative study" a detailed account of *guṇas* is given from the perspectives of Ayurveda. Many comparisons are brought out against yoga, showing the parallel and contrasts. Other texts like *Rāmāyaṇa*, *Bhagavadgītā*, *darśana*, were also referred (Tripathi, 2012).

In one of the studies, an entirely new approach to correlate the natural flux of *guṇas* in the nature with the Random Event Generator's (REG) output bit-stream was made. REG is an instrument which generates random bit streams and it seems to be influenced by various events happening around involving human minds. This study attempted to explore some recognizable patterns in the apparently random bit streams. The study was titled, "Measuring *guṇa* Prevalence with REG - A Pilot Study" (Rao, 2013).

In a Ph.D. thesis, titled, "Development of Human Potential through Yogic Practices assessed by Psychological and Health Variables", *guṇa* was proposed as one of the pillars of the model of full human potential (Khemka, 2012). The strength of the study was that a model was proposed for development of human

potential incorporating the four major streams of yoga, namely *Jñāna yoga*, *Rāja yoga*, *Bhakti yoga*, and *Karma yoga*.

Quality of life was assessed in a Ph.D. study titled, "A randomized control trial of the effect of Yoga on *Guṇas* (personality) and Health in normal healthy volunteers". In this *guṇas* was taken as one of the main variables, to assess quality of life (Deshpande, 2008). Various scriptures were extensively reviewed and the concept of quality of life was well illustrated. Summary of earlier work with their strength and limitations are presented in the following table 1.

**Table 1: Summary table of previous works**

<b>Authors &amp; Year</b>	<b>Summary</b>	<b>Strength</b>	<b>Limitations</b>
Mallikarjun, 2004 (M.Sc. Dissertation)	Explained the concept of <i>triguṇa</i> and <i>tridoṣa</i> to elucidate the holistic health concept and nature of psychosomatic diseases.	<ol style="list-style-type: none"> <li>1. Comparisons of Ayurveda and Yoga concepts</li> <li>2. Comprehensive approach towards holistic health</li> <li>3. Highlight use of <i>triguṇa</i> and <i>tridoṣa</i> for complete ascertainment of individual nature</li> </ol>	<ol style="list-style-type: none"> <li>1. No theoretical model</li> <li>2. Experimental work different from literary search</li> </ol>
Mohan, 2008 (M.Sc. Dissertation)	Highlighted challenges due to modern lifestyle, and their influence in attitude	<ol style="list-style-type: none"> <li>1. Presentation of <i>triguṇa</i> concept from practical perspective of lifestyle</li> </ol>	<ol style="list-style-type: none"> <li>1. No theoretical model</li> <li>2. Experimental work different from literary</li> </ol>

	<p>formation.</p> <p><i>Triguṇa</i> concept presented to suggest methods to overcome poor lifestyle and develop a better attitude towards life.</p>	management	search
Tripathi, 2012 (M.Sc. Dissertation)	A detailed comparison is made between yoga and ayurveda in understanding the concept of <i>triguṇa</i> .	<ol style="list-style-type: none"> <li>1. Parallels and contrasts in <i>triguṇa</i> according to yoga and ayurveda texts</li> <li>2. Major ayurvedic texts and yoga texts were referred</li> </ol>	<ol style="list-style-type: none"> <li>1. No theoretical model was proposed related to experimental work</li> <li>2. Experimental work different from literary search</li> </ol>
Rao, 2013 (M.Sc. Dissertation)	<p>Attempted a novel method to understand the basic equilibrium pattern in the <i>prakṛti</i>, the universe.</p> <p>Randomness in nature due to human interaction (<i>guṇa</i> flux) was studied using the Random Event</p>	<ol style="list-style-type: none"> <li>1. Concise review of relevant verses needed to support theoretical ideas</li> <li>2. New application of <i>triguṇa</i> theory</li> <li>3. Theoretical frameworks proposed related to experimental work</li> </ol>	Major focus on study of <i>guṇas</i> in inanimate <i>Prakṛti</i> (i.e., external environment)

	Generator (REG).	4. Introduction of the concept of <i>gunagraphy</i>	
Deshpande, 2008 (Ph.D. Thesis)	Quality of life was studied from various dimensions, having <i>triguna</i> as one of the main components of study.	1. Used <i>triguna</i> as the major tool for assessing personality 2. Extensive review from major <i>upanishads</i> , yoga and ayurveda texts	1. Major focus on quality of life, <i>triguna</i> being a part of the whole study 2. No theoretical model proposed related to experimental work
Khemka, 2012 (Ph.D. Thesis)	The study of development of human potential through practice of yoga and assessment of the changes using psychological and health variables.	1. Theoretical model proposed for development of human potential	3. Major focus on human potential model, <i>triguna</i> being a part of the whole study

In concluding this section, most of the earlier work focussed on compilation of verses from various texts, and a very few have attempted to use them to develop a theoretical framework supporting their experimental study. Hence in our study, we have attempted to achieve both of these aspects. Verses from relevant texts were compiled and suitably used to develop a theoretical framework. Also inspiration is drawn for empirical studies in future.

## 2.5 TEXT-WISE PRESENTATION OF VERSES RELATED TO TRIGUṆA

For text-wise elucidation of *guṇas*, the following eight texts were selected:

1) *Bhagavadgītā*, 2) *Caraka Saṁhitā*, 3) *Māṇḍūkya Upaniṣad*, 4) *Pañcadaśī*, 5) *Pātañjala Yoga Sūtra*, 6) *Sāṅkhya Kārikā*, 7) *Tattvabodhaḥ*, and 8) *Vivekacūḍāmaṇi*. Number of verses selected from each texts were 17, 6, 2, 3, 3, 3, 15, and 12 respectively, adding to 61 verses altogether. The discussion is mainly presented is two aspects: *triguṇa* as found in animate and in inanimate universe. For elucidating *triguṇa* for inanimate universe, the main texts used were *Tattvabodhaḥ*, and *Sāṅkhya Kārikā*. Other texts were used to find out *triguṇa* from the perspective of human personality. For understanding the nature of the tool IAT, *Pātañjala Yoga Sūtra*, and *Caraka Saṁhitā* were used.

### VERSES FROM BHAGAVADGĪTĀ

The concept of *guṇā* is well illustrated in sacred scripture, *Bhagavadgītā* (Tapasyananda, 2008), in particular, the fourteenth chapter, *Guṇatrayavibhāga Yoga* and the eighteenth chapter, *Mokṣa Sanyāsa Yoga*. *Guṇā* is a challenging concept to understand and comprehend. The very fact that it can be interpreted in different ways according to context is a matter of concern. Here the focus is about the constituent of nature which could be *satva*, *rajas*, or *tamas*. They are considered the basic fabric of personality structure. Sri Krishna asserts that, “there is nothing in this creation, including this world and heaven, which does not come under the influence of the three *guṇā* of Nature (*prakṛti*)” (Chinmayananda, 2008).

न तदस्ति पृथिव्यां वा दिवि देवेषु वा पुनः ।

सत्त्वं प्रकृतिजैर्मुक्तं यदेभिः स्यात् त्रिभिर्गुणैः ॥

*Na tadasti pṛthivyām vā divi deveṣu vā punaḥ।*

*Satvaṁ prakṛtijaiṛmuktaṁ yadebhiḥ syāt tribhiringuṇaiḥ ॥*

Nowhere, be it in this world or in the heavenly regions of the *Devas*, is there any being who is free from these three *guṇas* of nature (*prakṛti*) (Tapasyananda, 2003)

(*Bhagavad Gītā*, Ch: 18 V: 40)

This is a profound statement, which inspires us to undertake an in depth study of *guṇā*. Since it is so fundamental that if we succeed in evolving a theory or measurement tool based on *guṇā*, it should have greater validity and generalisability. The above verse is the propellant of this study.

सत्त्वं रजस्तम इति गुणाः प्रकृतिसम्भवाः ।

निबध्नन्ति महाबाहो देहे देहिनमव्ययम् ॥

*Satvaṁ rajastama iti guṇāḥ prakṛtisambhavāḥ।*

*Nibadhnanti mahābāho dehe dehinamavyayam ॥*

*Guṇās* are three in number, *satva* , *rajas*, and *tamas* and they bind the immortal soul to the body in its embodied state.

(*Bhagavad Gītā*, Ch: 14 V: 7)

Sri Krishna declares *guṇā* to be three in number, *satva* , *rajas*, and *tamas* in the above verse and adds that these *guṇās* bind the immortal soul to the body in its embodied state (Chinmayananda, 2008).

The nature of three *guṇas*, their expressions, and their mode of binding are explained in the following verses.

तत्र सत्त्वं निर्मलत्वात्प्रकाशकमनामयम् ।

सुखसङ्गेन बध्नाति ज्ञानसङ्गेन चानघ ॥

*Tatra satvaṁ nirmalatvātprakāśakamanāmayam ।*

*Sukhasaṅgena badhnāti jñānasaṅgena cānagha ॥*

Among these, *satva* is luminous and harmonious due to its essential purity. It binds the soul, O sinless one, with the feeling 'I am happy, I am full of knowledge'.

(*Bhagavad Gītā*, Ch: 14 V: 6)

रजो रागात्मकं विद्धि तृष्णासङ्गसमुद्भवम् ।

तन्निबध्नाति कौन्तेय कर्मसङ्गेन देहिनम् ॥

*Rajo rāgātmakam viddhi tṛṣṇāsaṅgasamudbhavam ।*

*Tannibadhnāti kaunteya karmasaṅgena dehinam ॥*

Know *rajas* to be passion-based, and productive of longings for unattained objects and attachment for those in one's possession. It binds the (actionless) soul, O son of Kunti, by entangling it in action (through the feeling 'I am the doer').

(*Bhagavad Gītā*, Ch: 14 V: 7)

तमस्त्वज्ञानजं विद्धि मोहनं सर्वदेहिनाम् ।

प्रमादालस्यनिद्राभिस्तन्निबध्नाति भारत ॥

*Tamastvājñānajaṁ viddhi mohanam sarvadehinām ।*

*Pramādālasyanidrābhīstannibadhnāti bhārata ॥*

As for the *guṇā* known as *tamas*, it is ignorance-born and is productive of delusion in all beings. It binds the soul, O scion of the Bharata clan! with the obsession of a disposition characterised by negligence, indolence and sleepiness.

(*Bhagavad Gītā*, Ch: 14 V: 8)

**Interpretation:** In the above verses the basic properties of *triguṇa* are explained. The way they bind a person with their characteristic properties, has been explained. Even *satva* is said to be binding with the feeling of 'I am happy' etc., i.e., it can bind with happiness. *Rajas*, which is a passion based, on the other hand binds by attachment, longings, and pushing into action. Finally, *tamas* is ignorance born and hence causes delusion. It binds by negligence, indolence, sleepiness, and in ability to come out of a state. The main point to be noted is that, whether good or bad, all the three *guṇas* are essentially binding in nature.

रजस्तमश्चाभिभूय सत्त्वं भवति भारत ।

रजः सत्त्वं तमश्चैव तमः सत्त्वं रजस्तथा ॥

*Rajastamaścābhibhūya satvaṁ bhavati bhārata ।*

*Rajaḥ satvaṁ tamaścaiva tamaḥ satvaṁ rajastathā ॥*

Overpowering *rajas* and *tamas*, *satva* prevails (sometimes); suppressing *satva* and *tamas*, *rajas* becomes dominant; and likewise dominating over *satva* and *rajas*, *tamas* hold the field.

(*Bhagavad Gītā*, Ch: 14 V: 10)

**Interpretation:** The above verse is very important as it explains how the relative dominance of a particular *guṇa* is manifested. All the time the three *guṇas* are active, however, at a given moment, one of them momentarily gains dominance and

overpowering others expresses its nature. Expression of a particular *guṇā* is merely a relative absence of the other two at that given moment. Also the implication suggests that freedom from a particular *guṇas* is never possible. Hence there are only two states, either bound by *triguṇa* or free from them, no intermediate. However, there can be degrees of bondage. It is further interesting to note the determinants which mediate this mechanism of relative expression of a *guṇa* at a given time. Why should *satva* overpower *rajas* and *tamas* momentarily, and similarly for the other two *guṇas*? The two factors are the external environment and the internal *samskāra*. The interplay of these two chief determinants of *triguṇas* decides which one of them will be active. Hence by controlling the nature internal, and the nature external, one can become free from the bondages of *guṇas*, as suggested by Swami Vivekananda. We can shatter the *tamas* by promoting *rajas*, we can control excessive *rajas* by promoting *satva*, which brings regulation, and similarly we can disturb *satva* by stepping into *rajas* or *tamas*. Hence the gradation of *tamas* to *rajas* to *satva* should be remembered by a spiritual seeker and use *guṇas* as a perfect instrument to create the best thing in the nature. This is what is creating our own destiny means.

सर्वद्वारेषु देहेऽस्मिन्प्रकाश उपजायते ।

ज्ञानं यदा तदा विद्याद्विवृद्धं सत्त्वमित्युत ॥

*Sarvadvāreṣu dehe'sminprakāśa upajāyate ।*

*Jñānaṁ yadā tadā vidyādvivṛddhaṁ satvamityuta ॥*

When through all the senses, which are the portals of the body, knowledge, happiness and similar characteristics manifest, then indeed it should be understood that *satva* is dominant. (*Bhagavad Gītā*, Ch: 14 V: 11)

लोभः प्रवृत्तिरारम्भः कर्मणामशमः स्पृहा ।

रजस्येतानि जायन्ते विवृद्धे भरतर्षभ ॥

*Lobhaḥ pravṛttirārambhaḥ karmaṇāmaśamaḥ sprhā ।*

*Rajasyetāni jāyante vivṛddhe bharatarṣabha ॥*

Avarice, extroversion, ceaseless planning and execution of works, restlessness, a desire for enjoyments-these arise when *rajas* prevails.

(*Bhagavad Gītā*, Ch: 14 V: 12)

अप्रकाशोऽप्रवृत्तिश्च प्रमादो मोह एव च ।

तमस्येतानि जायन्ते विवृद्धे कुरुनन्दन ॥

*Aprakāśo'pravṛttiśca pramādo moha eva ca ।*

*Tamasyetāni jāyante vivṛddhe kurunandana ॥*

When *tamas* dominate, there is a lack of intelligence, lack of effort, negligence and delusion.

(*Bhagavad Gītā*, Ch: 14 V: 13)

**Interpretation:** The above three verses, 11, 12, and 13 again explain the ways *triguṇa* is manifested in a person's behaviour and therefore in personality. When knowledge and happiness are expressed through all senses, which means in a person's behaviour, then *satva* is considered to be prevailing. *Rajas* is expressed in action as ceaseless planning and execution of works, restlessness, a desire for enjoyments. Due to lack of intelligence, *tamas* is expressed as lack of effort, negligence and delusion. Resistance to change is also a feature of *tamas*. Knowledge of the expression of *triguṇa* would help us to plan out a means of escape from the bondages of the *triguṇa*, as mentioned earlier, we can consciously invoke the other

*guṇas* to regulate the excessive activity of a particular *guṇa*. For personality development, this means to promote a fixed pattern of behaviour which would lead to the development of the desired dominance of *guṇas*.

ऊर्ध्वं गच्छन्ति सत्त्वस्था मध्ये तिष्ठन्ति राजसाः ।

जघन्यगुणवृत्तिस्था अधो गच्छन्ति तामसाः ॥

*Ūrdhvaṁ gacchanti satvasthā madhye tiṣṭhanti rājasāḥ ।*

*Jaghanyaguṇavṛttisthā adho gacchanti tāmasāḥ ॥*

Those established in *satva* evolve to higher goals, while those abiding in *Rajas* remain in the mid-course. Steeped in evil tendencies, the *tamas*-dominated ones degenerate.

(*Bhagavad Gītā*, Ch: 14 V: 18)

**Interpretation:** The verse 18, informs how the progress will be of a person who is dominated by a given *guṇa*. *Satva* will help to progress higher, *rajas* will keep us stagnant where we are, and *tamas* will degenerate us further. This statement follows the profound law of spirituality- freedom is evolution, and bondage is involution (spiritual degradation). *Satva*, as it is knowledge and illumination, there is a better chance of using one's inner freedom without bondage. These two aspects of *satva* namely, greater freedom of action, and lesser chance of being bound, make *satva* a cause for higher progress. *Rajas* has activity and restlessness, where the freedom is snatched by preconceived desires and wants, and choicelessly a person pursues after the objects of senses. Even though he is blinded by passion still he is in the current of water just managing his position. Hence *rajas* keeps us where we are, neither progress nor degradation. *Tamas*, as it induces ignorance and delusion, freedom is

extremely less and it leads to maximum bondage. Actions propelled by *tamas* dominance will inadvertently bring degradation.

For personality development aspect, the above analysis gives reasons why we should engage in the state of *satva*? To make a net progress, we need a state of *satva*, if our actions are not so, then at least we should be in a state of *rajas* so that we do not go down, and *tamas* should be restrained in all actions, so that we make a net positive progress.

**Objection:** Does it mean we should not undergo the process of sleep, which is full of *tamas*?

**Reply:** Sleep is an important physiological process which is supported by the predominance of *tamas*. As a part of our *prārabdha karma*, we are bound to experience a certain level of *tamas*, as expressed through sleep. However, excessive indulgence in sleep does degrade us. Though it is true that *tamas*, a state of sleep is a 'spiritually' degrading process, it is a part and parcel of a *jīva's prārabdha karma*. However, a yogi would definitely aspire to overcome this bondage also. Like the example of Sri Aurobindo and other great masters, who had awareness even during sleep state. *Patañjalī* considers *nidrā* (sleep) as a *vṛtti*, and calls for its *nirodha* (cessation) for liberation.

In the following seven verses, qualities of a person who has overcome this bondage of *triguṇa* has been described.

प्रकाशं च प्रवृत्तिं च मोहमेव च पाण्डव ।

न द्वेष्टि सम्प्रवृत्तानि न निवृत्तानि काङ्क्षति ॥

*Prakāśam ca pravṛttiṃ ca mohameva ca pāṇḍava |*

*Na dveṣṭi sampravṛttāni na nivṛttāni kāṅkṣati ||*

O son of Pandu! He who shows no aversion to knowledge, activity, or delusion when any of them is dominant, nor longs for them when absent; is a *guṇātīta*.

(*Bhagavad Gītā*, Ch: 14 V: 22)

उदासीनवदासीनो गुणैर्यो न विचाल्यते ।

गुणा वर्तन्त इत्येवं योऽवतिष्ठति नेङ्गते ॥

*Udāsīnavadāsīno guṇairyo na vicālyate |*

*Guṇā vartanta ityevam yo'vatiṣṭhati neṅgate ||*

Who remains like an unconcerned witness and is unperturbed by the *guṇā* -born sense objects; who knows that it is only the *guṇā* -born senses and mind that act and enjoy (and not his real self); who remains unwavering in all situations, is a *guṇātīta*.

(*Bhagavad Gītā*, Ch: 14 V: 23)

समदुःखसुखः स्वस्थः समलोष्टाश्मकाञ्चनः ।

तुल्यप्रियाप्रियो धीरस्तुल्यनिन्दात्मसंस्तुतिः ॥

*Samaduḥkhasukhaḥ svasthaḥ samaloṣṭāśmakāñcanaḥ |*

*Tulyapriyāpriyo dhīrastulyanindātmasaṃstutiḥ ||*

Who is self-poised alike in pleasure and in pain; who makes no difference between stone, iron, and gold; who is the same towards the loving and the hating; who is unmoved by praise and blame alike; is a *guṇātīta*.

(*Bhagavad Gītā*, Ch: 14 V: 24)

मानापमानयोस्तुल्यस्तुल्यो मित्रारिपक्षयोः ।

सर्वारम्भपरित्यागी गुणातीतः स उच्यते ॥

*Mānāpamānayostulyastulyo mitrāripakṣayoḥ ।*

*Sarvārambhaparityāgī guṇātitaḥ sa ucyate ॥*

Who is alike in honour and in humiliation; who views a friend and a foe alike; who has abandoned all sense of agency-such a person is said to have transcended the *guṇas*.

(*Bhagavad Gītā*, Ch: 14 V: 25)

त्रैगुण्यविषया वेदा निस्त्रैगुण्यो भवार्जुन ।

निर्द्वन्द्वो नित्यसत्त्वस्थो निर्योगक्षेम आत्मवान् ॥

*Traiguṇyaviṣayā vedā nistraiguṇyo bhavārjuna ।*

*Nirdvandvo nityasattovasto niryogakṣema ātmavān ॥*

O Arjuna! The Vedas deal with material ends. But you be established in the spirit, in the immutable purity of it, having abandoned all material values, attachment to possessions and concern with the contraries of life like pleasure and pain, heat and cold.

(*Bhagavad Gītā*, Ch: 2 V: 45)

योगस्थः कुरु कर्माणि सङ्गं त्यक्त्वा धनञ्जय ।

सिद्धयसिद्धयोः समो भूत्वा समत्वं योग उच्यते ॥

*Yogasthaḥ kuru karmāṇi saṅgaṁ tyaktvā dhanañjaya ।*

*Siddhyasiddhyoḥ samo bhūtvā samatvaṁ yoga ucyate ॥*

Engage yourself in action with the mind steadfast in Yoga. Abandon attachments, O Arjuna, and be unperturbed in success and failure. This unperturbed sameness in all conditions is Yoga.

(*Bhagavad Gītā*, Ch: 2 V: 48)

कर्मण्यकर्म यः पश्येदकर्मणि च कर्म यः ।

स बुद्धिमान्मनुष्येषु स युक्तः कृत्स्नकर्मकृत् ॥

*Karmanyakarma yaḥ paśyedakarmani ca karma yaḥ |*

*Sa buddhimānmanuṣyeṣu sa yuktaḥ kṛtsnakarmakṛt ||*

He who sees work in 'no work' and 'no work' in work, he is wise among men. Even while doing all work, he remains established in Yoga.

(*Bhagavad Gītā*, Ch: 4 V: 18)

**Interpretation:** The above mentioned four verses: 22, 23, 24, and 25 presents the quality of that personality which is beyond the bondage of *triguṇa*. He shows no inclination towards any activity emerging out of the influence of *triguṇa*, nor does he long for them in their absence; he remains as a witness, unaffected by any possible pairs of opposites, physical (e.g., heat & cold), emotional (e.g., loving & hating), and intellectual (e.g., honour & humiliation), and views all being as one, is a *guṇātīta*, a person who is beyond the influence of *triguṇa*. In a nutshell, *guṇātīta* is a state of perfect equanimity of mind under all internal and external circumstances. It is suggested that work should be done being in a state of *satva*, which is in a state of inner awareness. Anyone who does work in this detached way and unperturbed by failures and successes, is a *guṇātīta*.

**Objection:** A paradox which arises is: how a person who does not desire, does not involve in anything deeply, does not love or hate, who is resistant to external calls of challenges, can be considered a *guṇātīta*? Is it really a state of greater happiness that a human being can achieve? Won't we lose all zeal for doing any action?

**Reply:** The description presented above gives an impression of inactive people, without vitality. However, there is an ocean of difference between these two states. The characteristics of *guṇātīta* are the one that emerges spontaneously out of total detachment. When attachment begins, the very moment also starts the process of contraction. More desire and attachment leads to greater contraction of consciousness and it becomes so narrow that it goes to the state of *tamas*, total inertia. Involving in any pairs of opposite is a sign of contraction, hence curbing of degrees of freedom. Hence the key is not getting attached to the action. How do we actualize this? By being in a state of more freedom, i.e., to say in a state of *satva*. Higher state of *satva* means higher the state of freedom. Even *satva* is considered as a bondage, because as discussed above, *satva* is merely a state of low dominance of *tamas* and *rajas*, **not** their complete absence. Hence it is essential to go beyond all the three *guṇas*. We may involve in any action but not getting identified with that state is the key to mastery. Hence *guṇātīta* is a state more characterized by mastery over the *triguṇa* rather than their absence. We cannot imagine the total absence of *triguṇa* in this universe because, it would mean the cessation of creation, which does not happen.

The way a *guṇātīta* works is entirely different. Being in a state of inner awareness, he establishes himself in a state of *akarma*, non-action, and he engages in

various activities outside keeping a part of his mind available for such external activities, thereby being in a state of action, but without being affected by the action. This enables him to work without attachment and give other qualities of *the guṇātīta way* of doing actions.

**Summary:** From the above discussion of various verses from the *Bhagavadgītā* it can be deduced that *triguṇa* need not be considered as a set of characteristics of good, bad, and their mixture. Without *triguṇa* this creation is nil. All activities go on as per the cosmic plan. Being humans, endowed with freedom of choice, we can consciously make higher evolution, accelerating out spiritual growth. Once this important point that *triguṇa* is necessary for our actions in this world, we may give due respect to the laws that govern them and then become the master of that law and truly be called a *guṇātīta*, a state of perfect mastery.

### VERSES FROM VIVEKACUḌĀMAṆI

*Vivekacuḍāmaṇi* (Turiyananda, 1991) is one of the popular texts of Vedanta. The following verses were presented to support the concepts already highlighted in the *Bhagavadgītā*, and also to present some additional key points. The following verses are selected:

अहंकारः स विज्ञेयः कर्ता भोक्ताभिमान्ययम् ।

सत्त्वादिगुणयोगेन चावस्थात्रयमश्नुते ॥ १०४ ॥

*Ahaṅkāraḥ sa vijñeyaḥ kartā bhoktābhimānyayam |*

*Sattvādiguṇayogena cāvasthātrayamaśnute || 104||*

Know that it is the ego which, identifying with the body, becomes the doer or the experiencer, and in conjunction with the *Guṇas* such as *satva* etc, this ego assumes the three different states (of waking, dreaming, and deep sleep).

**Interpretation:** This verse brings out the main point that it is the ego (I) which gets identified with various adjuncts and wrongly assumes the Self (Atman) to them. This wrong conclusion leads to the three states of consciousness and involves in their respective activities, in a state of bondage.

अव्यक्तनाम्नी परमेशशक्तिः अनाद्यविद्या त्रिगुणात्मिका परा ।

कार्यानुमेया सुधियैव माया यया जगत्सर्वमिदं प्रसूयते ॥ १०८ ॥

*Avyaktanāmnī paramēśasaktiḥ anādyavidyā triguṇātmikā parā ।*

*Kāryānumeyā sudhiyaiṅvā māyā yayā jagatsarvamidam prasūyate ॥ 108॥*

Nescience (*avidyā*) or *māyā*, also called the "Unmanifest," is the power of the Lord.

It is without beginning; it comprises the three *guṇas* and is superior to their effects (as their cause). It is to be inferred only by one who has a clear intellect, from the effects it produces. It is this *māyā* which projects the entire universe.

**Interpretation:** This verse highlights *māyā* as the root cause of all creation, one of the central doctrine of *Advaita* philosophy and suggests the cause and effect relationship between the further evolutes. Whatever is created is just a projection and does not have a solid reality. The same concept will be further explained in the discussion of the evolution of the material universe in the coming sections.

विक्षेपशक्ती रजसः क्रियात्मिका यतः प्रवृत्तिः प्रसृता पुराणी ।

रागादयोऽस्याः प्रभवन्ति नित्यं दुःखादयो ये मनसो विकाराः ॥ १११ ॥

*Vikṣepaśaktī rajasāḥ kriyātmikā Yataḥ pravṛtṭiḥ prasṛtā purāṇī |*

*Rāgādayo'syāḥ prabhavanti nityam Duḥkhādayo ye manaso vikārāḥ || 111||*

*Rajas* has projecting power (*vikṣepaśakti*). Activity is its very nature. From it the initial flow of activity has originated. From it, mental modifications such as attachment and grief are also continuously produced.

कामः क्रोधो लोभदम्भाद्यसूया अहंकारेष्यामत्सराद्यास्तु घोराः ।

धर्मा एते राजसाः पुम्प्रवृत्तिः यस्मादेषा तद्रजो बन्धहेतुः ॥ ११२ ॥

*Kāmaḥ krodho lobhadambhādyasūyā ahaṅkāreṣyāmatsarādyāstu ghorāḥ |*

*Dharmā ete rājasāḥ pumpravṛtṭiḥ yasmādeṣā tadrajo bandhahetuḥ || 112||*

Desire, anger, greed, hypocrisy, arrogance, jealousy, egoism, envy, etc.—these are the dreadful attributes of *rajas*, from which the worldly tendencies of man are produced. *Rajas* is therefore the cause of bondage in life.

**Interpretation:** In the above two verses, the *rajas* is explained to have the function of projection (*vikṣepaśakti*). It is the cause of all activities, and leads to desire and all its ill by-products.

एषाऽऽवृतिर्नाम तमोगुणस्य शक्तिर्मया वस्त्ववभासतेऽन्यथा ।

सैषा निदानं पुरुषस्य संसृतेः विक्षेपशक्तेः प्रवणस्य हेतुः ॥ ११३ ॥

*Eṣā''vṛtirnāma tamoguṇasya śaktirmayā vastvavabhāstate'nyathā |*

*Saiṣā nidānaṁ puruṣasya saṁsṛteḥ vikṣepaśakteḥ pravaṇasya hetuḥ || 113||*

The veiling power (*āvṛtti*), is the power of *tamas*, which makes things appear to be other than what they actually are. It causes man's repeated transmigration and initiates the action of the projecting power (*vikṣepa*).

प्रज्ञावानपि पण्डितोऽपि चतुरोऽप्यत्यन्तसूक्ष्मात्मदृग्-व्यालीढस्तमसा न वेत्ति बहुधा संबोधितोऽपि

स्फुटम् ।

भ्रान्त्यारोपितमेव साधु कलयत्यालम्बते तद्गुणान् हन्तासौ प्रबला दुरन्ततमसः शक्तिर्महत्यावृतिः ॥

११४ ॥

*Prajñāvānapi paṇḍito'pi caturo'pyatyantasūkṣmātmadr̥g- Vyālīḍhastamasā na vetti*

*bahudhā sambodhito'pi sphuṭam ।*

*Bhrāntyāropitameva sādhu kalayatyālbate tadguṇān Hantāsau prabalā*

*durantatamaśaḥ śaktirmahatyāvṛtiḥ ॥ 114॥*

Even the wise and the learned, and those who are expert in the understanding of the supremely subtle meaning of the scriptures, are overpowered by *tamas* and cannot comprehend Truth, even though it is clearly explained in various ways. They consider as real what is simply superimposed by delusion and attach themselves to its effects. Alas! How powerful is the great veiling power of dreadful *tamas*!

अभावना वा विपरीतभावना असंभावना विप्रतिपत्तिरस्याः ।

संसर्गयुक्तं न विमुञ्चति ध्रुवं विक्षेपशक्तिः क्षपयत्यजस्रम् ॥ ११५ ॥

*Abhāvanā vā viparītabhāvanā asambhāvanā vipratipattirasyaḥ ।*

*Samsargayuktam na vimuñcati dhruvaṁ vikṣepaśaktiḥ kṣapayatyajasram ॥ 115॥*

Absence of correct judgment, contrary judgment, lack of definite belief and doubt— certainly these never leaves one who has any connection with this veiling power; also, the projecting power gives endless trouble.

अज्ञानमालस्यजडत्वनिद्रा- प्रमादमूढत्वमुखास्तमोगुणाः ।

एतैः प्रयुक्तो नहि वेत्ति किञ्चिन् निद्रालुवत्स्तम्भवदेव तिष्ठति ॥ ११६ ॥

*Ajñānamālasya jaḍatvanidrā- pramādamūḍhatvamukhāstamogunāḥ |*

*Etaiḥ prayukto nahi veti kiñcin nidrāluvatstambhavadeva tiṣṭhati || 116||*

Ignorance, laziness, dullness, sleep, inadvertence, stupidity etc., are the attributes of *tamas*. One tied up with these cannot comprehend anything, but remains like one asleep, or like a stump of wood or a block of stone.

**Interpretation:** The above four verses emphasizes the action and impact of *tamas*. *Tamas* is basically having veiling power, that means it will hide the truth and keep us under wrong knowledge. This also is indicative of inertia, resistance to change, etc. Even great scholars too, under the influence of *tamas* fail to see the truth.

सत्त्वं विशुद्धं जलवत्तथापि ताभ्यां मिलित्वा सरणाय कल्पते ।

यत्रात्मबिम्बः प्रतिबिम्बितः सन् प्रकाशयत्यर्क इवाखिलं जडम् ॥ ११७ ॥

*Satvaṁ viśuddham jalavattathāpi tābhyāṁ militvā saraṇāya kalpate |*

*Yatrātmabimbah pratibimbitah san prakāśayatyarka ivākhilam jaḍam || 117||*

Pure *satva* is like clear water, yet in combination with *rajas* and *tamas*, it provides for transmigration. But when the light of the Self gets reflected in *satva* alone, then, like the sun, it reveals the entire world of objects.

मिश्रस्य सत्त्वस्य भवन्ति धर्माः त्वमानिताद्या नियमा यमाद्याः ।

श्रद्धा च भक्तिश्च मुमुक्षता च दैवी च सम्पत्तिरसन्नवृत्तिः ॥ ११८ ॥

*Miśrasya satvasya bhavanti dharmāḥ tvamānitādyā niyamā yamādyāḥ |*

*Śraddhā ca bhaktiśca mumukṣatā ca daivī ca sampattirasannivṛttiḥ || 118||*

The characteristics of mixed *satva* are, utter absence of pride etc., *yama*, *niyama* etc., and also faith, devotion, yearning for liberation, the divine tendencies, and a natural turning away from everything unreal.

विशुद्धसत्त्वस्य गुणाः प्रसादः स्वात्मानुभूतिः परमा प्रशान्तिः ।

तृप्तिः प्रहर्षः परमात्मनिष्ठा यया सदानन्दरसं समृच्छति ॥ ११९ ॥

*Viśuddhasatvasya guṇāḥ prasādaḥ svātmānubhūtiḥ paramā praśāntiḥ ।*

*Tr̥ptiḥ praharṣaḥ paramātmaniṣṭhā yayā sadānandarasaṁ samṛcchati ॥ 119॥*

The characteristics of pure *satva* are cheerfulness, self realization, supreme peace, contentment, bliss, and a steady abidance in the supreme Self, by which the aspirant comes to enjoy everlasting bliss.

**Interpretation:** The above three verses present very unique aspect of *triguṇa*. Pure *satva* is the one which is unadulterated and fully reflects the light of consciousness. Mixed *satva* is the one which in combination of other *guṇas* gives rise to various virtues like contentment, absence of pride, and qualities of *yama* and *niyama*.

**Summary:** The concept of *satva*, *rajas*, and *tamas* were presented along with their characteristic features. The newer aspects of *triguṇa* added from this text are: the veiling power of *tamas* and projecting power of *rajas*, both of which leads to bondage. Another contribution is the difference between pure *satva* and mixed *satva*. It is the mixed *satva* which is of binding nature and not the pure *satva*. In fact *jīvana muktas* (liberated ones being in this body itself) would be present in a state of pure *satva*.

#### VERSES FROM CARAKA SAMHITĀ

The following verses are taken from the *Caraka Samhitā* of Śārīrasthāna (Acharya, 1994).

**Causes of miseries:**

धीधृतिस्मृतिविभ्रंशः संप्राप्तिः कालकर्मणाम् ।

असात्म्यार्थगमश्चेति ज्ञातव्या दुःखहेतवः ॥९८ ॥

*Dhīdhṛtismṛtīvibhraṅśaḥ samprāptiḥ kālakarmaṇām |*

*Asātmīyārthāgamaśceti jñātavyā dukhahetavaḥ ||98||*

Impairment of intellect, patience and memory advent of the maturity (of the results) of time and action and unwholesome contact with the objects of senses are considered to be the causative factors for miseries.

**Impairment of intellect:**

विषमाभिनिवेशो यो नित्यानित्ये हिताहिते ।

ज्ञेयः स बुद्धिविभ्रंशः समं बुद्धिर्हि पश्यति ॥९९ ॥

*Viṣamābhiniवेशo yo nityānitye hitāhite |*

*Jñeyāḥ sa buddhivibhraṅśaḥ samam buddhirhi paśyati ||99||*

If something eternal is viewed as ephemeral and something harmful, as useful and *vice versa*, this is indicative of the impairment of intellect. For, the intellect normally vies things as they are.

**Impairment of patience:**

विषयप्रवणं सत्त्वं धृतिभ्रंशान्न शक्यते ।

नियन्तुमहितादर्थद्धृतिर्हि नियमात्मिका ॥१०० ॥

*Viṣayapraṇaṇam satvaṁ dhṛtibhraṅśānna śakyate |*

*Niyantumahitādarthāddhṛtirhi niyamātmikā ||100||*

A mind indulging in worldly enjoyments cannot be restrained from harmful objects due to the impairment of patience. It is patience which can restrain the mind (from its harmful objects).

**Impairment of memory:**

तत्त्वज्ञाने स्मृतिर्यस्य रजोमोहावृतात्मनः ।

भ्रश्यते स स्मृतिभ्रंशः स्मर्तव्यं हि स्मृतौ स्थितम् ॥१०१॥

*Tattvajñāne smṛtiryasya rajomohāvṛtātmanah|*

*Bhraśyate sa smṛtibhramśaḥ smartavyaṁ hi smṛtau sthitam||101||*

If memory is impaired due to a person being overcome by *rajas* and *tamas*, this is known as the impairment of memory. Normally memory contains everything memorable.

धीधृतिस्मृतिविभ्रष्टः कर्म यत् कुरुतेऽशुभम् ।

प्रज्ञापराधं तं विद्यात् सर्वदोषप्रकोपणम् ॥ १०२ ॥

*dhīdhṛtismṛtivyibhraṣṭaḥ karma yat kurute'śubham|*

*prajñāparādhaṁ taṁ vidyāt sarvadoṣapraḥkopanam|| 102||*

A person whose intellect, patience and memory are impaired, subjects himself to intellectual blasphemy by virtue of his bad action. This intellectual blasphemy aggravates all the *doṣas*.

यच्चान्यदीदृशं कर्म रजोमोहसमुत्थितम् ।

प्रज्ञापराधं तं शिष्टा ब्रुवते व्याधिकारणम् ॥१०८॥

*Yaccānyadīdṛśaṁ karma rajomohasamutthitam|*

*Prajñāparādhaṁ taṁ śiṣṭā bruvate vyādhikāraṇam||108||*

Other physical evil acts arising out of *rajas* and *tamas* constitute intellectual blasphemy leading to the causation of various ailments.

**Interpretation:** The above verses from the *Caraka Saṁhitā* were taken in order to understand when a person yields to the senses and involves in inappropriate actions. This part has been selected to understand the concept of self-presentation bias, and social desirability factor. It is also useful to find the meaning of implicit-explicit incongruence that we find in the Implicit Association Test (IAT) (section 3.1). According to the above verses, a person indulges in wrong actions when any of the following: intellect, courage, or memory is impaired. When intellect is impaired, right understanding of the situation is lost and wrong comprehension happens. This leads to the wrong value system found as strong associations in the memory. When impulsive or automatic actions are executed, most often the guidelines dictated by the unconscious mind controls the behaviour. This wrong notion and value system is the cause for self-presentation bias and social desirability. Further, if a person is not having any cognitive dissonance, then what he says and what he thinks will be the same. In the IAT tool, the difference between what we say and what we think is, to some extent, reflected in the implicit-explicit congruence. Higher the congruence, greater will be the mental harmony.

### VERSES FROM SĀṆKHYA KĀRIKĀ

This text is the primary text of *Sāṅkhya* philosophy (Virupakshananda, 1995). The main reason to select this text is to present *triguṇa* as the basic fabric of creation, both animate and inanimate. Three main verses are selected and presented as follows:

त्रिगुणमविवेकि विषयः सामान्यमचेतनं प्रसवधर्मि ।

व्यक्तं तथा प्रधानं तद्विपरीतस्तथा च पुमान् ॥११॥

*Triguṇamaviveki viśayaḥ sāmānyamacetanāṁ prasavadharmiḥ*

*Vyaktāṁ tathā pradhānāṁ tadviparīṭastathā ca pumān||11||*

The manifest is constituted of the three attributes (of *satva*, *rajas* and *tamas*), is non-distinguishable, objective, common, non-intelligent, and prolific. So also is the Primordial Nature. The Spirit is the reverse of both of them and yet is similar in some respects.

प्रीत्यप्रीतिविषादात्मकाः प्रकाशप्रवृत्तिनियमार्थाः ।

अन्योन्याभिभवाश्रयजननमिथुनवृत्तयश्च गुणाः ॥१२॥

*Prītyapṛīṭivīṣādātmakāḥ prakāśapravṛttinīyamārthāḥ*

*Anyonyābhibhavāśrayajananamithunavṛttayaśca guṇāḥ||12||*

The attributes are of the nature of pleasure, pain and delusion; they serve the purpose of illumination, action and restraint and they are mutually dominating and supporting, productive and cooperative.

**Interpretation:** The following interpretation is taken from the *Sāṅkhya Kārikka* of *Īśvara Kṛṣṇa*, rendered by Swami Virupakshananda (1995).

### **Operations of *guṇas*:**

1. **Mutually dominating:** because, when one becomes active for some purpose, it dominates over the other (i.e. it subjugates the other). *Satva* attains its calm nature only after dominating over (or subjugating) the *rajas* and *tamas* attributes. Similarly, the *rajas* attains its agitated nature by subduing the *satva* and *tamas*.

2. **Mutually supporting:** *Satva* by resting upon activity and restraint, subserves *Rajas* and *Tamas* attributes with illumination. *Rajas* by resting upon illumination

and restraint subserves *satva* and *tamas* with activity; and *tamas* resting on illumination and activity subserves *satva* and *rajas* with restraint.

3. **Mutually productive:** One produces its effects resting upon the other two. Production here means modification and it is always of the same nature as the attributes. This is why it (modification) is not caused (i.e. not produced by some cause) because of the absence of a cause which is a different *tatva*.

4. **Mutually cooperative:** They are mutually concomitants and never exist separate from one another.

सत्त्वं लघु प्रकाशकमिष्टमुपष्टम्भकं चलं च रजः ।

गुरु वरणकमेव तमः प्रदीपवच्चार्थतो वृत्तिः ॥१३॥

*Satvaṁ laghu prakāśakamiṣṭmupaṣṭmbhakaṁ calaṁ ca rajaḥ ।*

*Guru varaṇakameva tamaḥ pradīpavaccārthato vṛttiḥ ॥13॥*

The *satva* attribute is buoyant and illuminating; the *rajas* attribute is exciting and mobile; and the *tamas* attribute is sluggish and obscuring; Their functioning is for a single purpose, like that of a lamp.

**Summary:** The three verses of *Sāṅkhya Kārikā* tries to illustrate the nature and their mutual functioning of *triguṇa*. These verses are not redundant to what has been mentioned earlier in the section of the *Bhagavadgītā*. The unique contribution is the explanation of four modes of operations of *triguṇa*, clearly indicating the inevitability of *triguṇa* for the sustenance of this creation. This explanation can be extended to both animate and inanimate creation.

**VERSES FROM TATTVABODHAḤ**

The text *Tattvabodhaḥ* (Dayananda, 2012) is one of the most basic texts of Vedanta, especially studied before taking up any rigorous texts, mainly to explain various technical terms and also most important concepts. The following verses explain the sequence of creation in a simple manner.

ततः आकाशः सम्भूतः । आकाशाद् वायुः । वायोस्तेजः । तेजस आपः । अभ्ययः पृथिवी ।

*Tataḥ ākāśaḥ sambhūtaḥ | Ākāśād vāyuḥ | Vāyostejaḥ | Tejasa āpaḥ | Abhdhayaḥ  
pṛthivī |*

From that (*Brahman* with *māyā*), space is born. From space, air (is born). From air, fire (is born). From fire, water (is born). From water, the earth (is born).

**Interpretation:** In the process of evolution, the former is considered as the cause of the latter. Hence the cause and effect relationship fully applies. The same sequence in reverse is followed when involution happens (*pralaya*). As the first product from the *māyā śakti*, space comes, then from it air is born, then comes fire, water and at last earth. In this sequence, earth is the grossest and space is the subtlest. One point to be highlighted is that before the creation, the *triguṇa* is in a state of perfect equilibrium. Once the process of evolution starts, the *triguṇa* has also started combining in various proportions to bring out this majestic creation. The subsequent verses explain what happens to each aspect of the *triguṇa*.

### Evolution of *sātvika* aspect of *triguṇa*

एतेषां पञ्चतत्त्वानां मध्ये आकाशस्य सात्विकांशात् श्रोत्रेन्द्रियं सम्भूतम् ।

वायोः सात्विकांशात् त्वगिन्द्रियं सम्भूतम् । अग्नेः सात्विकांशात् चक्षुरिन्द्रियं सम्भूतम् ।

जलस्य सात्विकांशात् रसनेन्द्रियं सम्भूतम् । पृथिव्याः सात्विकांशात् घ्राणेन्द्रियं सम्भूतम् ।

एतेषां पञ्चतत्त्वानां समष्टिसात्विकांशात् मनोबुद्ध्यहङ्कार चित्तान्तःकरणानि सम्भूतानि ।

*eteṣāṃ pañcatattvānāṃ madhye ākāśasya sātvikāṃśāt śrotrendriyaṃ sambhūtam |*  
*vāyoḥ sātvikāṃśāt tvagindriyaṃ sambhūtam | Agneḥ sātvikāṃśāt cakṣurindriyaṃ*  
*sambhūtam | Jalasya sātvikāṃśāt rasanendriyaṃ sambhūtam | Pṛthivyāḥ*  
*sātvikāṃśāt ghrāṇendriyaṃ sambhūtam | Eteṣāṃ pañcatattvānāṃ*  
*samaṣṭisātvikāṃśāt manobuddhyahaṅkāra cittāntaḥkaraṇāni sambhūtāni |*

Among these five elements, from the *sātvika* aspect of space is born the organ of hearing (the ear). From the *sātvika* aspect of air is born the organ of touch (skin). From the *sātvika* aspect of fire is born the organ of sight (the eye). From the *sātvika* aspect of water is born the organ of taste (the tongue). From the *sātvika* aspect of earth is born the organ of smell (the nose). From the *sātvika* aspect of these five elements, are born the mind, intellect, ego, memory, (called) the inner instruments.

### Evolution of *rājasika* aspect of *triguṇa*

एतेषां पञ्चतत्त्वानां मध्ये आकाशस्य राजसांशात् वागिन्द्रियं सम्भूतम् ।

वायोः राजसांशात् पाणीन्द्रियं सम्भूतम् । वन्हेः राजसांशात् पादेन्द्रियं सम्भूतम् ।

जलस्य राजसांशात् गुदेन्द्रियं सम्भूतम् । पृथिव्या राजसांशात् उपस्थेन्द्रियं सम्भूतम् ।

एतेषां समष्टिराजसांशात् पञ्चप्राणाः सम्भूताः ।

*Eteṣāṃ pañcatattvānāṃ madhye ākāśasya rājasāṃśāt vāgindriyaṃ sambhūtam ।  
Vāyoḥ rājasāṃśāt pāṇīndriyaṃ sambhūtam । Vanheḥ rājasāṃśāt pādendriyaṃ  
sambhūtam ।*

*Jalasya rājasāṃśāt upasthendriyaṃ sambhūtam । Pṛthivyā rājasāṃśāt gudendriyaṃ  
sambhūtam । Eteṣāṃ samaṣṭirājasāṃśāt pañcaprāṇāḥ sambhūtāḥ ।*

Now, the *rājasāṃśa* among these five elements beginning with the *rājasāṃśa* of askasa is being told. From that, the organ of speech is born. Vak-indriya, the organ of speech, is an organ of action. From the *rajas* aspect of air the (organ of action called) hand is born. From the *rajas* aspect of fire the (organ of movement called) feet is born. From the *rajas* aspect of water, the organ of evacuation is born. From the *rajas* aspect of the earth, the organ of procreation is born. From the total *rajas* aspect of these (five subtle elements) are born the five pranas (physiological functions).

