Study of Emotion Regulation Based on Yogic Personality Using Implicit, Explicit, and Eye Tracking Techniques

Abstract

**Context:** Emotion regulation (ER) is vital for well-being. Yogic personality traits, *gunas*, influence the expression of ER. **Aims:** To investigate the expression of ER based on *guna*-related personality traits employing explicit, implicit, and objective eye-tracking techniques. **Settings and Design:** Quota sampling was used, with a cross-sectional design with three groups, sattva, rajas, and tamas. Three hundred and ninety-four female students were screened and finally, 30 from sattva, 34 from rajas, and 36 from tamas were analyzed. **Methods:** Participants were given State and Trait Mindfulness Scales, Gita Inventory, Social Desirability Scale, state-trait anxiety inventory, Adult Attachment Scale, and Emotional Regulation Questionnaire. ER-Implicit Association Test (ER-IAT) and Eye Tracker were also used to evaluate the participants. **Statistical Analysis Used:** One-way repeated-measures analysis of variance was used to examine differences between sattva, rajas, and tamas. **Results:** Sattva group adopted a higher level of regulation strategy, ER-IAT scores were positive for sattva, negative for rajas and tamas. Mindfulness was highest and anxiety was least in sattva. In the eye tracker, within the non-emotional areas of interest (eAOI) regions of pleasant condition, and eAOI regions of unpleasant condition, sattva group had considerably higher dwell time. Pupil dilation was lowest in sattva for all the conditions, both within and outside eAOIs. **Conclusions:** Sattva *guna* was found to foster healthy ER, and other psychological attributes. Conscious cultivation of sattva is needed for healthy emotional life.

**Keywords:** Emotion regulation, eye tracker, *guna*, implicit measures, mindfulness, yoga

Introduction

Humans express themselves based on their inherent personality traits. According to Indian scriptures, human personality is a combination of three types of personality traits or *gunas*, which are classified as sattva, rajas, and tamas. The degree to which one of the *gunas* predominates in an individual, to that extent we characterize that person with that *guna*. Sattva is typically interpreted as self-control, mental balance, or stability; *Rajas* is commonly translated as a lack of emotional control or a drive for sense satisfaction; and *Tamas* is generally interpreted as inertia, fear, or mental imbalance. Pata and Sedlmeier as well as Murthy and Kumar have elaborated this further. Expression of emotions also traces its origin in *gunas*. Controlled expression of emotions is crucial for health and harmony. Emotion regulation (ER) can be characterised as a set of goal-directed mechanisms that control the intensity, duration, and type of emotion experienced. The ability to foster positive emotions and manage negative ones is a major goal of the regulatory process. Those with *sattvic* personality can regulate their emotions well. Successful ER is related to greater wellbeing. ER possibilities range from explicit, conscious, effortful, and controlled regulation to implicit, unconscious, effortless, and automatic regulation. However, empirical study of ER is a big challenge, owing to the complexity involved in assessment of ER.

Human behavior, including ER can be studied using explicit and implicit measures. Explicit measures are deliberate conscious, effortful, and are directed by rule-based learning. On the other hand, implicit measure is a consequence of automatic processes in which, the to-be-measured feature intrinsically influences the outcome. The implicit association test (IAT) is a popular implicit measure tool that is based on the notion...
that categorization ability should enable one to infer the categories that are more strongly linked in memory. An objective tool useful to infer implicit cognitive processes is an eye tracker. Eye-tracking has increased in popularity in the disciplines of cognitive science and affective information processing. Eye movement information is increasingly employed in studies because they may be used to infer a user’s engagement, visual search processes, and ER.

In our current study, we attempted to address the question-how ER can be understood based on the guna personality traits. Even though guna-related personality concepts have been well elucidated in ancient Indian scriptures, from the standpoint of modern research, empirical studies are still scarce. Hence, in our study, we study the expression of ER based on the guna-related personality traits, using mixed techniques such as explicit measures, implicit measures, and objective eye tracking. We propose to elucidate the mechanism of ER based on the yogic concept of gunas.

**Methods**

**Participants**

We adopted cross-sectional design, with three groups of sattva, rajas, and tamas. To achieve an expected power of above 80%, we chose a quota sampling with the size of 36 in each of the three groups. We screened 394 female student volunteers (mean age = 23.76, standard deviation = 3.46) from a women’s college in south India using Gita Inventory. After screening, we got 127 tamas, 237 rajas, and 30 sattva. Hence, we selected the first 36 participants from each of the three groups. We screened 394 female student participants. Participants with normal or corrected to normal vision, with basic computer literacy, and with no previous exposure to mindfulness or meditation training were included in the study. Participants with a known history of mental disorders in the past 2 years or presently under psychotropic medication and blood-injection-injury phobia were excluded. Ethical clearance was obtained from the institutional ethical committee. All the explicit measures were assessed in group, and all implicit measures were administered individually, using the computer and eye tracker. After the data collection, we gave 2 h seminar session on emotion management. We had to eliminate the data of two participants due to a technical error in the eye tracker. Finally, 30 sattva, 34 rajas, and 36 tamas participants were analyzed.

**Assessment tools**

**Mindfulness Awareness Attention scale**

The 15-item Mindful Awareness Attention Scale was used to assess dispositional mindfulness or present-focused awareness. It is a 6-point Likert scale to assess the degree of awareness and attention, with 1 = almost always and 6 = almost never.

**Emotion Regulation Questionnaire**

The revised 9-item Emotion Regulation Questionnaire was used to assess the use of prominent ER strategies, reappraisal, and suppression. Cognitive reappraisal is the process by which an individual tries to alter the way he or she perceives a situation to alter the circumstance’s emotional impact. Expressive suppression is a response-focused method in which an individual seeks to suppress the behavioral manifestation of personal emotions. All items are answered on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree), with higher scores suggesting increased utilization of that strategy of ER.

**The Gita inventory of personality**

The 10-item Gita inventory of personality was used to screen the gunas, sattva, rajas, and tamas. A score of 1 is given for tamas, 2 for rajas, and 3 for sattva. Total score <24 is considered as tamas, 24–28 is rajas, and a score greater than 28 is sattva.

**Marlowe–Crowne Social Desirability Scale**

The 10-item Marlowe-Crowne Social Desirability Scale was used to assess impression management in self-report measures. It has True or False responses, with scores of 1 and 0 respectively. Higher scores imply higher tendency social desirability.

**Revised Adult Attachment scale**

We used 18-item revised adult attachment scale. It has 5-point Likert scale responses (1 = “not at all characteristics of me;” 5 = “very characteristics of me”). It measures three fundamental elements of adult attachment style: close, depend, and anxiety.

**State trait anxiety inventory-short form**

The 6-item State-Trait Anxiety Inventory-Short Form (STAI-SF) was used to assess levels of calm, tense, upset, relaxed, content, and worried on a 4-point Likert scale ranging from “not at all” to “very much.”
State Mindful Attention Awareness Scale

The 5-item State Mindful Attention Awareness Scale was used to assess the current manifestation of mindfulness. It is scored on a 6-point scale, 1 (not at all) to 6 (very much). Higher scores demonstrate higher levels of state mindfulness.[15]

Emotion regulation-implicit association test

We used the ER-IAT[23] using the INQUISIT stimulus presentation software. In an ER-IAT task, we evaluate the strength of association between the target (ER and emotion expressive) and the attributes (positive and negative concepts). The words used are presented in Table 1.

During the trials, category labels appear on the top corners of the screen. The words representing the categories will appear one by one in the middle of the screen. The subjects are instructed to categorize the words by pressing the E key, if the stimulus word belongs to the category on the left, and I key, if the stimulus word belongs to the right-hand category. Participants are instructed to categorize each stimulus as quickly as possible but not making many errors. The ER-IAT had five blocks; three were practice blocks, and two critical blocks. When the participants pressed an incorrect answer, the program waited for the correct answer, leading to built-in error penalty.[24] Higher scores on ER-IAT indicate more positive implicit evaluation of ER relative to emotional expression. The possible scores range from −2 to +2.

Eye tracking

Eye-tracking is a noninvasive, image-based tracking technique that uses corneal reflection to detect pupil dilation and gaze fixations. We used Eye Tribe eye tracker, manufactured by the Danish start-up company with 60 Hz sampling rate, an average accuracy of 0.5°–1° and a latency of 20 ms and at 60 Hz.[25] The device has 9-, 12-, and 16-point calibration methods and can track up to 24” monitor. We get binocular gaze data by using USB 3.0 SuperSpeed connection (see Figure 1 for images of the eye tracker experimental setup).[26]

The device was positioned horizontally directly underneath the laptop’s display monitor. The participant sat on an adjustable chair with a back headrest, his or her gaze fixed on the middle of the display at a distance of approximately 60 cm. The tracker’s position is angled toward the participant’s eyes. The monitor and ceiling light were the sole sources of illumination as the room’s windows were blocked out. The eye tracker was controlled by PyGaze an open-source python script running on a laptop (Dell Inspiron 3542 Laptop, Core i3/4GB/1TB/windows 10). The python scripts used in the experiment are available from the github github.com/esdalmaijer/EyeTribe_test.[27]

Thirty trials were presented in three blocks of ten trials each (neutral, pleasant, and unpleasant). Each block started with nine-point calibration and concluded with a resting duration, depending on the subject’s need, taking 120 s excluding the calibration time. Calibration accuracy of <0.5° or <0.7° were along accepted, and lower accuracies were recalibrated.