### **Evolution of *Tāmasika* aspect of *triguṇa***

एतेषां पञ्चतत्त्वानां तामसांशात् पञ्चीकृतपञ्चतत्त्वानि भवन्ति ।

पञ्चीकरणं कथम् इति चेत् ।

एतेषां पञ्चमहाभूतानां तामसांशस्वरूपम् एकमेकं भूतं द्विधा विभज्य एकमेकमर्धं पृथक्  
तूष्णीं व्यवस्थाप्य अपरमपरमर्धं चतुर्धा विभज्य स्वार्धमन्येषु अर्धेषु स्वभागचतुष्टयसंयोजनं कार्यम् ।

तदा पञ्चीकरणं भवति ।

एतेभ्यः पञ्चीकृतपञ्चमहाभूतेभ्यः स्थूलशरीरं भवति ।

*Eteṣāṁ pañcatattvānām tāmasāṁśāt pañcīkṛtapañcatattvāni bhavanti |*

*Pañcīkaraṇam katham iti cet |*

*Eteṣāṁ pañcamahābhūtānām tāmasāṁśasvarūpam ekamekaṁ bhūtaṁ dvidhā  
vibhajya ekamekamardham pṛthak tūṣṇīm vyavasthāpya aparamaparamardham*

*caturdhām vibhajya*

*svārdhamanyeṣu ardheṣu svabhāgacatuṣṭayasamyojanam kāryam |*

*Tadā pañcīkaraṇam bhavati |*

*Etebhyaḥ pañcīkṛtapañcamahābhūtebhyaḥ sthūlaśarīram bhavati |*

From the *tamas* aspect of these five subtle elements, the five grossified elements are formed.

If it is asked, how the process of making each element five-fold (takes place), of these five (great) original elements, the *tamas* aspect of each element dividing into two halves, one half (of each element) remaining distinct (without further division or combining); dividing the other half of (of each element) four-fold. Combining each of these quarters with the other half of each element (which was undivided), is (called) *pañcīkaraṇam*, grossification. From these five elements which have undergone grossification (*pañcīkaraṇam*), the gross body is formed.

**Summary:** This text was selected for elucidation of creation (physical) and the role of *triguṇa*. According to the Vedantic model, creation can be traced back to the Brahman. The *māyā śakti* when evolves from Brahman due to the Brahman's own will. This is an apparent creation, which means there is really no reality involved, all are the power of projection (*vikkṣepaśakti* of *māyā*) and ignorance (*āvaraṇaśakti* of *māyā*). The above three groups of verses have explained the process of grossification or evolution for the three *guṇas*. It is to be noted that both *satva* and *rajas* aspect do

not undergo *pañcīkaraṇa*. Only *tamas* aspect undergoes the process of *pañcīkaraṇa* in order to materialize this universe.

## 2.6 THEORETICAL FRAMEWORK

An attempt is made to draw a theoretical framework and some of the points included are:

- 1) Can abnormal behaviour be explained using *guṇas*?
- 2) Are *guṇas* trait or state characteristics?
- 3) Can global or contextual prediction be made?
- 4) Influence of free will in expression of *guṇas*.
- 5) Group variation versus individual difference.
- 6) Cross cultural variations.
- 7) Operational definition.

Based on the analysis of texts, some of the above aspects are summarized in table 2.

**Table 2: Text-analysis of theoretical framework**

Reference	Translation	Interpretation
<b>1) Can abnormal behaviour be explained using <i>guṇas</i>?</b>		
वायुः पित्तं कफश्चोक्तः शारीरो दोषसंग्रहः । मानसः पुनरुद्दिष्टो रजश्च तम एव च ॥ <i>vāyuh pittaṁ kaphaścoktaḥ śārīro doṣasaṅgrahaḥ  </i> <i>mānasaḥ punaruddiṣṭo rajaśca tama eva ca   </i> ( <i>caraka saṁhitā, sūtrasthāna 57</i> )	The aggregate of bodily disorders is called <i>vāta</i> , <i>pitta</i> and <i>kapha</i> . While of the mind, the disorders are <i>rajas</i> and <i>tamas</i> .	The aggravation of <i>rajas</i> and <i>tamas</i> causes mental imbalances, also may influence the physical body.
<b>2) Are <i>guṇas</i> trait or state characteristics?</b>		
जागरितस्थानो बहिष्प्रज्ञः सप्ताङ्ग एकोनविंशतिमुखः स्थूल भुग्वैश्वानरः प्रथमः	The first quarter is <i>Vaiśvānara</i> whose	<b>Refer Figure 1.</b> <b>Interpretation 1:</b>

<p>पादः ॥ ३ ॥  <i>jāgaritasthāno bahiṣprajñāḥ saptāṅga</i>  <i>ekonaviṁśatimukhaḥ sthūla</i>  <i>bhugvaiśvānaraḥ prathamah pādah ॥</i>  3॥</p>	<p>sphere is the waking state, whose consciousness relates to things external, who is possessed of seven limbs and nineteen mouths, and who enjoys gross things.</p>	<p><i>Guṇa</i> in their unmanifest, potential form (<i>saṁskāra</i>), are trait qualities.  <i>Guṇa</i> in its expressive form (kinetic form) is state quality.  (Refer Figure 1)</p>
<p>स्वप्नस्थानोऽन्तः प्रज्ञाः सप्ताङ्ग एकोनविंशतिमुखः  प्रविविक्तभुक्तैजसो द्वितीयः पादः ॥ ४ ॥  <i>svapnasthāno'ntaḥ prajñāḥ saptāṅga</i>  <i>ekonaviṁśatimukhaḥ</i>  <i>praviviktabhuktaijaso dvitīyaḥ pādah ॥</i>  4॥</p> <p>(<i>Māṇḍūkya upaniṣat</i>)  (Gambhirananda, 1979)</p>	<p><i>Taijasa</i> is the second quarter, whose sphere is the dream state, whose consciousness is internal, who is possessed of seven limbs and nineteen mouths, and who enjoys subtle objects.</p>	<p><b>Interpretation 2:</b> <i>Guṇa</i> in the waking state are traits. Because identification is very strong with the body and external objects evoking <i>saṁskāra</i> are relatively stable. Hence <i>guṇa</i> manifested is relatively stable and thus a trait quality.  <i>Guṇa</i> in the dream state is a state quality. In the dream, the identification with a stable entity is absent (like the body), the whole creation is propelled by <i>saṁskāras</i> &amp; <i>vāsanās</i>. Hence it is state.</p>

3) Influence of freewill in expression of <i>guṇas</i> .		
<p>तद्विवेकाद्विविक्ताः स्युः कोषाः प्राणमनोधियः । ते हि तत्र गुणावस्थाभेदमात्रात्पृथक्कृताः ॥ ४० ॥ <i>tadvivekādviviktāḥ syuḥ koṣāḥ</i> <i>prāṇamanodhiyaḥ</i> । <i>te hi tatra</i> <i>guṇāvasthābhedamātrātpṛthakkr̥tāḥ</i> ॥ 40॥  (<i>Pañcadaśī</i>: Ch: 1. Verse: 40) (Swahananda, 1967) अक्शेष्वर्थापितेष्वेतद्गुणदोषविचारकम् । सत्त्वं रजस्तमश्चास्य गुणा विक्रियते हि तैः ॥ ९ ॥ <i>akṣeṣvārthāpitesvvetadguṇadoṣavicāra-</i> <i>ka-</i> । <i>satvaṁ rajastamaścāsya guṇā vikriyate</i> <i>hi taiḥ</i> ॥ 9॥  (<i>Pañcadaśī</i>: Ch: 2. Verse: 13)</p>	<p>The five sheaths are conditions of the three <i>guṇas</i>. <i>Prāṇamaya kośa</i> is the condition of the <i>rajas</i>, <i>manomaya</i> of <i>satva</i> and <i>rajas</i>, and <i>vijñānamaya</i> of <i>satva</i>.</p> <p>The mind enquires into the merits and defects of objects perceived by the senses. <i>Satva</i>, <i>rajas</i>, and <i>tamas</i> are its three constituents, for through them the mind undergoes various modifications.</p>	<p>Freewill increases as dominance of <i>vijñānamaya kośa</i> increases (Refer Figure1).</p> <p>The mind is considered the agent, by which freewill is executed.</p>
4) Group variation versus individual difference. & 6) Cross cultural variations.		
<p>माधुर्यादिस्वभावानामन्यत्र स्वगुणार्पिणाम् । स्वस्मिंस्तदर्पणापेक्षा नो न चास्तान्यदर्पकम् ॥ १४ ॥ <i>mādhuryādisvabhāvānāmanyatra</i> <i>svaguṇārpiṇām</i> ।</p>	<p>Objects of taste like sweet and bitter, impart their tastes to others, that is their nature, they do not stand in need of their being imparted to</p>	<p><i>Guṇa</i> may have universal manifestation, irrespective of culture. However, manifestation of different <i>guṇa</i> may vary according to the culture and individual</p>

<p><i>svasmiṁstadarpaṇāpekṣā no na cāstānyadarpakam    14  </i> (<i>Pañcadaśī</i>: Ch: 3. Verse: 14)</p>	<p>themselves. Nor are there other things to impart those tastes to themselves.</p>	<p>persons.</p>
<p><b>5) Operational definition.</b></p>		
<p>सत्त्वं रजस्तम इति गुणाः प्रकृतिसम्भवाः । निबध्नन्ति महाबाहो देहे देहिनमव्ययम् ॥ <i>Satvaṁ rajastama iti guṇāḥ prakṛtisambhavāḥ </i> <i>Nibadhnanti mahābāho dehe dehinamavyayam   </i> (<i>Bhagavad Gītā</i>, Ch: 14 Verse: 7)</p>	<p><i>Guṇās</i> are three in number, <i>satva</i> , <i>rajas</i>, and <i>tamas</i>, and these <i>guṇās</i> bind the immortal soul to the body in its embodied state.</p>	<p>This is the classification of <i>guṇas</i> according to the <i>Bhagavad Gītā</i>. Further characterizing features can be added to show the various attributes of these <i>guṇas</i> and thereby formulate an operational definition.</p>

The theoretical framework is proposed as follows

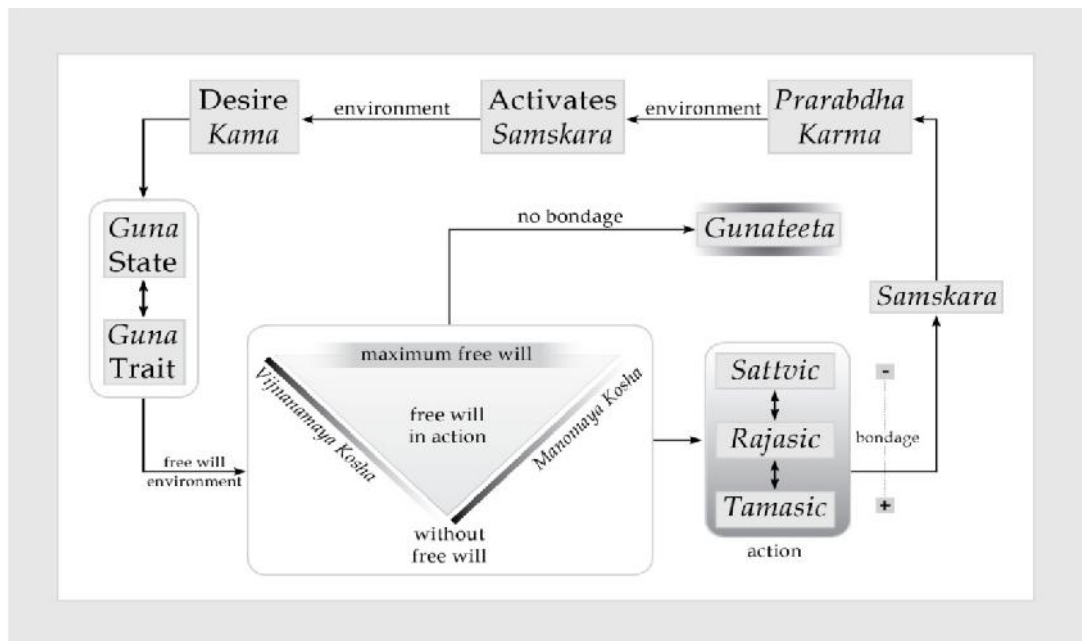


Figure 1: Model of saṁskāra, desire, guṇa, freewill and action

In this model, our *prārabdha karma* activates *saṁskāras* pertinent to the external environment, which in turn evokes desire. The expression of desire happens through *guṇas*, which are considered as a flux of both state and trait characteristics. This leads to *satvic*, *rajasic* or *tamasic* actions. However between the action and the thought of that action, there is a special element of freewill. The use of freewill is maximized as the dominance of *vijñānamaya kośa* is greater, and as more and more *manomaya kośa* takes over, the degree of freewill also diminishes in ordinary persons, because the actions are choicelessly executed out of emotional compulsion. A person who is established in his inner Self, uses his freewill with utmost ease and his actions does not bind him; this state is called *guṇātīta*. Other's action which is expressed through *sattvic*, *rajasic* or *tamasic* means cause further bondage and leads to accumulation of further *saṁskāras*, and thus the cycle continues.

## 2.7 IAT FROM THE PERSPECTIVE OF ANCIENT LORE

In this section, we analyse, what IAT measures from the perspectives of classical text. In an IAT procedure, generally a pair of target words are shown and their associated memory is invoked. Similarly, a series of attribute words of positive or negative valence are shown, and their association of these target and attribute category is measured. If we analyse from the scriptural point of view, certain *vṛttis* are created by showing some stimuli and association of two categories of *vṛttis* are measured.

*Vṛttis* are mental happenings. According to *Vedānta* (one of the six schools of philosophy), when an object of the senses comes in contact with the sense organs,

the mind assumes the shape of *that* object; and when that new modification of the mind is illumined by the *Brahman* as *cidābhāsa*, the cognition happens. This process of mental modification is called *vṛtti*.

प्रमाणविपर्ययविकल्पनिद्रास्मृतयः ॥ ६ ॥

प्रत्यक्षानुमानागमाः प्रमाणानि ॥ ७ ॥

अनुभूतविषयासम्प्रमोषः स्मृतिः ॥ ११ ॥

*Pramāṇaviparyayavikalpanidrāsmṛtayaḥ* ॥ 6 ॥

*Pratyakṣānumānāgamāḥ pramāṇāni* ॥ 7 ॥

*Anubhūtaviṣayasampramoṣaḥ smṛtiḥ* ॥ 11 ॥

*Vrittis* are five in number, they are right knowledge, wrong knowledge, fancy, sleep, and memory. Right knowledge (are based on) direct cognition, inference or testimony. Memory is not allowing an object which has been experienced to escape.

(*Pātañjala Yoga Sūtra*)

According to *Patañjalī* (Taimni, 2010) *vṛttis* are of five kinds, *pramāṇa* (right knowledge), *viparyaya* (wrong knowledge), *vikalpa* (fancy imagination), *nidrā* (deep sleep), and *smṛti* (memory). In IAT, *pramāṇa*, *viparyaya*, and *smṛti vṛttis* are involved. Both *pramāṇa* and *viparyaya* are invoked upon direct contact with external objects, like showing stimuli to the subject, however, *pramāṇa* causes right knowledge and *viparyaya* causes wrong knowledge. For *smṛti* direct contact with external objects is not necessary, rather the *vṛtti* is projected based on previous impressions formed due to earlier experiences *in attachment*. When a stimulus is

shown, the *vṛttis* formed in response, including its strength, depends on the earlier stored experience related to that shown stimulus. The strength of association measured in IAT is the relative strength of *vṛttis* of the target and attribute categories. If, upon showing a stimulus, the corresponding *vṛtti* formed is of greater strength, then it would facilitate the subject to respond faster. Similar too is the rationale behind IAT procedures. The implicit-explicit congruence i.e., the correlation between IAT and questionnaire, reflects cognitive dissonance. If we report something explicitly, it must correspond to what we think implicitly, assuming the explicit report as the reference of the truth. However, quite often we observe disparity between implicit and explicit measures, suggesting cognitive dissonance (what I think and what I say may not be matching). This implicit-explicit incongruence can be attributed to *prajñāparādhā* (Acharya, 1994), a concept of ayurveda, which says when discriminating faculty, courage, and memory is weak, the action done in their absence is called *prajñāparādhā*. In other words, it is an estimation of cognitive dissonance.

**Table 3: Summary table of literary review**

<b>Text Reference (no. of verses)</b>	<b>Description</b>	<b>Contribution to theoretical model/ experiment</b>
<i>Bhagavadgītā</i> (17)	Characteristic features of <i>triguṇa</i> , manifestation of <i>triguṇa</i> in behaviour.	Operational definition
<i>Caraka Saṁhitā</i> (6)	The concept of <i>prajñāparādhā</i> and its components were discussed	Understanding of concept implicit-explicit incongruence in the IAT
<i>Māṇḍūkya Upaniṣad</i> (2)	Concept of identification in wakeful and dream state	In understanding state and trait characteristics of <i>guṇas</i>
<i>Pañcadaśī</i> (3)	Concept of <i>triguṇa</i> , influence of freewill	Role of freewill in action, role of <i>vijñānamaya</i> ,

		<i>manomaya kośa</i>
<i>Pātañjala Yoga Sūtra</i> (3)	Various kinds of <i>vṛtti</i> involved in the process of IAT testing	Understanding of concept of the IAT
<i>Sāṅkhya Kārikā</i> (3)	Creation of the universe from the equilibrated <i>prakṛti</i> . Mutual interaction of the three <i>guṇas</i>	Understanding of <i>triguṇa</i> , and their mutual interaction
<i>Tattvabodhaḥ</i> (15)	Verses to elucidate the process of creation of inanimate objects and also the process of quintuplication ( <i>pañcikaraṇam</i> )	Understanding of <i>triguṇa</i> in creation, animate and inanimate
<i>Vivekacūḍāmaṇi</i> (12)	Concept of <i>āvaraṇaśakti</i> and <i>vikkṣepaśakti</i> . Concept of pure <i>satva</i> and mixed <i>satva</i> and their distinguishing feature	-

## 2.8 CONCLUSION

Relevant scriptures were reviewed to understand the concept of *guṇas*. Theoretical framework for *guṇas* and basis of implicit association tests have been discussed.

**CHAPTER – 3.0**

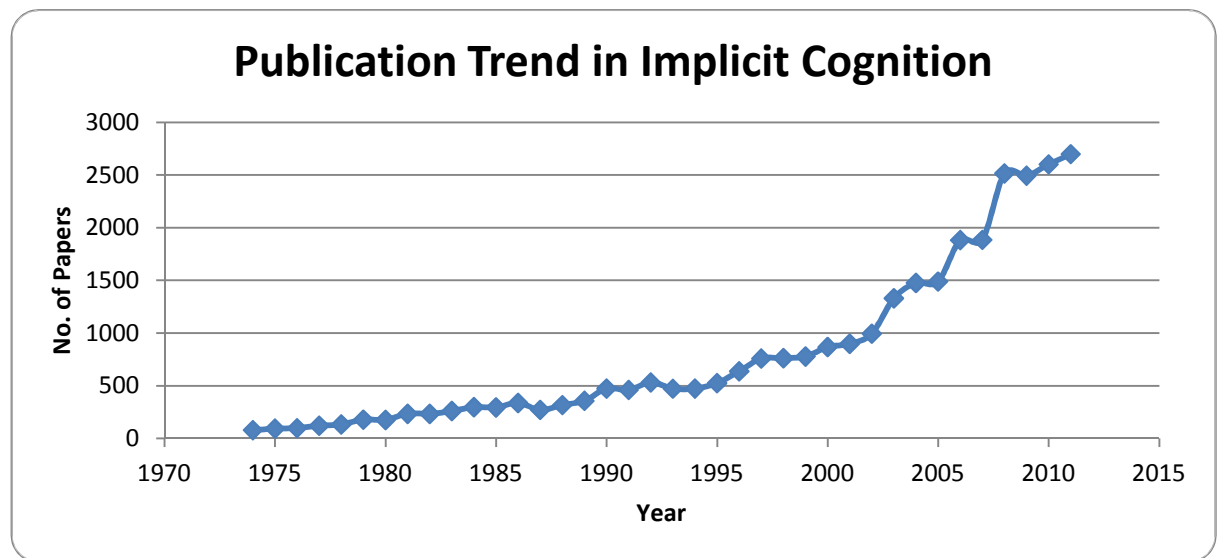
**REVIEW OF THE  
SCIENTIFIC LITERATURE**

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### 3.0 REVIEW OF SCIENTIFIC LITERATURE

Implicit measure is a tool used in the field of psychology to assess implicit processes. Recent times have seen a great upsurge in the use of this tool, as can be seen in the figure below, showing the number of publications in the last few years for a search using the keyword "implicit cognition".

**Figure 1: Publication trend in the field of Implicit Cognition**



Source: sciencedirect.com

Implicit measures have been surprisingly atheoretical, largely a methodological, and empirically driven enterprise (Fazio & Olson, 2003). The review of literature is structured into sections as follows:

- Background: The Implicit Association Test (IAT)
- Types of IATs
- Validity of IAT
- Scoring and interpretations
- Models of IATs
- Factors influencing Implicit-Explicit relation

- Applications of IAT in personality research
- Influencing role of Social Desirability

### **3.1 BACKGROUND**

#### **The Implicit Association Test (IAT)**

The Implicit Association Test was developed by Greenwald and his colleagues (Greenwald, McGhee, & Schwartz, 1998). The test was developed to capture implicit processes.

#### **What is an Implicit Association Test (IAT)?**

IAT is a computer based reaction time task to assess a person's implicit preferences, self-concept and attitudes. The Implicit Association Test (IAT) is defined as a test, which measures the extent to which two target concepts (e.g. I/Me) are associated in memory with positive and negative evaluative attributes, thereby giving an estimate of implicit attitudes (Karpinski & Hilton, 2001). IATs are a family of tests which are basically reaction time tasks, in which a subject is required to classify presented stimuli into four categories, two representing a target discrimination such as flowers versus insects, and two representing an attribute discrimination such as pleasant versus unpleasant valence. Subjects are asked to respond as quickly as possible with a right-hand key press to items representing one concept and one attribute (e.g., insects and pleasant), and with a left-hand key press to items from the remaining two categories (e.g., flowers and unpleasant). Subjects then perform a second task in which the key assignments for one of the pairs is interchanged (such that flowers and pleasant share a response, likewise insects and unpleasant). IAT measures are derived from latencies of responses to these two tasks. These measures are interpreted as association strengths because subjects respond more rapidly when the concept and attribute mapped onto the same response

are strongly associated (e.g., flowers and pleasant) than when they are weakly associated (e.g., insects and pleasant).

The experiment is divided into seven blocks. The first block is practice of attribute (pleasant and unpleasant); the second block is practice of target (flowers and insects). The third block is a practice block with a combination of both attribute and target. The fourth block is similar to the third block, except that it is a test block. The fifth block is a practice block of target with reversed key assignment i.e., the keys which were used in block two to denote target are reversed. The sixth block is a combined practice block with reversed target keys, and the seventh block is the final test block similar to the sixth block. In the above sequence of blocks, the first combined block is called a ‘congruent trial block’, if the target and attribute are in general strongly associated, but is called an ‘incongruent trial block’, if they are not strongly associated (Project Implicit, 2008).

### **3.2 TYPES OF IATS**

There are various types of IATs, differing slightly in their structure and construction. Each is found to be advantageous in a particular context. Some of these are briefly highlighted below.

#### **The standard IAT:**

The standard version of IAT requires subjects to classify stimuli into four categories, two targets and two attributes. Details were explained in the background section. They are called bipolar IATs as there are pairs of opposite concepts for both target and attribute (Gawronski & Payne, 2010).

#### **Single Category/Target IAT:**

This is a slight modification of standard IAT. In this three categories are used in both the stimulus set and the task instructions. There are again two variations in

this, i.e. Single Category IAT (SC-IAT) and Single Target IAT (ST-IAT). This version of the IAT eliminates the need for the second contrast category. In the standard IAT we can only measure relative association and not absolute association between target and attribute. ST-IAT (Siebler, et al., 2010) has a target concept share a response key with positive evaluation in one block, but with negative evaluation in the other. In SC-IAT, there is a change in response key assignment between blocks for one of the categories, giving it its own advantages over standard IAT.

### **Personalized IAT:**

The personalized IATs are an important variant. This version of IAT can successfully handle extrapersonal associations or knowledge. Extrapersonal influence refers to factors other than a person's internal factors like cultural knowledge, etc. Two modifications made in this type of IAT are: a) changing the attribute label, b) removing the error feedback. Its authors say this promotes *evaluation* over mere *categorization*. Personalizing an IAT has been shown to increase explicit evaluation of target categories (Nosek & Hansen, 2008).

### **OTHER METHODS TO ASSESS IMPLICIT COGNITION**

There are some other methods to evaluate implicit processes. How word fragments are completed has been used as a method of assessing implicit processes (Gilbert & Hixon, 1991). A number of researchers have employed some variant of a word-fragment completion task as an implicit measure of self-esteem (Hetts, Sakuma, & Pelham, 1999), racial prejudice (Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Son Hing, Li, & Zanna, 2002), or stereotypes (Sinclair & Kunda, 1999). The tendency of people to prefer the letters that appear in their own names, especially their initials, the name-letter preference effect has been employed as an implicit measure of self-esteem (Jones, Pelham, Mirenberg, & Hetts, 2001; Koole,

Dijksterhuis, & van Knippenberg, 2001; Pelham, Mirenberg, & Jones, 2002). An affective variant of the spatial Simon task as an implicit measure of attitudes was also developed (De Houwer & Eelen, 1998). Finally, Nosek & Banaji (2001) have introduced the Go/No-Go Association Task (GNAT), a variant of the IAT that does not require the use of a contrast category (Nosek & Banaji, 2001).

Most of these tools have this common theme, i.e., estimate of the construct of interest without having to directly ask the participant for a verbal report. Their major appeal is that these indirect estimates are likely to be free of social desirability concerns (Gawronski & Payne, 2010).

### **3.3 VALIDITY OF IAT**

Determining the validity of a tool means checking and ascertaining whether the tool measures what it is meant to. IAT has gained a huge attention in this regard mostly from various criticisms, especially in its earlier phases of development (Greenwald, 1998). This has contributed to refinement of empirical and theoretical understanding of it. More than 50 papers were published addressing these issues. Some aspects of validity investigated were predictive validity, construct validity, internal validity, and statistical conclusion validity; methodological issues discussed include familiarity, order of combined tasks, previous experience with IAT, assignment of categories to right or left key, handedness, fakeability, stimulus item selection, and statistical procedures to derive IAT effects and D scores.

#### **3.3.1 CONSTRUCT VALIDITY**

Construct validity in the IAT checks if it properly assesses variations in association strength relevant to a particular domain. De Houwer et al., (2009) indicated two normative criteria for an ideal measure: It should be clear (a) which attributes causally produce the measurement outcome and (b) how they do so.

Extensively quoting Borsboom et al. (2004; 2006), the same authors emphasized that the correlational approach of establishing construct validity might be weaker, and the experimental approach should be promoted, in which the attribute causing the measuring outcome is systematically manipulated. They also suggested that, any validation procedure presuming a construct's existence should be questioned. In spite of its dominance in the literature the correlational approach has serious limitations – third variable problems and others. Borsboom et al. (2004) also distinguished between validity and overall quality. A measure can be valid, but its overall quality may suffer, and vice-versa.

The majority of IAT studies have used the correlational approach to construct validity, which uses correlations with similar or related tools to establish convergent validity. In contradistinction to this, divergent validity seeks negative correlations with measuring tools conceptually opposite to the construct under consideration.

In a study of 2556 participants conducted over the internet prior to Germany's 2002 parliamentary elections, Bluemke and Friese (2008) used a Single-Target IAT to assess strength of association with multiple attitude objects, also studying their validity and reliability. The correlational approach was adopted to evaluate both discriminant and convergent validities. Construct validity was studied for conceptually closely related targets: attitude towards political parties in Germany. A mean implicit-explicit correlation of  $r = .39$  was obtained; reliabilities were also slightly higher than in previous studies.

Other methods employed for construct validation are multitrait-multimethod and confirmatory factor analyses. In the Multitrait-Multimethod (MTMM) procedure

(Campbell & Fiske, 1959) convergent validity is demonstrated when measures of a given trait correlate highly across measurement methods, and discriminant validity is shown when correlations between apparently different traits are low. The authors suggest that this procedure can be used to study method-specific variance. Nosek and Smyth (2007) employed the MTMM procedure of validation of IAT in their study. Another method is confirmatory factor analysis, which can separate method specific variances from the trait specific variances.

### **3.3.2 PREDICTIVE VALIDITY**

In a major review and meta-analysis of 99 published articles and 23 unpublished reports, Greenwald et al. (2009) demonstrated predictive validity across nine different domains: consumer preferences (40), Black–White interracial behaviour (32), personality differences (24), clinical phenomena (19), alcohol and drug use (16), non-racial intergroup behaviour (15), gender and sexual orientation (15), close relationships (12), and political preferences (11), a total of 184 research studies in 122 research documents. The main question was, “Does IAT successfully predict social behaviour and judgment?”

The four major findings were:

1. In all nine domains, IATs predicted social behaviour and judgment.
2. Both implicit and explicit measures independently predicted behaviour. This suggests incremental validity of the IATs.
3. Implicit-explicit correlations were highest in the domains, consumer and political preference.
4. In socially sensitive domains (e.g. racial), implicit-explicit correlations were weak; implicit measures predicted behaviour better than explicit measures.

These findings indicate the utility of IATs in real world research to study social cognition; i.e. of immense value in assessing socially sensitive constructs, where social desirability can obscure a person's actual tendency (Greenwald et al., 2009)

### **3.3.3 INTERNAL VALIDITY**

Internal validity addresses the possibility of IAT procedures generating effects due to variables other than category variations.

#### **FAMILIARITY**

Familiarity was found not to be a substantial source of artifact, so long as stimuli used to represent an IAT category were not entirely unfamiliar, such as nonsense strings (Brendl, Markman, & Messner, 2001).

#### **ORDER OF COMBINED TASKS**

The first IAT publication (Greenwald et al., 1998) observed that, other things being equal, strengths of associations used in the first of the IAT's two combined tasks appeared to be stronger than those used in the second. This finding was subsequently observed in numerous other studies using the procedure of counterbalancing order of presentation of the two combined tasks. Nosek, Greenwald, & Banaji (2005) showed the possibility of reducing this order effect by increasing the amount of practice on the 5th of the 7 blocks of the standard IAT procedure (section 3.1) .

#### **PREVIOUS EXPERIENCE WITH THE IAT**

Greenwald, Nosek, & Banaji (2003) reported that magnitude of IAT effects was slightly reduced for subjects with prior IAT experience. No interpretation of this has yet been offered.

## **INTER-TRIAL INTERVAL DURATION**

Greenwald et al. (1998, Experiment 1) reported that interval between successive IAT trials, in the range 100 – 700 ms has virtually no influence on effect magnitudes.

## **ASSIGNMENT OF CATEGORIES TO RIGHT OR LEFT KEY**

Some have opined that the pleasant category assigned to the left or the right side, would influence the measured association strengths. Greenwald et al. (1998) have found no effect of assigning pleasant and unpleasant categories to the right or left side.

## **HANDEDNESS**

Greenwald & Nosek (2001) reported no effects on IAT scores of subject self-reported handedness in a large web-based data collection.

## **SYSTEMATIC METHOD VARIANCE AND TASK-SWITCHING**

This category includes roles of task-switching, cognitive fluency, and age on IAT measures. Cognitive fluency and age are both associated with general slowing of response, which tends to increase latency difference effects (and therefore IAT measures). Effects of cognitive fluency and age on IAT measures are handled to a large extent using the IAT's improved scoring algorithm for the IAT (Greenwald, Nosek, & Banaji, 2003). Task switching is a concept according to which when a new trial is presented with a different mapping of target and attribute categories there is a change in response criteria, and this influences the IAT effect. The association strengths measured by the IAT reduce task-switching costs when associated categories share a response. It is considered that task switching costs may be integral

to what is measured by the IAT, rather than being an artifactual contributor to IAT effects.

### **FAKEABILITY**

Several studies have examined effects of asking subjects to fake their IAT performance. Findings reveal that it is difficult to fake IAT performance, although modest effects of faking have been observed in some studies. Clearly, the best strategy for faking is to respond slowly in the easier of the two combined tasks (Steffens, 2004).

### **STIMULUS ITEM (EXEMPLAR) SELECTION**

It is possible to influence IAT measures by selecting stimuli in a manner that it contradicts the expected valence of the category labels. Govan and Williams (2004) showed that category exemplars of flowers and insects could be varied by identifying liked insects (e.g., butterfly, firefly, grasshopper) and disliked flowers (some of which were not exactly flowers - e.g., poison ivy, nettles, weed). Hence it is very essential to select stimuli which uniformly match with each other with respect to valence mapping with the category labels. De Houwer (2001) showed that the IAT tolerated variance in an irrelevant attribute (valence) that was allowed to vary when subjects were asked to classify names as British (e.g., Princess Diana, the Queen Mother, and two mass murderers) and foreign (e.g., Einstein, Gandhi, Hitler, and Saddam Hussein).

### **3.3.4 STATISTICAL CONCLUSION VALIDITY**

Major questions asked in establishing statistical validity concern the numbers of IAT measures being interpreted: Is this being done appropriately? One was whether the zero point and units of IAT measures are meaningful. Another: the

meaningfulness of an IAT measure's zero point. It is showed that these issues bear little relation to construct validity and internal validity (Greenwald, Rudman, Nosek, & Zayas, 2006).

### 3.4 SCORING OF IAT

IAT psychometrics have witnessed great streamlining. The latest algorithm provided by the authors Greenwald et al. (2003) is now widely used in all studies. A summary of steps is as follows (Lane, 2007):

1. Delete trials greater than 1,000 msec.
2. Delete subjects for whom more than 10% of trials have latency less than 300 msec.
3. Compute the “inclusive” standard deviation for all trials in Stages 3 and 7; likewise for all trials in Stages 4 and 7.
4. Compute the mean latency for responses for each of Stages 3, 4, and 7.
5. Compute the two mean differences ( $\text{Mean}_{\text{Stage 7}} - \text{Mean}_{\text{Stage 3}}$ ) and ( $\text{Mean}_{\text{Stage 7}} - \text{Mean}_{\text{Stage 4}}$ ).
6. Divide each difference score by its associated “inclusive” standard deviation.
7.  $D$  = the equal-weight average of the two resulting ratios.

This reduces the score to a ‘ $D$  value’. Since mean differences are divided by standard deviations, it is very much like Cohen’s  $d$  value. Hence the IAT  $D$  is also a measure of effect size. However, a minor point of difference is that in calculating the IAT  $D$  score, inclusive standard deviation is used; that means standard deviations of both practice and test trial blocks are used. To distinguish it in the literature,  $D$  is thus represented in both italics and capital.

## **Understanding and Interpreting IAT Results**

Scientists in the field of IAT prohibit the use of IAT scores to derive conclusions about ourselves and others, since the literature is evolving and many conceptual and methodological issues remain to be resolved. Though the literature is surging, they suggest the field is still in its infancy. Therefore to use the tool as a standalone for clinical assessment or personnel selection may not be appropriate (Project Implicit, 2008) However, it can be used to bring awareness about one's own and others' likely automatic preferences and stereotypes.

### **3.5 MODELS OF IAT PROCESSING**

A few available models explain the processing of IAT. The MODE model is one of a class of dual process models. MODE is an acronym for Motivation and Opportunity as Determinants of whether attitude-to-behaviour processes are primarily spontaneous or deliberative in nature (Fazio & Olson, 2003). Attitudes exert influences through relatively spontaneous or more deliberative processes. Given the effortful reflection required for deliberative processing, some motivating force is necessary to induce individuals to engage in it. Time and resources to deliberate—what the model refers to as opportunity—also must exist. Many processes in implicit cognition are not process pure, i.e., both spontaneous and deliberate components can co-exist. This “mixed” process suggests that both motivation to engage in the necessary cognitive task, and opportunities should be available to do so (Gawronski & Payne, 2010).

Dual process theories, generally divide social cognitive processes into effortless, automatic processes, versus effortful, controlled processes. Smith and DeCoster's review article (2000) reconceptualised this approach, showing that it can be used to evaluate general sets of processes underlying a many phenomena.

Strack and Deutsch (2004) proposed their 'reflective-impulsive' model, distinguishing associative from propositional processes. Associative processes need activation of associations in memory, guided by principles of similarity and spatiotemporal contiguity. Propositional processes involve information activated by associations, which depends on syllogistic principles of logical consistency. The difference between these two kinds of process lies in the role of subjective truth or accuracy. Activation of associations is assumed to occur independently of whether such associations are considered accurate or inaccurate; propositional processes are inherently concerned with validation of activated information. Direct self-report measures assess subjective validity of propositional statements about some state of affairs (e.g., "How much do you agree with the statement . . ."), whereas indirect measures assess activation i.e. momentary accessibility of associations, independent of whether they are considered accurate or inaccurate (Gawronski & Payne, 2010).

**Process Dissociation Model (PD):**

This model was originally developed to separate implicit and explicit memory processes. In 2001, Payne used it in priming tasks with social cognition where automatic processes are thought to drive behaviour only when control over behaviour fails (Jacoby, 1991). In contrast, Lindsay and Jacoby (1994) suggest that automatic processes are dominant, and that controlled processes only drive behaviour in their absence.

Another model is the Quad model (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005). Whereas PD variants assume that either controlled or automatic processing is dominant whenever they conflict, the Quad model assumes that either kind of process can be dominant. The Quad model adds a third parameter that reflects whether automatic or controlled processes "win" when they are in

conflict and a fourth parameter for guessing biases. These models are all multinomial models, which describe a variety of unobserved processes as probabilities. Multinomial models are weaker towards temporal order, as they do not differentiate between processes that occur relatively early or late. However, Klauer, Voss, Schmitz, and Teige Mociemba (2007) proposed a diffusion model that incorporates both accuracy (as with multinomial models) and also reaction times.

Indirect measures sometimes reflect controlled processes. When a person is tired, distracted, or rushed, their responses are more likely to be based on automatic impulses than when they are energetic, focused, and unhurried (Strack & Deutsch, 2004).

### **Neuroscience of Implicit Social cognition:**

Some of the brain areas involved in implicit social cognition are: Amygdala – sensitive to explicit and implicit evaluative processes; Anterior cingulate cortex – reflects greater response conflict; prefrontal cortex – shows greater activity in situations requiring behavioural control; temporoparietal attention networks – reflect sensitivity of implicit and explicit categorization processes and greater attention to negative and social stimuli (Gawronski & Payne, 2010). Vanman et al. (1997) used facial electromyography (EMG) as a method of evaluating implicit social cognition, when examining racial prejudice. Phelps et al. (2000) and Hart et al. (2000) both examined amygdala activation as an indicator of racial evaluation using functional magnetic resonance imaging (fMRI). Eyeblick startle response to black versus white faces has also been utilized in this way (Phelps et al. 2000, Amodio et al. 2002). Cardiovascular reactivity indicating challenge versus threat have been employed to examine responses to interaction with blacks and other stigmatized individuals (Blascovich et al. 2001). In addition, Cacioppo et al. (1993) employed event-related

brain potentials as an on-line measure of categorization of stimuli as positive or negative (Ito & Cacioppo 2000).

### **3.6 MODERATORS OF IMPLICIT-EXPLICIT CORRELATION**

In an important article, Nosek (2005) identified four moderators mediating relationships between implicit and explicit evaluation: self-presentation, evaluative strength, dimensionality, and distinctiveness. To the already known self-presentation and evaluative strength (Karpinski, Steinman, & Hilton, 2005; Schuette & Fazio, 1995), he added two more: dimensionality (extent to which target objects conform to a simple, bipolar structure) and distinctiveness (extent to which one's evaluation is perceived to differ from cultural norms).

#### **Self-Presentation**

Self-presentation is defined as the tendency to alter a response for personal or social purposes (Nosek, 2005). According to Greenwald and Banaji (1995) implicit preferences are ones that participants are unwilling or unable to report. Self-presentation can be socially deceptive or genuine. Implicit measures may withstand faking, whereas explicit measures do not (Kim, 2003). Higher implicit–explicit congruence is thus expected when self-presentation factors are weak, while lower congruence is expected when self-presentation factors are strong.

#### **Evaluative Strength**

Distinguishing features of strong evaluations are: persistence, resistance to change, facilitation of information processing, and strongly predictive behaviour. Strong evaluations are more stable and consequential than weak ones. Various features of strength are importance, elaboration, knowledge or familiarity, frequency of thought, stability, extremity, and ambivalence. Evaluations that are personally important, highly familiar, frequently thought about, stable, extreme, and

unambivalent are thought to evoke higher implicit-explicit congruence than those that are unimportant, unfamiliar, infrequently thought about, unstable, insignificant, or ambivalent (Krosnick, Boninger, Chuang, Berent, & Carnot, 1993).

### **Dimensionality**

Bipolar structure is suspected to have cognitive benefits and easier automatic evaluation. Certain evaluations may be considered to have bipolar continuums, i.e. with opposite polarity like good-bad; vegetarian-non-vegetarian, etc. Unipolar constructs give less reliable attitudes, or are more malleable to situational influences owing to poor mental representation (Nosek, 2005).

### **Distinctiveness**

Distinctiveness is defined as the magnitude of the discrepancy between one's own evaluations and perceived norms. Higher values indicate greater perceived discrepancy from the norm, suggesting a perception that others feel differently (Nosek, 2005). High I-E correspondence suggests that introspection is similar to an indirectly revealed association between the objects and evaluations.

Accurately reporting an evaluation depends on two things: knowing one's feelings, and knowing how to accurately characterize one's feelings on a scale. Self-report ratings accurately reflect internal experience, rather than response biases or random errors, only when one can accurately report one's feelings. Implicit-explicit relationship would increase as this efficiency in accurate self-report increases.

To study multiple moderators simultaneously, multilevel modelling procedures are used (Nosek, 2005). This rigorous statistical approach gives greater freedom of analysis and interpretation.

### 3.7 PERSONALITY STUDIES USING IAT

Schmukle, Back, and Egloff (2008) used Implicit Association Tests to validate the Big Five Personality constructs. Their two studies ( $N=106$ , and  $N=92$ ), used confirmatory factor analyses to validate the five factor model. Internal consistencies for IAT measures were satisfactory. Correlations with explicit measures were small, achieving statistical significance only for Extroversion and Conscientiousness. However, they confirmed that the patterns of means and factor inter-correlations were similar for implicit and explicit personality measures. In their study, the five IATs used had the following pairs of category labels: extroversion vs. introversion, anxiety vs. calmness, agreeableness vs. disagreeableness, conscientiousness vs. carelessness, and openness vs. narrow-mindedness. From this study, they suggest that Implicit measures of the Big Five construct constitute a partially valid tool.

In another similar study ( $N=84$ ), Grumm, and Collani (2007) examined the use of the implicit association test for implicit evaluation of the Five-Factor model of personality. For explicit evaluation, NEO-FFI30 was used. They used factor analyses for establishing validity and found that the implicit IATs had satisfactory validity and acceptable internal consistencies. In the same paper, they also reported their study of overlap of the personality-IATs with implicit self-esteem. Extroversion and Neuroticism-IAT correlated moderately with self-esteem-IAT.

IATs are also used in other domains of personality research. In a study ( $N= 139$ ), Asendorpf, Banse, and Mucke (2002), showed that shyness (a self-concept of personality) could be implicitly assessed and unique variances could be explained controlling for the influence of social desirability. The IAT correlated moderately with explicit self-ratings, uniquely predicting spontaneous (but not controlled) shy

behaviour. Explicit ratings on the other hand uniquely predicted controlled (but not spontaneous) shy behaviour. This the authors call 'double dissociation'.

Another very interesting study made a crucial link between implicit measures and genetic influences. Certain relationships were shown between self-reported personality traits and specific variations in genes influencing serotonergic and dopaminergic pathways. This study on 96 women set out to identify potential genetic effects on personality-related associations measured by the IAT. They found that the 5-HTTLPR was linked to the anxiety IAT, whereas the DAT 3'-VNTR was associated with performance in the agentic-extraversion IAT. These findings pave the way for new areas of exploration at the interface of biological science and psychology. It is a good example of the versatility of the IAT tool for research (Osinsky et al., 2010).

Table 4, summarizes some of the most important IAT studies of personality. Most such personality studies have low implicit-explicit correlation. Hence similar results may also be expected for *Guṇa*-IAT, as was found to be the case.

**Table 1: Summary of IAT used in personality domain with implicit-explicit correlation**

Sno.	Citation	N	N crit	ICC	N IAT	IAT Type	ECC	N expl	Expl type	IEC
1	Asendorpf et al. (2003)	138	3	0.274	1	Self	0.27	3	Self	0.44
2	Banse (2007)	132	1	0.37	1	Attitude	0.48	1	Attitude	0.49
3	Banse & Fischer (2002)	94	1	0.219	2	Self	-0.17	1	Self	0.17
4	Bosson et al. (2000)	83	7	0.171	1	Self	0.397	4	Self	0.22
5	Brunstein & Schmitt (2004)	44	1	0.498	1	Self	-0.17	1	Self	-0.108
6	Brunstein & Schmitt (2004)	44	1	-0.009	1	Self	-0.079	1	Self	-0.028
7	Conner & Barrett (2007)	124	29	0.102	1	Self	0.277	1	Self	0.23
8	Conner & Barrett (2007)	84	13	0.087	1	Self	0.32	1	Self	0.001
9	Levesque & Brown (2004)	79	1	0.14	1	Self	0.44	1	Self	0.19
10	Levesque & Brown (2004)	78	2	0.07	1	Self	0.27	1	Self	-0.02
11	Martens et al. (2007)	37	1	0.47	1	Self	0.12	1	Attitude	-0.12
12	Nosek et al. (2002b)	227	1	0.38	1	Attitude	0.49	1	Attitude	0.42
13	Ronay & Kim (2007)	127	2	0.204	2	Belief	0.134	3	Belief	0.09
14	Steffens & Konig (2007)	89	7	0.192	7	Self	0.11	7	Self	0.091
15	Vargas et al. (2004)	227	1	0.17	1	Self	0.787	3	Multiple	0.12
16	Verplanken et al. (2007)	127	2	0.201	1	Self	0.441	1	Self	0.077

**Note:** Footnotes on next page

Footnotes of table 4:

N= Sample size; ICC = IAT- criterion average effect size (r) for sample; N IAT = number of distinct Implicit Association Test (IAT) measures in independent sample; IAT type = classification of IAT measures as attitude, belief, self-concept or self-esteem (“self”); ECC = self-report- criterion average effect size (r) for sample; N expl = number of distinct self-report (explicit) measures in independent sample; expl type = same as for IAT type is applied to self-report (explicit) measures; IEC = IAT– explicit correlation average effect size (r) for sample (Greenwald et al., 2009).