Stimuli from the international affective picture system

Thirty digital color images of 1024 - 768 pixels were selected by the experimenters from International Affective Picture System (IAPS) under three discrete categories neutral, pleasant, and unpleasant.[28] The jpg images used for the neutral set were 5390, 7000, 7001, 7002, 7003, 7006, 7010, 7021, 7053, and 7090. For pleasant category, images were 1441, 1603, 1620, 2045, 2160, 2341, 4619, 4645, 7330, and 7450. For unpleasant, the images were 1050, 1200, 1525, 2352, 2458, 3170, 8480, 9185, 9561, and 9301.

Generation of emotional areas of interest

Emotional areas of interest (eAOI) is a region in the image which has high emotional value for the participants. We undertook a distinct norming approach to identify and validate eAOIs, based on past work indicating that different areas of emotional scenes vary in the degree of emotional content.[29] We asked five participants to define eAOI for all the images. They were given adequate time to mark emotional areas for each neutral, pleasant, and unpleasant IAPS images with forming free shapes using a mobile photo sketch tool. They were particularly directed to cover all possible emotional regions in an image. We generated areas of interest for all 30 IAPS images by merging the ratings of all the participants.

Data extraction and analysis

For the analysis, data were extracted from 100 female participants, 34 rajas, 30 sattva, and 36 tamas. Eye tracker data from one of the participants from sattva group was discarded due to technical error in extraction. All the self-report measures were scored as per the scoring norms, and their reliability index, omega was calculated [Table 2]. All the measures showed acceptable internal consistencies.

The descriptive statistics is presented in Table 3.

For the implicit association test, the standard algorithm presented in the literature[23] was used, and we calculated the overall D score, the measure of implicit preference.
Table 2: Reliability analysis

| Domain                        | Omega |
|-------------------------------|-------|
| Social desirability           | 0.73  |
| Mindfulness trait             | 0.81  |
| Mindfulness state MAAS        | 0.86  |
| ERQ-reappraisal               | 0.82  |
| ERQ-suppression               | 0.69  |
| STAI                          | 0.86  |
| Adult attachment - close      | 0.69  |
| Adult attachment - dependent  | 0.64  |
| Adult attachment - anxiety    | 0.80  |
| Gunas                         | 0.82  |

MAAS=Mindful awareness attention scale, ERQ=Emotion regulation questionnaire, STAI=State trait anxiety inventory

Towards ER or suppression. Apart from the D score, average latency, and error rates were also extracted in order to remove any participants due to unreliable performance; however, we did not have to remove any participants on this basis.

For eye tracker, the data extraction was done using the R package, overtasking. In our study, in an eye tracking session, each participant was shown three types of images (conditions), pleasant, unpleasant, and neutral, with each image presented on the screen for 10,000 ms. The eye tracker data log was recorded in a text file, which had information about each of the session settings, and information about pupil size and fixation details. We wrote our code to clean and preprocess the eye tracker data. All the R scripts used in this process can be obtained from the authors on request. The main steps involved in processing eye tracker data were: (1) Adding subject id to each of the files, (2) remove trials with fixation values, (3) mark trials with eye blinks (complete and partial was represented with different codes in the eye tracker data), (4) create different timelines for analysis, for example, for the whole session, for each image, and for each trial, (5) creating emotional area of interest (eAOI) zones for each of the images and extracting relevant information (was done using “add_aoi” function in the eyetrackingR package), (6) calculate needed parameters for statistical analysis like fixation inside and outside the eAOI, dwell time within eAOI and outside eAOI, and pupil dilation change within eAOI and outside eAOI. We performed one-way analysis of variance with group as independent variable, and various continuous variables as dependent variables. Partial eta square is reported as a measure of effect size. Post hoc tests were done with Bonferroni corrections.

Results

Emotion regulation

In ER, the reappraisal strategy was statistically significant, F (2, 97) = 19.70, P < 0.001, η² = 0.29, and post hoc test revealed that sattva group adopted higher level of regulation strategy, than rajas and tamas groups. Similarly, suppression strategy was also found to be statistically significant, F (2, 97) = 26.38, P < 0.001, η² = 0.35, and rajas and tamas groups had adopted more of this strategy compared to sattva group.

Implicit measure of emotion regulation

The ER-IAT D score represents the degree to which a person implicitly associates with ER. Positive score means stronger association toward ER and negative score means stronger implicit association toward emotion expression. We found that ER-IAT D score was statistically significant between the three guna groups, F (2, 97) = 14.36, P < 0.001, η² = 0.23, with sattva have positive D score and rajas and tamas groups have negative D scores.

Mindfulness

We used both trait and state mindfulness scales. Trait mindfulness was statistically significant F (2, 97) = 37.78, P < 0.001, η² = 0.44, sattva had the highest mindfulness compared to rajas and tamas, and similar trend was also observed for state mindfulness, Group F (2, 97) = 32.56, P < 0.001, η² = 0.40.

Attachment style

There are three attachment styles, close, dependent, and anxious. All these three have shown statistically significant difference across the three guna groups, for close, F (2, 97) = 21.17, P < 0.001, η² = 0.30, for dependent, F (2, 97) = 4.01, P = 0.021, η² = 0.08, and for anxious, F (2, 97) = 13.65, P < 0.001, η² = 0.22. Post hoc tests showed that sattva group had higher levels of close and dependent styles of attachment, and lower levels of anxious attachment style, compared to rajas and tamas.

Anxiety

The STAI scores showed significant difference between the three guna groups, F (2, 97) = 20.68, P < 0.001, η² = 0.30, and again sattva had the least anxiety score compared to rajas and tamas.

Social desirability

The social desirability scores were also found to be significant, F (2, 97) = 55.54, P < 0.001, η² = 0.53, suggesting that the self-report measures might have been influenced by socially desirable responses. In alignment with our expectations, we found that sattva group had the least scores on social desirability compared to rajas and tamas.

Eye tracker dwell time

For the pleasant condition, dwell time within the emotional area of interest (eAOI) was not significant, F (2, 97) = 1.12, P = 0.329, η² = 0.02, however within the non-eAOI regions, the dwell time was statistically significant,
F (2, 97) = 3.72, P = 0.028, η²p = 0.07, where sattva group had considerably higher dwell time compared to rajas and tamas.

For the unpleasant condition, dwell time within the area of interest (eAOI) was significant, F (2, 97) = 4.54, P = 0.013, η²p = 0.09, and within non-eAOI, F (2, 97) = 3.57, P = 0.032, η²p = 0.07.

### Eye tracker pupil dilation

For the pupil dilation variable, all the three conditions, both in eAOI and non-eAOI regions, showed statistically significant difference between the three guna groups. For pleasant condition, within eAOI, F (2, 97) = 7.09, P = 0.001, η²p = 0.13, and within non-eAOI, F (2, 97) = 8.72, P < 0.001, η²p = 0.15. For unpleasant condition, within eAOI, F (2, 97) = 4.54, P = 0.013, η²p = 0.09, and within non-eAOI, F (2, 97) = 3.57, P = 0.032, η²p = 0.07.
For neutral condition, within eAOI, F (2, 97) = 7.56, P < 0.001, η² = 0.13, and within non-eAOI, F (2, 97) = 6.97, P = 0.001, η² = 0.13. In all the comparisons, we observed a common trend, where sattva had lowest pupil dilation compared to rajas and tamas.

Discussion

The purpose of this current research was to elucidate how the three gunas, namely sattva, rajas, and tamas, differ in the expression of ER, and other positive psychology-related traits. As a measure of ER, we used both psychological self-report measures and objective tool, eye tracker. Pupil size variation and fixations were primarily considered indicators of ER in the eye tracker.

In the yogic tradition, the importance of triguna has been strongly emphasized. Further, sattva guna has been portrayed to be supportive for the overall growth of personality, health, and harmony. In our study, we consistently observed that the sattva group had all those desirable qualities that make up a healthy personality. In the explicit ER measure, the sattva group had shown reappraisal as the predominant mode of ER strategy, and similar results were echoed in the implicit measure as well, where the ER-IAT scores has shown positive D scores for sattva, and negative scores for rajas and tamas. These internally consistent results strengthen our main findings of this study.