The structure of the IAT followed in our study was similar to that of Bluemke and Friese (2008), multiple single target IAT. Our study also had three concepts instead of five. Further the order of stimulus category was kept constant just changing the individual stimulus for each subject, in order to take care of task switching variance across subjects (Matthias Blümke, personal communication, March 20, 2012).

### **3.8 INFLUENCING ROLE OF SOCIAL DESIRABILITY**

While an earlier study showed that social desirability had only little influence on the higher order personality factor structures (Ellingson, Smith & Sackett), it is worth investigating situations under which social desirability obtains more prominence. In personality psychology research, social desirability scales are usually administered to see if both these measures correlate well. Kam (2013) has shown that while analyzing data to assess possible influences of social desirability in personality assessment, social desirability scale should be used as a continuous variable rather than dichotomizing it. Self-deception scores were found to detect item social desirability better than impression management scores (Paulhus, 1992).

In a meta-analytic study, Ones et al. claimed that social desirability may not be as serious an issue as anticipated earlier. They showed that only two of the Big Five domains, emotional stability and conscientiousness, had positive correlation with social desirability scores. Further social desirability does not act as a predictor, moderator, or suppressor for the criterion for job selection. These meta-analytic findings do not remove the possibility of obscuring true scores in explicit test measures, however. Hence to study individual differences, it would be still appropriate to know various modes of social desirability. Dodaj (2012) has reinforced that there are two ways to be socially desirable: egoistic expression, versus moralistic expression. In our current study, this distinction offers a lot of insights.

### **3.9 CONCLUSION**

Scientific literature related to personality domain using IAT tools was reviewed. It was seen that in general there is low implicit-explicit correlation for personality domains. Design for the current study was also derived from relevant studies by consulting experts in the field.

**CHAPTER – 4.0**  
**AIM AND OBJECTIVES**

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## **4.0 AIM AND OBJECTIVES**

### **4.1 AIM**

To investigate the implicit and explicit expressions of *guṇas* using the Implicit Association Test (IAT) and explicit measures in yoga students.

### **4.2 OBJECTIVES**

#### **Language IAT Study**

- 1) To find influence of language on IAT scores in Indian population.
- 2) To find culture specific determinants of IAT scores.

#### ***Guṇa* -IAT (G-IAT) Study**

- 3) To develop an implicit tool to assess a person's implicit *guṇas*
- 4) To evaluate convergent and discriminant validity of G-IAT
- 5) To evaluate internal consistencies of implicit and explicit measures
- 6) To find out test-retest reliability of G-IAT
- 7) To find out overall implicit-explicit congruence
- 8) To evaluate the influence of social desirability factor

#### **Personalized *Guṇa* - IAT (PG-IAT) Study**

- 9) To find if PG-IAT influences implicit-explicit correlation pattern
- 10) To find if the validity of the G-IAT can be improved by personalizing the G-IAT

#### **Yoga- IAT Study**

- 11) To assess implicit preference of students of yoga courses towards yoga.
- 12) To correlate implicit and explicit measures of preferences towards yoga.
- 13) To extend the application of IAT in yoga research to assess preference towards yoga.

### **4.3 RESEARCH QUESTIONS**

- 1) Can we administer the IAT in English to Indian populations?
- 2) Can we develop an implicit tool to assess *guṇas* and estimate self-presentation bias involved in self-report of *guṇas*?
- 3) Can we develop an implicit tool to assess a person's implicit preference towards yoga?

### **4.4 RESEARCH HYPOTHESES**

H<sub>a</sub>1: Does the administration of IAT in native language favor subjects in Indian populations?

H<sub>a</sub>2: Implicit correlation trend is similar to that of explicit correlation trend, in the three *guṇa* domains.

H<sub>a</sub>3: There would be at least moderate test-retest reliability after 15-days and comparatively lower after 30-days retest.

H<sub>a</sub>4: Social desirability would have significant influence on implicit-explicit congruence.

H<sub>a</sub>5: Yoga-IAT would show moderate Implicit preference towards yoga in a yoga population.

### **4.5 NULL HYPOTHESES**

H<sub>o</sub>1a: There is no difference in IAT D scores across three modes (section 5.3.1, p-23) of IATs.

H<sub>o</sub>1b: There is no difference in IAT mean latencies across three modes of IATs.

H<sub>o</sub>1c: There is no difference in IAT mean error rates across three modes of IATs.

- H<sub>0</sub>2a: Pearson correlation between implicit *satva* and explicit *satva* is zero.
- H<sub>0</sub>2b: Pearson correlation between implicit *rajas* and explicit *rajas* is zero.
- H<sub>0</sub>2c: Pearson correlation between implicit *tamas* and explicit *tamas* is zero.
- H<sub>0</sub>2d: Pearson correlation between explicit *satva* and explicit *rajas* is zero.
- H<sub>0</sub>2e: Pearson correlation between explicit *satva* and explicit *tamas* is zero.
- H<sub>0</sub>2f: Pearson correlation between explicit *rajas* and explicit *tamas* is zero.
- H<sub>0</sub>2g: Pearson correlation between implicit *satva* and implicit *rajas* is zero.
- H<sub>0</sub>2h: Pearson correlation between implicit *satva* and implicit *tamas* is zero.
- H<sub>0</sub>2i: Pearson correlation between implicit *rajas* and implicit *tamas* is zero.
- H<sub>0</sub>3: Test-retest reliabilities after 15 days and 30 days will be equal.
- H<sub>0</sub>4: Pearson correlation between implicit and explicit measures with social desirability scores is zero.
- H<sub>0</sub>5: Pearson correlation between Implicit and explicit measures of attitude towards yoga is zero.

#### **4.6 STUDY RATIONALE**

Explicit evaluation of *guṇas* is done using self-report questionnaires. Threats involved are self-presentation biases. As implicit measures are based on automatic preferences which are less subject to self-presentation biases, implicit evaluation may complement the explicit evaluation. Hence to assess a person's *guṇas* comprehensively we may need both implicit and explicit tools.

#### 4.7 OPERATIONAL DEFINITION

We operationally define the following terms:

**Implicit Satva:** The strength of association as assessed by the *Guna-* Implicit Association Test (G-IAT) using the words, charity, forgive, purity, compassion, and simplicity.

**Implicit Rajas:** The strength of association as assessed by the *Guna-* Implicit Association Test (G-IAT) using the words, pride, passion, ambition, attachment, and anxiety.

**Implicit Tamas:** The strength of association as assessed by the *Guna-* Implicit Association Test (G-IAT) using the words, delay, dull, sleepy, confusion, and lazy.

**Explicit Satva:** Satva score as measured using the Vedic Personality Inventory, VPI.

**Explicit Rajas:** Rajas score as measured using the Vedic Personality Inventory, VPI.

**Explicit Tamas:** Tamas score as measured using the Vedic Personality Inventory, VPI.

## **CHAPTER – 5.0**

# **METHODS**

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## 5.0 METHODS

### 5.1 SUBJECTS:

#### 5.1.1 Language IAT Study

Fifty four bilinguals attending university in southern India, with the following demographic details participated in the study. They were matched for gender, education level (undergraduate or postgraduate), native language (Hindi or Kannada).

**Table 1: Demographic details of subjects**

Age	Mean = 23.33	Range = 18-41 years
Gender	Male = 28	Female = 26
Education	UG = 28	PG = 26
Native language	Hindi = 29	Kannada = 25

#### 5.1.2 *Guṇa*-IAT Study

We had chosen a group of students studying in a Yoga University, in Bangalore. 90 (43 male), mean age 27.9 years. Subjects from undergraduate and postgraduate courses were selected. The inclusion criteria were both gender, normal or corrected to normal vision, healthy volunteers; and exclusion criteria were any chronic ailments and unwilling to participate in the research.

#### 5.1.3 Personalized *Guṇa*-IAT Study

Subjects were from five different batches of one month short term course at the Yoga University. Totally 77 students were assessed (32 males and 27 females), mean age  $30.23 \pm 11.31$ .

### **5.1.4 Yoga-IAT Study**

The study was conducted in a Yoga University, in southern India. It was conducted over a period of seven months (August 2012 to February 2013) and five independent samples were taken. The samples constituted of students of both long and short term yoga courses. The total sample size was 79 (27 males) with mean age  $27.17 \pm 7.14$  (n=48, as the age and explicit preference were not obtained in one of the batches of 21 subjects), and range (18-47 years). We present the results combining data of all the five independent samples.

## **5.2 ETHICAL CONSIDERATIONS**

The Institutional Ethics Committee had reviewed and approved the study (Appendix-1, p.142). Informed consent was presented during briefing session and those who had given their voluntary consents were considered in the studies.

## **5.3 DESIGN:**

### **5.3.1 Language IAT Study**

It is a one-time assessment with matched design (matched for gender, education, and language). The traditional flower-insect IATs were presented to the subjects in three modes, in English, native language, and picture. The order in which the three IATs were presented (six orders for three IATs) was randomized using the lottery method. As the subjects arrived at the lab, they were briefed about the experiment and were asked to choose their random order. All assessments were done in a batch of four to six subjects. Other factors considered, included medium of instruction at school (medium), two levels English, and native language; and frequency of usage of the latter compared to English (frequency), with three levels, more, less and equally frequently.

### 5.3.2 *Guṇa*-IAT Study

One-time assessment of both implicit and explicit measures. Hence it is basically a survey design. The *Guṇa*-Implicit Association Test (G-IAT) was used. The structure of the G-IAT is graphically presented in the appendix 3 (p. 157). There are seven blocks. The first block is the target discrimination, in which words related to the categories Me and Others have to be categorized. There are 20 trials in this block. In all the remaining blocks, there are 70 trials. The second block consists of a combined task in which either Me or Others category will be paired with one of the *guṇas*, i.e., *satva*, *rajas*, or *tamas*. In the next block the same *guṇa* will be paired with the opposite target, i.e., Others or Me. Similarly the six combined blocks are completed. For explicit evaluation, self-rating likert scale, Vedic personality inventory, forgiveness scale, satisfaction with life scale, trait anxiety scale, active procrastination scale, etc. were used, along with general demographic details. All the subject had taken the tests in the same order, i.e., first implicit measure and then explicit measures. For G-IAT, five words were chosen for each *guṇas*. One arbitrary random order was selected and all the subjects were given the same order but with different stimuli. This will help to control the task switching variance across subjects (Matthias Blümke, personal communication, March 20, 2012). The words to be shown were selected by a referee process. A list of words was compiled and sent to four reviewers to rate each word according to their relevance and strength (Appendix 6, p. 181). Rating scores of various reviewers were collected and after careful review, five words for each *guṇas* were selected by considering factors like ease of recognition, familiarity among yoga students, and word length.

For finding test-retest reliability, only G-IAT was administered after a gap of 17 days and 30 days. For this the subjects were either asked to come after 17 days or 30 days according to their choice. Retest assessment was optional and those who desired to come were included for retest study. 38 participated in 17-day retest and 23 after 30-day retest.

### **5.3.3 Personalized *Guṇa*-IAT Study**

The design, the inclusion and exclusion criteria were the same as in the G-IAT study. However, in this study, only a limited number of assessment tools were used as the major object was to extend the validity of the G-IAT.

### **5.3.4 Yoga-IAT Study**

Onetime assessment without a comparison group. It is basically a survey design using correlation approach.

## **5.4 ASSESSMENT TOOLS**

### **5.4.1 Language IAT Study**

Flower-insect IATs, and explicit likert scale rating for reporting explicit preferences.

### **5.4.2 *Guṇa*-IAT Study**

All the tests including questionnaires and demography data sheet were administered through the stimulus presentation software, INQUISIT, version 3.0.

**SC-IAT:** In the family of IATs, the SC-IAT is a test which assesses a single target instead of the two targets usual in bipolar IAT. These too have been employed equally effectively in various studies and have acceptable validity and reliability (Karpinski & Steinman, 2006; Bluemke & Friese, 2008). The choice of words for this test was done based on reviewer's selection. The following were the *satva*

words: serenity, humility, gratitude, contentment, forgive, charity, simplicity, purity, compassion, dispassion, happy, peace, calm, and service. The following were the rajas words: attachment, restless, passion, anxiety, greedy, impatience, jealousy, pride, anger, dynamic, envy, worry, and ambition. The following were the *tamas* words: tired, laziness, confusion, indecision, ignorance, inertia, forget, sleepy, drowsy, dull, delusion, arrogant, depression, careless, and delay.

**Vedic Personality Inventory (VPI):** It was developed by David Wolf (1999). It has 77 items and is used for assessing three *guṇas*, *satva*, *rajas*, and *tamas*. It was developed on a western population. Perhaps this is the only reported questionnaire to assess *guṇas* for which construct validity has been established using, statistically rigorous, factor analysis method. The *satva* subscale (15 items) has an alpha of .93, *rajas* subscale (19 items) had an alpha of .94, and *tamas* subscale (22 items) had an alpha of .94. The inventory is based on a 7-point likert scale. Scores are calculated for each of the sub-domain as well as for all the three domains together.

**Heartland Forgiveness Scale (HFS):** It is an 18-items questionnaire, used to measure a person's tendency to forgive self, others, and situation (Thompson et al., 2005). It is used to correlate with Satva domain of VPI questionnaire. It has three subscales: self-forgiveness, forgiving others and forgiving situations. Each of the subscales of this questionnaire has 6 questions which is answered based on the 7 point likert scale (1 completely disagree to 7 completely agree). Cronbach's Alpha ranges from 0.76 to 0.83.

**Satisfaction With Life Scale (SWLS):** The SWLS is a short 5-item instrument designed to measure global cognitive judgments of satisfaction in a person's life (Diener, Emmons, Larsen, & Griffin, 1987). This is used to see any positive correlation with implicit and explicit *satva*. Alpha was .87 for a sample of 176

undergraduates. It is a 7-point likert scale, with choices ranging from strongly disagree (1) to strongly agree (7), and with score ranging from 5 to 35.

**State and Trait Anxiety Inventory (STAI):** STAI is a well known instrument to assess anxiety (Spielberger, et al., 1983). In this study, only trait anxiety (20 items) was used as IAT is believed to assess strong associations in our cognitive system. This is expected to correlate with rajas of implicit and explicit measures. Alpha for STAI was found to be .89. Average test-retest reliability was .88 (Barnes, Harp, & Jung, 2002).

**Active Procrastination Scale (APS):** This 16 item, 4-point likert scale was used to correlate with *tamas*. It has an alpha of .80 (Choi & Moran, 2009). It has four domains: outcome satisfaction, preference for pressure, Intentional decision, and ability to meet deadlines.

**Feeling Thermometer (FT):** In this the subject will be asked to rate their perception of *guṇa* about themselves. Its three 7 point scales indicate how much they feel *sattvic*, *rajasic* and *tamasic*.

**Marlow-Crowne Social Desirability Scale (M-C SDS):** The M-C SDS (Crowne & Marlowe, 1960) is a 33-item true/false measure that assesses response bias (i.e., the degree to which individuals attempt to present themselves in a favourable light). Scores range from 0 to 33, with higher scores reflecting a greater degree of socially desirable responding. Test scores are high on both internal consistency ( $\alpha = .88$ ) and test-retest reliability ( $r = .89$ ) (Crowne & Marlowe, 1970).

#### 5.4.3 Personalized *Guṇas*-IAT Study

All the tests including questionnaires and demography data sheet were administered through the stimulus presentation software, INQUISIT, version 3.0.

#### 5.4.4 Yoga-IAT Study

The subjects took the Y-IAT and later an explicit rating scale to rate their preference towards yoga on a 7- point likert scale (very strongly dislike, strongly dislike, neutral, strongly like, very strongly like; -2 to +2). The order of taking congruent and incongruent tasks in the Y-IAT was balanced across the subjects (Greenwald et al., 2003). The whole test session lasted for about five to ten minutes.

In the Y-IAT, a series of words related to yoga were shown to subjects on the computer screen. The target words, related to yoga were: *yama, niyama, asana, prāṇāyāma, pratyāhāra, dhāraṇa, dhyāna,* and *samādhi*. Attribute category words were, for "Good" category: Good, Superb, Pleasure, Beautiful, Joyful, Glorious, Lovely, and Wonderful; and for "Bad" category: Hurt, Sorrow, Painful, Poison, Accident, Fearful, Bad, and Dirty. Selection of these words related to yoga category was based on the assumption that any student of yoga course would know these eight fundamental words from the *Patañjali's Yoga Sūtras*.

#### 5.5 SAMPLE SIZE CALCULATION

The results of previous studies using IAT as a tool in personality research suggest that the implicit-explicit correlation is weak to moderate. No earlier work has been done earlier in *guṇas*, we assume, based on the given yoga population being conservative, moderate strength of implicit-explicit correlation (Cohen's  $d = 0.3$ ) (Cohen, 1988). Hence the sample size was calculated taking effect size = 0.3, fixing  $\alpha = .05$ , and power = .80. The calculated sample size was 84 for a two tailed condition. We therefore took a sample of 90 subjects for the study.

**CHAPTER – 6.0**  
**DATA EXTRACTION AND ANALYSIS**

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## **6.0 DATA EXTRACTION AND ANALYSIS**

### **6.1 DATA COLLECTION**

The data were collected using computers. Inquisit stimulus presentation software was utilized for all tests including informed consent, questionnaires, and demography data sheet. IATs were administered through the stimulus presentation software, INQUISIT, version 3.0.

### **6.2 DATA SCORING**

The Inquisit program automatically generates and stores subjects' responses in a data file, with extension '.dat'. IAT scoring was done using the improved scoring algorithm (Greenwald et al., 2003). For scoring the questionnaires, scoring scripts were written in R. Demographic details were extracted directly from the Inquisit output file.

### **6.3 DATA ANALYSIS**

R statistical package (R Development Core Team, 2012) and its linear mixed effects model analysis package, nlme (Pinheiro et al., 2012) were used to analyse repeated measures data. For other tests, correlation and regression procedures were used. For data visualization and generating figures, ggplot2, manipulate, and ade4 packages were used. For validity and reliability psych and psychometric packages were used. Correlation and regression procedures were used for statistical analyses for which car package was used.

## **CHAPTER – 7.0**

# **RESULTS**

<b>CHAPTER</b>	<b>DETAILS</b>	<b>PAGE.NO.</b>
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## 7.0 RESULTS

### 7.1 LANGUAGE IAT STUDY

IAT scoring was performed using the improved scoring algorithm (Greenwald et al., 2003). D scores corresponding to mean error rate greater than 20% were discarded (Risch, et al., 2010) while missing scores were considered missing at random. However, if in the three IATs only one had an error rate greater than 20%, all three were retained. After treating outliers in this manner, it became an unbalance design (n=49) with missing values. Use of a linear mixed effects model to analyse repeated measures with missing values and unbalanced design is highly recommended (Locker, Hoffman, & Bovaird, 2007; Keselman, Algina, & Kowalchuk, 2001). Hence, for analysis we used R statistical package (R Development Core Team, 2012) and its linear mixed effects model analysis package, nlme (Pinheiro et al., 2012). The outcome variable was D score. Fixed effect variables were IAT type (native, English, and picture), frequency (more, less, and equal), medium (native and English), and order (six levels). The subject was a random effect variable. Baseline model was constructed using subject as random factor, and intercept. IAT type was then added to the model to find the effect of IAT type on D score. The overall model can be described using the following equation 1:

$$D\text{-Score} = 0 + \underbrace{(\text{IAT Type} + \text{frequency} + \text{medium} + \text{order})}_{\text{Fixed factors}} + \underbrace{b_{\text{subject}}}_{\text{Random factor}} + \text{-----} \quad (1)$$

Orthogonal contrasts were coded to assess differences between D scores for: picture versus word, and native versus English IATs. Frequency and medium, with their interaction terms, were added separately. The mean (SD) IAT D score for native

IAT was 0.59 (0.34), for English IAT 0.54 (0.33) and for picture IAT 0.47 (.34), as shown in figure 3 (p. 84).

Results found that, of the predicted factors, IAT type, frequency, medium, or order, none were significant, except picture versus word IAT D score - just significant,  $b = 0.03$ ,  $t(93) = 1.99$ ,  $p < .049$ . Nor were there any significant interaction effects (Table 6).

**Table 6: Estimates of Fixed Effects Results with IAT D Score as Outcome Variable**

		Study 1 (n=49)			
		Estimate	Std. Error	<i>t</i> value (df)	<i>p</i> value
Baseline	(Intercept)	0.737	0.037	14.797 (97)	< .001
Model 1	(Intercept)	0.737	0.037	14.477 (93)	< .001
IAT type	WordvsPicture	0.032	0.017	1.987 (93)	.049
	NativevsEnglish	0.027	0.028	0.947 (93)	.347
Model 2	(Intercept)	0.782	0.074	10.779 (89)	< .001
IAT type	WordvsPicture	0.028	0.023	1.217 (89)	.227
	NativevsEnglish	-0.020	0.041	-0.480 (89)	.732
Frequency	Frequencyless	-0.101	0.124	-0.810 (47)	.422
	Frequencymore	-0.087	0.079	-1.083 (47)	.287
IAT type x Frequency	WordvsPic xFrequencyLess	-0.003	0.070	-0.071 (89)	.972
	NatvsEngxFrequencyLess	-0.081	0.087	-0.930 (89)	.377
	WordvsPicxFrequencyMore	0.012	0.034	0.379 (89)	.713
	NatvsEngxFrequencyMore	0.133	0.079	2.274 (89)	.027
Model 3	(Intercept)	0.772	0.074	8.738 (91)	< .001

IAT type	WordvsPicture	0.014	0.028	0.497 (91)	.721
	NativevsEnglish	0.030	0.048	0.722 (91)	.737
Medium	MediumNative	-0.040	0.079	-0.704 (47)	.717
IAT type x Medium	WordvsPicxMediumNative	0.027	0.034	0.797 (91)	.428
	NatvsEngxMediumNative	-0.007	0.070	-0.092 (91)	.927
Model 4	(Intercept)	0.477	0.097	4.921 (93)	< .001
IAT type	WordvsPicture	0.032	0.017	1.973 (93)	.073
	NativevsEnglish	0.027	0.029	0.973 (93)	.343
Order	OrderEPN	0.049	0.130	0.373 (42)	.711
	OrderNEP	0.077	0.140	0.479 (42)	.742
	OrderNPE	0.198	0.127	1.772 (42)	.123
	OrderPEN	0.010	0.130	0.074 (42)	.942
	OrderPNE	0.078	0.124	0.749 (42)	.787

**significance:  $p < .05$**

These results suggest that, contrary to our hypothesis, language does not influence D score significantly, however the hypothesized trend was observed. To explore for further possible effects, which we felt must be present, we then performed an exploratory analysis, changing the model's outcome variable, first, to mean error percentage, and, second, to mean response latency.

The first (mean error percentage) gave results with significant main effects. Orthogonal contrasts revealed a significant difference, for native versus English IAT,  $b = -1.64$ ,  $t(97) = -3.55$ ,  $p < .001$ . There was an interaction between IAT type and medium,  $b = -1.53$ ,  $t(95) = -3.23$ ,  $p = .002$ . Subjects who had studied in native medium made more errors in English IAT and less errors in native IAT than those who had studied in English medium. It is shown in Figure 4 (p. 84).

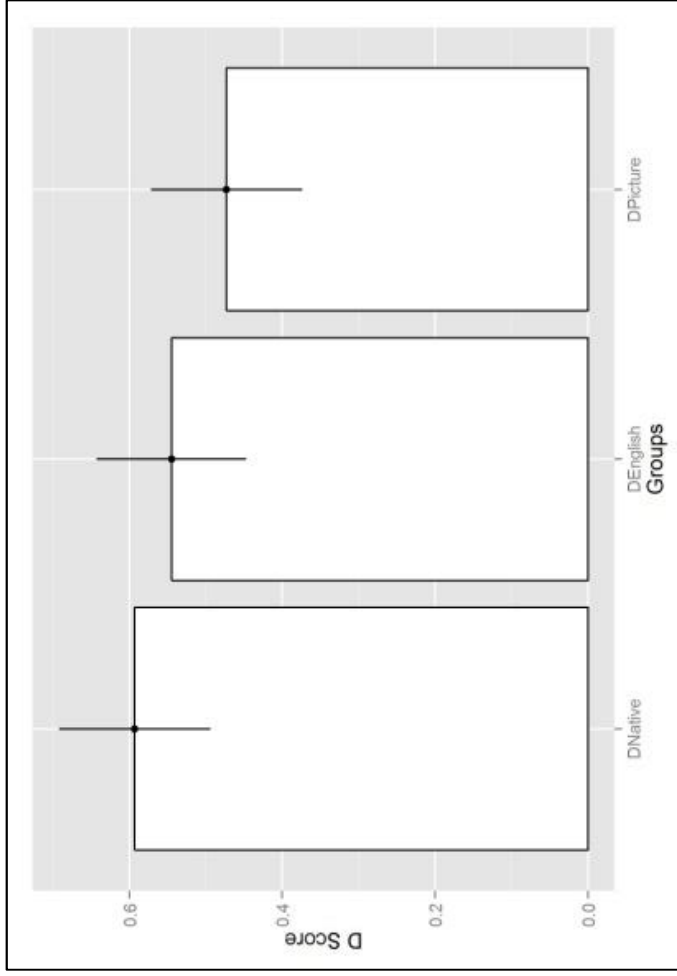


Figure 1: Mean D scores of three IATs

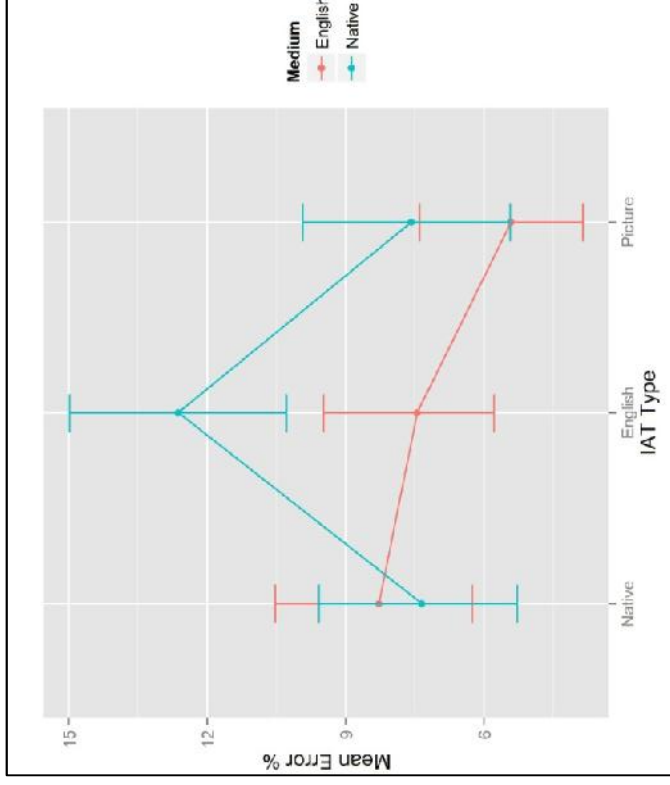


Figure 2: Interaction between IAT type and mean error percentage

For the second (mean response latency), IAT type - frequency interaction was just significant,  $b = -64.67$ ,  $t(93) = -1.99$ ,  $p = .049$ . Subjects who used their native language more frequently took less time in native language IAT than in English, while those who had used it less frequently took more time in native IAT than English IAT, as shown in Figure 5 (p. 86). IAT type - medium interaction was significant,  $b = -79.40$ ,  $t(95) = -3.64$ ,  $p < .001$ . Native medium participants took longer time in English IAT and English medium participants took longer time in native IAT, as shown in Figure 6 (p. 86).

No significant main effects or interactions were observed for order of IAT. Hence the results were not influenced by different IAT orders.

These results replicated error and latency trends from a non-randomized pilot study, in which small sample size only yielded trends rather than statistical significance. The results are tabulated in Table 7 (p. 87). Here the order of the IAT was not considered and the subjects were not assigned randomly, rather they took the tests as they came to the lab for testing.

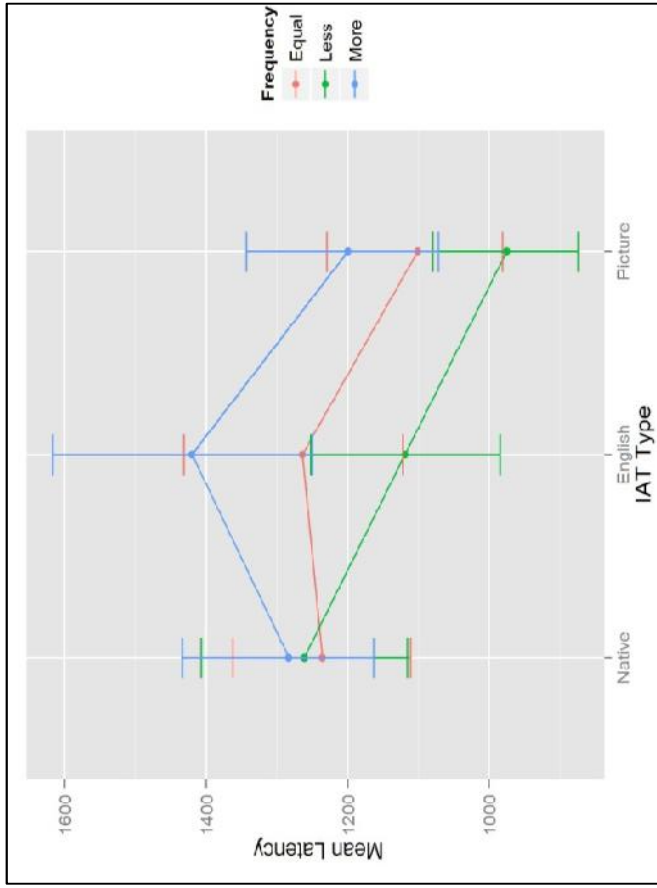


Figure 3: IAT type frequency interaction in mean latency

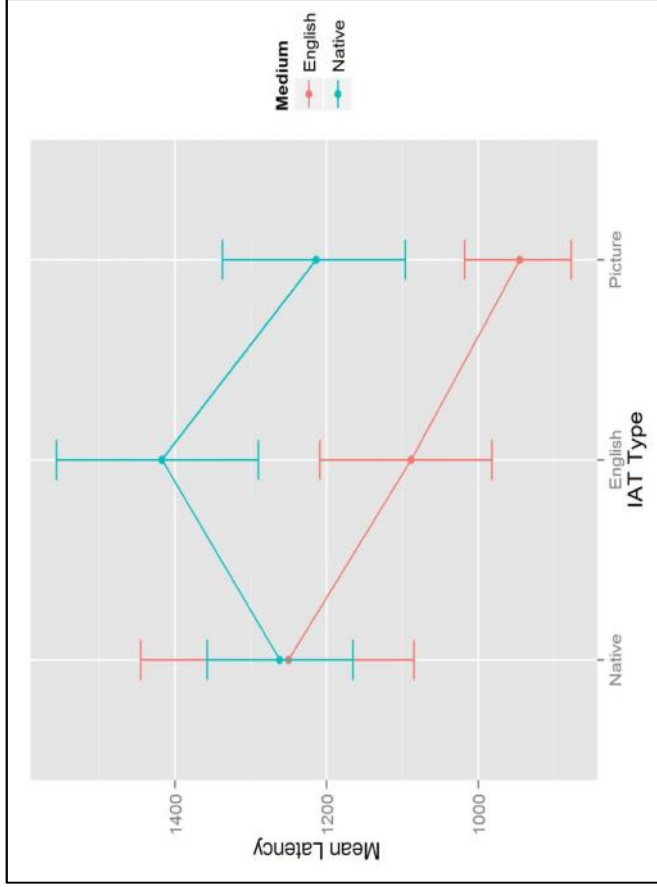


Figure 4: IAT type medium interaction in mean latency

**Table 7: Replicated Error and Latency Trends from a Non- Randomized Pilot Study**

	Mean Error % (n=22)				Mean Latency (n=22)			
	Estimate	Std. Error	t value (df)	p value	Estimate	Std. Error	t value (df)	p value
Baseline (Intercept)	3.247	0.724	7.192 (44)	< .001	1277.102	48.829	27.114(44)	<.001
Model 1 IAT type	3.247	0.732	7.097(42)	< .001	1277.102	49.798	27.709(42)	<.001
	0.337	0.220	1.719 (42)	.137	87.112	17.777	7.478(42)	<.001
	-0.077	0.381	-0.149 (42)	.882	-40.778	27.327	-1.488(42)	.144
Model 2 (Intercept)	3.377	0.478	7.019 (38)	.000	1270.279	47.773	27.701 (38)	<.001
IAT type	0.341	0.221	1.747 (38)	.130	87.387	17.742	7.191 (38)	<.001
	-0.041	0.382	-0.107 (38)	.917	-38.999	28.827	-1.373 (38)	.184
Frequency	0.777	0.779	0.870 (19)	.400	-79.387	77.774	-1.211 (19)	.241
	-1.794	0.779	-2.722 (19)	.014	132.778	77.774	2.023 (19)	.077
IAT type x Frequency	0.318	0.304	1.047 (38)	.302	-7.077	22.939	-0.274 (38)	.793
	-0.793	0.727	-1.704 (38)	.141	-23.877	39.732	-0.701 (38)	.772
	-0.394	0.304	-1.293 (38)	.204	3.034	22.939	0.132 (38)	.897
	0.713	0.727	1.174 (38)	.272	7.718	39.732	0.141 (38)	.888
Model 3 (Intercept)	3.247	0.727	7.187 (40)	.000	1277.102	70.773	27.114 (40)	<.001
IAT type	0.337	0.217	1.777 (40)	.128	87.112	17.274	7.742 (40)	<.001
	-0.077	0.373	-0.172 (40)	.880	-40.778	27.437	-1.738 (40)	.132
Medium	0.779	0.727	1.277 (20)	.217	10.101	70.773	0.199 (20)	.844
IAT type x Medium	0.147	0.217	0.777 (40)	.704	12.077	17.274	0.790 (40)	.434
	-0.701	0.373	-1.880 (40)	.077	-74.493	27.437	-2.071 (40)	.047

## 7.2 GUNA-IAT STUDY

### Scheme of analysis of *Guna-IAT* data:

The following steps were followed in the analysis of *Guna-IAT* data.

- 1) Data extraction
- 2) Data treatment and outliers analysis
- 3) Exploratory analysis with data visualization
- 4) Statistical analyses
- 5) Post-hoc power analysis

#### 1) Data extraction

Data collected from subjects were stored as INQUISIT data files. To extract the G-IAT data, R script was used, following Greenwald's new guidelines as before (Greenwald et. al., 2003) (Appendix 4, p. 159). Similarly, for extracting data from explicit measures and demographic details, R scripts were again written, which also took care of reverse scoring, recoding, and scale transformations (Appendix 4). Once the data had been extracted by the said procedure, a processed raw data sheet, containing of all the important variables was prepared (Appendix 7, p. 194) and further analysed using the R package for statistical computing. Integrity of data was checked by a) manually matching various outputs from different files using the subject ids, and further cross comparing with the experimenter's written notes of subject ids; b) manually checking all variable values for a few randomly selected subjects.

#### 2) Data treatment and outliers analysis

The following criteria were used for treatment of outliers: a) Error rate in IAT > 20%, b) subjects who could not complete the whole test due to technical problems, as information on all the variables is necessary for complete analysis. c)

those who could not follow the test instruction properly and took the test casually – aspects observed and recorded by the experimenter while administering the test.

**The following steps were used to analyse G-IAT data:**

- i. Remove all error trials
- ii. Recode latencies <300 ms and >3000 ms
- iii. Individually convert response latencies to Z-Score (To reduce between subject method variance)
- iv. Omit 1st trial (since deviation is larger;  $z > 1$ )
- v. Remove subjects with error % >20 in any one of the combined blocks.

**Separation of data sets:** For calculations of correlations and data visualization, the main datasets were separated based on positive D scores in the G-IAT for all three domains: *satva*, *rajas*, and *tamas*. The reason for choosing only positive values of analysis is as follows: The score in the IAT ranges from -2 to +2 through 0. Positive scores mean, *I implicitly evaluate myself to be satvic (having satvic disposition) compared to others*, and negative scores mean, *I do not implicitly evaluate myself to be satvic (having satvic disposition) compared to others*. Hence positive and negative scores cannot meaningfully be combined. In this way, six sub datasets were prepared for further analysis. Wherever,  $n=77$  is specified, the full dataset has been used, but in other places, only positive D scores were taken for analysis.

**3) Exploratory analysis with data visualization**

*Triguna* is a construct with three domains. The majority of previously developed questionnaires has treated the three domains as independent. However, it is more logical to treat the three with a certain degree of mutual overlap. Hence we used the trilinear plot to depict relationships between *satva*, *rajas*, and *tamas* simultaneously, using R's 'ade4' package to generate them. These plots require all

values to be positive, so in the implicit plot, constants were added to all three domains, making all values positive. This transformation, causing a systematic error in the data, does not influence the inter correlation information.

Figures 7a and 7b show explicit and implicit *gunas* (n=77) (p. 92) They are trilinear plots which are used to visualise three variables simultaneously. The scatter plot in the explicit measures (Figure 7a) gives a linear trend. Accumulation of points is along the higher end of *satva*, and middle region of *rajas* and *tamas*. This means that overall, the sample is high in *satva*, then followed by *rajas* and *tamas*. However, in the implicit plot (Figure 7b), the points are more scattered but concentrate more at the high end of *rajas*, and at moderate *satva* and *tamas*.

**The following are the explicit relationships:**

Figures 8a, 8b, and 8c (p.93) exhibit the correlations between explicit *satva*, *rajas* and *tamas*. Clear linear trends are evident, negative relationships in 8a and 8b, but positive in 8c, as expected for the explicit measures. The shaded region around the line (*lowess*) of regression is 95% confidence interval, which is quite narrow indicating good data reliability.

**The following are the implicit-explicit relationships:**

Figures 9a, 9b, and 9c (p.93) show implicit-explicit relationships for each *guna*. Since IAT D score is a standardized score, explicit *gunas* scores have also been z transformed. Hence both axes are in standardized scales. This transformation does not change correlation information but improves resolution and aids data visualization. Here only positive D scores are taken as they correlate better conceptually with explicit scores. We can also see some kind of non-linear relationship. No theoretical underpinning for the observed nonlinear relationship has

been identified, so we further analysed the data using a linear model, reporting all correlation coefficients accordingly. The wider spread of 95% confidence interval region reflects lower data reliability than for explicit measures; and also low to moderate correlation strength. This could however, also signify non-dependence of the three constructs' implicit scales, a point that merits further experimental validation.

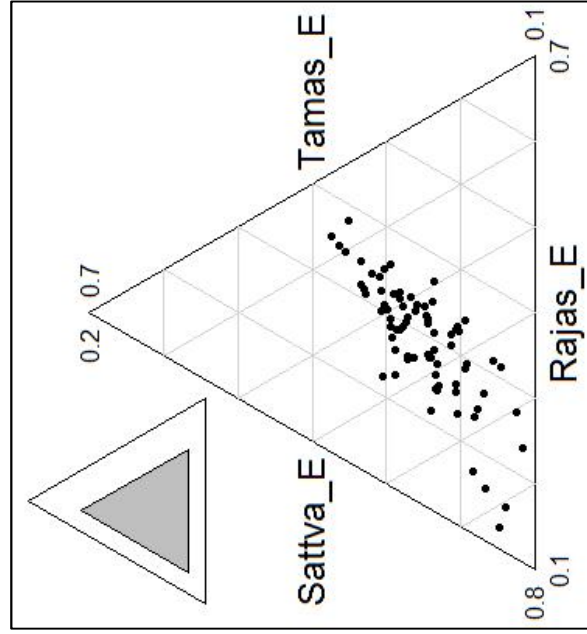


Figure 7a: Explicit *Triguna* relationship (n=77)

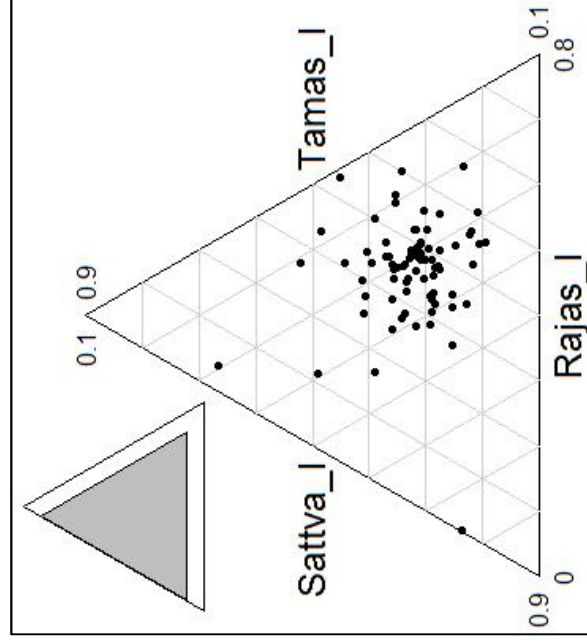
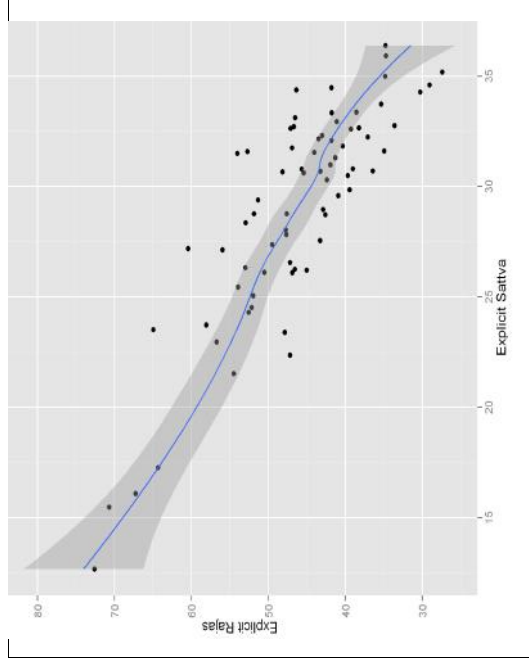
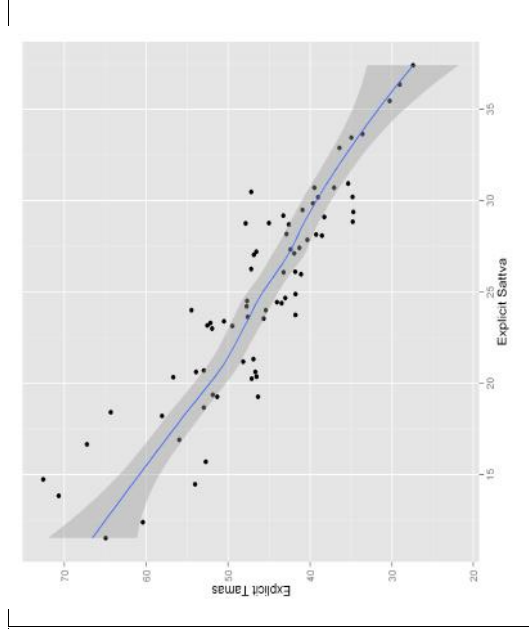


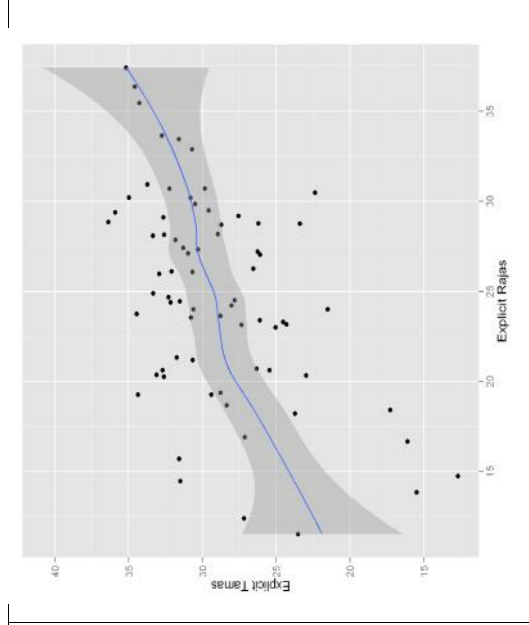
Figure 7b: Implicit *Triguna* relationship (n=77)



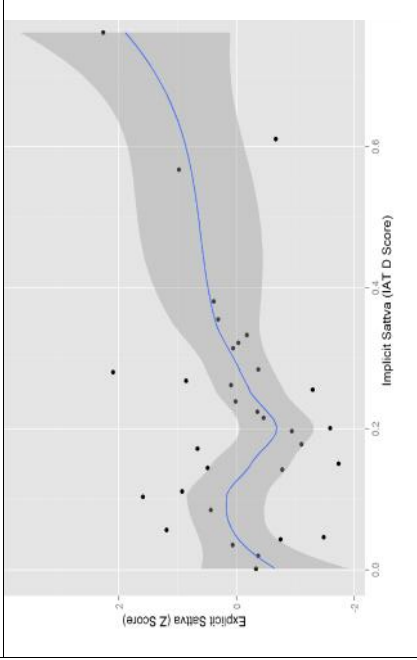
**8a: Explicit Satva- Explicit Rajas (n=77)**



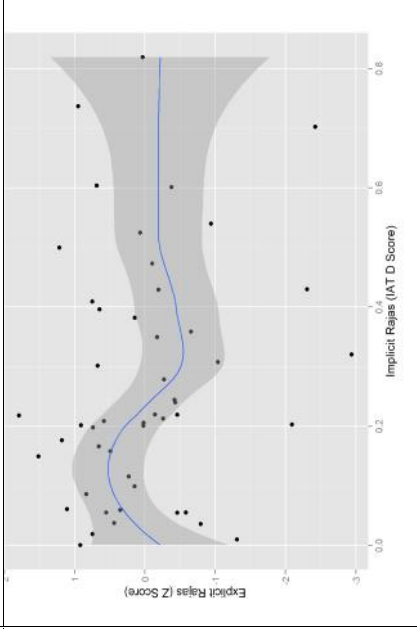
**8b: Explicit Satva- Explicit Tamas (n=77)**



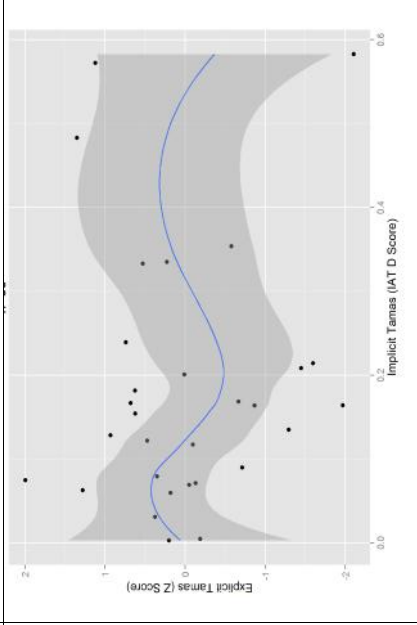
**8c: Explicit Rajas- Explicit Tamas (n=77)**



**9a: Implicit Satva- Explicit Satva (n=32)**



**9b: Implicit Rajas- Explicit Rajas (n=49)**



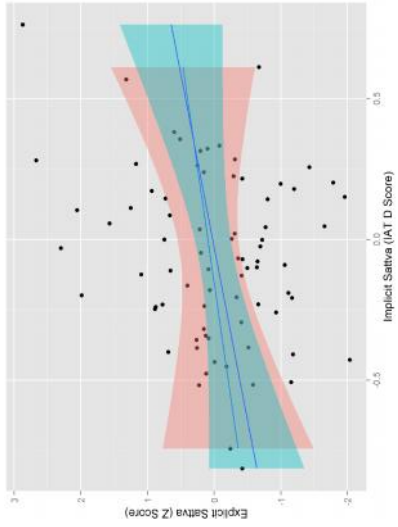
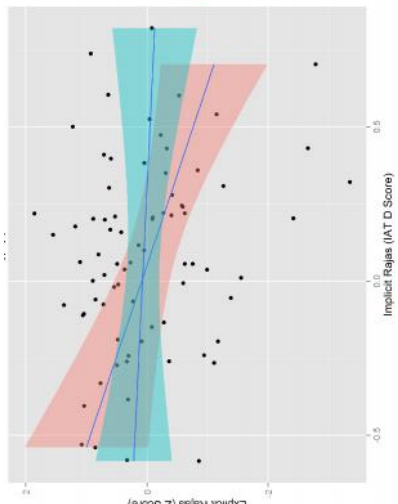
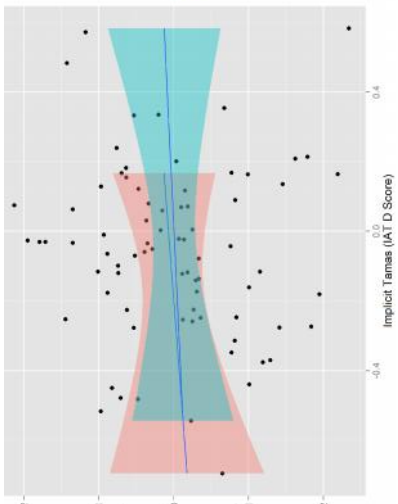
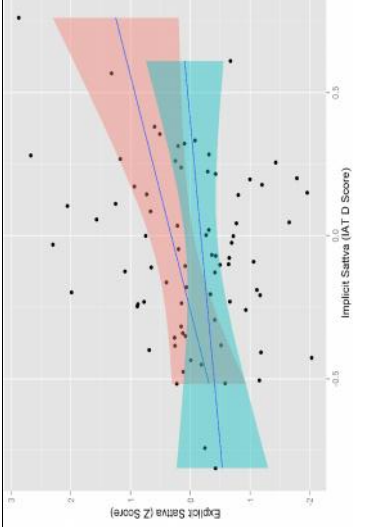
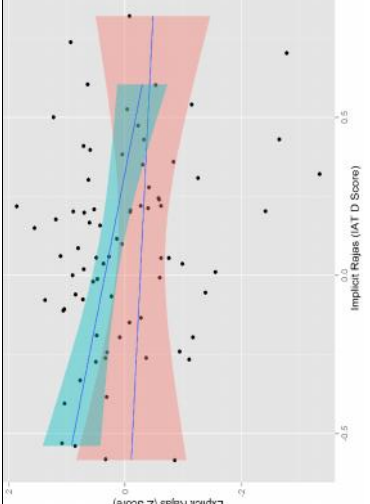
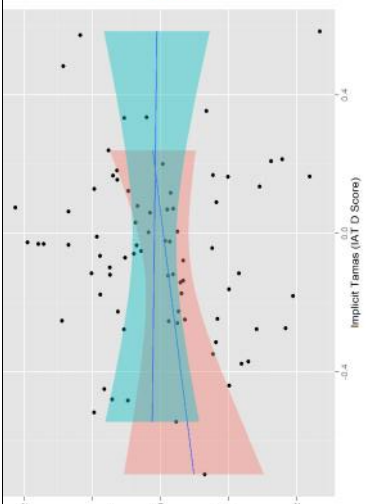
**9c: Implicit Tamas- Explicit Tamas (n=30)**

**Subgroup analysis:**

We also explored the data to identify possible influences from fixed factors like gender, education, etc. For this purpose, the whole dataset (n=77) was used, as splitting the data based on these minor sub factors would have led to too few data points for each sub-analysis and given poor estimates. Here too, explicit scores were z transformed.

**a) Influence of gender:** Figures 10a, 10b, and 10c (p. 95) show the gender wise implicit-explicit correlation for three *gunas*. These scatter plots show that gender does not influence implicit-explicit correlation. However, the observation that, for females in the *rajas* domain, higher explicit scores correspond to lower implicit scores, and vice-versa, is of interest. This hints at social desirability and a need to project more competitiveness and competency compared to others.

**b) Influence of education:** Figures 11a, 11b, and 11c (p. 95) show the education wise implicit-explicit correlation for three *gunas*. The scatter plots shows that education does not significantly influence implicit-explicit correlation either. However, post graduates tended to explicitly evaluate as more *satvic*, less *rajasic* and *tamasic* compared to undergraduates, possibly due to better knowledge of *triguna*.

	<p><b>10a: Implicit Satva-Explicit Satva (n=77)</b></p> <p style="text-align: center;"><b>Gender</b></p>		<p><b>10b: Implicit Rajas-Explicit Rajas (n=77)</b></p> <p style="text-align: center;"><b>Gender</b></p>		<p><b>10c: Implicit Tamas-Explicit Tamas (n=77)</b></p> <p style="text-align: center;"><b>Gender</b></p>
	<p><b>11a: Implicit Satva-Explicit Satva (n=77)</b></p> <p style="text-align: center;"><b>Education (UG-PG)</b></p>		<p><b>11b: Implicit Rajas-Explicit Rajas (n=77)</b></p> <p style="text-align: center;"><b>Education (UG-PG)</b></p>		<p><b>11c: Implicit Tamas-Explicit Tamas (n=77)</b></p> <p style="text-align: center;"><b>Education (UG-PG)</b></p>

<p><b>12a: Implicit <i>Satva</i>-Explicit <i>Satva</i> (n=77)</b> <b>Knowledge of <i>Gurias</i></b></p>	<p><b>12b: Implicit <i>Rajas</i>-Explicit <i>Rajas</i> (n=77)</b> <b>Knowledge of <i>Gurias</i></b></p>	<p><b>12c: Implicit <i>Tamas</i>-Explicit <i>Tamas</i> (n=77)</b> <b>Knowledge of <i>Gurias</i></b></p>
<p><b>13a: Implicit <i>Satva</i>-Explicit <i>Satva</i> (n=77)</b> <b>Years of Yoga Experience</b></p>	<p><b>13b: Implicit <i>Rajas</i>-Explicit <i>Rajas</i> (n=77)</b> <b>Years of Yoga Experience</b></p>	<p><b>13c: Implicit <i>Tamas</i>-Explicit <i>Tamas</i> (n=77)</b> <b>Years of Yoga Experience</b></p>

**c) Influence of Knowledge of *Guṇas*:** Figures 12a, 12b, and 12c (p. 96) show the implicit-explicit correlation for three *guṇas* according to the subjects' knowledge of *guṇas*. The scatter plots suggest that reported knowledge of *guṇas* does not influence implicit-explicit correlations.

**d) Influence of Years of Yoga Practice:** Figures 13a, 13b, and 13c (p. 96) show the implicit-explicit correlation for three *guṇas* according to the subjects' experience of yoga practice. The above scatter plots suggest that years of yoga practice do not influence implicit-explicit correlations. But in *satva*, the implicit-explicit congruence seems to be considerably higher for people with greater than 3 years of yoga experience (Figure 13a). Similarly, in *tamas*, the implicit-explicit congruence seems to increase in the group of three years-experienced yoga practitioners.

**Study of social desirability on implicit and explicit evaluation of *guṇas*:**

The green spheres/balls represent low social desirability and the blue spheres/balls represent high social desirability. In figure 14a (p. 98), both regression planes are the same and do not distinguish the influence of Social desirability factors. However, in the figure 14b (p. 98), there is a neat separation between high and low social desirability. This means that the implicit scale yields a resolution of social desirability, which would otherwise be difficult to identify empirically.

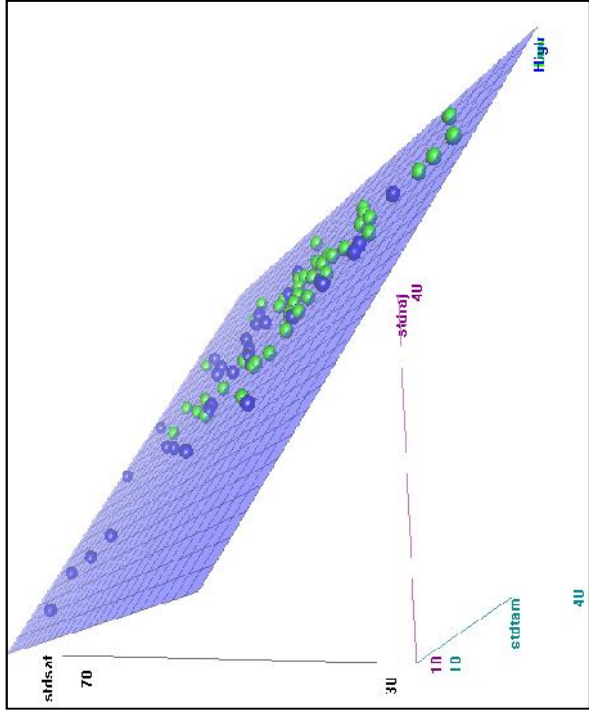


Figure 14a: Explicit *Satva*, *Rajas* and *Tamas* as a function of Social Desirability (n=77).

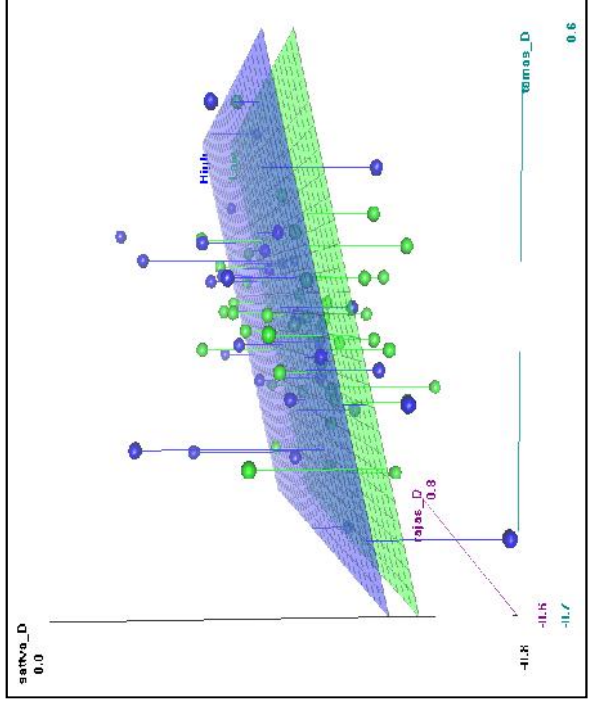
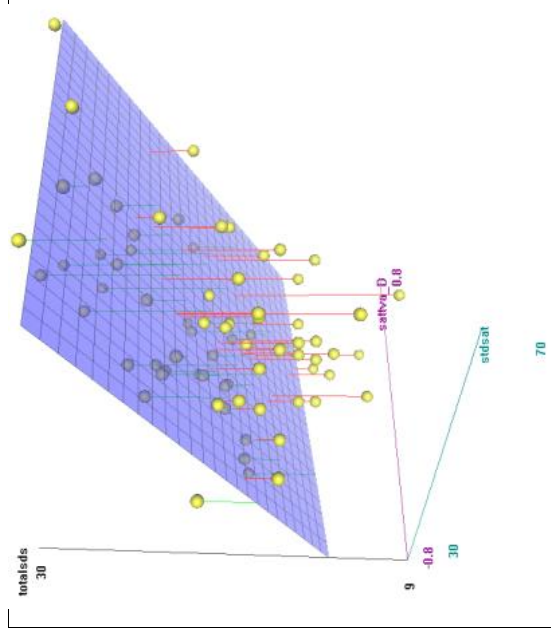
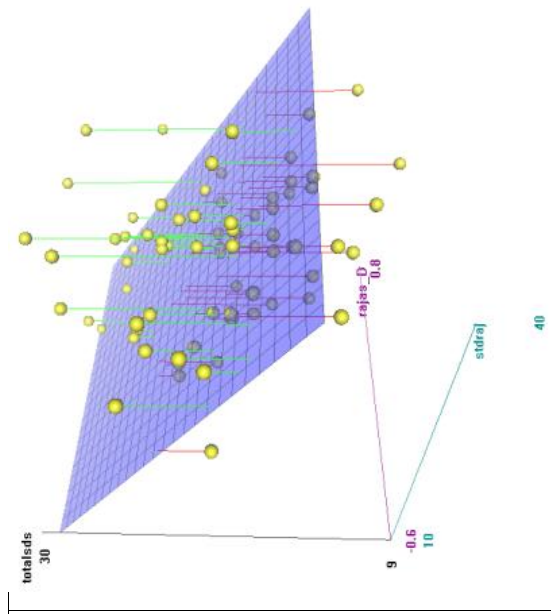


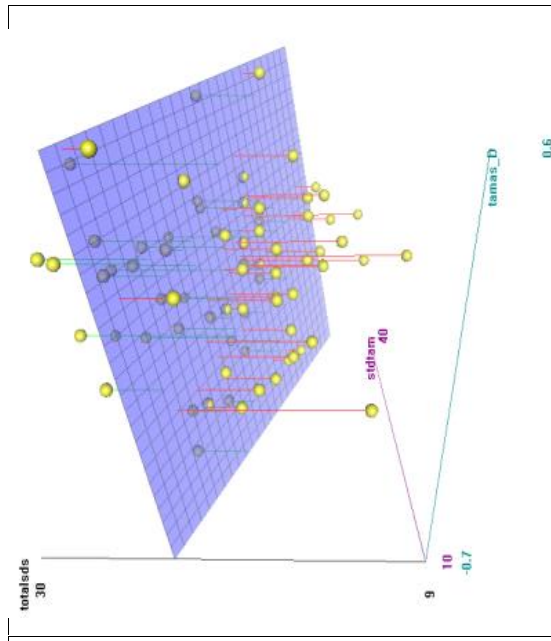
Figure 14b: Implicit *Satva*, *Rajas* and *Tamas* as a function of Social Desirability (n=77).



**Figure 15a: Implicit-Explicit *Satva* & Social Desirability**



**Figure 15b: Implicit-Explicit *Rajas* & Social Desirability**



**Figure 15c: Implicit-Explicit *Tamas* & Social Desirability**

In Figures 15a, 15b, and 15c (p. 99), we can see that that influence of social desirability shows up more on the explicit measure than the implicit measure, shown by the higher slopes on against the explicit axes, *stdsat* (15a), *stdraj* (15b), and *stdtam* (15c). This makes it clear that social desirability is an important factor in the evaluation of *guṇas* and must be incorporated into *triguṇa* assessment of personality.

#### 4) Statistical analyses:

**Table 8: Correlation table for implicit and explicit scales**

Variable	Positive/Negative	<i>r</i>	95% CI	<i>t</i> ( <i>df</i> )	<i>p</i> -value
I-E Satva	Positive	.32	-0.04, 0.60	1.82 (30)	.079
I-E Rajas	Positive	-.18	-0.44, 0.10	-1.27 (47)	.211
I-E Tamas	Positive	-.09	-0.44, 0.28	-0.50 (28)	.624
I-E Satva	Negative	.17	-0.13, 0.44	1.14 (43)	.259
I-E Rajas	Negative	-.04	-0.41, 0.34	-0.22 (26)	.830
I-E Tamas	Negative	.29	0.00, 0.53	2.04 (45)	.047

Table 8 above correlation table lists implicit-explicit correlation coefficients separately for positive and negative values. As mentioned earlier, the positive subset corresponds well with the theoretical meaning of the scores. So, we will focus on positive scores for our discussion. The *Satva* domain seems to have the highest correlation coefficient (.31), which is a moderate correlation strength. This positive correlation shows congruence between implicit and explicit scales. However, it is not seen for *rajas* and *tamas*. Further the 95% confidence interval indicates that the scores on *rajas* and *tamas* are less reliable as they change sign. For *satva* also a change of sign in 95% CI is observed, however, the lower bound is almost equal to

zero, and hence can be treated as positive values as well for all practical purposes. None of these three correlations were significant, may be due to low sample sizes.

### **Construct Validity:**

For the purpose of checking construct validity, convergent and divergent validities were checked. Various variables used are:

Satva\_I=Implicit Satva, Rajas\_I=Implicit Rajas, Tamas\_I=Implicit Tamas,

Satva\_E=Explicit Satva, Rajas\_E= Explicit Rajas, Tamas\_E= Explicit Tamas,

HFS= Heartland Forgiveness Scale

SWLS= Satisfaction With Life Scale

STAI= State and Trait Anxiety Inventory (Spielberg's) (Trait alone was used)

APS= Active Procrastination Scale

SDS= Social desirability scale (Marlow-Crowne Social Desirability Scale)

### **Convergent validity:**

For convergent validity, the three domains should correlate positively with other scales which are of similar nature.

#### *Satva*

**Table 9: Convergent validity for *Satva***

	satva_I	Satva_E	HFS	SWLS	SDS
Satva_I	1				
Satva_E	.31	1			
HFS	.22	.78	1		
SWLS	.00	.55	.68	1	
SDS	.29	.57	.49	.33	1

For *satva*, the implicit scores correlate positively with other related explicit measures like *satva* domain of VPI, forgiveness scale (HFS). Surprisingly, there was no correlation found between implicit *satva*, and wellbeing scale (SWLS). This shows low to moderate levels of convergent validity for implicit *satva*.

***Rajas*****Table 10: Convergent validity for *Rajas***

	<b>Rajas_I</b>	<b>Rajas_E</b>	<b>STAI</b>	<b>SDS</b>
<b>Rajas_I</b>	1			
<b>Rajas_E</b>	-.18	1		
<b>STAI</b>	-.30	.66	1	
<b>SDS</b>	.16	-.60	-.58	1

For *rajas*, the implicit scores do not correlate positively with explicit scores of *the guṇās*, and with STAI scores. This shows the poor convergent validity for the implicit *rajas* domain.

***Tamas*****Table 11: Convergent validity for *Tamas***

	<b>Tamas_I</b>	<b>Tamas_E</b>	<b>APS</b>	<b>SDS</b>
<b>Tamas_I</b>	1			
<b>Tamas_E</b>	-.09	1		
<b>APS</b>	.39	-.44	1	
<b>SDS</b>	.28	-.56	.52	1

For *tamas*, the implicit scores do not correlate positively with explicit scores of the same *guṇās*. However, a positive correlation is observed with active procrastination scale (APS), which is about nearly moderate strength.

**Divergent validity:**

Construct validity is further evaluated by finding divergent validity, in which the implicit measures should show negative correlation with opposite constructs.

*Satva***Table 12: Divergent validity for *Satva***

	Satva_I	Rajas_E	Tamas_E	STAI	APS	SDS
Satva_I	1					
Rajas_E	-.39	1				
Tamas_E	-.22	.74	1			
STAI	-.15	.69	.79	1		
APS	.15	-.51	-.49	-.63	1	
SDS	.29	-.5	-.55	-.62	.60	1

For *satva*, implicit *satva* scores negatively correlate with explicit *rajas*, explicit *tamas*, and STAI scores. The correlation ranges from low to moderate strength.

However, no negative correlation is found with APS.

*Rajas***Table 13: Divergent validity for *Rajas***

	Rajas_I	Satva_D	HFS	SWLS	SDS
Rajas_I	1				
Satva_D	.16	1			
HFS	.35	.80	1		
SWLS	.26	.48	.52	1	
SDS	.16	.64	.54	.37	1

Contrary to our expectation/hypothesis, implicit *rajas* does not negatively correlate with any of the hypothesised constructs like explicit *satva*, HFS, and SWLS. This show no discriminant validity for implicit *rajas*.

*Tamas***Table 14: Divergent validity for *Tamas***

	Tamas_I	Satva_D	HFS	SWLS	SDS
Tamas_I	1				
Satva_D	.05	1			
HFS	-.09	.70	1		
SWLS	.34	.38	.21	1	
SDS	.28	.59	.28	.24	1

For implicit *tamas*, there is a weak correlation (-.09) with HFS. With SWLS there is a positive correlation. This again shows poor and unsatisfactory discriminant validity for *tamas*.

### Reliability:

**Table 15: Test-retest reliability correlation coefficients for implicit measures**

Implicit domains	17 Days ( <i>r</i> ) (n=38)	30 Days ( <i>r</i> ) (n=25)
Satva	.73	-.08
Rajas	.37	.23
Tamas	.10	.77

For testing test-retest reliability, the G-IAT was administered to those who were willing to participate on a retest after about 17 days or a month. For the retest, 38 participated after 17 day retest, 25 for 30 day retest, and 14 could not/did not prefer to come again. After 17 (mean) day retest, the correlation for *satva* was found to be very high (.73) and for *rajas* and *tamas*, moderate and low respectively. After 30 day retest, the correlation values obtained are less comprehensible, and seem to be quite unreliable. The only inference that can be made from the above observations is that *satva* alone seems to be stable for a short period of 15 days, whereas *rajas* and *tamas* have lower reliability index. Retest estimates for a 30 day period would certainly require further experiments to give more reliable results.

### Validity and Reliability of explicit measures and implicit G-IAT:

Though finding validity and reliability of explicit measures is not our main objective in this study, it is useful to assess them to find out the strength of the tools that we have used, against which we validated our implicit tool.

Regarding validity of explicit measures, it can be seen that, overall, the convergent validity is satisfactory, as all correlations have the expected signs, and

the strength of correlations varies from above average to high. Hence we can say that the explicit tools used to validate the implicit tools were all valid to a greater extent, except for SWLS scale for which the convergent validity was found to be only 0.55.

In assessing the reliability of explicit measures, Cronbach's  $\alpha$  was calculated (Table 16). The results show satisfactory reliability index for all the measures. Hence we can infer that the reliability of explicit measures used were very good and poor reliability of implicit scores is not due to, or not influenced by, the reliability of explicit measures.

**Table 16: Cronbach's  $\alpha$  for explicit measures used in this study (n=77)**

<b>Tool</b>	<b>No. of items</b>		<b>95% CI</b>
VPI			
Satva	15	.83	.77, .88
Rajas	19	.85	.82, .89
Tamas	22	.89	.85, .92
Total	56	.93	.91, .95
APS	16	.77	.69, .84
HFS	18	.81	.74, .87
MCSDS	33	.73	.64, .81
STAI	20	.87	.82, .91
SWLS	5	.77	.68, .84

To determine the internal consistency of the implicit measure, G-IAT, the split-half method was adopted, in which each subject's odd and even trials on the two combined blocks for each of the *gunas* were separately calculated. These are tabulated in Table 17. The internal consistencies of the various measures set limits to the maximum possible correlation between them. Hence we can find out using the

internal consistency, what would be the maximum possible implicit-explicit correlation. The formula applied is  $[M_1 * M_2]$ , where M1 and M2 are two measures and  $\alpha$  is the measure of internal consistency.

**Table 17: Internal consistencies of implicit and explicit measures and their maximum limit (n=77)**

<b>Domain</b>	<b>Implicit consistency (G-IAT)</b>	<b>Explicit consistency (VPI)</b>	<b>Max. Achievable I-E correlation</b>
<i>Satva</i>	.68	.83	.75
<i>Rajas</i>	.56	.85	.69
<i>Tamas</i>	.31	.89	.53

**Regression analysis to find the influence of social desirability factor:**

Having obtained estimates of validity and reliability, it becomes possible to propose a correction factor to modify explicit measures based on the two main determinants, identified in this study, implicit measure and social desirability. We constructed three regression equations (Eqs. 2, 3 & 4), one for each domain of *triguna*. Model parameters are presented in Table 12. Though model equations are constructed for all three *guṇa*, we emphasize that it was only possible to achieve satisfactory validity and reliability for the *satva* domain and not for *rajas* and *tamas*. Further research is required in this direction.

Equations for the various models are:

Model 1: Prediction of explicit *satva* using implicit *satva*, and social desirability.

$$\text{Satva}_{\text{Explicit}} = 10.67 * \text{Satva}_{\text{Implicit}} + 1.15 * \text{Social Desirability} + 21.27 \text{ ---- (2)}$$

Model 2: Prediction of explicit *rajas* using implicit *rajas*, and social desirability.

$$\text{Rajas}_{\text{Explicit}} = -2.37 * \text{Rajas}_{\text{Implicit}} + -0.64 * \text{Social Desirability} + 41.90 \text{ ---- (3)}$$

Model 3: Prediction of explicit *tamas* using implicit *tamas*, and social desirability.

$$\text{Tamas}_{\text{Explicit}} = 2.81 * \text{Tamas}_{\text{Implicit}} + -0.72 * \text{Social Desirability} + 38.95 \text{ ---- (4)}$$

**Table 18: Multiple regression for predicting explicit measures, using implicit measures and social desirability**

	$R^2$	$B$	$SE B$		$P$
Model 1: Satva	0.35				
Constant		21.27	6.88		.004
Satva_D		10.67	10.21	0.16	.305
SDS		1.15	0.34	0.52**	.002
Model 2: Rajas	0.36				
Constant		41.90	2.67		< .001
Rajas_D		-2.37	3.17	-0.09	0.458
SDS		-0.64	0.13	-0.58**	< .001
Model 3: Tamas	0.32				
Constant		38.95	4.14		< .001
Tamas_D		2.81	6.86	0.07	.685
SDS		-0.72	0.21	-0.58**	0.002

\*\* =  $p < .01$

It is very evident that social desirability factors significantly predict explicit scores. In model 1, 35% of the variance in explicit *satva* was explained by both implicit *satva* and social desirability factors, and 36% and 32% in model 2 and 3 for *rajas* and *tamas* respectively. However, 65% of the variance still remains to be explained, which suggests that there are other factors also which contributes to implicit-explicit evaluation of *guṇas*.

Based on the eq. 2, we can introduce correction factors to the explicit scores.

A few examples are given below:

**Table 19: Corrected satva scores based on regression equations**

<b>Explicit <i>Satva</i> Observed</b>	<b>Implicit <i>Satva</i></b>	<b>SDS</b>	<b>Explicit <i>Satva</i> Corrected</b>
38	0.284	15	41.53
58	0.280	26	54.14
62	0.355	19	46.88
63	0.215	9	33.90
73	0.144	16	41.20
75	0.197	22	48.65
90	0.761	28	61.54
93	0.262	17	43.59
95	0.201	11	36.05
100	0.056	22	47.17

By introducing a correction factor as mentioned in the above procedure, we can reduce the influence of social desirability and obtain a more realistic estimate of a person's *satva* score. Further refinement in assessment may enable us to construct more reliable estimates of *rajas* and *tamas*, which is not currently possible in view of their poor validity and reliability.

##### **5) Post-hoc power analysis:**

Finally, to try to identify the reason for non-significant influence of implicit measures over the explicit measures, we carried out a post-hoc power analysis. This should show whether the lack of correlation was due to inadequate sample size. The achieved power was calculated with the observed  $r$  values as the effect size, supplying the correspond sample size and fixing the  $\alpha = .05$ . This is presented in table 20.

**Table 20: Post-hoc power analysis for implicit variables**

Variable	Positive/Negative	<i>r</i>	Achieved Power
I-E Satva	Positive	.32	0.44
I-E Rajas	Positive	-.18	0.24
I-E Tamas	Positive	-.09	0.09
I-E Satva	Negative	.17	0.20
I-E Rajas	Negative	-.04	0.05
I-E Tamas	Negative	.29	0.52

The post-hoc power analysis clearly shows that the statistically non-significant results may be due to inadequate power. As it can be seen for implicit-explicit *satva*, the *r* values is .32, which is a moderate strength of relationship. However, due to a lower power or only .44, the results failed to show as significant and hence we can still assume that implicit scores may have substantial influence on explicit scores. Furthermore, from the above post-hoc power analysis, we strongly recommend further studies with higher sample sizes.

### 7.3 PERSONALIZED GUNA- IAT STUDY

#### Personalized G-IAT:

The personalized G-IAT was conducted as an extension of G-IAT, hoping to find greater congruence between implicit and explicit scores of guans. Figure 16a and 16b shows the overall implicit and explicit relationships (p. 111). The trend is similar to that found in the G-IAT study. The correlation coefficients are presented in the table 21.

**Table 21: Correlation coefficients for implicit-explicit scores on Personalized G-IAT**

Variable	Positive/Negative	<i>r</i>	95% CI	<i>t</i> ( <i>df</i> )	<i>p</i> -value
I-E Satva	Positive	.17	-.17, .47	0.99 (34)	.328
I-E Rajas	Positive	.19	-.16, .50	1.09 (31)	.285
I-E Tamas	Positive	.16	-.25, .52	0.79 (23)	.440
I-E Satva	Negative	.02	-.43, .46	0.09 (18)	.931
I-E Rajas	Negative	-.02	-.43, .39	-0.11 (21)	.911
I-E Tamas	Negative	.04	-.32, .39	0.22 (29)	.825

The correlations were found to be all positive, indicating better congruence compared to the G-IAT results. However the strength of the relationship seems to be reduced. This may be due to a larger range of 95% confidence intervals. We can observe that for all the *r* values, the 95% CI has changed the sign, which means that the *r* values is more varying in the population, and hence less reliable. From the results of the above study, we can say that we were partially successful in achieving the indented goal. We could bring better congruence compared to G-IAT, but failed to achieve higher strength, which could be the focus of future research.

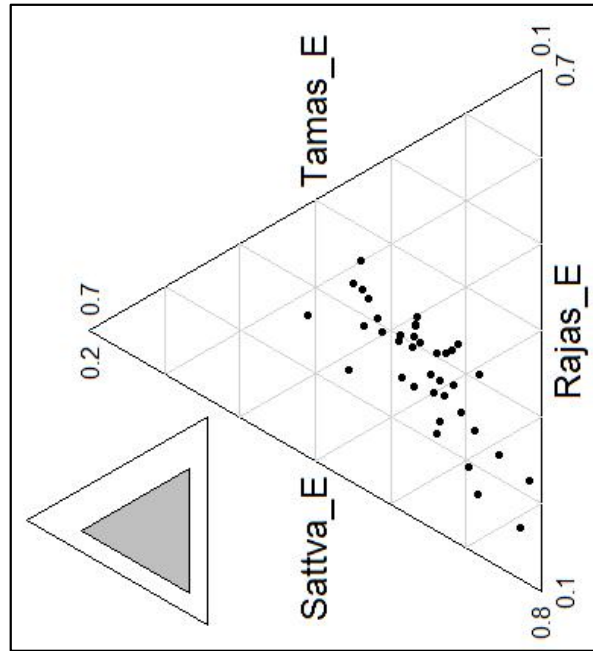


Figure 16a: Explicit *Triguna* relationship (n=39)

Personalized GIAT

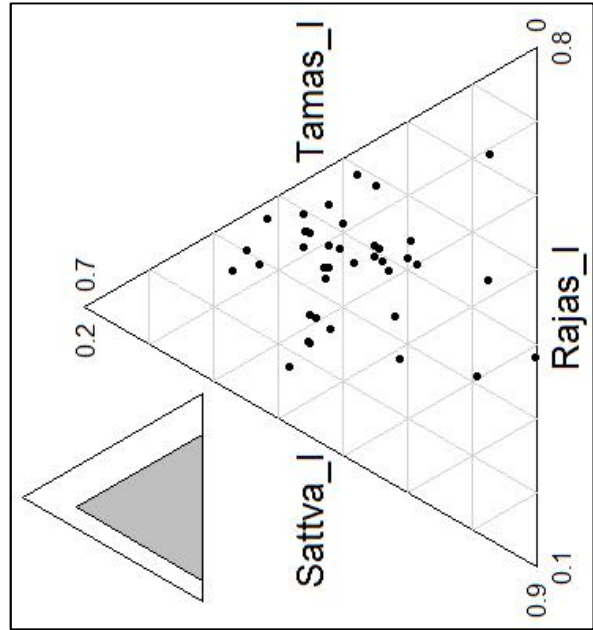


Figure 16b: Implicit *Triguna* relationship (n=39)

Personalized GIAT

#### 7.4 YOGA- IAT STUDY

Scoring of Y-IAT again used Greenwald's improved scoring algorithm (Greenwald et al., 2003). The detailed R script scoring procedure is given in Appendix 4 (p. 159). Mean latencies for each block were measured. The block in which "Yoga" is paired with "Good" is called the 'compatible block' and the one where "Yoga" is paired with "Bad" is called the 'incompatible block'. D score is obtained by difference of mean latencies of incompatible and compatible blocks and then the whole is divided by the pooled standard deviation. Positive scores indicate positive implicit evaluation of yoga, while negative scores suggest a negative implicit evaluation of yoga.

We discarded seven subjects from analysis, because the Y-IAT showed a negative D score. We treated them as outliers, because our underlying assumption was that all participants coming for yoga courses must have positive inclinations towards yoga. Their explicit scores supported this assumption. Hence negative scores meant that the subjects did not belong to the intended population. Three more subjects were removed for their high response error rate (>20%) (Karpinski & Steinman, 2006). After removing these ten outliers, the average D score was  $0.347 \pm 0.27$ , range 0.001 to 0.896; mean latency was  $1024.17 \text{ ms} \pm 300.10 \text{ ms}$ ; average error rate of 4.38% (after removing outliers); mean explicit score was  $1.27 \pm 0.79$  showing strong positive preference towards yoga; implicit-explicit correlation was  $r = .18$  ( $t = 1.14$ ,  $df = 37$ ,  $p = .274$ ), reflecting low implicit-explicit congruence.

## **CHAPTER – 8.0**

# **DISCUSSION**

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## 8.0 DISCUSSION

**Table 22: Summary of results of all the studies**

Null Hypothesis	H <sub>0</sub> Rejected/ Failed to reject	Inference
<b>Ha1: Does the administration of IAT in native language favor subjects in Indian populations?</b>		
H <sub>0</sub> 1a (Section 4.5, p-71)	Failed to reject H <sub>0</sub>	IAT D scores in not influenced by language in the study population
H <sub>0</sub> 1b	Reject H <sub>0</sub>	Language influences mean response rate
H <sub>0</sub> 1c	Reject H <sub>0</sub>	Language influences mean error rate
<b>Ha2: Implicit correlation trend is similar to that of explicit correlation trend, in the three <i>guṇa</i> domains</b>		
H <sub>0</sub> 2a	Failed to reject H <sub>0</sub>	Implicit-explicit congruence correlation strength is weak
H <sub>0</sub> 2b	Failed to reject H <sub>0</sub>	
H <sub>0</sub> 2c	Failed to reject H <sub>0</sub>	
H <sub>0</sub> 2d	Reject H <sub>0</sub>	Explicit correlation pattern was observed as expected
H <sub>0</sub> 2e	Reject H <sub>0</sub>	
H <sub>0</sub> 2f	Reject H <sub>0</sub>	
H <sub>0</sub> 2g	Failed to reject H <sub>0</sub>	
H <sub>0</sub> 2h	Failed to reject H <sub>0</sub>	Implicit correlation pattern was not observed as expected, and was found to be different from implicit measures' pattern.
H <sub>0</sub> 2i	Failed to reject H <sub>0</sub>	
<b>Ha3: There would be at least moderate test-retest reliability after 17-days and comparatively litter lower after 30-day retest.</b>		
H <sub>0</sub> 3	Reject H <sub>0</sub>	Test-retest reliability was found to be satisfactory for <i>satva</i> after 17 days.
<b>Ha4: Social desirability would have significant influence on implicit-explicit congruence.</b>		
H <sub>0</sub> 4	Reject H <sub>0</sub>	Social desirability significantly predicted explicit expression of <i>guṇa</i> .

<b>Ha5: Yoga-IAT would show moderate Implicit preference towards yoga in a yoga population.</b>		
H <sub>05</sub>	Failed to reject H <sub>0</sub>	Yoga IAT showed low implicit-explicit congruence may be due to social desirability

### 8.1 LANGUAGE IAT STUDY

The purpose of the language IAT study was to assess the need to conduct the experiment in subjects' native language rather than English. The results tended to suggest that language does not influence D scores of bilinguals in India, at least for less sensitive IATs. In contrast, two earlier studies (Danziger & Ward, 2010; Ogunnaiké et al., 2010) observed significantly different D scores. However, they used culturally sensitive constructs, and a possible reason our results were not similar is that our study did not involve sensitive constructs. Another possible reason is the use of the modified scoring algorithm, which is robust. Despite D scores not being influenced, distinct trends were observed in the average error percentage and average latency.

These trends indicate the need for further investigation of factors influencing differences between native and English IAT D scores. Our study design did not suggest any, but circumstantial evidence suggested level of representation (LR), mode of second language acquisition and frequency of use as possible causes. Level of representation (LR) is defined as the degree with which a given stimulus represents the referent category. IAT is more sensitive to mental representations at the level of categories than that of category exemplars (as cited in Foroni, 2010). Therefore, during the whole session, various stimuli help to build up a relation to the category label, and towards the end we interpret the IAT results as the difference

between ease of response to two critical blocks. It has been established that Low-LR stimuli recruit semantic-verbal networks, while High-LR stimuli seem to use perceptual-visual networks. Pictures, considered to have low-LR, require less extraneous knowledge, are easier to categorize, and have less semantic interference. Words, on the other hand, are high-LR stimuli, which also activate many low-LR exemplars and perceptual features related to the stimulus category. They therefore become more difficult to categorize, and require more extraneous knowledge (as cited in Foroni, 2010). Our results indicate that when the use of English and native language is about equal, there is less difference in IAT D scores, suggesting that languages may have different levels of representation when one of the languages is less familiar. In India, many schools introduce English in primary classes, so that despite the language being acquired in an instructed way, it may form an LR equal to that of the native language. Investigation of trends in rural India, where students predominantly use their native language and only use English sparsely, would shed more light on this.

Though differences in D score results are non-significant, interesting trends appeared. a) Subjects who had studied in native medium made more errors in English IAT and less errors in native IAT than those who had studied in English medium. b) Subjects who used their native language more frequently took less time in native language IAT than in English, while those who had used it less frequently took more time in native IAT than English IAT. c) Native medium participants took longer time in English IAT and English medium participants took longer time in native IAT. Although these observations may seem obvious, they show that taking into account relative frequency of use of native IAT may enhance IAT effects

marginally, and that any systematic error due to these factors could be controlled for, yielding better estimates of IAT effects.

These results replicated error and latency trends from an earlier non-randomized pilot study, suggesting that future IAT studies in India should include frequency of language use and medium of instruction as determinants, in addition to those suggested by Banaji et al. (2010), for they definitely seem to mediate IAT effects in Indian populations. Data could also be subjected to process dissociation models like the diffusion (Klauer, Voss, Schmitz & Teige-Mocigemba, 2007) or quad models (Conrey, Sherman, Gawronski, Hugenberg & Groom, 2005), to determine IAT components responsible for the observed effects. Finally, less sensitive IATs can be administered to bilingual Indian populations in either language.

## 8.2 *Guṇa*-IAT STUDY & PERSONALIZED *Guṇa*-IAT STUDY

### Summary of major points:

1. Trends in results obtained from *Guṇās* -IAT and explicit measure are not the same.
2. Scores seem to be strongly influenced by the social desirability factor, as expected.
3. On the explicit scale, subjects reported having maximum *satva*, next *rajas* then *tamas*.
4. On the implicit scale, *rajas* was found to be maximum, then *satva* and then *tamas*.

5. Regression analyses show that all three domains of *triguṇā* are strongly influenced by the social desirability factor.
6. Correlations between explicit measures (VPI) of *triguṇā*'s three domains show expected trends.
7. The implicit-explicit relationships seem to have moderate to low correlations, with possible indications of non-linear relationships, with no theoretical explanations.
8. Subgroup analyses showed no influence of gender (Male, Female), education (UG, PG), knowledge of the *guṇās* (low, moderate, high), and years of yoga practice (Less than 3 years, up to 3 years, More than 3 years), on the implicit-explicit relationships. However, interesting trends were observed including higher expression of *guṇā* scores for postgraduates than undergraduates; and distinctively higher implicit-explicit congruence for yoga practitioners with more than three years' experience. These trends strongly suggest that as yoga students gradually learn its concepts, including *guṇās*, their implicit knowledge increases, and after a phase transition period, possibly marked by inner conflict, they tend to show greater implicit-explicit congruence.
9. Explicit measures failed to resolve social desirability factors, but on the implicit scales, differences between high and low social desirability were clearly resolved.
10. Influence of social desirability is exhibited more on explicit measures than implicit measures.
11. Statistical analyses show acceptable implicit-explicit correlation only for *satva*. However, low power prevented the groups of positive implicit scores

reaching statistical significance. The 95% confidence interval shows large variations for *rajas* and *tamas*; for *satva* it is relatively acceptable.

#### 12. Convergent Validity:

- a. For *satva*, implicit scores correlate positively with related explicit measures like *satva* domain of VPI, and forgiveness scale (HFS). Surprisingly, no correlation was found between implicit *satva*, and satisfaction with life scale (SWLS). This implies low to moderate levels of convergent validity for implicit *satva*.
- b. For *rajas*, implicit and explicit scores do not correlate positively, nor with STAI scores, indicating poor convergent validity for the implicit *rajas* domain.
- c. For *tamas*, implicit and explicit scores do not correlate positively. However, a moderate strength positive correlation is observed with active procrastination scale (APS).

#### 13. Divergent Validity:

- a. Implicit *satva* scores negatively correlate with explicit *rajas*, explicit *tamas*, and STAI scores. Correlations range from low to moderate strength, but no negative correlation is found with APS.
- b. Contrary to expectations, implicit *rajas* does not correlate negatively with any hypothesized construct like explicit *satva*, HFS, or SWLS. No discriminant validity was identified for implicit *rajas*. Negative correlations were expected for these explicit measures with the implicit *rajas* score because they are conceptually opposite. For implicit *tamas*, there was a weak correlation (-.09) with HFS

(forgiveness scale). With SWLS there was a positive correlation. This again shows poor and unsatisfactory discriminant validity for *tamas*.

14. Reliability:

- a. At 17 day retest, correlation for implicit *satva* was very high (.73), but those for *rajas* and *tamas* were moderate and low respectively. 30 day retest correlation values make the measures seem quite unreliable, and are less comprehensible. The only inference that can be made from the above observations is that *satva* alone seems to be stable for short periods of 17 days or so, whereas *rajas* and *tamas* have lower reliability indices. Retest estimates for the 30 day period certainly require further investigation to achieve more reliable results.
- b. Regarding validity of explicit measures: all correlations are in expected directions, so the overall convergent validity is satisfactory. Also, their strength varies from above average to high. Hence we can say that the explicit tools used to validate the implicit tools all had greater validity. In assessing the reliability of explicit measures, Cronbach's  $\alpha$  was calculated. The results show satisfactory reliability index for all the measures. Hence we can infer that the reliability of explicit measures used was very good, and that poor reliability of implicit scores was not due to, or influenced by, low reliability of explicit measures.

15. Influence of social desirability:

- a. Having finally obtained estimates of validity and reliability, it may be possible to propose correction factors to modify the explicit measures bases on the two main determinants identified in this study, implicit

measure and social desirability. We constructed three regression equations, one for each of the domains of *triguṇās*. Their use should make it possible to correct for self-presentation bias in explicit self-report measures.

- b. Results of multiple regression show that social desirability significantly predicts explicit scores in all three domains of *triguṇās*.

By introducing a correction factor as mentioned in the above procedure, we should be able to reduce the influence of social desirability and obtain a more realistic estimate of a person's *satva* score. Further refinement in assessment may enable us to construct more reliable estimate of *rajas* and *tamas*, which is not possible with the current status of their poor validity and reliability.

16. Post-hoc power analysis: This suggests that lack of achieved power was the reason for failure to obtain statistically significant results. In the case of implicit-explicit *satva*, the  $r$  values is .32, which is a moderate strength of relationship. The low power of .44 may have been the reason why the results failed to reach significance. Hence, we may still assume that implicit scores substantially influence explicit scores. From the above post-hoc power analysis, we can strongly recommend further studies with larger sample sizes.

17. Implicit-explicit correlations for PG-IAT were all positive, indicating better congruence than for the G-IAT results. However the strength of the relationship was reduced. This may be associated with larger 95% confidence interval ranges. For all  $r$  values, the 95% CI changed sign, implying that population  $r$  values vary more, and are less reliable. These

results indicate only partial success in achieving the intended goal. PG-IAT brought better congruence than G-IAT, but failed to improve strength, a possible focus for future research.

Social desirability significantly predicted scores on explicit evaluation of *guṇās*. Observing such trends in yoga students was surprising, as longer practice of yoga is generally thought to lead to inner harmony and greater cognitive resonance. Contrary to expectations, results showed the opposite trend. This may be due to the following reason: as students read and learn more about the *guṇā* concept during their academic training and become more familiar with it, they gain an image of how a person's *guṇās* should ideally be. This ideal notion about *guṇās* may be better crystallized intellectually rather than reflecting on one's personality. When reporting on *guṇās* explicitly through questionnaires, students may respond, by stating what they should be rather than what they are. Though such a phenomenon would obscure results, to label it self-presentation bias needs reconsideration. Though it may appear a kind of social desirability effect, such a *presentation bias* could occur implicitly (without conscious awareness) and, perhaps, even without the intention to appear socially desirable. This possibility is supported by the data concerning the influence of education on implicit-explicit correlations. Postgraduates scored higher on G-IAT than undergraduates, in whom the concept of *guṇās* may be less crystallized. To clarify this aspect of social desirability in yoga students, further research is needed.

Recently, questionnaires have been developed distinguishing answers to two categories of question: (1) 'What do you think about this ideal?', and (2) 'What you think about this personally for you?' (Fisher, 2010). Contextual manipulation

through instructions given is known to increase the predictive validity of explicit measures (Tourangeau & Rasinski, 1988). Such approaches could also be used to evaluate this aspect of social desirability in yoga students. However, in keeping with the field, we would like to consider this phenomenon in yoga students as a type of social desirability, and propose to term it ‘*Guṇā* dissonance’, a mismatch between ‘what I consider an ideal *guṇā* is’ and ‘how much do I think I have it’. Expression of *guṇā* dissonance could be both because of self-presentation and knowledge expression. Another piece of evidence which indicates more implicit knowledge expression than self-presentation, is that, as years of yoga experience increase, increasing congruence is seen, particularly in practitioners with more than three years yoga experience. This suggests that, in the long run, yoga does bring greater cognitive resonance, i.e. greater implicit-explicit congruence. For beginners, the greater incongruence may be due to an internal dilemma between their already existing value system, and the new value system learned in the course of yoga training.