To explore the possible mechanisms of how individuals with higher sattva express themselves, additional psychological and eye tracker variables have provided further insights. Both trait and state mindfulness were higher in the sattva group. Mindfulness is a disposition of mind where an individual gets a unique inner space which can help in many reflective processes. Endowed with such a mental space, ER can become an easy task. Furthermore, being in a mindful state propensity to pursue aimless pursuits decreases and hence the mind becomes free of negative thought processes, and ruminations. To support this view, in our study, we found that the anxiety scores were lowest in the sattva group compared to rajas and tamas. To understand how sattva can help build a positive state of mind at a perceptual level, the eye tracker data had provided further insights. In an eye-tracking experiment, large amount of time spent in viewing a desirable site, and lesser amount of time spent viewing an undesirable site can indicate possible ER strategy as it clearly reflects approach and avoidance behaviors, respectively. In our study, the dwell time in unpleasant conditions was higher for sattva group while looking at a target eAOI, and for pleasant nontarget AOI regions also sattva group had a higher dwell time. This shows nonavoidance of unpleasant exposure and nondwelling of pleasant exposure in sattva group, which according to yogic parlance is a state of samatva (equanimity). Hence, we can assume that sattvic disposition leads to equipoise state of mind where pairs of opposites do not much disturb the stable mind grounded in sattva. Similarly, the amount of pupil dilation is a measure of physiological arousal and in terms of ER it can indicate emotional engagement with the shown stimuli. In our study, across all the conditions, we observed the lowest pupil dilation in sattva compared to rajas and tamas. This shows that even though individuals with higher sattva disposition tend to perceive the stimuli, their emotional engagement is not very deep, thereby not allowing them to be lost in the emotional transactions of the external world. This is an important observation as the mind tends to engage always with external stimuli, and based on the inner inclinations it forgetfully engages with those sensory objects and later leads to various unpleasant experiences due to distractions and unfulfillment of those pursuits. However, sattva provides a natural inner detachment and due to that even though interaction with the external world happens but still forgetful and binding emotional engagement does not happen. This psychological mechanism can also be considered apt to explain how sattva can help maintain higher mindfulness without distractions.

Some of the aspects of sattva can be groomed like mindfulness by conscious mindfulness practices and other yoga practices, but at the same time, there are some personality traits that can naturally foster sattva right from childhood. According to the attachment theory, the experience of positive social engagement behaviors, especially in early life, can promote improved ER.[31] In our study, the sattva group had a higher degree of close and dependent styles of attachment and lesser of anxious type of attachment style. This shows that sattvic individuals tend to trust others and seek others’ support when in need which makes their social life very healthy and purposeful. They also reciprocate the same feeling of trust and support to their community, which makes them a socially vibrant being.

The cultivation of positive emotions aids in the development of resilience to stressful experiences, which eventually help one’s well-being.[32] In previous research, it was discovered that the Sattvic personality type was significantly associated with well-being[33] and adversely associated with psychological distress.[34] Further, Sattva guna has been linked to emotional styles that support the development of a positive emotional pattern.[35] It has been observed that having a higher level of mindfulness can help people better regulate their emotions.[36] The findings indicate that mindfulness is positively connected with Sattva and negatively correlated with Rajas.[34] Hence, increased mindfulness may be linked to better ER.

Strengths and limitations of the study

In our study, we employed quota sampling, and hence the study results are less generalizable. Further, we had only female participants and the reason for this was limited to the educational institution where we conducted.
the study. However, due to this, results are not skewed because of the influence of male participants and their characteristics responses of ER. Males and females tend to differ in their emotional regulation strategies in some contexts.  

Although we attempted to make our study a balanced design with equal representation of all the three gunas, due to technical shortcomings, we ended up with unequal numbers in the three groups. We believe the overall sample size of around 30 in each of the groups will help to generate reproducible results under similar study setups. Further, we consider that this is the first study where the role of trigunas was explored from multiple dimensions to gain an overall perspective of expressions of trigunas and its interaction with key psychological factors.

**Conclusions**

ER, an important part of human social interaction was studied from the perspective of the yogic concept of gunas. Sattva guna was found to foster healthy ER, and other psychological attributes, at implicit and explicit levels. Conscious cultivation of sattva is, therefore, an important recommendation from yoga toward achieving healthy emotional life.

**Ethical clearance**

Ethical clearance was obtained from the institutional ethical committee of Swami Vivekananda Yoga Anusandhana Samasthana (SVYASA) (RES/IEC-SVYASA/72/2015).

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**Conflicts of interest**

There are no conflicts of interest.

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