### **Comparison with the literature:**

The following important observations in our study need discussion in light of the existing literature. 1) The weak validity and reliability of two implicit *guṇā* domains; 2) observed trends in implicit-explicit correlations; and 3) the influence of social desirability on both implicit and explicit evaluation of *guṇās*.

#### **1) Weak validity and reliability of two of the domains of implicit *guṇās*:**

Validity concerns whether the tool is measuring *what it is supposed to measure*. Here, validity for implicit *guṇās* would mean that the tool really assesses

the construct, *triguṇā*. This statement presupposes the existence of implicit *guṇās* i.e. implicit self-evaluation of self-concept in terms of *guṇās* is possible. This point requires deeper consideration. Though *triguṇā* may in principle always be present, knowledge of the field in those terms, and also understanding the terminology is equally important for successful implicit evaluation of *guṇās*. If subjects do not know much about the category label / category being assessed, IAT is considered weak or unsuitable (A.G. Greenwald, personal communication, January 03, 2012). In this context, IAT measures not only trait characteristics, but also contextual variations that emerge immediately prior to or during the process of taking the test (Han, Czellar, Olson & Fazio, 2010). Various models for this have been proposed, including MODE (Conrey et al., 2005), Process Diffusion (Schmitz & Teige-Mocigemba, 2007), and Dual Process Models (DeCoster, 2000), which try to identify various determinants of implicit processing. These models attempt separation of different components of variances involved in implicit processing. In general, they suggest that validity of an implicit measure can be compromised by poor assimilation of concept, or by non-specific experimental factors, which usually contribute to unsystematic variances (Correll, 2008). However, certain kinds of systematic variance originate in error rates in the trial by trial analysis, so that valuable information can be gathered from apparently useless error data: one example is 1/f noise (Correll, 2008) said to be a carrier signal of ‘working mind’ (Correll, 2008). 1/f is said to be influenced by effort and difficulty of tasks; social desirability factors could be studied from this perspective. 1/f noise emerges from dynamic systems operating at the Edge of Chaos (as cited in Correll, 2008). Observed 1/f noise in measures of response time, indicate the presence of self-

organized criticality in corresponding brain functions (as cited in Correll, 2008). Hence future studies of implicit expressions could study such factors to refine our understanding of them.

## **2) Observed trend of implicit-explicit correlations:**

Implicit-explicit congruence may be challenged by various factors, one being the internal consistency of the measures themselves: the maximum limit of correlations between measures is limited by the internal consistency of each measure. Implicit and explicit modes of evaluation are mediated by other factors, like effort, availability heuristics, etc. (Nosek, 2007). Generally, constructs that are sensitive to social opinions or difficult to introspect exhibit low implicit-explicit correlations (Nosek, Greenwald & Banaji, 2005). Less sensitive constructs usually exhibit larger correlations, and models like those described above can be used to identify possible reasons for poor implicit-explicit congruence (Hofmann, Gschwendner, Nosek & Schmitt, 2005). In our study low implicit-explicit correlation may be due to lack of proper implicit understanding of the construct, and also partly due to social desirability.

## **3) Influence of social desirability on implicit and explicit evaluation of *guṇās*:**

Social desirability is a common human tendency to present oneself more favourably than is really the case. Paulhus's model of social desirability is well known, which describes two modes of self-deception- egoistic and moralistic biases (Paulhus & John, 1998). Social desirability can arise due to self-deception and impression management. Self-deception is the unconscious tendency to present oneself favourable. Impression management is a deliberate act to be socially desirable (Dodaj, 2012). Both the egoistic and the moralistic biases involve self-deception and impression management styles. Egoistic bias is the tendency to

exaggerate one's abilities. Moralistic bias is the tendency to neglect socially undesirable behaviour and thereby claiming positive social image. Hence social desirability has the unconscious self-deception and conscious impression management. In our study, the cause for self-presentation bias may be interpreted a little differently. As students learn more about the concept of *guṇās*, they tend to respond to 'what should be' rather than 'what they are', in spite of explicit instruction to report the aspect of 'what they are'. Hence self-presentation bias may occur without an intention to be socially desirable, just as an expression of knowledge. This is supported by the trend shown in education as a factor influencing implicit-explicit congruence. However, in our study, we are currently unable to dissociate these two determinants of social desirability. This requires clarification through further experiments.

In summary, implicit and explicit measures of *guṇas* are different, and their differences are significantly moderated by the social desirability factor. Hence the study of implicit measures of *guṇa* may be essential to fully understand them. Implicit-explicit correlations were weak. Test-retest reliability was better after 17 days than after 30 days. Correlations between explicit self-report measures were moderate to high and all in the theoretically expected direction. However this study strongly indicates that relying on explicit measures alone may not yield a comprehensive picture of a person; hence the development and refinement of an implicit tool to access *guṇa* is essential. Personalized G-IAT, in which subjects choose their own words of association with *guṇas* may improve implicit-explicit

correlations; also, administering G-IAT in the native language may marginally enhance the strength of the IAT effect.

### **8.3 YOGA- IAT STUDY**

Another objective of the study was to determine whether we can assess implicit preferences for yoga using the IAT paradigm. Sample selection of those who had expressed strong explicit preference toward yoga was appropriate. Results showed the study sample had only moderate implicit preference towards yoga. These preliminary results suggest that we can measure implicit preference towards yoga. 90% of participants had shown various degrees of positive implicit preference for yoga. The low correlation indicates the possible extraneous influence of self-presentation biases, so study of the influence of social desirability factors on implicit preference for yoga is important. In the current study no measure of self-presentation bias was taken for this, so we could not evaluate its mediating effect.

Y-IAT's application is restricted to those familiar with yoga, since category labels and stimuli used were words related to yoga. But IATs may not always reflect actual preference, as these may be clouded by strong beliefs. For instance, if we wrongly estimate our own beliefs in something, those wrong notions will show up in implicit assessment. Such discrepancy information is highly valuable, both clinically and for general research.

We suggest further studies to evaluate discriminant validity, i.e., to decide if non-yoga subjects show negative or weak preferences towards yoga. Predictive validity should also be attempted, as the current study does not predict outcome of yoga practice or adherence to it. As a further step, an attempt should be made to reproduce and generalize results in different samples. Specifically, for Y-IAT, other psychometric properties need to be evaluated. Another general requirement for

implicit cognition studies in yoga research is the development of a normative pool of visual and verbal stimuli. The International Affective Picture System (IAPS) (Lang, Bradley & Cuthbert, 2008) is a database that provides a set of normative emotional stimuli for experimental investigations of emotion and attention. Development of such databases for yoga studies would help develop evidence that could be compared across experiments. Mechanisms of cognitive refinement brought about by yoga practices are intricate and definitely involve unconscious or implicit factors. To realize this need of the hour, use of implicit tools is highly encouraged.

When fully developed, Y-IAT will have application in academic settings, especially in yoga universities, to assess students' growth and inherent interest in yoga. We should also be able to determine whether the explicit score or implicit score is a better predictor of future academic performance. IATs can also be used to assess constructs that are difficult to self-report. In these ways, the IAT paradigm can be used to overcome self-presentation biases in the field of yoga.

## **CHAPTER – 9.0**

# **APPRAISAL**

<b>CHAPTER</b>	<b>DETAILS</b>	<b>PAGE.NO</b>
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## 9.0 APPRAISAL

### 9.1 SUMMARY

In this thesis, we have attempted to bring to the attention of yoga researchers, an implicit tool that assesses various constructs in yoga (*guṇas* and attitude towards yoga) which are more prone to self-presentation bias or constructs which are difficult to self-report. They are summarized as:

- 1) Language of presentation of IAT does not significantly influence the IAT D scores in Indian population, especially those who are equally using their native and English language.
- 2) The validity and reliability were found to be satisfactory only for *satva* and not for *rajas* and *tamas*.
- 3) Assessment of *guṇas* on students' population of yoga courses showed influence of social desirability factor.
- 4) The implicit-explicit correlations were weak for *guṇas*.
- 5) Test-retest reliability of G-IAT was relatively more stable after 17 days than 30 days.
- 6) Personalized G-IAT also revealed the same trend as G-IAT, with improved implicit-explicit congruence for *rajas* and *tamas* domains compared to G-IAT.
- 7) An implicit tool to assess preference towards yoga showed a moderate implicit preference on a yoga population, here also social desirability might have influenced the results.

The results clearly point out that assessment of through questionnaires is not devoid of self-presentation biases. Hence future assessment of *guṇas* should consider this factor in order to have a valid assessment of a person's personality.

This IAT paradigm can also be used in other areas of Yoga where social desirability or unawareness about the construct may obscure the results.

## **9.2 CONCLUSION**

Implicit tools should be considered along with explicit measures to assess social desirable constructs in yoga like *guṇas*. Administration of IAT in Indian populations can be either in English or in the native language, especially for those bilinguals who used their native language to the same extent as the English. Reliability of G-IAT becomes weaker over 15 days. This new methodology to assess implicit attitudes and preferences can be used in yoga research.

## **9.3 STRENGTH OF THE STUDY**

- 1) First report of using the IAT paradigm in Indian populations, and also in the field of yoga.
- 2) Brings out an important mediating factor of social desirability on explicit evaluation of *guṇas*.

## **9.4 LIMITATIONS OF THE STUDY**

- 1) The tool can be applied only to people or students who have yoga background. It means this tool cannot be used on those who do not know the concept of *guṇas*.
- 2) The sample sizes of the two major studies were a bit low. Though a consistent trend was observed, higher power can be achieved by using a larger sample size.
- 3) Did not use more sophisticated statistical procedures for analysis like multilevel modeling.

## 9.5 APPLICATION OF THE STUDY

This tool can be extended and applied in assessing those constructs which subjects deliberately try to bias their responses or are unaware of their inherent biases/ implicit preferences. In Yoga there are many constructs which are difficult to self-report like experience of meditation, our evaluation about our spiritual growth, etc. For such difficult constructs where either social desirability factor or other factors might influence, implicit tools can be used.

## 9.6 SUGGESTIONS FOR FUTURE WORK

In future, the *Guṇa*-IAT can undergo further rigorous validation by administering the tool on varied populations, especially across cultures. Other constructs in yoga like inherent attitude towards karma yoga etc., can be assessed. In stress research, unconscious rumination and worry, which causes perseverative cognition, can be assessed. We propose the following eight guidelines for empirical work in *guṇas*:

- 1) Theoretical framework and ontology validation of *guṇas* must be attempted, including the role of free will.
- 2) Operational definition must be stated clearly in each study.
- 3) Valid and reliable tools to assess *guṇas* must be promoted and use of the existing tools must be encouraged further.
- 4) Implicit tools of assessing *guṇas* must be initiated as it might give new dimensions of *guṇa* concepts.
- 5) More statistically intense procedures must be used like dimensional reduction, and factor analysis.

- 6) Confirmatory and replication study must be conducted to add stronger evidences.
- 7) Integration with other contemporary theories.

Cross cultural variations must be studied for *guṇa* construct.

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# **APPENDICES**

**APPENDIX -1: INSTITUTIONAL ETHICS COMMITTEE APPROVAL AND INFORMED CONSENT**

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## APPENDIX - 1

INSTITUTIONAL ETHICS COMMITTEE APPROVAL AND INFORMED  
CONSENT

	<p style="text-align: center;"><b>स्वामी विवेकानन्द योग अनुसंधान संस्थान</b> <b>Swami Vivekananda Yoga Anusandhana Samsthana</b></p>				
	<p style="text-align: center;">A University, established under Section 3 of the UGC Act, 1956 vide Notification No. F.9-45/2001-U.3 dated 08-05-2001 of the Government of India No. 19, 'Eknath Bhavan', Gavipuram Circle, Kempegowda Nagar, Bangalore - 560 019. Ph : 26612669 Telefax : 26608645 e-mail : svyasabl@yahoo.com website : www.vyasa.org</p>				
<p>Date: February 4, 2012</p>					
<p>RES/IEC-SVYASA/06/2011</p>					
<p>To, Prof. Alex Hankey, Division- Yoga and Management, S-VYASA University, Bengaluru, Karnataka</p>					
<p>Reference: Development and Validation of a <i>Guna</i>-Implicit Association Test (G-IAT), and Its Application to Investigate the Relationship between Implicit and Explicit Evaluations of <i>Gunas</i>: Ethics Committee Approval of the above mentioned study.</p>					
<p>Dear Prof. Hankey, We have received from you 6 copies of each of following study related documents vide your letter dated November 4, 2011</p>					
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">1</td> <td>Proposed project</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Informed consent form</td> </tr> </table>		1	Proposed project	2	Informed consent form
1	Proposed project				
2	Informed consent form				
<p>Ethics committee meeting was held on January 29, 2012 at 11 am and your referenced letter and the above documents were examined and discussed. After due consideration, the committee has decided to approve the conduct of the aforementioned study at Swami Vivekananda Yoga AnusandhanaSamsthana (SVYASA), Bengaluru.</p>					



स्वामी विवेकानन्द योग अनुसंधान संस्थान  
Swami Vivekananda Yoga Anusandhana Samsthana

A University, established under Section 3 of the UGC Act, 1956 vide  
Notification No. F.9-45/2001-U.3 dated 08-05-2001 of the Government of India  
No. 19, 'Eknath Bhavan', Gavipuram Circle, Kempegowda Nagar, Bangalore - 560 019.  
Ph : 26612669 Telefax : 26608645  
e-mail : svyasabr@yahoo.com website : www.vyasa.org

We approve trial to be conducted in its presented form at Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA), Bengaluru.

This is to confirm that neither Prof. Alex Hankey nor any study staff participating in this study were involved in the voting procedures and decision making for these study documents.

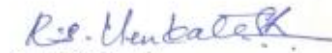
The Institutional Review Board / Independent Ethics Committee expected to be informed about the progress of the study, any changes in the protocol and patient information / informed consent. The investigators are also expected to submit a copy of the final report to IEC for records.

This approval is valid up to the completion of the study at this site.

Please submit to the EC the status report of the study as per EC SOP's.

The EC is organized & operates according to the requirements of ICH – GCP, Indian Council of Medical Research guidelines & Schedule Y.

Best wishes,

  
R. S. Venkatesh,  
Member Secretary,  
Institutional Ethics Committee,  
SVYASA, Bengaluru

Date: February 4, 2012

1).

**Participant Informed Consent**

Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore

Study title: Development and Validation of a Guna-Implicit Association Test (G-IAT), and Its Application to Investigate the Relationship between Implicit and Explicit Evaluations of Gunas.

Principal Investigator: V. Judu Iyavarasu, Ph.D. Scholar, Division of Yoga and Management, SVYASA, Bangalore. (Phone No: +919035730812)

Faculty Adviser: Dr. Alex Hankey, Professor, Division of Yoga and Physical Sciences, SVYASA, Bangalore. (Phone No: +918277365084)

This study is to validate an implicit tool to measure gunas (personality characteristics). This would help in developing better and precise tool to measure gunas. These assessments consist of a categorization task and questionnaires. The whole session will be delivered through computer and may take approximately 45 minutes

No incentives will be provided for participating in this study. However, if you wish results of your test scores will be sent to you through e-mail. Your valuable participation would help establish validity of a new tool to measure gunas, which is of high practical application and will contribute to the field of yoga and psychology research.

No potential risks are anticipated by undergoing these tests. Spending 45 minutes before monitor may cause eye fatigue, and tiredness. However, discomfort will not exceed minimal risk. You are free to express any discomfort or problem during your test session to the test administrator. You are free to withdraw your participation at any point of the study without penalty.

This assessment session is coded. In demographic sheet, giving your name is optional. If you need your results, you may provide your e-mail ID. No other sensitive information is collected. All information obtained in this study is strictly confidential unless disclosure is required by law.

**Voluntary Consent by Participant**

I agree that I have read this informed consent fully. I fully understand the contents of this document and am openly willing to consent to take part in this study. I am 18 years of age or older and am agreeing to participate in this study voluntarily. All the queries related to my participation were clarified to me and in case of any problem or further clarification I may contact the above mentioned persons.

I agree  I do not agree

**Confirm**

**APPENDIX - 2: INSTRUMENTS USED****1) Demographic Details**

Please answer the following demographic questions

**1). Name (Optional)****2). Age****3). Gender**

- Male  
 Female

**4). Marital Status**

- Married  
 Unmarried

**5). e-mail ID (If results required)****6). Education (Course currently doing)**

- Undergraduate  
 Postgraduate

**7). Occupation**

Please answer the following demographic questions (continued)

8). Do you have earlier experience of yoga practice?

- No experience
- 0-6 months
- 6-12 months
- 1-3 years
- 3-5
- Above 5 years

9). What is your mother tongue?

10). Medium of Instruction in school

- English
- Hindi
- Other language
- More than one medium

11). How often do you use your mother tongue compared to English?

- Very often
- Almost Equally
- Less often

12). How well do you know the concept of Gunas?

- Very little
- Moderate
- Very Well

Back

Finish

## 2) Feeling Thermometer

### Feeling Thermometer (FT)

For each of the following statements, please choose the point on the scale (10 levels/points) that you feel is most appropriate in describing you.

1). In general, I consider myself:



2). In general, I consider myself:



3). In general, I consider myself:



4). My confidence in the above ratings is:



Finish

### 3) The Vedic Personality Inventory

#### Vedic Personality Inventory

Please rate each of the following statements using the scale provided below.

Select best describes your own opinion of what is generally true for you

1). I am straightforward in my dealings with other people.

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

2). I have very little interest in spiritual understanding.

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

3) I am satisfied with my life

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

4) Fruits and vegetables are among my favorite foods

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

5) All living entities are essentially spiritual

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

6) In conducting my activities, I do not consider traditional wisdom

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

7) I often act without considering the future consequences of my actions

Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

Next

**Please rate each of the following statements similarly.**

8). I usually feel discontented with life.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

9). I become happy when I think about the material assets that I possess.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

10). I am good at using willpower to achieve goals.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

11). I enjoy spending time in bars (or public places of enjoyment)

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

12). Cleanliness is very important to me.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

13). Others say that my intelligence is very sharp.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

14). I often feel depressed.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

15). I often put off or delay my responsibilities.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

16). I greatly admire materially successful people.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

17). When I speak, I really try not to irritate others.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

18). I believe life is over when the body dies.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

19). I often feel helpless.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

20). I enjoy foods with strong tastes.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

21). I am constantly dissatisfied with my position in life.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

22). Having possessions is very important to me.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

23). When things are tough, I often bail out (withdraw).

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

24). I often feel like a victim (Victim=one who suffers from problem/situation).

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

25). I feel that my knowledge is always increasing.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

26). I prefer city night life to a walk in the forest.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

27). For me, sex life is a major source of happiness.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

28). I take guidance from higher ethical and moral laws before I act.

- Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

- 29). I enjoy intoxicating substances (including coffee, cigarettes and alcohol).  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 30). I often feel greedy.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 31). I become greatly distressed when things don't work out for me.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 32). I am often angry  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 33). I often feel fearful.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 34). I do not have doubts about my responsibilities in life.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 35). I often feel emotionally unbalanced.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 43). I often neglect my responsibilities to my family.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 44). I am easily affected by the joys and sorrows of life.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 45). I often whine (Talk in a tearful manner).  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 46). Regardless of what I acquire or achieve, I have an uncontrollable desire to obtain more.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 47). I am currently struggling with an addiction, physical or psychological, to some type of intoxicant (including caffeine, cigarettes and alcohol).  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 48). I often envy (ill-will) others.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 49). My job is a source of anxiety.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 50). I never think about giving up my wealth and position for a simpler life.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 51). It often happens that those things that brought me happiness later become the source of my suffering.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 52). I often feel mentally unbalanced.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 53). I don't have much will power.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 54). I often neglect my responsibilities to my friends.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 55). I often act violently towards others.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree
- 56). I am good at controlling my senses and emotions.  
 Very Strongly Disagree  Strongly Disagree  Somewhat Disagree  Neutral  Somewhat Agree  Strongly Agree  Very Strongly Agree

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[Finish](#)

### 4) Satisfaction with Life Scale

**The Satisfaction with Life Scale.**

**DIRECTIONS: Below are five statements with which you may agree or disagree. Using the 1-7 scale below, indicate your agreement with each item by selecting appropriate point. Please be open and honest in your responding.**

- 1). In most ways my life is close to my ideal.  
 Strongly Disagree    Disagree    Slightly Disagree    Neither Agree or Disagree    Slightly Agree    Agree    Strongly Agree
- 2). The conditions of my life are excellent.  
 Strongly Disagree    Disagree    Slightly Disagree    Neither Agree or Disagree    Slightly Agree    Agree    Strongly Agree
- 3). I am satisfied with life.  
 Strongly Disagree    Disagree    Slightly Disagree    Neither Agree or Disagree    Slightly Agree    Agree    Strongly Agree
- 4). So far I have gotten the important things I want in life.  
 Strongly Disagree    Disagree    Slightly Disagree    Neither Agree or Disagree    Slightly Agree    Agree    Strongly Agree
- 5). If I could live my life over, I would change almost nothing.  
 Strongly Disagree    Disagree    Slightly Disagree    Neither Agree or Disagree    Slightly Agree    Agree    Strongly Agree

**Finish**

### 5) Heartland Forgiveness Scale

**Heartland Forgiveness Scale**

**Directions: In the course of our lives negative things may occur because of our own actions, the actions of others, or circumstances beyond our control. For some time after these events, we may have negative thoughts or feelings about ourselves, others, or the situation. Think about how you typically respond to such negative events. Please select the appropriate from the 7-point scale below that best describes how you typically respond to the type of negative situation described. There are no right or wrong answers. Please be as open as possible in your answers.**

- 1). Although I feel bad at first when I mess up (disturb/destroy), over time I can give myself some slack (being loose/ less hard).  
 Almost Always False of Me    More Often False of Me    More Often True of Me    Almost Always True of Me
- 2). I hold grudges (ill-will) against myself for negative things I've done.  
 Almost Always False of Me    More Often False of Me    More Often True of Me    Almost Always True of Me
- 3). Learning from bad things that I've done helps me get over them.  
 Almost Always False of Me    More Often False of Me    More Often True of Me    Almost Always True of Me
- 4). It is really hard for me to accept myself once I've messed up (disturbed/destroyed).  
 Almost Always False of Me    More Often False of Me    More Often True of Me    Almost Always True of Me

**Next**

- 5). With time I am understanding of myself for mistakes I've made.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 6). I don't stop criticizing myself for negative things I've felt, thought, said, or done.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 7). I continue to punish a person who has done something that I think is wrong.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 8). With time I am understanding of others for the mistakes they've made.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 9). I continue to be hard on others who have hurt me.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 10). Although others have hurt me in the past, I have eventually (finally) been able to see them as good people.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 11). If others mistreat me, I continue to think badly of them.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 12). When someone disappoints me, I can eventually (finally) move past (easily let-go) it.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 13). When things go wrong for reasons that can't be controlled, I get stuck in negative thoughts about it.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 14). With time I can be understanding of bad circumstances in my life.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 15). If I am disappointed by uncontrollable circumstances in my life, I continue to think negatively about them.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 16). I eventually (finally) make peace with bad situations in my life.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 17). It's really hard for me to accept negative situations that are not anybody's fault.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me
- 18). Eventually (finally) I let go of negative thoughts about bad circumstances that are beyond anyone's control.
- Almost Always False of Me     More Often False of Me     More Often True of Me     Almost Always True of Me

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[Finish](#)

## 6) STAI- Trait Questionnaire

### STAI- Trait Questionnaire

**Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then select the appropriate number to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel..**

1) I feel pleasant

Not At All  Somewhat  Moderately So  Very Much So

2) I feel nervous and restless

Not At All  Somewhat  Moderately So  Very Much So

3) I feel satisfied with myself

Not At All  Somewhat  Moderately So  Very Much So

4) I wish I could be as happy as others seem to be

Not At All  Somewhat  Moderately So  Very Much So

5) I feel like a failure

Not At All  Somewhat  Moderately So  Very Much So

6) I feel rested

Not At All  Somewhat  Moderately So  Very Much So

7) I am "calm, cool, and collected"

Not At All  Somewhat  Moderately So  Very Much So

Next

8) I feel that difficulties are piling up (build up/ increase) so that I cannot overcome them

Not At All  Somewhat  Moderately So  Very Much So

9) I worry too much over something that really doesn't matter

Not At All  Somewhat  Moderately So  Very Much So

10) I am happy

Not At All  Somewhat  Moderately So  Very Much So

11) I have disturbing thoughts

Not At All  Somewhat  Moderately So  Very Much So

12) I lack self-confidence

Not At All  Somewhat  Moderately So  Very Much So

13) I feel secure

Not At All  Somewhat  Moderately So  Very Much So

14) I make decisions easily

Not At All  Somewhat  Moderately So  Very Much So

15). I feel inadequate

- Not At All    Somewhat    Moderately So    Very Much So

16). I am content (satisfied)

- Not At All    Somewhat    Moderately So    Very Much So

17). Some unimportant thought runs through my mind and bothers me

- Not At All    Somewhat    Moderately So    Very Much So

18). I take disappointment so keenly that I can't put them out of my mind

- Not At All    Somewhat    Moderately So    Very Much So

19). I am a steady person

- Not At All    Somewhat    Moderately So    Very Much So

20). I get in a state of tension or turmoil as I think over my recent concerns and interests

- Not At All    Somewhat    Moderately So    Very Much So

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Finish

## 7) Active Procrastination Questionnaire

### ACTIVE PROCRASTINATION QUESTIONNAIRE

**Directions: The following questions ask about your actual use of time. Please rate yourself according to the scale provided and circle a number that best describes you.**

1). My performance tends to suffer when I have to race against deadlines.

- Not at all true                   Very true

2). I don't do well if I have to rush through a task.

- Not at all true                   Very true

3). If I put things off (delay) until the last moment, I'm not satisfied with their outcomes.

- Not at all true                   Very true

4). I achieve better results if I complete a task at a slower pace, well ahead of a deadline.

- Not at all true                   Very true

5). It's really a pain for me to work under upcoming deadlines.

- Not at all true                   Very true

6). I'm upset and reluctant to act when I'm forced to work under pressure.

- Not at all true                   Very true

7). I feel tense and cannot concentrate when there's too much time pressure on me.

- Not at all true                   Very true

Next

- 8). I'm frustrated when I have to rush to meet deadlines.
- Not at all true                     Very true
- 9). To use my time more efficiently, I deliberately postpone some tasks.
- Not at all true                     Very true
- 10). I intentionally put off work to maximize my motivation.
- Not at all true                     Very true
- 11). In order to make better use of my time, I intentionally put off some tasks.
- Not at all true                     Very true
- 12). I finish most of my assignments right before deadlines because I choose to do so.
- Not at all true                     Very true
- 13). I often start things at the last minute and find it difficult to complete them on time.
- Not at all true                     Very true
- 14). I often fail to accomplish goals that I set for myself.
- Not at all true                     Very true
- 15). I'm often running late when getting things done.
- Not at all true                     Very true
- 16). I have difficulty finishing activities once I start them
- Not at all true                     Very true
- 

## 8) Marlowe-Crowne Social Desirability Scale

### Marlowe-Crowne Social Desirability Scale

**Directions: Listed below are a number of statements concerning personal attitudes and traits. Please read each item and decide whether the statement is true or false as it applies to you. For each item, please select TRUE or FALSE.**

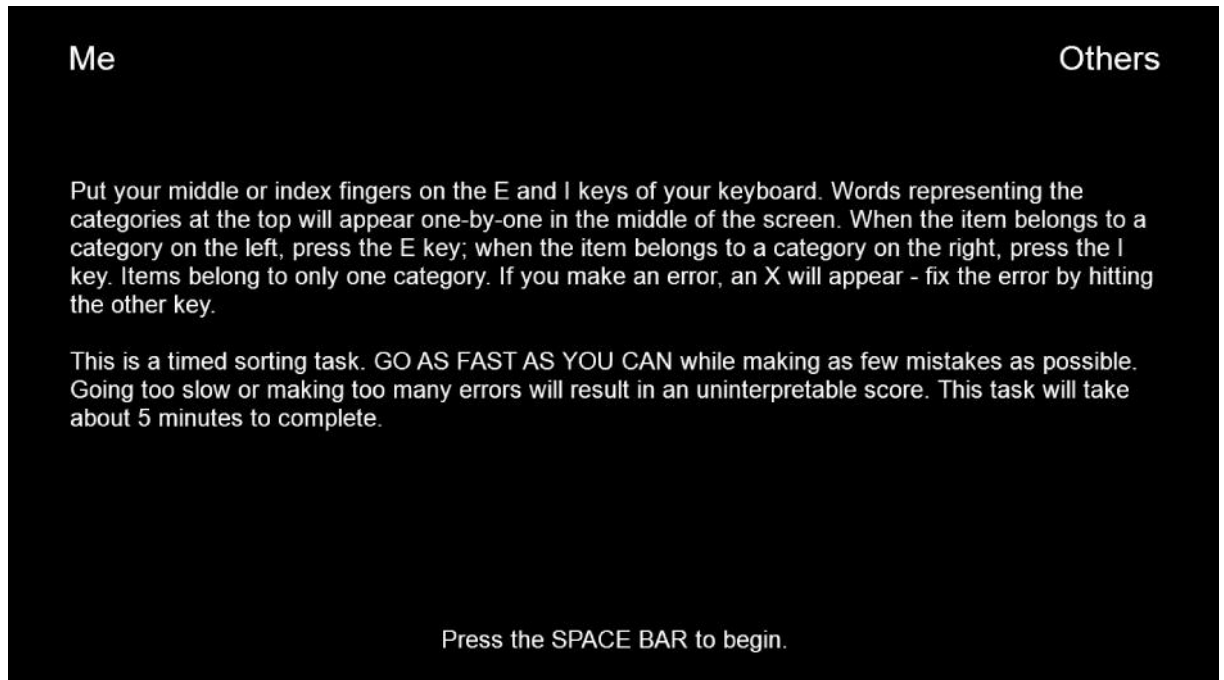
- 1). Before voting I thoroughly investigate the qualifications of all the candidates.
- True     False
- 2). I never hesitate to go out of my way to help someone in trouble. (to go out of way = going beyond capacity)
- True     False
- 3). It is sometimes hard for me to go on with my work if I am not encouraged.
- True     False
- 4). I have never intensely disliked anyone.
- True     False
- 5). On occasion I have had doubts about my ability to succeed in life.
- True     False
- 6). I sometimes feel resentful (ill-will) when I don't get my way.
- True     False
- 7). I am always careful about my manner of dress.
- True     False

- 8). My table manners at home are as good as when I eat out at a restaurant.  
 True  False
- 9). If I could get into a movie without paying and be sure I was not seen I would probably do it.  
 True  False
- 10). On a few occasions I have given up doing something because I thought too little of my ability.  
 True  False
- 11). I like to gossip at times.  
 True  False
- 12). There have been times when I felt like rebelling (fight) against people in authority, even though I knew they were right  
 True  False
- 13). No matter who I am talking to, I am always a good listener.  
 True  False
- 14). I can remember 'playing sick' (act differently) to get out of something.  
 True  False
- 15). There have been occasions when I took advantage of someone.  
 True  False
- 16). I am always willing to admit when I made a mistake.  
 True  False
- 
- 17). I always try to practice what I preach.  
 True  False
- 18). I don't find it particularly difficult to get along (go with) with loud-mouthed (talk badly), obnoxious (bad) people.  
 True  False
- 19). I sometimes try to get even (calming by accepting) rather than forgive and forget.  
 True  False
- 20). When I don't know something, I don't mind at all admitting it.  
 True  False
- 21). I am always courteous (polite), even to people who are disagreeable.  
 True  False
- 22). At times I have really insisted (wish strongly) on having things my own way.  
 True  False
- 23). There have been occasions when I felt like smashing (breaking) things.  
 True  False
- 24). I would never think of letting someone else be punished for my wrongdoings.  
 True  False

- 25). I never resent (feel bitter/ ill-will) being asked to return a favour.  
 True  False
- 26). I have never been irked (irritated) when people expressed ideas very different from my own.  
 True  False
- 27). I never make a long trip without checking the safety of my car/ vehicle.  
 True  False
- 28). There have been times when I was quite jealous of the good fortune (luck/ wealth) of others.  
 True  False
- 29). I have almost never felt the urge to tell someone off (bad/ unpleasant).  
 True  False
- 30). I am sometimes irritated by people who ask favours of me.  
 True  False
- 31). I have never felt that I was punished without cause.  
 True  False
- 32). I sometimes think when people have a misfortune they only got what they deserved.  
 True  False
- 33). I have never deliberately said something that hurt someone's feelings.  
 True  False

[Back](#)[Finish](#)

**APPENDIX- 3**  
**GUNA-IAT EXPERIMENTAL SCHEME**



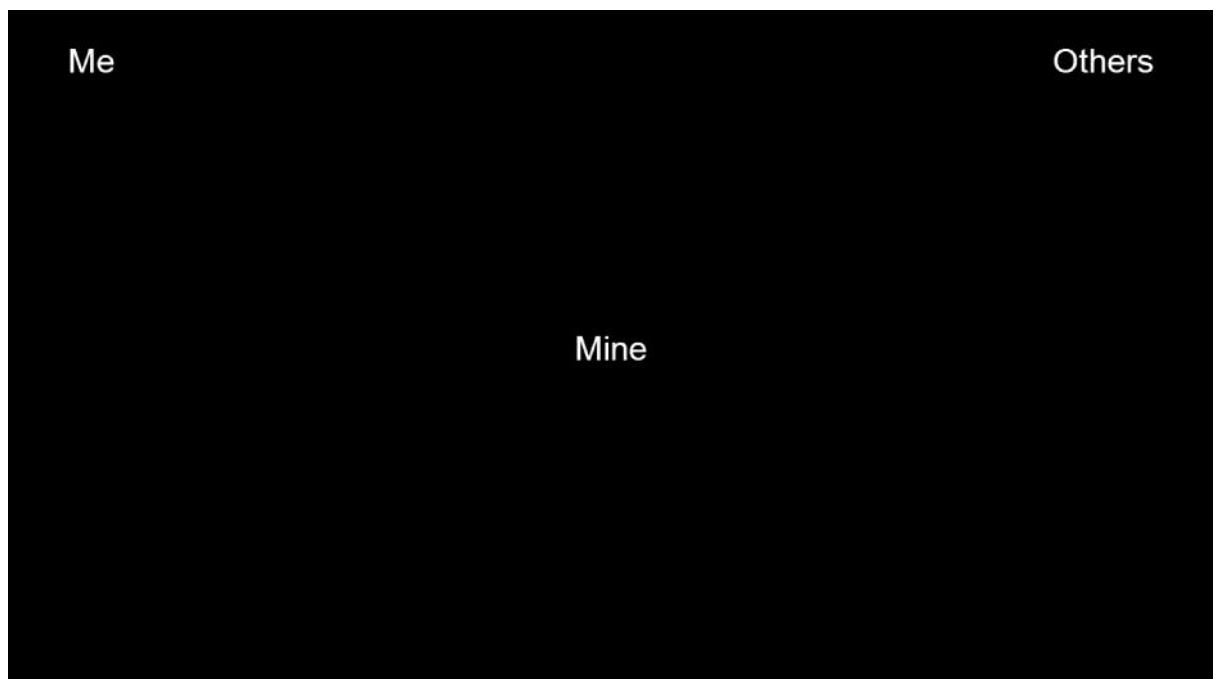
Me Others

Put your middle or index fingers on the E and I keys of your keyboard. Words representing the categories at the top will appear one-by-one in the middle of the screen. When the item belongs to a category on the left, press the E key; when the item belongs to a category on the right, press the I key. Items belong to only one category. If you make an error, an X will appear - fix the error by hitting the other key.

This is a timed sorting task. GO AS FAST AS YOU CAN while making as few mistakes as possible. Going too slow or making too many errors will result in an uninterpretable score. This task will take about 5 minutes to complete.

Press the SPACE BAR to begin.

**Screen 1: Instruction screen before the beginning of the G-IAT task**



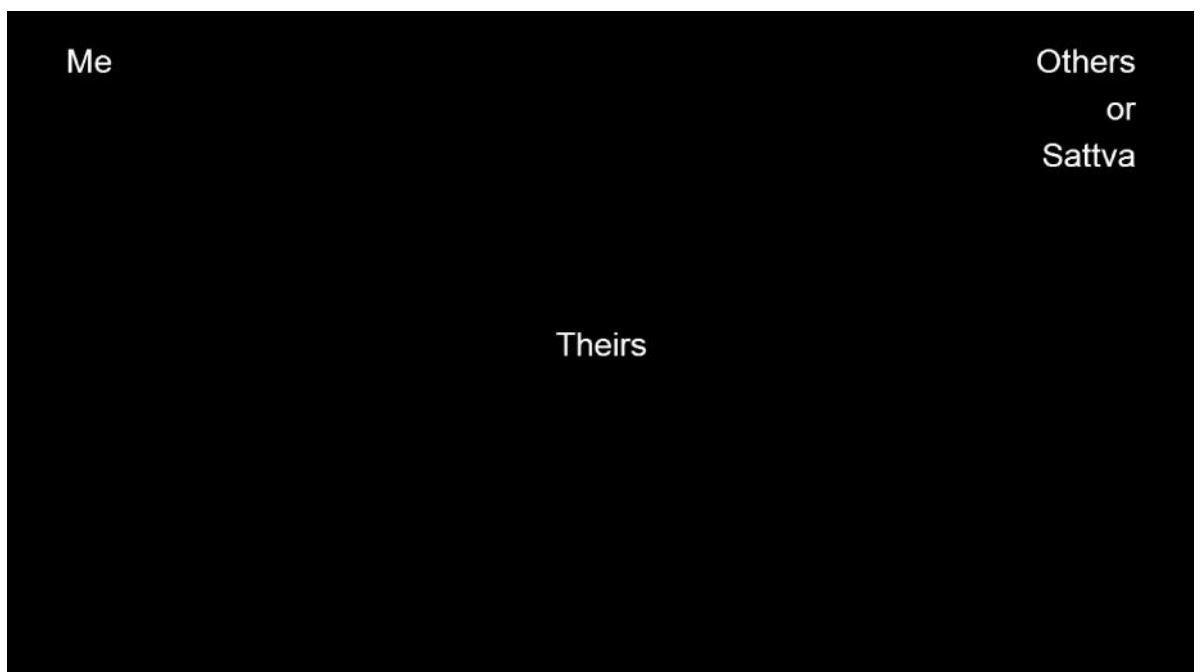
Me Others

Mine

**Screen 2: Block 1, in which the words related to the target categories (Me or Others) are categorized.**



**Screen 3: Block 3 is the combined task in which target category Me is paired with Sattva.**



**Screen 4: Block 4 is the combined task in which target category Others is paired with Sattva.**

**APPENDIX - 4: EXPERIMENTAL AND SCORING SCRIPTS****Scoring script in R for extracting raw data from IAT**

```
#####
# Date created: 12-Jan-2012

# Script developed at S-VYASA Yoga University (http://www.svyasa.org)
# This script was developed as per the guidelines of revised scoring algorithm
suggested by (Greenwald, Nosek, & Banaji, 2003):
# Greenwald, A. G, Nosek, B. A., & Banaji, M. R. (2003). Understanding and
using the Implicit Association Test: I. An improved scoring
# algorithm. Journal of Personality and Social Psychology, 85, 197-216.
# This R script will handle data files generated from INQUISIT program. If you are
using Inquisit and you have multiple files, Inquisit 4 offers
# to merge them all. The is available under file options. INQUISIT software can be
downloaded from https://www.millisecond.com/download/
# To report any bug or clarification in using this script, mail us at:
judu[AT]svyasa.org (Replace [AT] with @)
# Note: Line starting with # is a comment line and may be ignored.
# To run this script, copy the entire script to R script file and run the whole script.
The program will prompt you to choose a data file for
# analysis (INQUISIT FILES ONLY). Select the file and the excel output will be
delivered to D: drive with a file name IAT output file.xlsx
#####

# Implicit Association Test (IAT) scoring Script
# Get file from the source
getFile<-file.choose()
iat1 <- read.table(getFile, header=TRUE, sep="\t", na.strings="NA",
strip.white=TRUE)

# Error percentage, Average Latency calculation for test block trial.
# All these calculations are done before any trial elimination
# Subset of only test trails
iat1<- subset(iat1, subset=blockcode!="targetincompatiblepractice" &
blockcode!="targetcompatiblepractice" & blockcode!="attributepractice")
# Calculation of total number of test trails attempted
iatValid <- aggregate(iat1[,c("correct"), drop=FALSE],
by=list(subject=iat1$subject), FUN=length)
iatValid$valid<-iatValid$correct
iatValid$correct<-NULL
# Calculation of Average latency for each subject
iatMeanLat <- aggregate(iat1[,c("latency"), drop=FALSE],
by=list(subject=iat1$subject), FUN=mean)

# Calculation of error percentage
iatError <- subset(iat1, subset=correct==1)
```

```

iatError <- aggregate(iatError[,c("correct"), drop=FALSE],
by=list(subject=iatError$subject), FUN=length)
iatError<- merge(iatError, iatValid, by="subject")
iatError$ErrPer<-((iatError$valid-iatError$correct)/iatError$valid)*100
iatError$correct<-NULL

# Percentage of trials < 300 ms
iat300 <- subset(iat1, subset=latency<300)
iat300 <- aggregate(iat300[,c("correct"), drop=FALSE],
by=list(subject=iat300$subject), FUN=length)
iat300<- merge(iat300, iatValid, by="subject",all=TRUE)
iat300$Err300<-((iat300$correct/iat300$valid)*100)
iat300$correct<-NULL
iat300$valid<-NULL
iat300$Err300 [is.na(iat300$Err300)]<-0
iat300 <-iat300[,c("subject", "Err300")]

# Percentage of trials < 400 ms
iat400 <- subset(iat1, subset=latency<400)
iat400 <- aggregate(iat400[,c("correct"), drop=FALSE],
by=list(subject=iat400$subject), FUN=length)
iat400<- merge(iat400, iatValid, by="subject",all=TRUE)
iat400$Err400<-((iat400$correct/iat400$valid)*100)
iat400$correct<-NULL
iat400$valid<-NULL
iat400$Err400 [is.na(iat400$Err400)]<-0
iat400 <-iat400[,c("subject", "Err400")]

# Percentage of trials > 10,000 ms
iat10k <- subset(iat1, subset=latency>10000)
iat10k <- aggregate(iat10k[,c("correct"), drop=FALSE],
by=list(subject=iat10k$subject), FUN=length)
iat10k<- merge(iat10k, iatValid, by="subject",all=TRUE)
iat10k$Err10k<-((iat10k$correct/iat10k$valid)*100)
iat10k$correct<-NULL
iat10k$valid<-NULL
iat10k$Err10k [is.na(iat10k$Err10k)]<-0
iat10k <-iat10k[,c("subject", "Err10k")]

# Remove latencies greater than 10,000 msec
iat1 <- subset(iat1, subset=latency<=10000)

# Calculation of Na and Nb
Na <- subset(iat1, subset=blockcode=="incompatiblest1" |
blockcode=="compatiblest1")
Na <- aggregate(Na[,c("correct"), drop=FALSE], by=list(subject=Na$subject),
FUN=length)
Na$Na<-Na$correct
Na$correct<-NULL

```

```

Nb <- subset(iat1, subset=blockcode=="incompatiblest2" |
blockcode=="compatiblest2")
Nb <- aggregate(Nb[,c("correct"), drop=FALSE], by=list(subject=Nb$subject),
FUN=length)
Nb$Nb<-Nb$correct
Nb$correct<-NULL

# Subset main dataset into 4 differnt datasets
incom1 <- subset(iat1, subset=blockcode=="incompatiblest1")
incom2 <- subset(iat1, subset=blockcode=="incompatiblest2")
com1 <- subset(iat1, subset=blockcode=="compatiblest1")
com2 <- subset(iat1, subset=blockcode=="compatiblest2")
sd1 <- subset(iat1, subset=blockcode=="incompatiblest1" |
blockcode=="compatiblest1")
sd2 <- subset(iat1, subset=blockcode=="incompatiblest2" |
blockcode=="compatiblest2")

# Individual block total has to be calculated

# Calculation of N1, N2, N3 and N4
Nc1 <- subset(iat1, subset=blockcode=="compatiblest1")
Nc1 <- aggregate(Nc1[,c("correct"), drop=FALSE], by=list(subject=Nc1$subject),
FUN=length)
Nc1$Nc1<-Nc1$correct
Nc1$correct<-NULL

Nic1 <- subset(iat1, subset=blockcode=="incompatiblest1")
Nic1 <- aggregate(Nic1[,c("correct"), drop=FALSE], by=list(subject=Nic1$subject),
FUN=length)
Nic1$Nic1<-Nic1$correct
Nic1$correct<-NULL

Nc2 <- subset(iat1, subset=blockcode=="compatiblest2")
Nc2 <- aggregate(Nc2[,c("correct"), drop=FALSE], by=list(subject=Nc2$subject),
FUN=length)
Nc2$Nc2<-Nc2$correct
Nc2$correct<-NULL

Nic2 <- subset(iat1, subset=blockcode=="incompatiblest2")
Nic2 <- aggregate(Nic2[,c("correct"), drop=FALSE], by=list(subject=Nic2$subject),
FUN=length)
Nic2$Nic2<-Nic2$correct
Nic2$correct<-NULL

# Other Error components
Err1a <- subset(com1, subset=correct==1)
Err1a <- aggregate(Err1a[,c("correct"), drop=FALSE],
by=list(subject=Err1a$subject), FUN=length)
Err1a<- merge(Err1a, Nc1, by="subject",all=TRUE)

```

```
Err1a$Err1a<-((Err1a$Nc1-Err1a$correct)/Err1a$Nc1)*100
Err1a$correct<-NULL
Err1a$Nc1<-NULL
```

```
Err2a <- subset(incom1, subset=correct==1)
Err2a <- aggregate(Err2a[,c("correct"), drop=FALSE],
by=list(subject=Err2a$subject), FUN=length)
Err2a<- merge(Err2a, Nic1, by="subject",all=TRUE)
Err2a$Err2a<-((Err2a$Nic1-Err2a$correct)/Err2a$Nic1)*100
Err2a$correct<-NULL
Err2a$Nic1<-NULL
```

```
Err1b <- subset(com2, subset=correct==1)
Err1b <- aggregate(Err1b[,c("correct"), drop=FALSE],
by=list(subject=Err1b$subject), FUN=length)
Err1b<- merge(Err1b, Nc2, by="subject",all=TRUE)
Err1b$Err1b<-((Err1b$Nc2-Err1b$correct)/Err1b$Nc2)*100
Err1b$correct<-NULL
Err1b$Nc2<-NULL
```

```
Err2b <- subset(incom2, subset=correct==1)
Err2b <- aggregate(Err2b[,c("correct"), drop=FALSE],
by=list(subject=Err2b$subject), FUN=length)
Err2b<- merge(Err2b, Nic2, by="subject",all=TRUE)
Err2b$Err2b<-((Err2b$Nic2-Err2b$correct)/Err2b$Nic2)*100
Err2b$correct<-NULL
Err2b$Nic2<-NULL
```

```
# Merge all errors
```

```
ErrAll <- merge(Err1a, Err2a, by="subject",all=TRUE)
ErrAll$Na.x <- NULL
ErrAll$Na.y <- NULL
ErrAll <- merge(ErrAll, Err1b, by="subject",all=TRUE)
ErrAll$Nb <- NULL
ErrAll <- merge(ErrAll, Err2b, by="subject",all=TRUE)
ErrAll$Nb <- NULL
```

```
# To convert NA to 0.0
```

```
ErrAll$Err1a [is.na(ErrAll$Err1a)]<-0
ErrAll$Err1b [is.na(ErrAll$Err1b)]<-0
ErrAll$Err2a [is.na(ErrAll$Err2a)]<-0
ErrAll$Err2b [is.na(ErrAll$Err2b)]<-0
```

```
ErrAll$ERR_1<-(ErrAll$Err1a+ErrAll$Err1b)/2
ErrAll$ERR_2<-(ErrAll$Err2a+ErrAll$Err2b)/2
```

```
# Aggregate as mean for each block
```

```
incom1MeanLat <- aggregate(incom1[,c("latency"), drop=FALSE],
by=list(subject=incom1$subject), FUN=mean)
incom1MeanLat$latIncom1<-incom1MeanLat$latency
```

```

incom1MeanLat$latency <- NULL
incom2MeanLat <- aggregate(incom2[,c("latency")], drop=FALSE],
by=list(subject=incom2$subject), FUN=mean)
incom2MeanLat$latIncom2<-incom2MeanLat$latency
incom2MeanLat$latency <- NULL
com1MeanLat <- aggregate(com1[,c("latency")], drop=FALSE],
by=list(subject=com1$subject), FUN=mean)
com1MeanLat$latcom1<-com1MeanLat$latency
com1MeanLat$latency <- NULL
com2MeanLat <- aggregate(com2[,c("latency")], drop=FALSE],
by=list(subject=com2$subject), FUN=mean)
com2MeanLat$latcom2<-com2MeanLat$latency
com2MeanLat$latency <- NULL
iatsd1 <- aggregate(sd1[,c("latency")], drop=FALSE], by=list(subject=sd1$subject),
FUN=sd)
iatsd1$sd1<-iatsd1$latency
iatsd1$latency <- NULL
iatsd2 <- aggregate(sd2[,c("latency")], drop=FALSE], by=list(subject=sd2$subject),
FUN=sd)
iatsd2$sd2<-iatsd2$latency
iatsd2$latency <- NULL

# Merge into one dataset
iatScore<- merge(incom1MeanLat, incom2MeanLat, by="subject")
iatScore<- merge(iatScore, com1MeanLat, by="subject")
iatScore<- merge(iatScore, com2MeanLat, by="subject")
iatScore<- merge(iatScore, iatsd1, by="subject")
iatScore<- merge(iatScore, iatsd2, by="subject")

# D Score Calculation and final output
iatScore$Da <- (iatScore$latIncom1-iatScore$latcom1)/iatScore$sd1
iatScore$Db <- (iatScore$latIncom2-iatScore$latcom2)/iatScore$sd2
iatScore$D <- ((iatScore$Da+iatScore$Db)/2)
iatScore$ORDER<-ifelse(iatScore$subject%%2==1,1,2)

DScore<- merge(iatScore, iatError, by="subject")
DScore<- merge(DScore, ErrAll, by="subject")
DScore<- merge(DScore, Na, by="subject")
DScore<- merge(DScore, Nb, by="subject")
DScore<- merge(DScore, iatMeanLat, by="subject")
DScore<- merge(DScore, iat300, by="subject")
DScore<- merge(DScore, iat400, by="subject")
DScore<- merge(DScore, iat10k, by="subject")
DScore

# To generate output similar to the SPSS script available on www.millisecond.com

```

```
DScore1 <- data.frame(Subject=DScore$subject, ORDER=DScore$ORDER,  
D_biep_a=DScore$Da, D_biep_b=DScore$Db, M1a=DScore$latcom1,  
M2a=DScore$latIncom1, M1b=DScore$latcom2, M2b=DScore$latIncom2,  
ERR1a=DScore$Err1a, ERR2a=DScore$Err2a, ERR1b=DScore$Err1b,  
ERR2b=DScore$Err2b, Na=DScore$Na, Nb=DScore$Nb, ERR_1=DScore$ERR_1,  
ERR_2=DScore$ERR_2, D_biep=DScore$D, PCT_300=DScore$Err300,  
PCT_400=DScore$Err400, PCT_10K=DScore$Err10k,  
AVELTNCY=DScore$latency, ERRORPCT=DScore$ErrPer,  
NTRIALS=DScore$valid)
```

```
# To create an output file in excel format and store it in  
write.table(DScore1, "D:/IAT output file.xlsx", sep="\t", col.names=TRUE,  
row.names=FALSE, quote=TRUE, na="NA")
```

## Inquisit Script to run Y-IAT Experiment

\*\*\*\*\*

### Single Target Yoga Implicit Association Test (ST YIAT)

\*\*\*\*\*

Last Modified:28-07-2012 at 03:00 PM (IST)

\*\*\*\*\*

This script was modified from the IAT script available at the Inquisit website,  
[www.millisecond.com/ download/library/IAT/](http://www.millisecond.com/download/library/IAT/)

Other IAT scripts can be downloaded from this website.

This sample IAT can be easily adapted to different target categories  
 and attributes. To change the categories, you need only change the  
 stimulus items and labels immediately below this line.

To run this script, copy the whole script and paste it in the Inquisit program and run.

\*\*\*\*\*

<item attributeAlabel>

/1 = "Good"

</item>

<item attributeA>

/1 = "Good"

/2 = "Superb"

/3 = "Pleasure"

/4 = "Beautiful"

/5 = "Joyful"

/6 = "Glorious"

/7 = "Lovely"

/8 = "Wonderful"

</item>

<item attributeBlabel>

/1 = "Bad"

</item>

<item attributeB>

/1 = "Hurt"

/2 = "Sorrow"

/3 = "Painful"

/4 = "Poison"

/5 = "Accident"

/6 = "Fearful"

/7 = "Bad"

/8 = "Dirty"

</item>

<item targetAlabel>

/1 = "Yoga"

</item>

<item targetA>

```

/1 = "Yama"
/2 = "Niyama"
/3 = "Asana"
/4 = "Pranayama"
/5 = "Pratyahara"
/6 = "Dharana"
/7 = "Dhyana"
/8 = "Samadhi"
</item>

```

```

*****
To change the categories, you need only change the stimulus items and
labels immediately above this line. All commands below relate to the
IAT procedure, and need only be changed if you wish to modify the
generic IAT procedure.
*****

```

```

*****
Performance summary
*****

```

```

<trial summary>
/ stimulustimes = [0=summary]
/ validresponse = (" ")
/ recorddata = false
/ ontrialbegin = [values.magnitude = "little to no"]
/ ontrialbegin = [if( abs(expressions.d) > 0.15 ) values.magnitude = "a slight"]
/ ontrialbegin = [if( abs(expressions.d) > 0.35 ) values.magnitude = "a moderate"]
/ ontrialbegin = [if( abs(expressions.d) >= 0.65 ) values.magnitude = "a strong"]
/ ontrialbegin = [if(expressions.d >= 0.0) expressions.attitude = "positive"]
/ ontrialbegin = [if(expressions.d < 0.0) expressions.attitude = "negative"]
</trial>

```

```

<text summary>
/ items = ("Your IAT score (D) was <% expressions.d %>, which suggests <%
values.magnitude %> <% expressions.attitude %> implicit attitude towards <%
item.targetALabel.1 %>.~n~n~nPress the spacebar to complete this session.")
/ size = (60%, 60%)
/ hjustify = left
</text>

```

```

*****
Task instruction stimuli
*****

```

```

<trial instructions>
/ stimulustimes = [1=instructions, spacebar]
/ correctresponse = (" ")
/ errormessage = false
/ recorddata = false
</trial>

```

```

<text instructions>
/ items = instructions
/ hjustify = left
/ size = (90%, 60%)
/ position = (50%, 85%)
/ valign = bottom
/ select = sequence
/ resetinterval = 20
</text>

```

```

<item instructions>
/ 1 = "Put your middle or index fingers on the E and I keys of your keyboard. Words
representing the categories at the top will appear one-by-one in the middle of the
screen. When the item belongs to a category on the left, press the E key; when the
item belongs to a category on the right, press the I key. Items belong to only one
category. If you make an error, an X will appear - fix the error by hitting the other
key.

```

This is a timed sorting task. GO AS FAST AS YOU CAN while making as few mistakes as possible. Going too slow or making too many errors will result in an uninterpretable score. This task will take about 5 minutes to complete."

```

/ 2 = "See above, a new category now appears together with one of the previous
categories you saw. Remember, each item belongs to only one group. For example,
if the categories yoga and good appeared on the separate sides above - words
meaning yoga would go in the yoga category, not the good category.

```

Use the E and I keys to categorize items into three groups left and right, and correct errors by hitting the other key."

```

/ 3 = "Sort the same three categories again. Remember to go as fast as you can while
making as few mistakes as possible.

```

Use the E and I keys to categorize items into the three groups left and right, and correct errors by hitting the other key."

```

/ 4 = "See above, the three categories now appear together in a new configuration.
Remember, each item belongs to only one group.

```

Use the E and I keys to categorize items into the three groups left and right, and correct errors by hitting the other key."

```

/ 5 = "Sort the same three categories again. Remember to go as fast as you can while
making as few mistakes as possible.

```

Use the E and I keys to categorize items into the three groups left and right, and correct errors by hitting the other key."

```

</item>

```

```

<text spacebar>
/ items = ("Press the SPACE BAR to begin.")
/ position = (50%, 95%)

```

```
/ valign = bottom
</text>

<text attributeA>
/ items = attributeA
/ fontstyle = ("Arial", 5%)
/ txcolor = (255, 255, 255)
</text>

<text attributeB>
/ items = attributeB
/ fontstyle = ("Arial", 5%)
/ txcolor = (255, 255, 255)
</text>

<text targetA>
/ items = targetA
/ fontstyle = ("Arial", 5%)
/ txcolor = (255, 255, 255)
</text>

<text error>
/ position = (50%, 75%)
/ items = ("X")
/ color = (255, 0, 0)
/ fontstyle = ("Arial", 10%, true)
</text>

<text attributeAleft>
/ items = attributeAlabel
/ valign = top
/ halign = left
/ position = (5%, 5%)
/ txcolor = (255, 255, 255)
/ fontstyle = ("Arial", 5%)
</text>

<text attributeBright>
/ items = attributeBlabel
/ valign = top
/ halign = right
/ position = (95%, 5%)
/ txcolor = (255, 255, 255)
/ fontstyle = ("Arial", 5%)
</text>

<text targetAleftmixed>
/ items = targetAlabel
/ valign = top
/ halign = left
```

```

/ position = (5%, 19%)
/ fontstyle = ("Arial", 5%)
</text>

```

```

<text targetArightmixed>
/ items = targetAlabel
/ valign = top
/ halign = right
/ position = (95%, 19%)
/ fontstyle = ("Arial", 5%)
</text>

```

```

<text targetAleft>
/ items = targetAlabel
/ valign = top
/ halign = left
/ position = (5%, 5%)
/ fontstyle = ("Arial", 5%)
</text>

```

```

<text targetAright>
/ items = targetAlabel
/ valign = top
/ halign = right
/ position = (95%, 5%)
/ fontstyle = ("Arial", 5%)
</text>

```

```

<text orleft>
/ items = ("or")
/ valign = top
/ halign = left
/ position = (5%, 12%)
/ fontstyle = ("Arial", 5%)
</text>

```

```

<text orright>
/ items = ("or")
/ valign = top
/ halign = right
/ position = (95%, 12%)
/ fontstyle = ("Arial", 5%)
</text>

```

```

*****

```

**Trials**

```

*****

```

```

<trial attributeA>
/ validresponse = ("E", "I")

```

```

/ correctresponse = ("E")
/ stimulusframes = [1 = attributeA]
/ posttrialpause = 250
</trial>

```

```

<trial attributeB>
/ validresponse = ("E", "I")
/ correctresponse = ("I")
/ stimulusframes = [1 = attributeB]
/ posttrialpause = 250
</trial>

```

```

<trial targetAleft>
/ validresponse = ("E", "I")
/ correctresponse = ("E")
/ stimulusframes = [1 = targetA]
/ posttrialpause = 250
</trial>

```

```

<trial targetAright>
/ validresponse = ("E", "I")
/ correctresponse = ("I")
/ stimulusframes = [1 = targetA]
/ posttrialpause = 250
</trial>

```

```

*****

```

### Blocks

```

*****

```

```

<block attributepractice>
/ bgstim = (attributeAleft, attributeBright)
/ trials = [1=instructions;2-21 = random(attributeA, attributeB)]
/ errormessage = true(error,200)
/ responsemode = correct
</block>

```

```

<block compatibletest1>
/ bgstim = (attributeAleft, orleft, targetAleftmixed, attributeBright)
/ trials = [1=instructions; 2-21 = noreplace(targetAleft, attributeA, attributeB)]
/ errormessage = true(error,200)
/ responsemode = correct
/ ontrialend = [if(block.compatibletest1.latency <= 10000 &&
block.compatibletest1.currenttrialnumber != 1 ) values.sum1a = values.sum1a +
block.compatibletest1.latency]
/ ontrialend = [if(block.compatibletest1.latency <= 10000 &&
block.compatibletest1.currenttrialnumber != 1 ) values.n1a = values.n1a + 1]
/ ontrialend = [if(block.compatibletest1.latency <= 10000 &&
block.compatibletest1.currenttrialnumber != 1 ) values.ss1a = values.ss1a +
(block.compatibletest1.latency * block.compatibletest1.latency)]

```

</block>

```
<block compatibletest2>
/ bgstim = (attributeAleft, orleft, targetAleftmixed, attributeBright)
/ trials = [1-40 = noreplace(targetAleft, attributeA, attributeB)]
/ errormessage = true(error,200)
/ responsemode = correct
/ ontrialend = [if(block.compatibletest2.latency <= 10000) values.sum1b =
values.sum1b + block.compatibletest2.latency]
/ ontrialend = [if(block.compatibletest2.latency <= 10000) values.n1b = values.n1b
+ 1]
/ ontrialend = [if(block.compatibletest2.latency <= 10000) values.ss1b =
values.ss1b + (block.compatibletest2.latency * block.compatibletest2.latency)]
</block>
```

```
<block incompatibletest1>
/ bgstim = (attributeAleft, targetARightMixed, orright, attributeBright)
/ trials = [1=instructions; 2-21 = noreplace(targetAright, attributeA, attributeB)]
/ errormessage = true(error,200)
/ responsemode = correct
/ ontrialend = [if(block.incompatibletest1.latency <= 10000 &&
block.incompatibletest1.currenttrialnumber != 1) values.sum2a = values.sum2a +
block.incompatibletest1.latency]
/ ontrialend = [if(block.incompatibletest1.latency <= 10000 &&
block.incompatibletest1.currenttrialnumber != 1) values.n2a = values.n2a + 1]
/ ontrialend = [if(block.incompatibletest1.latency <= 10000 &&
block.incompatibletest1.currenttrialnumber != 1) values.ss2a = values.ss2a +
(block.incompatibletest1.latency * block.incompatibletest1.latency)]
</block>
```

```
<block incompatibletest2>
/ bgstim = (attributeAleft, targetARightMixed, orright, attributeBright)
/ trials = [1-40 = noreplace(targetAright, attributeA, attributeB)]
/ errormessage = true(error,200)
/ responsemode = correct
/ ontrialend = [if(block.incompatibletest2.latency <= 10000) values.sum2b =
values.sum2b + block.incompatibletest2.latency]
/ ontrialend = [if(block.incompatibletest2.latency <= 10000) values.n2b =
values.n2b + 1]
/ ontrialend = [if(block.incompatibletest2.latency <= 10000) values.ss2b =
values.ss2b + (block.incompatibletest2.latency * block.incompatibletest2.latency)]
</block>
```

```
<block compatibletestinstructions>
/ bgstim = (attributeAleft, orleft, targetAleftmixed, attributeBright)
/ trials = [1=instructions]
/ recorddata = false
</block>
```

```

<block incompatibletestinstructions>
/ bgstim = (attributeAleft, attributeBright, orright, targetArightmixed)
/ trials = [1=instructions]
/ recorddata = false
</block>

```

```

<block summary>
/ trials = [1=summary]
/ recorddata = false
</block>

```

```

*****

```

### Experiment

```

*****

```

```

<defaults>
/ fontstyle = ("Arial", 3.5%)
/ screencolor = (0,0,0)
/ txbgcolor = (0,0,0)
/ txcolor = (255, 255, 255)
/ minimumversion = "3.0.0.0"
</defaults>

```

```

*****

```

### Experiment

```

*****

```

```

<expt>
/ blocks = [1=attributepractice; 2=block1; 3=block3; 4=block4; 5=block5; 6=block6;
7=block7; 8=summary]
</expt>

```

```

<variables>
/ group = (1 of 2) (block1=compatibletest1; block3=compatibletestinstructions;
block4=compatibletest2; block5=incompatibletest1;
block6=incompatibletestinstructions; block7=incompatibletest2)
/ group = (2 of 2) (block1=incompatibletest1; block3=incompatibletestinstructions;
block4=incompatibletest2; block5=compatibletest1;
block6=compatibletestinstructions; block7=compatibletest2)
</variables>

```

```

*****

```

### Data Columns

```

*****

```

```

<data>
/ columns = [date, time, subject, blockcode, blocknum, trialcode, trialnum, response,
correct, latency, stimulusnumber, stimulusitem, expressions.da, expressions.db,
expressions.d, expressions.latdiffa, expressions.latdiffb, expressions.latdiff]
</data>

```

\*\*\*\*\*

### Test Monkey

\*\*\*\*\*

```
<monkey>
/ latencydistribution = normal(500, 100)
/ percentcorrect = 90
</monkey>
```

\*\*\*\*\*

### Scoring

\*\*\*\*\*

```
<values>
/ sum1a = 0
/ sum2a = 0
/ sum1b = 0
/ sum2b = 0
/ n1a = 0
/ n2a = 0
/ n1b = 0
/ n2b = 0
/ ss1a = 0
/ ss2a = 0
/ ss1b = 0
/ ss2b = 0
/ magnitude = "unknown"
</values>
```

\* 1 is compatible, 2 is incompatible  
\* a is first block, b is second block

### <expressions>

```
/ m1a = values.sum1a / values.n1a
/ m2a = values.sum2a / values.n2a
/ m1b = values.sum1b / values.n1b
/ m2b = values.sum2b / values.n2b
/ sd1a = sqrt((values.ss1a - (values.n1a * (expressions.m1a * expressions.m1a))) /
(values.n1a - 1))
/ sd2a = sqrt((values.ss2a - (values.n2a * (expressions.m2a * expressions.m2a))) /
(values.n2a - 1))
/ sd1b = sqrt((values.ss1b - (values.n1b * (expressions.m1b * expressions.m1b))) /
(values.n1b - 1))
/ sd2b = sqrt((values.ss2b - (values.n2b * (expressions.m2b * expressions.m2b))) /
(values.n2b - 1))
/ sda = sqrt((((values.n1a - 1) * (expressions.sd1a * expressions.sd1a) + (values.n2a
- 1) * (expressions.sd2a * expressions.sd2a)) + ((values.n1a + values.n2a) *
((expressions.m1a - expressions.m2a) * (expressions.m1a - expressions.m2a)) / 4) ) /
(values.n1a + values.n2a - 1) )
/ sdb = sqrt((((values.n1b - 1) * (expressions.sd1b * expressions.sd1b) + (values.n2b
- 1) * (expressions.sd2b * expressions.sd2b)) + ((values.n1b + values.n2b) *
```

```
((expressions.m1b - expressions.m2b) * (expressions.m1b - expressions.m2b)) / 4 )  
/ (values.n1b + values.n2b - 1) )  
/ da = (m2a - m1a) / expressions.sda  
/ db = (m2b - m1b) / expressions.sdb  
/ d = (expressions.da + expressions.db) / 2  
/ latdiffa = m2a - m1a  
/ latdiffb = m2b - m1b  
/ latdiff = ((values.sum2a + values.sum2b) / (values.n2a + values.n2b)) -  
((values.sum1a + values.sum1b) / (values.n1a + values.n1b))  
/ attitude = "unknown"  
</expressions>
```

## APPENDIX 5: RESULTS INTIMATION

Dear <name of the participant>,

Thanks for participating in the research and supporting us.

Here are the results of the study.

**Objective of the study:** To assess a person's *guna* without his/her conscious awareness or without self presentation bias. For example, if we give a questionnaire, there are chances we can bias our responses with or without our knowledge. This study was to develop a tool which will help us assessing *guna* without these limitations of questionnaires.

The test used in the study is called the Implicit Association Test. The logic of the test is: We take less time to respond to those stimuli which our cognitive system is well acquainted with. This kind of assessment is called **Implicit assessment**, and all questionnaire based evaluations are called **Explicit assessment**. The study was to see how well this implicit (what I think within) and explicit (what I say/project outside) self-evaluation correlate. For more details follow: <https://implicit.harvard.edu/implicit/>

The following tests were administered:

1. **Guna- Implicit Association Test (G-IAT):** A reaction time task.
2. **Feeling Thermometer (FT):** A 10-point self-rating scale to evaluate your *guna*.
3. **Vedic Personality Inventory (VPI):** 56 question Questionnaire to assess *guna*. This is to correlate with *sattva* scores of a person.
4. **Satisfaction with life scale (SWLS):** 5 question Questionnaire to assess total satisfaction which we have with our life. This is to correlate with *sattva* scores of a person.
5. **Hartland Forgiveness Scale (HFS):** This is a 20 item questionnaire to assess how well we can forgive others, and forgive ourselves for the unpleasant things done to us by others and ourselves respectively. This has three sub-scales. This is to correlate with *sattva* scores.
6. **Spielberg's State-Trait Anxiety Inventory (STAI):** Here only the trait questions were used which are 20 in number. This score will show how much anxiety we have in general. This is to correlate with *rajas* scores.
7. **Active Procrastination Scale (APS):** This is a 16 item questionnaire, which measures how you procrastinate (delay). There are four sub-scales in it. This is to correlate with other *tamas* scores.
8. **Marlow Corwne Social Desirability Scale (MCSDS):** This is a 33 item questionnaire. The score suggests how much we tend to self-present ourselves in a socially desirable manner. High score means we are very much concerned for other's opinions.

Now following are your scores in the test and its interpretation:

**Subject ID: 1**

**G-IAT**

<b><i>Guna (Implicit)</i></b>	<b>Your Score</b>
<i>Sattva</i>	- <b>23.280000000000001</b>
<i>Rajas</i>	<b>97.680000000000007</b>
<i>Tamas</i>	- <b>14.460000000000001</b>

**Your G-IAT Retest score after Score Not Available**

<b><i>Guna (Implicit)</i></b>	<b>Your Score</b>
<i>Sattva</i>	<b>Score Not Available</b>
<i>Rajas</i>	<b>Score Not Available</b>
<i>Tamas</i>	<b>Score Not Available</b>

**Interpretation of G-IAT scores:** The range of score is from -600 to +600 millisecond. More positive score you get, more you evaluate yourself to be *sattvic* implicitly, i.e., within. Negative score means you do not evaluate yourself to be *sattvic* implicitly, i.e., within. A score of 0 means you do not have special preference towards either side. For example, a score of +230 means I consider myself *very sattvic* inherently. A score of -50 would mean I consider myself *not sattvic* slightly. Similarly, the scores of *rajas* and *tamas* are evaluated.

**Feeling Thermometer scores:**

<b><i>Guna (Explicit)</i></b>	<b>Your Score</b>
<i>Sattva</i>	<b>5</b>
<i>Rajas</i>	<b>4</b>
<i>Tamas</i>	- <b>14.460000000000001</b>

This is how much do you rate yourself to be *sattvic*, *rajas*, and *tamasic* on a 10-point visual analog scale. A positive score means you consider yourself to be more *sattvic*, a negative score means you consider yourself to be not *sattvic*, score of 0 means you consider yourself to be moderately *sattvic*. Similarly the scores of *rajas* and *tamas* are interpreted.

**Vedic Personality Inventory (VPI):**

<b>Guna Percentage (Explicit)</b>	<b>Your Score</b>
<i>Sattva</i>	<b>35.869999999999997</b>
<i>Rajas</i>	<b>31.25</b>
<i>Tamas</i>	<b>32.890000000000001</b>

VPI has 56 questions. It gives estimate of your sattva, rajas, and tamas as reported by you. The scores are given as percentages e.x., 30% tamas, 40% rajas, and 30% sattva etc. For each guna your score may vary from 0 to 100 %.

**Satisfaction with life scale (SWLS):** It is a 5 item questionnaire. The score ranges from 1 to 35.

<b>SWLS Score</b>	<b>Satisfaction with life</b>	<b>Your Score</b>
30 – 35	highly satisfied	<b>29</b>
25- 29	Well satisfied	
20 – 24	Moderately satisfied	
15 – 19	Slightly below average in life satisfaction	
10 – 14	Dissatisfied	
5 – 9	Extremely Dissatisfied	

For detailed interpretation of SWLS score follow:  
<http://internal.psychology.illinois.edu/~ediener/Documents/Understanding%20SWLS%20Scores.pdf>

**Hartland Forgiveness Scale (HFS):**

Your score

<b>Forgiveness of SELF</b>	<b>Forgiveness of OTHERS</b>	<b>forgiveness of SITUATION</b>	<b>Total score</b>
<b>22</b>	<b>25</b>	<b>24</b>	<b>71</b>

This is 18 item scale, It assesses your tendency to forgive. It has three subscales, 1) forgiveness of SELF, 2) forgiveness of OTHERS, and 3) forgiveness of SITUATION. Scores on the three HFS subscales can range from 6 to 42. Scores on the Total HFS can range from 18 to 126.

### Forgiveness of Self Subscale

One's score on the Forgiveness of Self subscale indicates how forgiving a person tends to be of oneself, with higher scores indicating higher levels of forgiveness, and lower scores indicating lower levels of forgiveness.

- **A score of 6 to 18** means that one is usually unforgiving of oneself.
- **A score of 19 to 29** means that one is about as likely to forgive oneself as that person is not to forgive oneself.
- **A score of 30 to 42** means that one is usually forgiving of oneself.

### Forgiveness of Others Subscale

One's score on the Forgiveness of Others subscale indicates how forgiving a person tends to be of other people, with higher scores indicating higher levels of forgiveness, and lower scores indicating lower levels of forgiveness.

- **A score of 6 to 18** means that one is usually unforgiving of other people.
- **A score of 19 to 29** means that one is about as likely to forgive others as that person is not to forgive others.
- **A score of 30 to 42** means that you are usually forgiving of other people.

### Forgiveness of Situations Subscale

One's score on the Forgiveness of Situations subscale indicates how forgiving a person tends to be of negative circumstances, events, or situations that are beyond anyone's control (such as an illness or a natural disaster). Higher scores indicate higher levels of forgiveness, and lower scores indicate lower levels of forgiveness.

- **A score of 6 to 18** means that one is usually unforgiving of uncontrollable situations.
- **A score of 19 to 29** means that one is about as likely to forgive uncontrollable situations as that person is not to forgive uncontrollable situations.
- **A score of 30 to 42** means that one is usually forgiving of uncontrollable situations.

### Total HFS

One's score on the Total Heartland Forgiveness Scale indicates how forgiving a person tends to be of oneself, other people, and uncontrollable situations. Higher scores indicate higher levels of forgiveness, and lower scores indicate lower levels of forgiveness.

- **A score of 18 to 54** means that one is usually unforgiving of oneself, others, and uncontrollable situations.
- **A score of 55 to 89** means that one is about as likely to forgive, as one is not to forgive oneself, others, and uncontrollable situations.
- **A score of 90 to 126** means that one is usually forgiving of oneself, others, and uncontrollable situations.

**Spielberg's State-Trait Anxiety Inventory (STAI):**

Your score

<b>STAI- Trait score</b>
<b>54</b>

This is a 20 item questionnaire to assess your trait anxiety level, i.e., how anxious you are in general. A score of around 35 is considered normal. The Trait-STAI score can range from 20 to 80. Any score much higher than 35 is considered trait anxious.

**Active Procrastination Scale (APA):**

Your score:

<b>Outcome satisfaction</b>	<b>Preference for pressure</b>	<b>Intentional decision to procrastinate</b>	<b>Ability to meet deadlines</b>
<b>7</b>	<b>7</b>	<b>25</b>	<b>6</b>

This is a 16 item questionnaire. Active Procrastination is a concept according to which, a person deliberately (by his own will) procrastinates (delays) decision making and action, in order to meet deadlines, and to achieve satisfactory outcomes. There are four sub-scales in this questionnaires, i) Preference for pressure, ii) Intentional decision to procrastinate, iii) Ability to meet deadlines, iv) Outcome satisfaction. Scores in each sub-scale can range from 4 to 28. Higher scores in each of the domain means your procrastinate (delay) things deliberately (at will) in order to achieve desirable outcome and meet deadlines.

**Marlow Corwne Social Desirability Scale (MCSDS):**

Your score

<b>Social Desirability score</b>
<b>21</b>

This is a 33 item questionnaire. It assesses how much do you tend to self-project in a socially desirable manner which also gives an idea of how much do you consider other's views ('what others will think about me') to be important. Your score can range from 0 to 33.

**Low Scorers (0-8)**

If you scored in this range, you (a) answered most of the questions in a socially *undesirable* direction, but (b) answered them in a way more honest and true to real life than most people. This means you do not feel discomfort when other people view you as behaving in a socially undesirable way.

**Average Scorers (9-19)**

Scores here represent a combination of socially desirable and socially undesirable responses. This combination represents a balance for you in your day-to-day behavior.

**High Scorers (20-33)**

Your score in this range suggests that being seen as socially acceptable is very important to you. You feel a need for approval from others. If so, a high level of this need for approval can adversely affect your social interactions. If a high need for approval describes you, you may feel frequent social insecurity, or anxiety about doing what others expect.

---

**Overall outcome of the study**

We found that reported and implicitly measured scores correlate well only for those subjects whose knowledge of English was quite good (assessed through medium of instruction at school). The explicit measures of *guna* show expected directions of correlations among themselves; however, implicit measures do not do so that strongly.

**NOTE:** The implicit tool is being developed still so the interpretation of score is not very conclusive. Hence interpret the results with caution. However, all questionnaire scores are standardized and would reflect your actual position *if you had attempted them properly*.

We heartily thank you for your active participation in the research program. We hope that you would have enjoyed taking the test. For any clarifications, you may write to us.

Thank you.

With regards,

Judu Ilavarasu.

(Ph.D. Scholar, S-VYASA)

Phone: 9035730812

## APPENDIX -6 : GUNA WORDS REFEREE SHEET

### Selection of Words for *Guna*-Implicit Association Test

**Name of referee:**

**Designation:**

**Institute:**

**Purpose of study:** The Implicit Association Test is a test to measure person's implicit preferences. The test requires word stimuli to be shown to the participants. The words should invoke the meaning and association in subjects.

**Instructions:** There are 42 words to be evaluated. For each word, there are two rating scales. One is to mention whether the word belongs to *Sattva*, *Rajas*, or *Tamas* category. If you feel that the word belongs to more than one category of *guna*, then select the last option, which is "More than one *Guna*". The second rating scale is to mention how strongly it belongs to that category. Select only one option.

**Required Criteria for rating of words:** 1) Clear, 2) Consistent, 3) Practical, 4) Distinct, 5) Subjective importance (how relevant it is subjectively), 6) Thought frequency (how frequently the word is processed), 7) Familiarity

**For example:**

#### **Compassion**

a) It is word representing

Sattva

Rajas

Tamas

More than one Guna

b) How strongly the word represents the above category according to the required criteria?

Very weakly

Weakly

Neutral

Strongly

Very Strongly

**1) Serenity**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**2) Humility**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**3) Gratitude**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**4) Contentment**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**5) Forgive**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**6) Charity**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**7) Simplicity**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**8) Purity**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**9) Compassion**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**10) Dispassion**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**11) Happy**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**12) Peace**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**13) Calm**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**14) Service**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**15) Attachment**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**16) Restless**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**17) Passion**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**18) Anxiety**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**19) Greedy**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**20) Impatience**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**21) Jealousy**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**22) Pride**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**23) Anger**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**24) Dynamic**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**25) Envy**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**26) Worry**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**27) Ambition**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**28) Tired**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**29) Laziness**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**30) Confusion**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**31) Indecision**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**32) Ignorance**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**33) Inertia**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**34) Forget**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**35) Sleepy**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly**36) Drowsy**

a) It is word representing

 Sattva                       Rajas                       Tamas More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly Very Strongly

**37) Dull**

a) It is word representing

 Sattva                       Rajas                       Tamas

 More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly

 Very Strongly
**38) Delusion**

a) It is word representing

 Sattva                       Rajas                       Tamas

 More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly

 Very Strongly
**39) Arrogant**

a) It is word representing

 Sattva                       Rajas                       Tamas

 More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly

 Very Strongly
**40) Depression**

a) It is word representing

 Sattva                       Rajas                       Tamas

 More than one Guna

b) How strongly the word represents the above category according to the required criteria?

 Very weakly               Weakly                       Neutral                       Strongly

 Very Strongly

**41) Careless**

a) It is word representing

Sattva                       Rajas                       Tamas

More than one Guna

b) How strongly the word represents the above category according to the required criteria?

Very weakly               Weakly               Neutral               Strongly

Very Strongly

**42) Delay**

a) It is word representing

Sattva                       Rajas                       Tamas

More than one Guna

b) How strongly the word represents the above category according to the required criteria?

Very weakly               Weakly               Neutral               Strongly

Very Strongly

**Further Comments (If you have specific observations):**

**Thank You for your valuable comments and ratings.**



APPENDIX 7- RAW DATA

a) *Guna* Implicit Association Test (G-IAT) study (n=77)

Sno	ID	age	gender	education	yoga	medium	frequency	guna	Sattva_I	Rajas_I	Tamas_I	sattva_D	rajas_D	tamas_D
1	S1	24	M	UG	More3	Native	Equally	Moderate	-39.36	68.37	-14.46	-0.091	0.158	-0.033
2	S2	24	M	UG	More3	English	Often	More	-60.23	152.34	-118.89	-0.125	0.278	-0.276
3	S5	21	M	UG	Less3	Native	Equally	Moderate	-8.20	105.94	178.16	-0.025	0.198	0.333
4	S6	21	M	UG	More3	Native	Equally	Moderate	7.95	93.51	65.19	0.056	0.213	0.164
5	S8	20	F	UG	Less3	English	Often	More	198.67	39.29	41.31	0.611	0.116	0.128
6	S10	22	M	UG	Three	Native	Less	More	-127.11	20.41	-115.18	-0.351	0.086	-0.314
7	S11	21	M	UG	Three	English	Equally	More	-137.72	93.10	11.73	-0.427	0.218	-0.031
8	S12	34	M	UG	Three	Native	Less	Moderate	107.85	-33.65	75.69	0.333	-0.007	0.182
9	S13	21	M	UG	More3	Native	Often	Moderate	-79.59	63.43	-37.83	-0.295	0.206	-0.120
10	S14	20	F	UG	Three	Native	Often	More	24.72	172.39	66.12	0.142	0.409	0.167
11	S17	19	F	UG	More3	English	Less	Moderate	-175.56	-32.76	-9.65	-0.408	-0.078	-0.099
12	S18	19	F	UG	Less3	English	Equally	Moderate	127.95	49.27	-100.85	0.381	0.099	-0.440
13	S19	19	F	UG	Less3	Native	Equally	Moderate	-30.20	-134.72	-88.26	-0.001	-0.261	-0.177
14	S21	34	M	UG	More3	English	Less	Moderate	-24.60	59.58	3.53	-0.106	0.240	0.031
15	S22	20	M	UG	Less3	Native	Equally	Moderate	166.13	244.99	91.01	0.284	0.382	0.122
16	S24	18	M	UG	Less3	Native	Less	Less	-141.38	-89.09	132.16	-0.385	-0.243	0.354
17	S26	19	M	UG	Less3	Native	Equally	Moderate	13.12	128.27	123.21	0.103	0.540	0.583
18	S27	20	M	UG	Less3	Native	Less	Moderate	-81.95	-39.91	-23.58	-0.451	-0.190	-0.123

19	S29	18	M	UG	Less3	Native	Equally	Moderate	-28.30	-38.51	-30.64	-0.180	-0.111	-0.161
20	S30	18	F	UG	Less3	Native	Often	Moderate	-205.43	46.99	-104.19	-0.743	0.166	-0.254
21	S32	19	M	UG	Less3	Native	Equally	Moderate	82.17	232.75	-22.10	0.224	0.603	-0.022
22	S33	19	M	UG	Less3	Native	Often	Moderate	-1.78	-1.28	43.35	-0.001	0.056	0.208
23	S34	21	M	UG	Less3	Native	Equally	Moderate	105.19	-16.66	44.10	0.322	-0.076	0.168
24	S35	22	M	UG	Less3	Native	Less	Moderate	99.62	-163.06	251.55	0.255	-0.405	0.483
25	S36	26	M	PG	More3	Native	Often	Moderate	12.80	139.03	-159.56	0.001	0.429	-0.479
26	S37	37	M	PG	More3	Native	Often	Moderate	128.79	-83.81	-105.43	0.567	-0.266	-0.376
27	S38	23	M	PG	Three	Native	Equally	Moderate	26.59	0.87	-2.55	0.144	0.036	-0.078
28	S39	30	M	PG	Less3	Native	Often	Less	-70.50	-76.74	-62.54	-0.164	-0.260	-0.137
29	S40	24	M	PG	Three	Native	Equally	Moderate	-55.67	119.93	-15.67	-0.099	0.202	-0.051
30	S41	40	F	PG	More3	Native	Often	Moderate	-5.96	62.04	31.48	-0.032	0.430	0.135
31	S43	28	M	PG	Three	Native	Often	Moderate	-216.16	-75.37	10.32	-0.357	-0.134	0.071
32	S44	24	M	PG	More3	Native	Often	Moderate	144.97	97.58	43.76	0.314	0.220	0.069
33	S45	23	M	PG	More3	Native	Equally	Moderate	-239.54	-320.52	-124.38	-0.435	-0.581	-0.226
34	S46	21	M	UG	More3	Native	Less	Moderate	-7.50	-83.26	16.62	-0.102	-0.331	0.060
35	S47	26	M	PG	More3	Native	Often	Moderate	-21.35	-12.10	-1.68	-0.067	-0.066	-0.059
36	S48	22	M	PG	Three	English	Less	More	-84.09	68.82	-30.32	-0.208	0.177	-0.065
37	S49	26	M	PG	More3	English	Often	Less	-72.50	-9.96	-68.90	-0.516	-0.020	-0.483
38	S50	34	M	PG	More3	Native	Often	More	190.58	92.13	53.69	0.761	0.320	0.214
39	S51	26	M	UG	Three	English	Often	Moderate	58.37	-6.65	-53.99	0.172	0.010	-0.118
40	S52	19	F	UG	Three	Native	Often	Moderate	58.79	209.26	-90.23	0.085	0.359	-0.249
41	S53	21	M	UG	More3	English	Equally	Moderate	22.95	-6.56	4.88	0.046	-0.107	-0.031
42	S54	21	F	UG	More3	Native	Less	Moderate	-20.57	36.33	-59.03	-0.260	0.302	-0.517
43	S55	25	M	PG	Less3	Native	Often	Moderate	80.32	35.83	-29.88	0.201	0.061	-0.026
44	S56	23	M	PG	Three	Native	Less	Moderate	83.38	127.13	2.26	0.262	0.350	-0.024

45	S57	18	F	UG	Less3	English	Equally	Moderate	14.60	138.50	41.53	0.035	0.473	0.117
46	S58	19	F	UG	Less3	English	Less	Less	-27.53	-105.71	-144.74	-0.048	-0.149	-0.259
47	S59	18	F	UG	Three	English	Equally	Less	-52.20	39.28	-85.97	-0.205	0.201	-0.226
48	S60	18	F	UG	Less3	English	Less	Moderate	-53.22	20.02	-140.76	-0.078	0.059	-0.450
49	S61	33	F	PG	More3	English	Less	Moderate	-89.52	-37.60	17.09	-0.518	-0.196	0.154
50	S62	25	M	PG	Less3	Native	Equally	Moderate	39.00	120.08	6.36	0.150	0.500	0.075
51	S63	24	M	PG	Less3	Native	Equally	Moderate	-90.13	-28.21	-26.23	-0.318	-0.055	-0.010
52	S64	23	M	PG	More3	English	Equally	Less	73.16	-334.01	-178.91	0.111	-0.584	-0.371
53	S65	26	M	PG	Less3	Native	Less	Moderate	-22.90	-5.79	-28.68	-0.129	0.038	-0.035
54	S66	21	M	PG	Three	Native	Often	More	-62.46	10.36	-98.22	-0.240	0.055	-0.349
55	S67	23	M	PG	Less3	Native	Often	Less	-167.39	90.93	27.83	-0.231	0.149	0.005
56	S68	29	M	PG	Less3	Native	Often	Moderate	-57.10	64.18	-37.60	-0.198	0.203	-0.116
57	S69	20	M	PG	Less3	English	Equally	More	-32.50	-30.02	95.40	-0.071	-0.060	0.201
58	S70	28	M	PG	Less3	English	Often	Moderate	-77.58	-54.60	-39.16	-0.506	-0.273	-0.252
59	S71	19	F	UG	Three	English	Equally	More	-72.27	-2.95	-71.66	-0.236	0.019	-0.247
60	S72	23	F	UG	More3	Native	Equally	Less	41.94	185.41	-88.05	0.020	0.525	-0.277
61	S73	18	F	UG	Three	Native	Equally	More	21.40	-205.37	-26.19	0.043	-0.539	-0.070
62	S74	28	M	UG	Three	Native	Often	More	42.42	13.53	168.67	0.178	0.001	0.572
63	S75	19	F	UG	Three	English	Equally	Moderate	82.72	67.00	1.15	0.268	0.308	0.090
64	S77	27	M	UG	Three	Native	Often	Moderate	-204.89	-136.43	-107.10	-0.813	-0.531	-0.544
65	S78	34	M	UG	Less3	Native	Often	Moderate	76.56	193.83	108.20	0.238	0.601	0.335
66	S79	34	M	PG	More3	Native	Equally	Moderate	-238.27	21.42	21.26	-0.476	0.055	0.079
67	S80	28	F	PG	More3	English	Equally	More	49.04	97.11	-23.96	0.280	0.702	-0.181
68	S81	20	F	UG	Three	Native	Equally	More	61.39	-105.52	-1.42	0.197	-0.384	0.063
69	S82	26	M	PG	More3	English	Equally	More	-63.42	-39.63	-26.41	-0.400	-0.241	-0.173
70	S83	25	M	PG	Less3	Native	Equally	More	-37.80	-2.26	-42.31	-0.248	-0.012	-0.274

71	S84	29	M	PG	Three	English	Often	More	61.00	111.42	1.67	0.215	0.396	0.003
72	S85	28	M	PG	Three	Native	Often	More	-89.29	-58.01	47.94	-0.384	-0.196	0.239
73	S86	22	M	PG	More3	English	Often	More	-38.12	210.93	46.42	-0.111	0.819	0.164
74	S87	26	M	PG	Three	English	Often	Moderate	-79.05	302.57	-58.29	-0.190	0.737	-0.116
75	S88	26	M	PG	More3	English	Equally	More	111.99	96.81	-43.76	0.355	0.219	-0.142
76	S89	29	F	PG	More3	Native	Equally	Less	-95.12	40.88	-144.80	-0.341	0.209	-0.696
77	S90	25	F	PG	Three	Native	Equally	Moderate	-31.05	31.99	-4.92	-0.231	0.244	-0.043

Sno	ID	VpIsat	VpIRaj	VpITam	StdSat	StdRaj	StdTam	HFS	STAI	APS	SDS	SWIS	sattva_R	rajas_R	tamas_R	RetestFa	ct	SDS_fac
1	S1	87	96	117	35.87	31.25	32.89	71	54	45	21	29	NA	NA	NA	NA	NA	High
2	S2	88	54	39	55.97	27.12	16.91	83	31	79	18	25	0.49	187.65	-5.90	2	2	Low
3	S5	78	82	82	39.27	32.59	28.15	80	51	67	16	25	6.78	12.19	61.52	2	2	Low
4	S6	93	53	28	60.42	27.18	12.40	109	33	74	22	27	-4.91	101.27	-37.69	2	2	High
5	S8	71	68	81	39.46	29.84	30.70	69	53	54	22	20	14.80	37.06	-28.65	2	2	High
6	S10	81	73	52	46.53	33.11	20.37	90	35	70	20	26	-52.11	34.59	-56.47	2	2	High
7	S11	38	69	73	26.71	38.30	34.99	72	44	55	18	11	NA	NA	NA	NA	NA	Low
8	S12	80	59	75	45.02	26.21	28.77	70	46	65	14	20	NA	NA	NA	NA	NA	Low
9	S13	75	65	77	41.94	28.70	29.36	74	45	60	19	20	49.25	-7.99	32.39	2	2	Low
10	S14	86	93	96	38.24	32.65	29.11	77	46	56	15	28	NA	NA	NA	NA	NA	Low
11	S17	58	76	72	34.71	35.91	29.38	91	45	53	18	23	50.85	147.02	-54.44	2	2	Low
12	S18	80	58	44	51.35	29.39	19.26	80	37	76	22	20	-23.12	-23.02	-200.32	2	2	High
13	S19	89	89	101	39.01	30.80	30.19	80	38	72	18	29	NA	NA	NA	NA	NA	Low
14	S21	84	60	72	46.55	26.25	27.20	76	43	63	19	28	-79.29	-177.26	140.40	2	2	Low

15	S22	84	73	80	42.82	29.38	27.80	75	38	61	15	31	-37.49	296.38	222.01	2	Low
16	S24	93	75	60	48.16	30.66	21.18	82	42	55	22	32	-195.01	16.60	-1.85	2	High
17	S26	96	44	25	64.96	23.51	11.53	100	25	89	25	30	NA	NA	NA	NA	High
18	S27	86	78	70	44.03	31.53	24.44	72	39	66	17	23	-53.58	-20.85	-71.98	2	Low
19	S29	82	77	50	46.36	34.37	19.27	65	42	63	15	28	23.81	1.06	15.54	2	Low
20	S30	79	74	65	43.47	32.15	24.39	75	40	59	16	27	NA	NA	NA	NA	Low
21	S32	82	78	69	43.02	32.30	24.68	89	29	69	27	28	20.39	176.41	8.66	2	High
22	S33	87	66	38	52.72	31.58	15.70	95	28	65	29	30	-17.71	38.83	7.82	2	High
23	S34	71	63	46	46.68	32.70	20.62	91	34	78	27	21	98.76	84.73	68.09	2	High
24	S35	53	71	80	32.40	34.26	33.34	95	40	59	22	24	20.05	264.55	397.79	2	High
25	S36	93	75	92	43.27	27.55	29.18	84	35	94	19	28	-91.55	47.63	-52.50	2	Low
26	S37	87	45	40	58.08	23.72	18.21	95	32	59	21	32	-12.57	-32.16	-23.94	2	High
27	S38	82	48	53	52.55	24.29	23.16	84	34	57	16	31	5.25	44.48	-106.38	2	Low
28	S39	70	49	48	49.50	27.36	23.14	82	34	74	20	15	NA	NA	NA	NA	High
29	S40	73	78	72	39.75	33.53	26.73	63	47	61	14	24	-53.60	126.01	-73.09	2	Low
30	S41	99	30	36	67.24	16.09	16.67	107	25	58	26	28	37.69	-16.39	68.64	2	High
31	S43	63	46	46	48.21	27.79	24.00	111	44	75	17	18	295.68	-5.75	87.05	2	Low
32	S44	69	51	52	47.68	27.82	24.50	84	43	67	25	28	-53.95	42.88	85.63	2	High
33	S45	82	70	62	45.67	30.78	23.55	81	38	70	23	25	-73.61	51.05	1.72	2	High
34	S46	68	69	63	41.11	32.93	25.97	98	38	58	13	26	160.86	-126.97	-17.36	1	Low
35	S47	74	67	70	42.38	30.29	27.33	81	44	71	14	28	-42.99	-25.57	66.77	1	Low
36	S48	66	84	84	34.81	34.98	30.21	77	56	56	14	19	51.49	230.00	25.23	1	Low
37	S49	76	76	77	40.32	31.83	27.85	82	43	58	16	18	-46.24	28.45	-99.47	1	Low
38	S50	104	23	31	72.58	12.67	14.75	126	20	92	28	29	97.40	260.22	-22.17	1	High
39	S51	82	41	53	54.48	21.51	24.01	73	30	69	24	24	-31.20	-54.21	28.70	1	High
40	S52	77	47	50	51.96	25.04	23.00	94	38	64	25	26	49.16	93.30	48.50	1	High

41	S53	60	86	103	30.28	34.27	35.45	64	53	57	13	21	13.53	55.38	3.24	1	Low
42	S54	79	87	96	37.07	32.23	30.71	76	43	75	15	26	85.40	-35.12	-50.57	1	Low
43	S55	61	92	112	29.05	34.59	36.36	43	76	35	11	5	NA	NA	NA	NA	Low
44	S56	81	59	60	48.07	27.65	24.28	87	45	65	17	21	29.71	118.17	12.48	1	Low
45	S57	78	58	58	47.75	28.03	24.21	98	29	58	20	31	56.57	46.47	49.86	1	High
46	S58	81	62	59	47.60	28.76	23.64	81	36	71	27	27	-102.48	-71.03	26.97	1	High
47	S59	82	70	81	42.60	28.71	28.69	80	52	52	23	23	102.30	-57.46	-35.26	1	High
48	S60	77	75	85	39.66	30.49	29.85	84	54	46	20	26	-98.86	45.26	-101.91	1	High
49	S61	84	52	74	47.86	23.39	28.75	126	21	83	19	29	20.06	51.41	-11.53	1	Low
50	S62	40	65	80	27.42	35.18	37.40	66	55	61	14	21	-32.51	178.75	62.51	1	Low
51	S63	95	57	90	47.18	22.35	30.47	86	26	72	24	28	31.05	42.95	11.39	1	High
52	S64	80	44	36	57.44	24.94	17.62	92	31	48	19	28	52.90	-2.37	-60.56	1	Low
53	S65	78	73	74	41.92	30.97	27.11	85	37	62	15	28	-61.40	-18.17	6.31	1	Low
54	S66	82	49	46	53.93	25.44	20.63	87	42	69	17	26	-3.28	-21.83	-17.82	1	Low
55	S67	73	86	64	39.56	36.79	23.65	85	44	58	19	19	NA	NA	NA	NA	Low
56	S68	100	34	42	64.32	17.26	18.42	112	26	85	28	29	-11.41	-19.90	-3.22	1	High
57	S69	95	96	83	41.78	33.33	24.89	81	43	60	18	29	42.40	104.46	3.81	1	Low
58	S70	62	71	87	34.96	31.60	33.44	77	53	63	18	10	-21.82	4.14	-18.35	1	Low
59	S71	73	64	46	47.13	32.62	20.25	78	37	71	16	24	NA	NA	NA	NA	Low
60	S72	83	71	80	42.87	28.95	28.17	97	42	72	19	31	72.28	55.76	65.34	1	Low
61	S73	73	80	78	38.56	33.36	28.09	72	42	58	19	24	40.34	71.78	84.65	1	Low
62	S74	65	80	88	34.55	33.57	31.89	68	41	72	18	27	-5.45	-25.29	-10.80	1	Low
63	S75	78	40	41	56.71	22.96	20.33	111	27	70	25	27	53.70	-38.28	-45.43	1	High
64	S77	90	94	75	41.79	34.46	23.75	93	33	87	20	32	-81.28	96.61	-61.56	1	High
65	S78	87	62	71	47.19	26.55	26.26	80	34	73	29	31	NA	NA	NA	NA	High
66	S79	78	55	66	46.87	26.09	27.04	96	43	62	18	16	-234.03	-73.13	15.55	1	Low

67	S80	101	28	29	70.69	15.47	13.84	122	22	82	26	34	6.31	1.57	-37.11	1	High
68	S81	74	79	98	36.42	30.70	32.89	67	47	56	22	16	-17.27	69.23	6.34	1	High
69	S82	84	50	55	52.18	24.52	23.30	93	50	84	21	24	10.65	-9.96	-25.99	1	High
70	S83	84	62	33	54.04	31.49	14.47	90	38	81	12	21	NA	NA	NA	NA	Low
71	S84	71	69	65	41.82	32.08	26.10	102	39	36	9	26	-61.09	156.53	-102.30	1	Low
72	S85	71	65	75	40.93	29.58	29.48	80	46	63	19	22	1.04	10.02	-12.90	1	Low
73	S86	84	59	46	51.87	28.76	19.37	106	34	67	23	22	-188.80	154.94	-222.33	1	High
74	S87	67	81	86	35.34	33.73	30.93	75	43	65	11	21	-44.43	78.58	-124.38	1	Low
75	S88	81	53	55	50.52	26.10	23.39	102	28	90	19	35	178.94	70.25	131.80	1	Low
76	S89	63	54	42	46.92	31.75	21.33	79	42	67	22	16	-55.17	-2.53	-82.27	1	High
77	S90	89	56	51	52.98	26.32	20.70	90	36	57	17	19	NA	NA	NA	NA	Low

**b) Personalized Guna Implicit Association Test (PG-IAT) STUDY (n=57)**

Sno	subjectID	age	gender	educ	yoga	medium	frequency	guna	sattva_I	rajas_I	tamas_I	sattva_D	rajas_D	tamas_D	vpisat
1	1AugYS	24	M	PG	>3 Yrs	English	More	Moderate	6.72	-96.07	-21.82	0.03	-0.36	-0.08	73
2	2AugYS	25	F	PG	1-3 Yrs	English	Less	Moderate	270.49	-6.51	-75.51	0.74	-0.02	-0.21	74
3	3AugYS	67	M	UG	1-3 Yrs	English	Equal	Moderate	93.45	-62.69	-3.34	0.25	-0.17	-0.01	87
4	4AugYS	38	M	PG	>3 Yrs	Native	More	Well	219.53	-31.66	128.19	0.49	-0.07	0.29	88
5	5AugYS	32	M	PG	>3 Yrs	Native	More	Moderate	4.69	-203.70	159.88	0.01	-0.34	0.27	73
6	6AugYS	23	M	PG	1-3 Yrs	English	More	Well	-110.41	-68.18	97.21	-0.35	-0.21	0.31	98
7	7AugYS	24	M	PG	1-3 Yrs	Native	Less	Well	77.08	286.56	136.17	0.20	0.74	0.35	77

8	8AugYS	23	M	PG	>3 Yrs	English	Less	Moderate	84.42	125.23	-36.64	0.28	0.41	-0.12	87
9	9AugYS	24	M	PG	>3 Yrs	English	Less	Moderate	-67.44	-85.26	-83.53	-0.18	-0.23	-0.22	98
10	10AugYS	28	M	PG	>3 Yrs	English	More	Well	69.31	-44.95	-185.13	0.20	-0.13	-0.53	81
11	11AugYS	24	M	PG	1-3 Yrs	Native	Equal	Well	192.66	164.45	-240.05	0.26	0.22	-0.33	87
12	1AugYIC	30	F	UG	No Exper	Native	More	Little	-203.77	132.60	-23.45	-0.75	0.49	-0.09	72
13	2AugYIC	32	F	PG	No Exper	English	Less	Moderate	270.08	265.32	-2.87	0.52	0.51	-0.01	95
14	3AugYIC	34	M	UG	>3 Yrs	Native	Less	Moderate	75.45	-92.90	35.97	0.15	-0.19	0.07	81
15	4AugYIC	40	M	PG	>3 Yrs	Native	Less	Well	-80.06	79.54	18.63	-0.10	0.10	0.02	98
16	5AugYIC	25	M	UG	Upto 1 Year	English	More	Little	414.44	63.19	-205.09	0.80	0.12	-0.40	69
17	6AugYIC	36	M	UG	>3 Yrs	Native	More	Moderate	23.70	90.44	-67.15	0.08	0.29	-0.22	73
18	7AugYIC	28	M	UG	1-3 Yrs	Native	More	Well	-112.26	-100.31	2.96	-0.40	-0.35	0.01	80
19	8AugYIC	41	M	UG	>3 Yrs	Native	More	Little	628.05	308.95	159.13	0.87	0.43	0.22	79
20	9AugYIC	24	M	UG	Upto 1 Year	Native	Less	Moderate	-169.68	-170.29	-53.82	-0.33	-0.33	-0.10	78
21	10AugYIC	24	F	PG	No Exper	Native	More	Well	10.46	136.60	116.23	0.03	0.43	0.37	NA
22	11AugYIC	27	F	PG	>3 Yrs	English	More	Moderate	-178.97	58.90	-158.02	-0.38	0.12	-0.33	98
23	100AugYIC	16	M	UG	1-3 Yrs	English	More	Moderate	42.97	-96.17	-21.26	0.22	-0.50	-0.11	96
24	31Sep	40	F	UG	1-3 Yrs	English	Equal	Moderate	-109.55	-64.38	-55.35	-0.37	-0.22	-0.19	59
25	32Sep	23	F	UG	Upto 1 Year	English	Less	Moderate	-52.03	1.75	160.00	-0.13	0.00	0.39	80
26	33Sep	18	F	UG	1-3 Yrs	English	Less	Moderate	43.99	-122.61	-14.31	0.21	-0.57	-0.07	64
27	34Sep	28	F	UG	Upto 1 Year	English	Less	Little	129.59	-4.42	-161.77	0.50	-0.02	-0.62	72
28	35Sep	43	F	UG	>3 Yrs	Native	Equal	Moderate	-192.29	-63.45	-289.43	-0.34	-0.11	-0.51	94
29	36Sep	35	F	UG	No Exper	English	Equal	Moderate	-24.01	81.81	57.36	-0.06	0.20	0.14	96
30	37Sep	25	F	PG	Upto 1 Year	Native	Equal	Little	81.79	-157.04	31.71	0.23	-0.44	0.09	83
31	38Sep	42	M	UG	Upto 1 Year	Native	More	Moderate	79.24	85.22	76.62	0.24	0.26	0.24	65
32	39Sep	57	M	UG	>3 Yrs	English	Less	Moderate	40.40	-117.29	50.78	0.10	-0.30	0.13	82
33	40Sep	31	F	PG	>3 Yrs	Native	More	Moderate	98.63	133.48	-103.06	0.24	0.32	-0.25	72

34	41-Sep	31	M	UG	>3 Yrs	Native	Equal	Moderate	-21.26	-4.56	-127.97	-0.06	-0.01	-0.33	91
35	42-Sep	32	F	PG	Upto 1 Year	English	Equal	Moderate	-23.49	89.16	74.00	-0.09	0.32	0.27	67
36	43-Sep	20	M	UG	>3 Yrs	English	Equal	Moderate	26.07	101.51	43.06	0.12	0.46	0.20	101
37	44-Sep	47	F	PG	Upto 1 Year	Native	Equal	Little	-71.72	100.35	-3.90	-0.29	0.40	-0.02	82
38	45-Sep	27	M	UG	>3 Yrs	Native	More	Well	124.57	-112.67	-151.78	0.20	-0.18	-0.25	93
39	46-Sep	21	F	UG	Upto 1 Year	English	More	Little	40.97	62.24	-28.17	0.29	0.43	-0.20	64
40	47-Sep	75	M	PG	>3 Yrs	Native	Equal	Well	-112.01	-113.93	-197.33	-0.18	-0.19	-0.32	82
41	48-Sep	26	F	UG	Upto 1 Year	English	Less	Moderate	41.26	105.12	23.99	0.06	0.15	0.03	57
42	01-Dec	24	F	UG	1-3 Yrs	English	Equal	Moderate	125.33	1.98	-105.29	0.64	0.01	-0.54	99
43	02-Dec	25	M	UG	No Exper	English	More	Moderate	37.96	348.83	18.40	0.11	0.98	0.05	79
44	03-Dec	20	F	UG	No Exper	English	Equal	Moderate	-91.66	48.76	17.77	-0.19	0.10	0.04	98
45	04-Dec	21	M	UG	Upto 1 Year	Native	More	Moderate	53.33	115.89	-60.13	0.13	0.28	-0.15	89
46	01-Jan	24	F	PG	Upto 1 Year	English	Equal	Moderate	146.73	162.23	-103.16	0.28	0.31	-0.19	82
47	02-Jan	31	M	UG	Upto 1 Year	Native	More	Little	-203.34	377.37	152.03	-0.31	0.57	0.23	73
48	12-Jan	29	M	UG	Upto 1 Year	Native	Equal	Moderate	304.13	268.23	240.26	0.52	0.46	0.41	63
49	13-Jan	26	F	PG	Upto 1 Year	English	Less	Moderate	67.42	151.42	-110.66	0.20	0.45	-0.33	74
50	16-Jan	22	M	UG	>3 Yrs	English	Less	Little	14.94	132.79	708.47	0.02	0.20	1.05	83
51	18-Jan	20	F	UG	No Exper	English	Less	Moderate	-5.55	-1.60	-20.31	-0.02	-0.01	-0.08	80
52	19-Jan	19	F	UG	No Exper	English	Equal	Moderate	-38.25	134.13	207.01	-0.05	0.19	0.29	83
53	20-Jan	31	F	PG	No Exper	English	Equal	Moderate	-27.12	295.61	28.23	-0.06	0.62	0.06	89
54	21-Jan	24	M	PG	No Exper	English	More	Little	111.84	-52.34	-318.97	0.21	-0.10	-0.60	79
55	22-Jan	26	M	UG	Upto 1 Year	Native	Less	Moderate	34.01	189.91	50.67	0.11	0.63	0.17	76
56	23-Jan	47	M	UG	Upto 1 Year	Native	More	Little	232.75	231.63	-12.54	0.39	0.38	-0.02	73
57	24-Jan	24	F	UG	Upto 1 Year	English	Equal	Moderate	175.76	10.97	106.97	0.48	0.03	0.29	91

Sno	subjectID	vpiraj	vpitam	stdsat	stdraj	stdtam
1	1AugYS	51	66	46.13	25.44	28.43
2	2AugYS	69	85	39.69	29.22	31.09
3	3AugYS	56	57	51.15	25.99	22.85
4	4AugYS	81	82	42.34	30.77	26.90
5	5AugYS	94	95	34.44	35.01	30.56
6	6AugYS	42	53	58.58	19.82	21.60
7	7AugYS	81	83	38.98	32.37	28.65
8	8AugYS	35	41	61.02	19.38	19.61
9	9AugYS	58	55	54.06	25.26	20.69
10	10AugYS	73	65	44.27	31.50	24.22
11	11AugYS	87	83	40.98	32.36	26.66
12	1AugYIC	46	55	49.38	24.91	25.72
13	2AugYIC	27	33	68.44	15.36	16.21
14	3AugYIC	67	85	42.22	27.57	30.21
15	4AugYIC	30	47	63.75	15.41	20.85
16	5AugYIC	81	96	34.78	32.23	32.99
17	6AugYIC	50	91	41.83	22.62	35.55
18	7AugYIC	84	77	40.24	33.36	26.41
19	8AugYIC	61	47	49.62	30.25	20.13
20	9AugYIC	57	59	47.79	27.57	24.64
21	10AugYIC	NA	NA	NA	NA	NA
22	11AugYIC	32	26	69.51	17.92	12.57
23	100AugYIC	51	38	59.20	24.83	15.98
24	31Sep	90	98	29.97	36.09	33.94
25	32Sep	69	73	43.42	29.57	27.01

26	33Sep	83	102	32.15	32.92	34.93
27	34Sep	51	64	46.18	25.83	27.99
28	35Sep	46	60	54.90	21.21	23.89
29	36Sep	32	40	64.63	17.01	18.36
30	37Sep	58	52	50.53	27.88	21.59
31	38Sep	63	85	37.64	28.80	33.56
32	39Sep	72	57	46.14	31.99	21.87
33	40Sep	64	73	41.79	29.32	28.89
34	41Sep	82	61	46.12	32.81	21.08
35	42Sep	69	83	37.63	30.59	31.78
36	43Sep	54	49	57.05	24.08	18.87
37	44Sep	69	63	45.70	30.36	23.94
38	45Sep	77	86	43.78	28.62	27.60
39	46Sep	80	95	33.35	32.91	33.75
40	47Sep	73	72	43.45	30.54	26.01
41	48Sep	58	105	32.69	26.26	41.05
42	01-Dec	28	26	71.31	15.92	12.77
43	02-Dec	52	65	48.06	24.98	26.96
44	03-Dec	41	25	66.48	21.96	11.56
45	04-Dec	58	63	50.07	25.76	24.17
46	01-Jan	63	43	50.91	30.88	18.20
47	02-Jan	58	52	47.33	29.69	22.99
48	12-Jan	98	121	28.27	34.71	37.02
49	13-Jan	63	53	46.29	31.11	22.60
50	16-Jan	91	86	38.88	33.65	27.47
51	18-Jan	79	76	41.20	32.12	26.68

52	19-Jan	72	57	46.45	31.81	21.75
53	20-Jan	48	57	53.69	22.86	23.45
54	21-Jan	73	81	41.18	30.04	28.79
55	22-Jan	54	53	49.11	27.55	23.35
56	23-Jan	78	76	39.16	33.04	27.80
57	24-Jan	43	34	61.43	22.92	15.65

c) Language IAT Study, Study 1 (n=49)

Sno	subject	age	gender	marital	education	yoga	native	medium	frequency	orderlikings	D_Eng	LATENCY_Eng	ERROR%_Eng	D_Pic
1	S31	22	Male	Unmarried	UG	1 Yr	Kannada	English	Less	English	0.504	866.93	5.83	0.631
2	S32	23	Male	Unmarried	UG	6 Mo	Hindi	Native	Equal	Native	0.228	1316.38	15.00	0.206
3	S33	18	Male	Unmarried	UG	1 Yr	Kannada	Native	More	Native	0.364	1304.13	12.50	0.490
4	S35	19	Male	Unmarried	UG	6 Mo	Kannada	English	Equal	English	0.155	1051.76	5.00	0.608
5	S38	18	Female	Unmarried	UG	No	Kannada	English	Equal	Picture	0.728	1174.01	6.67	0.128
6	S39	19	Female	Unmarried	UG	6 Mo	Hindi	English	Less	English	0.138	1215.75	8.33	0.585
7	S42	17	Female	Unmarried	UG	No	Kannada	Native	More	Native	0.053	1345.53	18.33	-0.145
8	S43	25	Male	Unmarried	UG	No	Hindi	Native	More	Native	0.138	2030.41	15.83	0.406
9	S44	18	Male	Unmarried	UG	No	Hindi	Native	Equal	Native	0.886	1262.19	14.17	0.663
10	S45	18	Male	Married	UG	Above 5 Yr	Hindi	English	Less	Picture	0.914	1026.99	15.00	0.368

11	S47	20	Male	Unmarried	UG	1 Yr	Hindi	Native	Equal	Native	0.383	2170.00	19.17	0.014
12	S48	20	Male	Unmarried	UG	6 Mo	Hindi	Native	Less	Native	0.449	1001.56	16.67	0.264
13	S49	19	Male	Unmarried	UG	6 Mo	Hindi	Native	More	English	0.828	1625.74	17.50	0.490
14	S50	19	Male	Unmarried	UG	6 Mo	Hindi	Native	Equal	Native	0.700	1648.14	9.17	0.511
15	S51	18	Male	Unmarried	UG	No	Hindi	Native	Equal	English	0.525	1346.50	19.17	0.806
16	S52	19	Female	Unmarried	UG	1 Yr	Kannada	English	Equal	English	0.237	1066.88	5.83	0.705
17	S53	20	Female	Unmarried	UG	No	Hindi	Native	Equal	Native	0.272	1479.54	13.33	0.816
18	S54	21	Male	Unmarried	UG	Above 5 Yr	Kannada	Native	Equal	Native	0.753	794.98	15.00	-0.024
19	S57	19	Female	Unmarried	UG	3 Yr	Hindi	Native	More	Picture	0.254	1500.75	20.00	0.372
20	S58	20	Female	Unmarried	UG	Above 5 Yr	Hindi	English	More	Native	0.432	1682.56	4.17	0.269
21	S59	22	Female	Unmarried	UG	Above 5 Yr	Kannada	Native	Equal	English	0.981	1075.42	5.83	0.552
22	S60	20	Female	Unmarried	UG	Above 5 Yr	Kannada	Native	More	English	0.425	1236.31	0.83	0.665
23	S63	41	Female	Unmarried	PG	Above 5 Yr	Hindi	Native	More	Picture	0.886	969.02	1.67	0.897
24	S64	33	Male	Unmarried	UG	6 Mo	Kannada	Native	More	Native	0.489	1696.78	10.00	0.401
25	S65	25	Male	Unmarried	PG	3 Yr	Hindi	English	Equal	Native	0.529	1575.83	10.00	0.650
26	S67	22	Male	Unmarried	UG	3 Yr	Kannada	Native	Less	Native	0.912	1302.34	12.50	0.465
27	S68	24	Female	Unmarried	PG	1 Yr	Kannada	Native	Equal	Native	0.540	1167.83	5.00	0.379
28	S71	23	Female	Unmarried	PG	No	Hindi	English	More	English	0.773	1018.55	7.50	0.607
29	S72	32	Female	Married	PG	6 Mo	Hindi	Native	More	English	0.055	1271.13	9.17	-0.515
30	S73	25	Male	Unmarried	PG	6 Mo	Hindi	Native	More	English	0.705	1040.95	3.33	0.777
31	S74	26	Male	Unmarried	PG	Above 5 Yr	Hindi	Native	More	Native	0.599	2602.76	15.00	0.254
32	S75	21	Female	Unmarried	PG	3 Yr	Hindi	English	Equal	English	1.093	1102.42	3.33	0.872
33	S76	27	Male	Unmarried	PG	6 Mo	Hindi	Native	More	Native	0.513	1538.13	5.00	0.618
34	S77	27	Male	Unmarried	PG	3 Yr	Kannada	Native	Equal	Native	1.099	806.86	5.00	0.519
35	S81	26	Male	Unmarried	PG	3 Yr	Kannada	Native	More	Native	0.160	1523.35	5.83	0.685
36	S82	28	Male	Unmarried	PG	1 Yr	Kannada	Native	More	Native	0.171	1201.15	7.50	0.608

37	S83	28	Male	Unmarried	PG	1 Yr	Kannada	English	More	English	0.562	893.99	15.83	1.177
38	S84	29	Male	Unmarried	PG	6 Mo	Kannada	Native	More	English	0.600	1038.04	2.50	0.368
39	S85	27	Female	Unmarried	PG	1 Yr	Kannada	English	Equal	English	1.174	944.56	3.33	0.377
40	S86	35	Female	Married	PG	1 Yr	Kannada	English	Equal	English	0.996	935.51	6.67	0.491
41	S87	26	Female	Unmarried	PG	1 Yr	Kannada	English	Equal	English	0.731	810.85	5.83	0.880
42	S88	31	Female	Married	PG	Above 5 Yr	Kannada	Native	Equal	Native	0.737	1491.48	16.67	0.406
43	S89	26	Female	Married	PG	3 Yr	Kannada	English	Equal	English	-0.282	1074.22	10.00	0.803
44	S40	18	Female	Unmarried	UG	6 Mo	Hindi	Native	Equal	Native	0.828	1101.77	17.50	0.930
45	S56	26	Male	Unmarried	UG	1 Yr	Kannada	English	More	Native	0.041	971.78	5.83	-0.607
46	S61	22	Female	Unmarried	PG	6 Mo	Hindi	Native	More	Native	0.427	1916.59	14.17	NA
47	S62	23	Male	Unmarried	PG	1 Yr	Hindi	Native	Equal	Native	NA	2246.67	27.50	0.168
48	S67	22	Male	Unmarried	PG	1 Yr	Kannada	Native	Less	Native	0.912	1302.34	12.50	0.465
49	S41	18	Female	Unmarried	UG	No	Kannada	Native	Equal	Native	NA	1425.67	33.33	0.643

Sno	subject	AVELTNCY_Pic	ERROR%_Pic	D_Nat	LATENCY_Nat	ERROR%_Nat	Lang_fact	OrderThree	OrderSix	flower_F	Insect_F
1	S31	779.96	4.17	0.520	1547.33	18.33	Kannada	Native	NPE	3	2
2	S32	1139.69	6.67	-0.173	1153.36	13.33	Hindi	Picture	PEN	4	1
3	S33	1103.99	10.00	0.851	1461.43	10.83	Kannada	Picture	PNE	5	2
4	S35	1072.28	4.17	0.868	1358.54	3.33	Kannada	Picture	PEN	5	2
5	S38	921.24	3.33	0.524	1349.25	9.17	Kannada	Native	NPE	5	2
6	S39	919.56	4.17	-0.076	1385.86	10.83	Hindi	English	EPN	5	1

7	S42	1181.38	18.33	0.460	1272.78	12.50	Kannada	Native	NEP	4	2
8	S43	1744.48	5.00	0.823	1982.79	6.67	Hindi	Native	NPE	3	3
9	S44	843.54	1.67	0.639	906.55	0.83	Hindi	Native	NEP	4	2
10	S45	948.73	13.33	0.983	1049.11	13.33	Hindi	Picture	PNE	4	3
11	S47	1232.24	5.00	0.045	1332.27	1.67	Hindi	English	ENP	4	2
12	S48	898.43	7.50	-0.394	1011.13	15.83	Hindi	Picture	PNE	5	2
13	S49	1000.63	5.00	1.148	1106.72	5.00	Hindi	English	ENP	3	3
14	S50	1475.58	3.33	0.457	1980.32	11.67	Hindi	Native	NPE	5	3
15	S51	966.55	6.67	1.026	1140.13	7.50	Hindi	Native	NEP	5	3
16	S52	1149.87	5.83	0.626	1277.96	7.50	Kannada	Picture	PNE	4	4
17	S53	1885.83	17.50	0.336	1193.62	15.00	Hindi	Picture	PEN	5	5
18	S54	650.32	15.00	0.597	787.32	25.00	Kannada	English	EPN	4	3
19	S57	1291.60	13.33	0.537	1359.77	10.00	Hindi	Picture	PNE	4	1
20	S58	1112.38	4.17	0.530	2055.12	10.00	Hindi	Picture	PNE	4	2
21	S59	706.59	2.50	0.913	812.31	3.33	Kannada	English	ENP	5	1
22	S60	916.41	0.83	0.609	1085.33	0.83	Kannada	Picture	PEN	5	1
23	S63	942.39	0.00	1.169	1111.88	0.83	Hindi	Native	NPE	5	1
24	S64	1338.19	5.00	0.679	1355.27	3.33	Kannada	English	EPN	4	1
25	S65	1218.87	3.33	0.598	1399.57	9.17	Hindi	English	ENP	5	4
26	S67	1152.35	10.83	0.794	1287.13	11.67	Kannada	Native	NPE	5	1
27	S68	1097.09	1.67	0.407	1212.76	1.67	Kannada	English	ENP	4	1
28	S71	827.68	3.33	0.814	788.54	5.00	Hindi	English	EPN	5	2
29	S72	1305.95	4.17	0.282	1052.69	1.67	Hindi	English	ENP	5	5
30	S73	958.83	0.83	0.918	1185.72	0.83	Hindi	Native	NPE	5	1
31	S74	1321.28	0.83	0.473	1385.08	2.50	Hindi	English	EPN	5	2
32	S75	1089.83	2.50	0.881	1287.18	5.00	Hindi	Picture	PEN	5	1

33	S76	1385.40	4.17	0.808	1431.88	0.00	Hindi	English	EPN	4	2
34	S77	786.71	8.33	0.835	792.13	5.83	Kannada	Picture	PNE	5	1
35	S81	1470.70	3.33	0.264	1385.42	4.17	Kannada	Picture	PNE	5	2
36	S82	1368.83	5.83	0.719	1292.68	5.83	Kannada	English	ENP	4	2
37	S83	936.66	15.83	0.758	797.32	13.33	Kannada	Picture	PEN	5	1
38	S84	879.21	1.67	0.141	1098.90	3.33	Kannada	Native	NEP	4	2
39	S85	940.88	2.50	0.129	1901.94	3.33	Kannada	Native	NPE	3	3
40	S86	725.28	2.50	0.753	932.51	1.67	Kannada	Native	NEP	5	1
41	S87	773.77	6.67	0.689	1035.86	8.33	Kannada	Picture	PNE	5	1
42	S88	1187.03	2.50	0.500	1291.58	4.17	Kannada	English	EPN	5	2
43	S89	872.16	5.00	1.011	906.03	9.17	Kannada	Picture	PEN	5	1
44	S40	1555.94	15.83	NA	1510.78	25.00	Hindi	Native	NPE	4	2
45	S56	834.24	5.83	0.083	935.37	5.00	Kannada	Picture	PEN	4	2
46	S61	2079.07	32.50	0.942	1522.33	4.17	Hindi	Picture	PNE	5	1
47	S62	1857.44	9.17	0.657	1773.18	6.67	Hindi	Native	NEP	3	3
48	S67	1152.35	10.83	0.794	1287.13	11.67	Kannada	Native	NPE	3	3
49	S41	1173.42	14.17	0.505	1089.63	9.17	Kannada	English	EPN	3	3

d) Language IAT Study, Study 2 (n=23)

Sno	ID	age	gender	marital	education	yoga	medium	frequency	flower	insect	ORDER	D_Pic	LATENC Y_Pic
1	S1	36	female	married	PG	one	English	equal	4	1	1	0.690	1219.83
2	S2	53	male	married	PG	above one	Native	more	5	2	2	-0.171	1191.22
3	S3	25	male	unmarried	UG	one	Native	more	3	2	1	0.590	891.58
4	S4	34	female	unmarried	UG	no	English	equal	5	1	2	0.388	1078.92
5	S5	25	female	married	PG	no	Native	less	5	2	1	0.097	1482.00
6	S6	32	female	married	UG	one	Native	less	3	1	2	0.399	1230.92
7	S7	38	male	married	PG	above one	Native	more	4	1	1	0.417	1070.06
8	S8	24	male	unmarried	UG	one	Native	more	5	2	2	0.448	839.63
9	S9	30	female	married	UG	one	Native	less	5	1	1	0.443	857.06
10	S10	34	female	unmarried	PG	above one	English	more	4	2	2	0.379	1003.86
11	S11	37	male	married	UG	one	Native	less	3	3	1	-0.115	1758.81
12	S12	33	female	married	PG	one	Native	equal	5	1	2	0.806	1283.43
13	S13	29	female	married	UG	above one	English	less	5	1	1	1.020	1021.71
14	S14	31	female	married	PG	one	English	equal	5	1	2	-0.334	1757.63
15	S15	23	female	unmarried	UG	no	English	equal	5	3	1	0.432	1100.45
16	S30	43	male	unmarried	UG	one	English	less	4	3	2	0.451	771.66
17	S31	60	male	married	UG	above one	English	equal	5	1	1	0.630	1029.54
18	S32	26	female	married	PG	one	Native	equal	5	2	2	0.452	1342.75
19	S33	43	male	married	PG	above one	Native	more	3	3	1	0.839	808.79
20	S34	23	female	unmarried	UG	one	English	more	4	3	2	0.356	1155.59

21	S35	28	female	unmarried	PG	no	English	less	5	1	1	0.908	865.69
22	S36	25	male	unmarried	PG	one	Native	equal	5	1	2	0.676	980.07
23	S37	29	male	married	UG	no	English	more	4	4	1	-0.001	1280.94

Sno	ID	ERROR% <sub>Pic</sub>	D_Eng	LATENCY_Eng	ERROR% <sub>Eng</sub>	D_Nat	LATENCY_Nat	ERROR% <sub>Nat</sub>	Lang_fact
1	S1	0.83	1.264	1322.04	0.00	1.006	1174.89	0.00	K
2	S2	2.50	0.737	1684.65	5.83	0.558	1380.08	1.67	H
3	S3	2.50	0.906	1084.60	5.00	0.659	1016.08	9.17	H
4	S4	0.83	0.425	1768.02	0.00	0.380	1445.16	0.83	H
5	S5	2.50	0.955	2240.08	10.83	0.202	1382.91	0.83	H
6	S6	2.50	0.259	1384.86	0.00	0.928	1380.77	0.83	K
7	S7	2.50	0.884	1619.56	6.67	1.090	1146.08	1.67	K
8	S8	0.83	0.983	1357.81	5.83	0.290	1094.86	0.00	H
9	S9	7.50	0.536	1061.81	6.67	0.590	962.93	5.00	H
10	S10	0.83	0.660	1288.73	2.50	0.303	1359.29	0.83	H
11	S11	28.33	0.763	2739.73	36.67	0.392	2072.43	4.17	H
12	S12	1.67	0.509	1755.93	1.67	0.210	1912.08	3.33	K
13	S13	4.17	1.130	1041.84	4.17	0.270	1753.12	15.00	H

14	S14	0.83	0.393	1736.24	0.00	0.473	1555.90	0.00	H
15	S15	0.83	0.909	1175.70	0.00	0.890	1465.81	1.67	K
16	S30	0.83	0.016	1315.34	0.00	0.661	1145.94	0.00	K
17	S31	2.50	0.631	1459.23	2.50	0.317	1162.63	0.00	H
18	S32	5.00	0.314	1805.13	1.67	0.432	1615.88	9.17	H
19	S33	4.17	0.906	1085.86	10.83	0.388	939.47	6.67	H
20	S34	3.33	-0.258	1121.08	3.33	0.054	1254.30	4.17	K
21	S35	5.00	1.245	918.93	7.50	0.785	1088.18	9.17	H
22	S36	0.83	-0.057	1183.46	1.67	1.023	1339.30	1.67	K
23	S37	4.17	0.656	1430.29	3.33	0.419	1476.58	5.83	H

## **PUBLICATIONS FROM THIS DOCTORAL WORK**

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- 1. Ilavarasu, J. V.,** Mohan, S., & Hankey, A. Triguna as personality concept: guidelines for empirical research. *International Journal of Yoga-Philosophy, Psychology and Parapsychology*. (in press)
- 2. Ilavarasu, J. V.,** Rajesh, S. K., & Hankey, A. Implicit measure for yoga research: Yoga Implicit Association Test. *International Journal of Yoga*. (in press)
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## Triguna as personality concept: Guidelines for empirical research

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### ABSTRACT

In the East *triguna* is considered an important personality concept. Compared to western models of personality, *triguna* is less popular globally. Even in the East, research on *triguna* is scarce. Interest in the area peaked in the 1970s when theoretical works led to the development of several questionnaires. However, practical use of these tools failed to take off. *Triguna* research remains sporadic, strongly suggesting a lack of channelized work. The new tools, which were developed are also not much used. Apart from psychology, in recent times, management research has taken to investigating *triguna* and other related constructs like *karma yoga*. Considering the current situation of *triguna* research, if guidelines were drawn up, researchers would have a direction to guide their studies, at least for coming few years and be able to contribute incrementally to the field. This paper is presented in light of these considerations. We discuss the concept of *triguna*, characteristics of a successful personality theory and challenges in *triguna* research, in light of which we propose a set of eight guidelines to assist future research in the field. In addition, we discuss some of the new tools emerging from mainstream psychology, which may also be used in *triguna* research. Hopefully, we may look forward to some major landmarks of evidences for the *triguna* construct, over the coming period of time.

**Key words:** Empirical research, guidelines, *Samkhya*, *Triguna*, yoga

### INTRODUCTION

Psychologists have been the most active group in personality research. Though personality is an important domain in psychology, development of personality theories within psychology was not smooth. Its acceptance in mainstream psychology has always been a challenge. In the west personality researchers had a reputation of being atheoretical and vague, not sticking to the disciplines of the mainstream psychology.<sup>[1]</sup> Hence, development of personality theories was a struggle. In India, some models of personality are prevalent, though not taken seriously in the west.

Here, we present and discuss a classic Eastern model of personality-*triguna*.

The total number of papers published on *triguna* is relatively small. Interest in *guna* research has waxed and waned, growing stronger in the 1970s and then declining (Google Ngram).<sup>[2]</sup> There are more books than scientific articles explaining *gunas*, the majority are from the field of philosophy. In earlier days, the development of tools (questionnaires) to assess *triguna* was the prime focus.<sup>[3-6]</sup> One overriding issue is the scarcity of studies using these questionnaires to study human behavior in different contexts.<sup>[7-10]</sup> Nor have they been used to explore other constructs, in the way the big five has been used to correlate with mindfulness,<sup>[11]</sup> etc., indicating that *triguna* has not yet gained the attention of researchers in the field, not even among researchers in yoga, for which the construct is particularly relevant.

The current state of *triguna* research presents the background for the present paper, a critical analysis and

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description of the concept of *guna* with emphasis on possible guidelines for the next stages of research in the field. The intention of this paper is to suggest further direction to *triguna* research incorporating emerging research techniques from other discipline. We have attempted to describe, certain aspects of *triguna* concept, which are essential for designing empirical studies. We have discussed the characteristics of a good personality theory and have identified challenges in *triguna* research. From all this, we have drawn few guidelines to conduct empirical research in *triguna*. This has been presented in three stages based on priority of importance. We have also commented on what has been done already in each stage and what can to be done in the future. All these factors, we believe would give researchers a good direction to conduct their studies.

### TRIGUNA AS PERSONALITY CONCEPT

Our goal in this section is not to give a detailed account of the concept of *triguna*, which has been done already in the literature.<sup>[5,6,12]</sup> Various ways in which *triguna* was conceptualized by various researchers was also analyzed.<sup>[13]</sup> However, we present certain important concepts inspired from the scriptures, which might help us figure out the area where we need to focus to conduct empirical research. These are authors' understanding about the concept *triguna* and the discussion might appear non-scientific for the want of scientific evidences; nonetheless, we present it here to draw our empirical guidelines. From a personality perspective, *triguna* is considered as a set of three basic types of tendency. *Sattva*, *rajas* and *tamas* are the three components. Each of these *gunas* is characterized by its own properties. *Triguna* is basically a tendency of expression of behavior. Depending upon the observed behavioral characteristic we can assess the *guna*, which propelled that action. The element of freedom also decreases from *sattva* to *rajas* to *tamas*. The *tamas* is the state of maximum inertia, *rajas* drives the activity with attachment and associated excitement and misery. *Sattva* is a state of equilibrium and least agitation of mind. Even in *sattva* state the bondage is present though the freedom is also available to a greater extent.

According to *Samkhya* (one of the six schools of Vedic philosophy), the three *gunas* are balanced in the unmanifest form of *prakriti*. When it moves to the manifest form, it happens with the imbalance of the *triguna*.<sup>[14]</sup> It is this *triguna*, with a spectrum of qualities, which pervades throughout the creation. Hence, it is considered the basic fabric of creation.<sup>[15]</sup> Although taking birth, a person takes up a particular combination of *gunas* according to his previous births' experiences or *samskaras* (pregenetic disposition<sup>[16]</sup>) and very specifically according to his *prarabdha karma* (a part of the total *karma*, called *sanchita karma*, which has already started working on a person in this birth), which has to be exhausted taking this birth. Importantly,

he is responsible for the kind of *guna* that he possesses. However, once the combination of the *gunas* is determined, it strongly binds the person in this birth. They almost guide every behavior of his. How does a particular *guna* emerge at a given time? What factors determine that? Why *gunas* are required? These are some of the common questions. Basically, we are propelled to exhaust our *karmas* by involving in action. This fruition of the fruits of karma starts from our *samskaras* (all the impressions of our previous experiences, including earlier births). Our *samskaras* create a desire, which is an attempt of expression of *samskaras*. This expression of desire requires certain vehicle to convey and that can be attributed as *gunas*. *Gunas* are the means through which our *samskaras* are expressed in terms of thoughts of desires, which impel us into action. There are deeper implications to this. As the impetus of *samskaras* cannot be suppressed; similarly, inhibition of expression of behaviors through one of the *gunas* or through any of their combinations is not equally possible. Like the force of gravity on earth, the laws of *gunas* are always acting on us, hence we cannot neglect them, so the best approach would be to understand them and use them according to our needs.

When a particular *samskara* finds suitable environment outside, for its expression that *samskara* would emerge and manifest itself. This gives the reason, why a particular thought must arise in our mind at a given time or situation? Time and situation provide congruent environmental support for the expression of *samskaras*. We can control the manifestation of *samskaras* by controlling the inner nature or by carefully choosing the external environment. That is the reason, it is considered very important to have a congenial environment for one's growth, because a good external environment might inhibit the emergence of ill *samskaras* and promote manifestation of good *samskaras*. Once the *samskaras* manifest, they happen through one of the *gunas*. This conceptual framework can be further expanded to incorporate the element of free will as attempted in Figure 1.

The *prarabdha Karma*, which is available for fruition in this birth, activates *samskaras* according to the influence

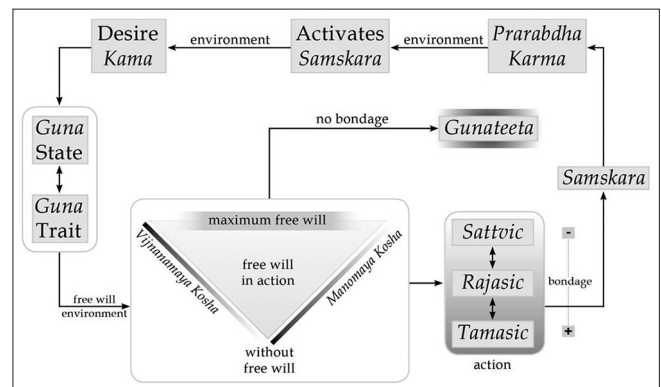


Figure 1: Model of Karma, Guna, Samskara and free will, in action

of the environment including imagination from memory. as a *samskara* gets activated, it creates a desire. Desire propels a person into action. the expression of the action happens through *gunas*. Before action is actually executed, there is an element of “free will,” which is the inherent capacity to execute choices. Action can be executed with or without free will. Action with maximum utility of free will leads to no bondage and that is *gunateeta* state. Here, influence of *vijnanamaya kosha* is maximum. However, the less we use our degree of free will, owing to the dominance of *manomaya kosha* or influence of our emotions, more will be the bondage as at this level *raga* (likes) and *dvesha* (dislikes) operates fully. Actions with decreasing gradation of free will cause bondage and strengthen further *samskaras*. Such actions are expressed through one of the possible combinations of the *gunas*. Hence, the key to freedom from actions is action without attachment by consciously using the free will, with awareness. Use of free will decide whether an action will lead to further bondage or freedom

The presented line of argument would help to discover whether *guna* should be given a status of trait or state construct to dichotomise would be very difficult at this stage; however, it should be possible to predict the amount of trait feature and state feature by assessing the behavior. If the behavior can be predicted by previously known *guna* factors, then it is more likely to have trait quality, whereas, if previously known *guna* factors do not predict new behavior then that behavior is more likely to get influenced by state features which are more transient. From the developmental point of view, it is reasonable to assume that any drastic change in the environment would influence the expression of the *gunas*. This would give direction to study *gunas* across the human life span

For scientific investigation, the internal factor cannot be accommodated easily as it is more of a philosophical discussion and doing an experiment under laboratory conditions may not be that feasible. However, the second factor, external environment, can be manipulated in a controlled setup. However, it is a real challenge to estimate the percentage of variance contributed by each of these factors.

### CHARACTERISTICS OF PERSONALITY THEORY

According to Hall *et al.*, the essence of a personality theory should consist of a set of assumptions concerning human behavior together with empirical definitions. It should be relatively comprehensive and should be able to predict behavior in a wide range of situations. Many of the existing western theories of personality do not satisfy all these conditions and have their own inherent limitations. Temporal and trans-situational consistencies

are the most desirable criteria for considering a personality theory successful.<sup>[1]</sup>

Traditionally, personality has been explored as a trait concept, something, which is the characteristic feature of a person and quite durable. When durable characteristics, trait, is sought, the idea of the dynamic structure of personality is seriously neglected. We tend to assume that the characteristic features of a person should not change over a short span of time. This altogether neglects the possibility of phenomenal transformations, which people can undergo due to various factors. We emphasize that use of free will should be a determinant in the exploration of the *gunas*. We may not have developed a valid and reliable tool to assess free will, but it currently deserves all focus and attention. Associated research in the areas of self-concept and locus of control might give valuable insights.

A related feature of *triguna*, which is less mentioned, is the idea of *gunateeta*, the possibility of transcending *gunas*. This may happen, the scriptures suggest, when inner freedom has been consciously utilized to realize the highest human potential. The experience of an “inner space” in which a person can modify reactions or make decisions is not uncommon. By the term inner freedom or free will, we mean the state of being aware of our thoughts and actions, witnessing them uninvolved emotionally or cognitively and experiencing the “inner space.” This brings out the important feature of the conditional existence of *triguna*. *Gunas* do not always determine the behavior, since it may be possible to transcend them. In such states, actions are not impulsively exhibited, but are consciously guided by the “will.” We suggest that unconscious determinants may have less influence on behavior under such conditions.

### CHALLENGES IN GUNA RESEARCH

*Guna* theory of personality currently does not possess all the characteristics required of an ideal personality theory. Its ability to predict behavior under a wide variety of situations is yet to be verified. Hence, further research is required in this direction. Some practical questions which *guna* researchers need to address are now discussed.

### CAN ABNORMAL BEHAVIOR BE EXPLAINED USING GUNAS?

This represents a practical challenge for *guna* researchers. Many western theories are successfully applied to understand abnormal behavior and treatment modalities are developed using those models. The Freudian model, social learning model, etc., are some examples. From the *triguna* perspective, a subject which is explored extensively in Ayurveda and which we shall treat in a subsequent article, extreme *gunas* may be considered as predictors of

unusual or abnormal behavior. According to the Ayurvedic text, *Charaka Samhita* (*Sutrasthana*, chapter 1, sutras, 57), *rajas* and *tamas* are considered as mental *doshas* (defects). *Sattva* is considered as a state of equilibrium. Furthermore, the sutra 58 says mental disorders can be overcome by right knowledge, boldness, memory and yogic practices like *samadhi*. In chapter 11, sutra 47 stresses moderation in life-style as therapy for mental disorders.<sup>[17]</sup> Hence, directions can be sought from such classical Ayurvedic texts for addressing the issue of abnormal behaviors. Further research needs to be done to clearly identify how particular *gunas* produce abnormal influences on behavior.

### ARE GUNAS TRAIT OR STATE CHARACTERISTICS?

This is another challenging question. From the perspective of personality psychology, *gunas* are considered more durable and lasting in a person, if the element of inner freedom is not used to consciously override behavior. This means that the majority of the people, who are propelled into action without using their inner freedom, are more likely to express trait aspects of *guna*. The behavior of those who consciously try to use their inner freedom may be less predictable as they may consciously override inner tendencies to behave constructively. Given an element of inner freedom, therefore, *gunas* may be both trait and state, with predominance requiring judgment according to context. In general, the *gunas* are considered as a trait concept. In Ayurvedic text also it can be found that personality is described as 16 types, seven *sattva*, six *rajas* and three *tamas*, which are majorly trait characteristics.<sup>[17]</sup> If experimental studies are conducted keeping the state aspect into the framework, influence of situational factors on behavior can be studied. With our current understanding, we propose that state *gunas* are influenced by the immediate effects of a given situational action, however if they are continually reinforced, they would become more durable trait quality. We suggest future researches consider this aspect of dynamic flux of state and trait *gunas*, which were not addressed earlier.

### CAN GLOBAL OR CONTEXTUAL PREDICTION BE MADE?

Prediction is the ultimate gold standard for a successful personality theory. Can *guna* theory be used to predict general behavior of humans? Can it be used to predict specific contextual behavior such as in a crisis, in an interview, in a classroom, etc., Various situations may evoke different responses. *Triguna* theory is not put into these tests. Hence, finding predictive validity may be given attention in future studies.

### INFLUENCE OF FREE WILL IN EXPRESSION OF GUNAS

As intimated earlier, free will, should be considered when assessing *gunas* as a potential moderator variable between

*gunas* and behavior. Influence of free will may cause completely different expression of the *gunas*. This would be the most challenging part of *guna* research. Other related constructs, which can be studied are self-concept (opinion about one's own self) and locus of control (how much a person is internally or externally guided in making decisions). To study *triguna* incorporating free will, these constructs may offer useful strategies. An attempt should be made to integrate free will concept into the framework of *triguna*.

### GROUP VARIATION VERSUS INDIVIDUAL DIFFERENCE

These are the two ways of looking at people in personality research. In personality research, more focus is given to individual difference. Hence, *guna* theory should be able to distinguish individual differences. Group variations also need to be studied as a part of organizational setup, or classroom setup, etc., and should give guidance to categorize people. Group behavior may be quite different from individual behavior as there are many more external factors, which determine group behavior. *Triguna* theory must bring these aspects of social psychology to experimental field.

### CROSS-CULTURAL VARIATIONS

Though *triguna* is considered as universal, in manifestation and expression, it would be interesting to study any cross-cultural difference in expression of *gunas*. Whether certain aspects of *gunas* are more dominant in particular societies or groups would require global cross-cultural studies. Such findings can help to address psychological and social issues better, considering the nature of society or group. Planning of health interventions or public activities can also be guided by this knowledge.

### OPERATIONAL DEFINITION

Finally, operational definition should be concisely formulated to target particular aspects of *gunas* proposed for measurement. Operational definition gives direction to the formulation of precise hypotheses. The challenge involved here is that each *guna* is a combination of various individual constructs. For example, *rajas* is expressed as passion, anxiety, jealousy, etc., which are psychological constructs in themselves. Combining them and presenting them as a single construct would be inappropriate. Hence, the operational definition would help the researcher define what aspect of the *triguna* is being assessed. Once a clear hypothesis is formulated, further investigation becomes easier.

### GUIDELINES FOR EMPIRICAL RESEARCH

Based on the above points, we would like to discuss guidelines for future *guna* research in three stages,

arranged in order of priority. Note that no work has been done in these areas, but critical examination of what has been done, helps in gaining insights into what may be best done in the future.

### STAGE ONE: DRAWING CLEAR THEORETICAL FRAMEWORK OF *TRIGUNA*

In any research, the foremost step is to make basic concepts clear, in this case, *triguna*. What does *triguna* mean in terms of personality? Apte's Sanskrit dictionary gives 31 different meanings of the word *guna*,<sup>[18]</sup> here when we talk about *triguna*, a personality concept, we essentially mean *sattva*, *rajas* and *tamas*. They are the three different modes with which a person expresses his inner tendencies as behavior. The concept of *triguna* is mainly discussed in the Bhagavad Gita<sup>[15,19]</sup> and in the *Samkhya Karika*.<sup>[14]</sup> There are three *gunas*: *sattva*, *rajas* and *tamas*. *Sattva* is characterized by knowledge, illumination, serenity, compassion, etc., *Rajas* is characterized by passion, arrogance, jealousy, etc., *Tamas* is characterised by drowsy, sleepy, lazy, etc., These characteristics are like constructs in psychology. In order to assess them using a suitable tool, we must define them. Hence, the operational definition of the *gunas* is very essential. To operationally define *gunas*, the abstract constructs must be translated to measurable framework. Finally, ontological validation gives the study of *gunas* a scientific status and acceptance. Ontological validations focuses on systematizing the construct *triguna* hierarchically and express its interrelationships with other similar constructs.

Works related to this stage have been done in a scattered way and more research needs to be done focusing on each element of the theoretical framework.

### STAGE TWO: NATURE OF RESEARCH QUESTIONS FOR VALIDATION OF *GUNAS*

In the next stage various theoretical proposals are put to the test. Theoretical works should be promoted in order to have good ontological validation of the construct. For this literary, study must be promoted. In this regard one point to be noted is that though the work is being carried out in various other disciplines, researchers are working independently of experimentalists. For example, they are quite often Sanskrit scholars who would do intense literary research. However, there is no connecting link between them and the experimentalists so that those conceptual ideas can be taken into empirical studies.

To conduct empirical research, the first thing that comes to our mind is the tools that should be used to assess *gunas*. Toward this, substantial work has been done majorly to develop questionnaires to assess *gunas*. There are about a dozen questionnaires to assess *gunas*. These

*guna* questionnaires were mostly developed in 70s and 80s, mainly from India. The Vedic Personality Inventory developed by David Wolf,<sup>[20]</sup> developed in the western population, is one of the most rigorously validated questionnaires until date, in which the author has used statistical procedure called factor analysis for validation. The most recently developed tool is the Mysore *Triguna* Scale developed by Shilpa et al.<sup>[21]</sup> In this work, the authors have attempted to develop scales both based on *triguna* and on *tridosha*, an Ayurvedic concept to classify people based on their *prakriti*.

The recent development in the field of social psychology is the introduction of implicit tools to assess various constructs. Implicit cognition is becoming popular and is widely accepted among researchers. The basic premise is that there are many determinants of our behavior, which we are not quite aware of their influencing mechanism, are predominantly unconscious, but still capable of exerting a strong influence on the behavior of an individual. Implicit tools can be used majorly under two conditions: 1) when there is a chance of self-presentation bias and 2) when the construct itself is difficult to self-report, though the subject wants to honestly report them.<sup>[22]</sup> The construct *guna* may have both these features, especially the domain *sattva*. People may tend to project themselves more *sattvic* than what they actually think implicitly. Such distinctions can be addressed by use of implicit tools. Moreover, for the want of deeper self-introspection, many times it might be difficult to self-report *gunas*. Hence, the use of implicit tools for *guna* research would be the further step in the experimental validation of the construct, *triguna*.

Then comes the confirmatory studies and replication studies. The hallmark of any science is reproducibility. Hence, evidence, (weaker or stronger) as soon as obtained must be taken to the next step of reproducibility. If more number of independent studies is showing evidence of construct validity and predictive validity, no doubt the concept would be taken to practical field; else it would always remain in the domain of academic research. The most powerful evidences would be gathered if predictive experiments are conducted in which behavior can be predicted on the basis of the concepts of *gunas* as assessed by the measuring tools.

### STAGE THREE: INTEGRATION WITH OTHER CONTEMPORARY THEORIES

Once the construct is well-grounded and well-established, its relationship with other relevant constructs must be explored. Like the relationship between *gunas*, spiritual well-being, mindfulness, etc., These correlational studies would pave the way toward understanding the interrelationship between different constructs. This is a step before simplification and unification of the theory.

As mentioned earlier, a theory's success is evaluated more on its utilitarian ground and hierarchical structure inside a theory is more guided by utilitarian basis. For example, anger and anxiety are two different constructs according to the western psychology and indeed they can be shown to be two distinct constructs, may be partially overlapping. Researchers are however, able to distinguish people having these different characteristics and hence this classification has functional utility. On one side, our attempt to find a simpler classification of personality, should not affect our functional classification. We may tend to think of the big five to simple three (*gunas*); however, we should not overlook the contributions of big five and other such similar theories. Unlike the big five, *triguna* may fail to emerge as a construct having three independent domains. In fact, the theory itself suggests the possibility of overlap and gradation of *gunas* based on the three primary *gunas*. Hence, *triguna* should be considered with its own distinguished characteristics.

### SUMMARY OF THREE STAGES

We summarize by drawing the following guidelines for future work in *gunas*:

1. Theoretical framework and ontology validation of *gunas* must be attempted, including the role of free will
2. Operational definition must be stated clearly in each study
3. Valid and reliable tools to assess *gunas* must be promoted and use of the existing tools must be encouraged further
4. Implicit tools of assessing *gunas* must be initiated as it might give new dimensions of *guna* concepts
5. More statistically intense procedures must be used such as dimensional reduction and factor analysis
6. Confirmatory and replication study must be conducted to add stronger evidences
7. Integration with other contemporary theories
8. Cross-cultural variations must be studied for *guna* construct.

Most of these guidelines may appear to be a general outline for any field of research, however even adherence of such general guidelines is found to be poor in the literature. We also suggest a specific guideline, like the use of implicit measures for *guna* research which might give insight into the unconscious domain.

### CONCLUSION

We conclude that the guidelines drawn in this paper would help researchers to identify what best can be done for *guna* research. Practical guidelines for research methodology would also help to make empirical studies. We hope this

basic framework would be available for further expansion and refinement.

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## **Implicit Measure for Yoga Research: Yoga Implicit Association Test**

### **Abstract**

**Context:** The Implicit Association Test, a new tool for yoga research is presented. Implicit measures could be used in those situations where 1) the construct is difficult to self-report, 2) there is threat of social desirability. Clinically we can assess cognitive dissonance by evaluating incongruence between implicit and explicit measures. Explicit preferences are self-reported. Implicit preferences are what we inherently believe, often without our conscious awareness.

**Aims:** To provide a bird's eye view of the field, Implicit Cognition, with emphasis on the Implicit Association Test (IAT). To illustrate through an example of our study to develop an implicit tool to assess implicit preference towards yoga.

**Settings and Design:** Five independent samples of total 69 students undergoing short and long term yoga courses in a Yoga University were assessed for their implicit and explicit preferences towards yoga.

**Methods and Material:** The Yoga-Implicit Association Test (Y-IAT), explicit self-rating scale were administered through computers using Inquisit software. Experimental and scoring materials are provided.

**Statistical analysis used:** Data were extracted using recommended scoring algorithm and descriptive statistics highlighting basic psychometric properties of Y-IAT are presented along with its congruence with explicit self-measure.

**Results:** A moderate preference towards yoga was detected, with a lower implicit-explicit congruence, reflecting possible confound of social desirability in the self-report of preference towards yoga.

**Conclusions:** Implicit measures may be used in the yoga field to assess constructs which are difficult to self report or may have social desirability threat. Y-IAT may be used to evaluate implicit preference towards yoga.

**Key words:** Yoga, Implicit Association Test, misattribution, implicit explicit congruance.

## **Introduction**

Yoga research is indeed a multidisciplinary venture, and has adopted tools from various disciplines like biology, medicine, psychology, psychiatry, sociology, etc. The strength of any field lies in the strength of its methods and measurement tools used. Effects of yoga can be studied at various levels using various methods. Tools of medicine and psychology are majorly used in yoga research. For self-report of subjective feelings and thoughts questionnaires are chiefly used. However, there are many constructs which are difficult to self-report and might have influence of social desirability (a voluntary or an involuntary mode of response to project socially desirable). Do I say what I actually think? Am I influenced by my conditioning, unaware of myself? Often people tend to deliberately distort their responses to questionnaires or give the wrong response quite unknowingly. To address such questions, implicit measures were successfully utilized.<sup>[1]</sup> In this article we present a tool, extensively used in the west, especially in psychology since last 15 years, and which has attained a status of state-of-the-art tool in the field. We propose to review this tool and highlight its utility in the field of yoga, with an example of a study conducted by us. The objective of this paper is not to present a detailed review of the field but to spotlight the most relevant aspect of the field which can be utilized in yoga research.

## **Implicit Cognition**

Implicit cognition is a broad term which encompasses all those cognitive processes that happen, without any or much awareness about them, but still influence our behaviors. More precisely implicit processes are characterized the process which happens with lack of awareness, less cognitive resource, short time, and independent of proximal goal.<sup>[2]</sup> Implicit measures are those which can measure such influences of implicit processes. Some commonly used related terms are unconscious, automatic, uncontrolled, implicit, and subliminal. For an overview of how implicit social cognition functions, the recent book, *Blindspot*<sup>[3]</sup>, should interest naive readers.

## **Implicit Measures:**

There are many tools used in psychology which are categorized under implicit measures. They are the Implicit Association Test (IAT)<sup>[4]</sup>, priming<sup>[5]</sup>, Go/No-Go Association Task (GNAT)<sup>[6]</sup>, The Extrinsic Affective Simon Task<sup>[7]</sup>, etc. For a detailed review of the most popular tools, refer the paper on implicit measures in social cognition by Fazio et al.<sup>[8]</sup> One of the common goals of implicit measures is to assess those preferences and attitudes which may be inhibited due to choice or ignorance. In this paper, we focus on one of the most well-researched tools, the IAT. Since its inception in 1998, many papers have been published using this tool in diverse fields, and over 50 papers were only on various aspects of its validity and psychometrics. The next popular tool is the priming tool, though equally powerful, but compared to the IATs it has lower internal consistency and effect size.<sup>[9]</sup> Hence we focus on the IAT.

### **The Implicit Association Test (IAT)**

The IAT was first reported in 1998 by Greenwald et al.<sup>[4]</sup> It is a reaction time task, which requires a certain way of categorization of the shown stimuli on the computer screen. This test measures automatic preferences. These tests require about 5 to 10 minutes to complete, and have high effect size compared to priming measures. Even for personality domains, like self-esteem, IATs were found to have internal consistencies above 0.80, and test retest reliability ranging from 0.60 to 0.70. IAT's ease of administration, higher effect size, and reliability are some of the features which captured the attention of many researchers. IATs can be constructed and delivered very easily using any stimulus presentation software. Some of the commercial software are Empirisoft, E-Prime, Inquisit, Paradigm, SuperLab, etc.<sup>[10]</sup> Affect 4.0<sup>[11]</sup> is a free software which is capable of doing the same thing.

### **Structure and procedure of IAT**

The structure of IAT can be illustrated using *flower-insect* IAT. The traditional IAT has seven blocks (Table 1) in which subjects have to respond to the shown stimuli.

Table 1: IAT structure

Block	No. of trials	Task	Response key assignment	
			Left key	Right key
1	20	Target discrimination	Flowers	Insects
2	20	Attribute discrimination	Good	Bad
3	20	Initial combined task (Practice)	Flowers, Good	Insects, Bad
4	40	Initial combined task (Test)	Flowers, Good	Insects, Bad
5	20	Reversed target discrimination	Insects	Flowers
6	20	Reversed combined task (Practice)	Insects, Good	Flowers, Bad
7	40	Reversed combined task (Test)	Insects, Good	Flowers, Bad

In the IAT a subject responds to a series of items that are to be classified into four categories: typically, two representing a concept discrimination (also known as targets) such as flowers versus insects and two representing an attribute discrimination (also known as attributes) such as *good* versus *bad*. Targets are those which we are interested in evaluating, here implicit evaluation towards *flowers* versus *insects*. Attributes are those qualities with which we want to find the target's association strength. The subjects are asked to respond rapidly without making much error. The right hand side key is to respond for right hand side categories (target or attribute) and vice-versa for left hand key. The position of the target would change to produce congruent and incongruent blocks. Congruent blocks are those in which conceptually associated pairs are present like *flowers* with *good*, and *insects* with *bad*. The feedback on error may<sup>[12]</sup> or may not be given<sup>[13]</sup>. Feedback of error is indicated by 'X' which prompts the subject to give the correct response. From latencies of congruent and incongruent blocks, IAT scores are calculated. The Logic of the test is subjects respond more

rapidly in the block where the target and attribute are strongly associated (*flowers* and *good*) than when they are weakly associated (*insects* and *bad*).

### **IAT Scoring**

Psychometrics of IAT has witnessed great streamlining. The latest algorithm provided by Greenwald et al.<sup>[14]</sup> is now widely used in all studies. Summary of steps is as follows<sup>[15]</sup> :

1. Delete trials greater than 10,000 ms.
2. Delete subjects for whom more than 10% of trials have latency less than 300 ms.
3. Compute the “inclusive” standard deviation for all trials in Stages 3 and 6 and likewise for all trials in Stages 4 and 7.
4. Compute the mean latency for responses for each of Stages 3,4,6 and 7
5. Compute the two mean differences ( $\text{Mean}_{\text{Stage 6}} - \text{Mean}_{\text{Stage 3}}$ ) and ( $\text{Mean}_{\text{Stage 7}} - \text{Mean}_{\text{Stage 4}}$ )
6. Divide each difference score by its associated “inclusive” standard deviation
7.  $D$  = the equal-weight average of the two resulting ratios.

Finally the score is reduced to a  $D$  value. Since mean differences are divided by standard deviation, it is like Cohen’s  $d$  value. Hence IAT  $D$  is also a measure of effect size. However, a slight point of difference is that in the calculation of the IAT  $D$  score, inclusive standard deviation is used that means standard deviation of both practice and test blocks are used. The  $D$  score ranges from -2 to +2 through 0. Negative score means negative preference towards one of the target objects. This could be reversed also by suitably designing the IAT. Generally, a score below 0.35 means weak preference, a score up to 0.65 means moderate preference, and above 0.65 means high implicit preference. The sign indicates the direction of preference, i.e., towards which target. The IAT  $D$  scores might be influenced by order of taking the congruent and incongruent tasks, recent experience, social setup, familiarity with the stimuli, etc.<sup>[1]</sup>

## **Variations of IATs**

In recent times, many variations of the IAT have emerged. Firstly to overcome the relative preference assessment, single category<sup>[16]</sup> and single target<sup>[17]</sup> IATs are developed. In these IATs, the target to be assessed need not have an opposite counterpart. These are useful where constructs are unipolar. In an attempt to make IAT brief, yet reliable, the Brief IAT (B-IAT)<sup>[18]</sup> was developed. Another variation is personalized IAT<sup>[19]</sup>, in which participants themselves can choose the category labels and corresponding stimuli, which need to be presented during the test. This personalized IAT is reported to give higher congruence with explicit measures, especially in socially desirable constructs like personality domains. Finally multifactor IAT, in which multiple factors like Big Five can be simultaneously evaluated.<sup>[20]</sup> The stimuli in these IATs can be given as words or as pictures. The picture IATs are shown to have low effect size compared to word IATs, however, average latency of response, and average errors are less.<sup>[21]</sup> These various versions of IATs have their own unique advantages and a researcher has a range of choice.

## **Implicit tools for yoga research**

For convenience, yoga research can be classified into clinical and non-clinical.

Majority of yoga research has published on clinical aspects, because the primary interest in yoga is due to concerns about health and harmony at physical and mental levels. The other side is non-clinical, in which we can categorize all studies related to physical, mental, and cognitive development due to yogic practices. This also encompasses higher dimensions of spiritual unfoldment. We shall discuss how implicit tools can be used in these two broad aspects of yoga research.

The clinical use of implicit tools is well demonstrated. The chapter 23 of the Handbook of Implicit Social Cognition<sup>[22]</sup> describes them elaborately. Here are some of the relevant aspects useful for yoga research. Clinically relevant aspect of implicit cognition is

dissociation of impulsive process and reflective process. Impulsive processes are automatic and associative in nature, where implicit memory plays a key role. On the other hand, reflective processes are more controlled. Taking to unhealthy lifestyle, natural rhythm and regulation of body is compromised and the system goes uncontrolled, leading to clinical conditions. Examples of obesity, depression, obsessive compulsive disorder, narcissism, etc. demonstrate some of these aspects. The unhealthy and uncontrolled mind becomes the precursor for unhealthy body.

Yoga is the process of reverse engineering in which more of automatic or implicit processes are brought under conscious control by deliberate practice. According to Integrated Approach of Yoga Therapy (IAYT)<sup>[23]</sup>, based on the five sheath model of existence, the cause of disease is *Aadhi*. We term *Aadhi* as *Implicit Misattribution Effect*. Implicit is something that happens automatically without the awareness of the person, hence very subtle hard to perceive, but very strong. Misattribution is attributing some quality or notion about something which is not true. The Effect is that which is caused by such Implicit Misattributions. Hence *Aadhi* is the effect which is caused by automatic (Implicit) wrong notions (Misattributions). Implicit misattribution can happen when we wrongly cognize something and believe it completely. Such strong wrong belief is predominantly an implicit process, and about which a person has least awareness and control. Yoga involves systematic training of body and mind along with notional corrections, which reverses the process of implicit misattribution effects through building up the strength of rational discriminating process, which helps in recognizing the weaker reasons behind such implicit misattributions. Gradually the process of desensitization happens that optimizes the process of regulation at the mental level (*manomaya kosha*), at pranic level (*pranamaya kosha*) and at the physical level (*annamaya kosha*). Hence understanding implicit processes might give deeper insights to yoga therapy. One important concept which emerges from IATs is the correlation between

implicit and explicit measures.<sup>[24]</sup> This is called congruence between implicit and explicit measures. It has been reported that for socially sensitive measures, the implicit explicit congruence would be low, indicating, possible cognitive dissonance. Hence this congruence between implicit and explicit measures could be considered as a marker of state of psychological well being. Higher the congruence, the greater is the psychological harmony, and vice versa.

Recent development in stress research is the introduction of the perseverative cognition theory. According to this, greater cause of stress is constant rumination and repeated processing of worrying thoughts, both anticipatory and retrospective. This can happen unconsciously also, terming it as unconscious perseverative cognition, which is believed to be a major determinant of stress.<sup>[25]</sup> The unconscious influence can be studied using IAT tools.<sup>[26]</sup>

For a non-clinical application in yoga, implicit measures can be used in situations where there is a serious threat of self-presentation bias, or social desirability. One example is assessment of *triguna*. *Triguna* is a personality concept according to Indian Psychology. *Sattva*, *rajas*, and *tamas*, are its three factors. When questionnaires to assess *triguna* are administered in a yoga population, the participants by virtue of their knowledge of the concept *triguna*, may bias their responses in order to be socially desirable. In those conditions we may use implicit tools for assessment. Likewise other constructs which are difficult to self-report or where social desirability is a concern, implicit measures may be utilized as potential solution.

## **Yoga-IAT: Assessment of implicit attitude towards Yoga**

### **Overview of the experiment**

We present the Yoga- Implicit Association Test (Y-IAT) to evaluate a person's inherent preference towards yoga. Can we assess a person's preference towards yoga, without asking

them to self report? The Y-IAT was constructed in the same fashion as described in an earlier section. However, the only difference was we chose one category instead of two. Hence this is a single target IAT.

## **Methods and Materials**

### **Subjects**

The study was conducted in a Yoga University, in southern India. It was conducted over a period of seven months (August 2012 to February 2013) and five independent samples were taken. The samples constituted of students of both long and short term yoga courses. The total sample size was 69 (27 males) with mean age  $27.17 \pm 7.14$  ( $n=48$ , as the age and explicit preference were not obtained in one of the batches of 21 subjects), and range (18-47 years). We present the results combining data of all the five independent samples.

### **Methods and Materials**

The whole experiment was administered through computers using Inquisit 3.0 stimulus presentation software.<sup>[27]</sup> The assessments were done in a batch of three to four participants. The procedure and requirement for the test were explained to the participants. After informed consent, the subjects typed demographic details, and took the Y-IAT and later an explicit rating scale to rate their preference towards yoga on a 5- point likert scale (very strongly dislike, strongly dislike, neutral, strongly like, very strongly like; -2 to +2). The order of taking congruent and incongruent tasks in the Y-IAT was balanced across the subjects.<sup>[14]</sup> The whole test session lasted for about five to ten minutes.

In the Y-IAT, a series of words related to yoga were shown to subjects on the computer screen. Each stimulus had an inter trial interval of 250 milliseconds. The subjects had to respond by pressing the appropriate response key on the keyboard, to indicate whether the shown stimulus was on the left hand side or right hand side. "E" key was assigned to left

hand response and "I" key was allotted for right hand response. The subjects had to respond as quick as possible without making much error. If an error occurred, they had to correct it and proceed further. The target words, related to yoga were: *Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana, and Samadhi*. Attribute category words were, for "Good" category: Good, Superb, Pleasure, Beautiful, Joyful, Glorious, Lovely, and Wonderful; and for "Bad" category: Hurt, Sorrow, Painful, Poison, Accident, Fearful, Bad, and Dirty. Selection of these words related to yoga category was based on the assumption that any student of yoga course would know these eight fundamental words from the *Patanjali's Yoga Sutras*. However, mental representations of these words in various individual may vary. The single category Y-IAT had five blocks, the first block (20 trials) was attribute practice, in which subjects had to categorize words which were of categories "Good" and "Bad". Next block was the combined practice block which also included category "Yoga". In this block, subjects had to categorize words related to one of the earlier mentioned categories. There were 20 trials in this block. The third block was the test block, same as second block with 40 trials. In the fourth block, the target word changed position from left hand side to right hand side or vice-versa. This block is called practice block for reversed target and had 20 trials. The fifth block had a similar structure that of the fourth one with 40 trials. (Inquisit script for Y-IAT: Appendix 1).

## **Results**

R statistical software was used for analysis.<sup>[28]</sup> Scoring of Y-IAT were done using the improved scoring algorithm.<sup>[14]</sup> We have provided a detailed scoring procedure as an R script (Appendix 2). Mean latencies for each block were measured. The block in which "Yoga" is paired with "Good" is called compatible block and the block in which "Yoga" is paired with "Bad" is called incompatible block. D score is obtained by difference of mean latencies of incompatible and compatible blocks and then whole divided by the pooled standard

deviation. The positive score indicates the positive implicit evaluation towards yoga and negative score suggests negative implicit evaluation towards yoga.

We discarded seven subjects from analysis because, the Y-IAT showed a negative D score. As negative scores could strongly influence the mean, we removed them. An additional reason to consider these negative scores as outliers is: we assume that all those participants who came for yoga courses must be having a positive inclination towards yoga. Their explicit scores support this assumption. Hence any negative score would mean that the subject does not belong to the intended population. Further three subjects were removed for their high response error rate (>20%).<sup>[16]</sup> After removing these ten outliers, we observed an average D score of  $0.346 \pm 0.25$ , ranging from 0.001 to 0.896. The mean latency was  $1024.17 \text{ ms} \pm 300.10 \text{ ms}$ . They had an average error rate of 4.38% (after treating outliers). The mean explicit score was  $1.26 \pm 0.59$  showing strong positive preference towards yoga. The implicit-explicit correlation was found to be:  $r = 0.18$  ( $t = 1.14$ ,  $df = 37$ ,  $P = 0.264$ ). This correlation reflects low implicit-explicit congruence.

## **Discussion**

The Objective of the current study was to find out whether we can assess implicit preference towards yoga using the IAT paradigm. The selection of the sample was appropriate as they expressed strong explicit preference toward yoga. The results showed moderate implicit preference towards yoga in this study sample. These preliminary results suggest that we can measure implicit preference towards yoga. 90% of the participants had shown various degrees of positive implicit preference towards yoga. The low correlation is an indication of possible extraneous influence through self-presentation biases, hence it becomes further interesting to study the influence of social desirability factors on implicit preference towards yoga. In the current study no measure of self-presentation bias was taken, so we could not find its mediating effect.

Y-IAT's application is restricted to those who are familiar with yoga, as the category label and stimuli used were words related to yoga. Moreover, IATs may not be able to reflect the actual preference always, as they may be clouded by person's strong belief. For instance, if we happened to wrongly believe something, those wrong notions would be reflected in implicit assessment. However, this discrepant information is highly valuable both clinically and for general research.

We suggest further studies to evaluate discriminant validity, i.e., to find out if a sample of non-yoga subjects, show negative or weak preference towards yoga. Predictive validity should also be attempted as the current study does not predict outcome of yoga practice or adherence to yoga practice. As a further step, an attempt should be made to reproduce and generalize the results in different samples. Specifically for Y-IAT, other psychometric properties need to be evaluated. Another general requirement for implicit cognition studies in yoga research is development of normative pool of visual and verbal stimuli. The International Affective Picture System (IAPS)<sup>[29]</sup> and the Affective Norms for English Text (ANET)<sup>[30]</sup> are databases that provide a set of normative emotional stimuli for experimental investigations of emotion and attention. Development of such databases for yoga studies would help develop evidences which can be compared across experiments. Mechanism of cognitive refinement brought about by yogic practices is intricate and definitely involves unconscious or implicit factors. Realizing this necessity of the hour, resorting to implicit tools is highly encouraged.

Development of Y-IAT will have application in academic settings especially in yoga universities to assess the growth of students and their inherent interest towards yoga. We can also evaluate if explicit score or implicit score predicts better the future academic performance. Also, IATs can be used to assess those constructs which are difficult to self-

report. Therefore this IAT paradigm which promises to overcome self-presentation biases can be used in the field of yoga.

## **Conclusion**

In this article we have attempted to present before the yoga researchers a new tool for exploration, the IAT. Necessary details of the use of this tool in yoga research were discussed using Y-IAT. Relevant materials are provided to design new experiments and scoring them. We emphasize that Implicit measures would find immense application in the field of yoga, where no work has been done using this tool. Promotion and wide use of implicit tools can bring new evidences to yoga research.

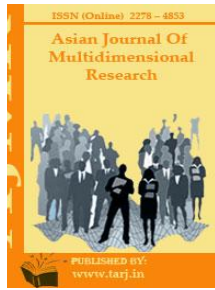
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## INFLUENCE OF LANGUAGE ON IMPLICIT ASSOCIATION TEST SCORES IN INDIAN POPULATION

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### ABSTRACT

*The Implicit Association Test (IAT) has been used by psychologists to assess attitudes that can be biased while reporting due to social desirability factors or attitudes that are difficult to self report. It has been found sensitive to language of delivery for bilinguals. Here, we report a first study of IAT from India, specifically on the influence of language on IAT scores in Indian bilingual populations. Motivation for the study was to explore culture and language specific determinants that might influence IAT effects in Indian populations. The standard flower-insect IAT was administered in three modalities, native language, English, and picture. In contrast to earlier works, we found that IAT D scores were not influenced significantly between native and English languages. For further analysis, we then added two more determinates, frequency of usage of native language, and medium of instruction at school, in the model. Indian populations' varied language and culture make these appropriate. Error rates were significantly higher and latencies longer for English IATs compared to native IATs, for those using their native language more frequently. The opposite was also true. We propose that, for bilingual Indian populations, less sensitive IATs can be administered in either English or native language. Our result suggest that, because their second language is used under natural conditions, the nature of bilinguals in India may be different, and require further study.*

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**KEYWORDS:** *bilinguals, Implicit Association Test, Indian population, language.*

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## INTRODUCTION

Psychological testing is increasingly making use of implicit measures, especially in the west to measure subjects' inherent attitudes and preferences. Self-presentation bias due to social desirability is one of the most challenging problems in any questionnaire based self-report measure. Implicit tools are considered to avoid this problem. They also facilitate access to constructs which may be difficult to self-report. The Implicit Association Test (IAT) (Greenwald et al. 1998) is one of the most popular tools used in Implicit cognition research. Over 100 articles are annually published, but until now, no report has appeared from India. In order to carry out research using IAT in India, certain methodological issues must be considered, including choice of language to deliver stimuli. As the world's second most populous country, India has diverse cultures and languages; many Indians are bilingual, with English as their second language, since it is a common medium of communication in schools.

## REVIEW OF LITERATURE

Danziger and Ward (2010) reported that in Arab Israeli bilinguals, language changes IAT D scores in an Arab-Jew IAT. Another study of bilinguals (Ogunnaike et al. 2010) showed that participants' implicit attitude toward social categories was altered by the language in which the test was administered. Foroni and Bel-Bahar (2010) reported that IAT effects are influenced by level of representation (LR), the degree to which a shown word represents the corresponding category. Processing of lower LR cues happens through the semantic-verbal network, while higher LR cues are processed through the perceptual visual network. They also showed that picture cues have low LR (activate less extraneous knowledge, easier to categorise, and less semantic interference) while words have high LR (activate high extraneous knowledge, are harder to categorise, and more semantic interference) and consequently, higher IAT effects are found in word IATs than in picture IATs. The way LR is activated might differ from one language to another. It is well recognised that in language acquisition implicit and explicit learning play a key role. Interestingly, second language acquisition process differs between instructed and naturalistic modes (Dörnyei 2009). In the Indian context, this distinction between instructed and naturalistic second language acquisition is relevant as many schools use English as a medium of instruction, and media and the environment are redolent with English.

## OBJECTIVES AND HYPOTHESIS

As a first investigation, we aimed to evaluate language's influence on IAT D score in an Indian population, We administered the flower-insect IAT in three different modalities, English, mother tongue (Hindi or Kannada), and picture. Picture IAT was used to cross check previously established significant differences between picture and word IATs. The motivation for the study stemmed from the general observation that use of English is often restricted to academic pursuits; at home, native language is used more frequently. Hence, we hypothesised, dominant use of mother tongue would alter IAT D scores in Indian bilinguals. Results did not show any

significant difference in IAT D scores across modalities, however, interesting trends were observed in mean latency and mean error percentage.

## METHODOLOGY

Fifty four bilinguals (28 males, 26 females) attending university in southern India, mean age, 23.33, range (18- 41 years), were balanced for gender, education level (undergraduate or postgraduate), native language (Hindi or Kannada). The order in which the three IATs were presented (six orders for three IATs) were randomised using lottery method. As the subjects arrived at the lab, they were briefed about the experiment and were asked to choose their random order. All assessments were done in a batch of four to six subjects. Other factors considered, included medium of instruction at school (medium), two levels English, and native language; and frequency of usage of the latter compared to English (frequency), with three levels, more, less and equally frequently. A seven block IAT structure was adopted from Greenwald et al. (2003), with flower-insect categories substituted. The response keys were 'e' and 'i' to respond towards left and right hand side categories. The first block contained 20 trials which was a practice block for target discrimination. Subjects had to categorised them into two categories, 'Flowers' or 'Insects'. The second block was again a practice block of 20 trials to categorise attribute words, 'Good' or 'Bad'. The third block was a initial combined task in which 20 stimuli of both target and attribute categories were presented for categorisation. This was also a practice block. The fourth block was the test block similar to third block with 40 trials. The fifth block was a reversed target discrimination block with 20 trials in which the response keys for target categories were reversed. The sixth block (20 trials) and the seventh block (40 trials) combine the attribute and reversely mapped target (Gawronski & Payne 2010). Positive D score reflected positive implicit attitude towards flowers. All assessments were done using Inquisit stimulus presentation software (Inquisit 2010). Participants gave their consent to participate and typed demographic details, then took the standard flower-insect IAT in the modalities described above, in randomly selected order, and finally a 5-point likert scale to report explicit preferences. Flower-insect IAT was chosen for less ambiguity with explicit self-report measure. However, the stimuli selected (appendix 1) were slightly different to match common usage in an Indian population. We had conducted a pilot study prior to this work with a smaller sample of 22. In this study, the order of the three IATs were fixed.

## RESULTS

IAT scoring was done using the improved scoring algorithm (Greenwald et al. 2003). D scores corresponding to mean error rate greater than 20% were discarded (Risch et al. 2010) and the missing scores considered missing at random. However, if in the three IATs only one had error rate greater than 20%, all three were retained. After treating outliers in this manner, it became unbalance design (n=49) with missing values. Use of linear mixed effects model to analyse repeated measures with missing values and unbalanced design is highly recommended (Locker, Hoffman, & Bovaird 2007; Keselman, Algina, & Kowalchuk 2001). Hence, for analysis we used R statistical package (R Development Core Team 2012) and its linear mixed effects model analysis package, nlme (Pinheiro et al. 2012). The outcome variable was D score. Fixed effect variables were IAT type (native, English, and picture), frequency (more, less, and equal), medium (native and English), and order (six levels). The subject was random effect variable.

Baseline model was constructed using subject as random factor, and intercept. IAT type was then added to the model to find the effect of IAT type on D score. Orthogonal contrasts were coded to assess differences between D scores for: picture versus word, and native versus English IATs. Frequency and medium, with their interaction terms, were added separately. The mean (SD) IAT D score for native IAT was 0.59 (0.34), for English IAT 0.54 (0.33) and for picture IAT 0.47 (.34).

Results found that, of the predicted factors, IAT type, frequency, medium, or order, none were significant, except picture versus word IAT D score - just significant,  $b = 0.03$ ,  $t(93) = 1.99$ ,  $p < .049$ . Nor were there any significant interaction effects (Table 1).

**TABLE 1: ESTIMATES OF FIXED EFFECTS RESULTS WITH IAT D SCORE AS OUTCOME VARIABLE**

		Study 1 (n=49)			
		Estimate	Std. Error	t value (df)	p value
Baseline	(Intercept)	0.535	0.037	14.596 (95)	< .001
Model 1	(Intercept)	0.535	0.037	14.476 (93)	< .001
IAT type	WordvsPicture	0.032	0.016	1.987 (93)	.049
	NativevsEnglish	0.027	0.028	0.947 (93)	.346
Model 2	(Intercept)	0.582	0.054	10.779 (89)	< .001
IAT type	WordvsPicture	0.028	0.023	1.216 (89)	.227
	NativevsEnglish	-0.020	0.041	-0.480 (89)	.632
Frequency	Frequencyless	-0.101	0.124	-0.810 (45)	.422
	Frequencymore	-0.085	0.079	-1.083 (45)	.285
IAT type x Frequency	WordvsPic x FrequencyLess	-0.003	0.050	-0.061 (89)	.952

	NatvsEng x FrequencyLess	-0.081	0.087	-0.930 (89)	.355
	WordvsPic x FrequencyMore	0.012	0.034	0.369 (89)	.713
	NatvsEng x FrequencyMore	0.133	0.059	2.264 (89)	.026
Model 3	(Intercept)	0.562	0.064	8.738 (91)	< .001
IAT type	WordvsPicture	0.014	0.028	0.496 (91)	.621
	NativevsEnglish	0.030	0.048	0.622 (91)	.536
Medium	MediumNative	-0.040	0.079	-0.504 (46)	.617
IAT type x Medium	WordvsPic x MediumNative	0.027	0.034	0.796 (91)	.428
	NatvsEng x MediumNative	-0.006	0.060	-0.092 (91)	.927
Model 4	(Intercept)	0.466	0.095	4.921 (93)	< .001
IAT type	WordvsPicture	0.032	0.016	1.963 (93)	.053
	NativevsEnglish	0.027	0.029	0.953 (93)	.343
Order	OrderEPN	0.049	0.130	0.373 (42)	.711
	OrderNEP	0.066	0.140	0.469 (42)	.642
	OrderNPE	0.198	0.126	1.572 (42)	.123
	OrderPEN	0.010	0.130	0.074 (42)	.942
	OrderPNE	0.068	0.124	0.549 (42)	.586

These results suggest that, contrary to our hypothesis, language does not influence D score significantly, however expected trend as hypothesised was observed. To explore for further possible effects, which we felt must be present, we then performed an exploratory analysis, changing the model's outcome variable, first, to mean error percentage, and, second, to mean response latency.

The first gave results with significant main effects. Orthogonal contrasts revealed significant difference, for native versus English IAT,  $b = -1.64$ ,  $t(97) = -3.55$ ,  $p < .001$ . There was an interaction between IAT type and medium,  $b = -1.53$ ,  $t(95) = -3.23$ ,  $p = .002$ . Subjects who had studied in native medium made more errors in English IAT and less errors in native IAT than those who had studied in English medium.

For the second, IAT type - frequency interaction was just significant,  $b = -64.67$ ,  $t(93) = -1.99$ ,  $p = .049$ . Subjects who used their native language more frequently took less time in native language IAT than in English, while those who had used it less frequently took more time in native IAT than English IAT. IAT type - medium interaction was significant,  $b = -79.40$ ,  $t(95) = -3.64$ ,  $p < .001$ . Native medium participants took longer time in English IAT and English medium participants took longer time in native IAT.

**TABLE 2: REPLICATED ERROR AND LATENCY TRENDS FROM A NON-RANDOMIZED PILOT STUDY**

		Mean Error % (n=22)				Mean Latency (n=22)			
		Estimate	Std. Error	t value (df)	p value	Estimate	Std. Error	t value (df)	p value
Baseline	(Intercept)	3.245	0.524	6.192 (44)	< .001	1275.102	48.829	26.114 (44)	< .001
Model 1	(Intercept)	3.245	0.532	6.096 (42)	< .001	1275.102	49.598	25.709 (42)	< .001
	WordvsPicture	0.335	0.220	1.519 (42)	.136	86.112	15.777	5.458 (42)	< .001
	NativevsEnglish	-0.057	0.381	-0.149 (42)	.882	-40.658	27.327	-1.488 (42)	.144
Model 2	(Intercept)	3.356	0.478	7.019 (38)	.000	1270.259	47.573	26.701 (38)	< .001

IAT type	WordvsPicture	0.341	0.22 1	1.54 7 (38)	.130	86.387	16.64 2	5.191 (38)	< .001
	NativevsEnglish	-0.041	0.38 2	- 0.10 6 (38)	.916	-38.999	28.82 5	- 1.353 (38)	.184
Frequency	FrequencyLessMore	0.567	0.65 9	0.86 0 (19)	.400	-79.385	65.57 4	- 1.211 (19)	.241
	FrequencyEqualLess	-1.794	0.65 9	- 2.72 2 (19)	.014	132.658	65.57 4	2.023 (19)	.057
IAT type x Frequency	WordvsPic x FrequencyLess	0.318	0.30 4	1.04 6 (38)	.302	-6.055	22.93 9	- 0.264 (38)	.793
	NatvsEng x FrequencyLess	-0.793	0.52 7	- 1.50 4 (38)	.141	-23.866	39.73 2	- 0.601 (38)	.552
	WordvsPic x FrequencyMore	-0.394	0.30 4	- 1.29 3 (38)	.204	3.034	22.93 9	0.132 (38)	.896
	NatvsEng x FrequencyMore	0.613	0.52 7	1.16 4 (38)	.252	5.618	39.73 2	0.141 (38)	.888
Model 3	(Intercept)	3.245	0.52 5	6.18 6 (40)	.000	1275.10 2	50.77 3	25.11 4 (40)	< .001
IAT type	WordvsPicture	0.335	0.21 5	1.55 5 (40)	.128	86.112	15.26 4	5.642 (40)	< .001
	NativevsEnglish	-0.057	0.37	-	.880	-40.658	26.43	-	.132

			3	0.15 2 (40)			7	1.538 (40)	
Medium	MediumEngNat	0.669	0.52 5	1.27 6 (20)	.217	10.101	50.77 3	0.199 (20)	.844
IAT type x Medium	WordvsPic x EngNat	0.145	0.21 5	0.67 5 (40)	.504	12.057	15.26 4	0.790 (40)	.434
	NatvsEng x EngNat	-0.701	0.37 3	- 1.88 0 (40)	.067	-54.493	26.43 7	- 2.061 (40)	.046

These results replicated error and latency trends from a non- randomised pilot study, for which small sample size only yielded trends rather than statistical significance. The results are tabulated in the Table 2.

## DISCUSSION

These results tend to suggest that, when administering IAT tests to bilinguals in India, language does not influence D score, at least in less sensitive IATs. The two earlier studies using culturally sensitive constructs (Danziger and Ward, 2010; Ogunnaiké et al. 2010) observed significantly changed D scores. Despite the trend revealed by average error percentage and average latency, D score was not influenced, probably because of its robustness. This strongly suggest further investigation of possible reasons for our not finding differences between native and English IAT D scores. Our study design does not suggest any particular reason for the differences in result. Factors to investigate could include level of representation (LR) and mode of second language acquisition and frequency of use. In India, many schools introduce English in primary classes, so that despite the language being acquired in an instructed way, it may form an LR equally high as the native language. It would be interesting to investigate trends in rural India, where students predominantly use their native language and only use English sparsely.

## RECOMMENDATIONS AND CONCLUSION

Our results which replicated error and latency trends from a non- randomised pilot study, suggest future studies could include frequency of use, and medium of instruction, in addition to the determinants suggested by Banaji et al. (2010), for they seem to mediate IAT effects in Indian populations. Also the data could be subjected to various process dissociation models like the diffusion (Klauer et al. 2007) or quad models (Conrey et al. 2005), to determine IAT components responsible for the observed effects. Finally, less sensitive IATs can be administered to bilingual Indian populations in either language. This first report on language effects in the Indian

population should therefore encourage further related research including factors like multilingualism, or sensitive constructs.

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## APPENDIX 1

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### WORD STIMULI USED IN THE IAT

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#### ENGLISH WORDS

Flowers: hibiscus, lily, rose, lotus, jasmine, sunflower, marigold, flower

Insects: termite, mosquito, bug, spider, earthworm, housefly, cockroach, insect

Good: wonderful, lovely, joyful, beautiful, superb, blissful, glorious, pleasure

Bad: poison, fearful, hurt, accident, painful, sorrow, vomit, dirty

#### HINDI WORDS

Phool: gudahal, jalkamal, gulab, kamal, chameli, suryamukhi, genda, phool

Keede: deemak, macchar, khatmal, makadi, kenchuA, makkhi, cockroach, keeda

Accha: adbhut, pyara, santosh , sundar, shAndar, Anand, mahAn, sukh

Bura: vish, bhay, chot , durghatana, dhuk, shouk, ulti, ganda

#### KANNADA WORDS

Huvu: dasavala, naidile, gulabi, kamala, mallige, suryakanti, chandu huvu, huvu

Keetagalu: geddalu, solle,tagane, , jeda, hulu, nona, jirale, kita

Valleya: ascharyakara, manohara, anandapurna, sundara, utkrasta, ananda, divya, paramasukha

Ketta: visa, bhayanaka, himse, apaghata, trasadayaka, dukha, vant, kolaku

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