



A Pilot Study on Measuring the Readers' Emotions Using HRV Biofeedback at University Malaysia Pahang

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Abstract

Positive associations have been found between reading and emotions. Various techniques, including traditional as well as modern, have been used to measure emotions in the previous studies. However, emotional measurement of the readers of a literary piece through HRV Biofeedback has never been investigated. A study was undertaken to assess whether Heart Rate Variability (HRV) biofeedback regarding measurement of emotions in the readers of English Literature is likely to be effective or not for the first time at University Malaysia Pahang. In this study two scripts of the plays "Dr. Faustus" and "Waiting for Godot" were used. The Scripts were prepared from the Original Texts of these two plays, which might convey the overall message of the plays to the readers and resultantly produce the desired effect on the readers' emotions. The total words of these two scripts were around 1050 each, allowing the students to complete one script in 7-8 minutes. Six subjects were selected randomly. While they were sitting calm and quiet at the desk, photoplethysmograph sensor was attached to their one of the earlobes which was connected to the emWave Desktop-PC software to record their Baseline HRV. The subjects, one at a time, read the Script 1 "Waiting for Godot" silently. After completion of the reading of Script 1, the emWave software was stopped and the HRV of the subject was recorded and saved automatically in the computer. The same process was repeated with Script 2 "Dr. Faustus". In this way, emWave software recorded three HRV data for every subject. Results show obvious changes and significant correlations in the HRV of the participants while reading both the scripts. VLF increased for Script 1 while it decreased for Script 2. On the other hand, HF increased for Script 1 and further increased for Script 2. LF decreased for Script 1 and increased for Script 2. These results point out the tendency that the stress level of the participants was increased while they read the Script 1 "Waiting for Godot" - which conveys the message that 'there is no God' and vice versa. This further indicates that the literature reading affects the reader's emotions which may be successfully measured using HRV Biofeedback.

Keywords: Literature, Emotions, Emotions Measurement, Biofeedback, Heart Rate Variability

1. Introduction

The connection amongst literary writings and feelings is confirmed. The job of a literary piece is to portray, express, or recommend what happens in the brain of different characters, and what is the unfurling of their activities and feelings of the peruser. Writing is a decent investigation of feelings of life; thus it offers some truth about human psychology also. Some contemporary rationalists trust that literature is void of value relating knowledge, or just has an extremely frail one. Peter Lamarque, for instance, contends in a late book that literature can't give knowledge "on the grounds that fictive (or imaginative) settings don't give genuine statistics" (Lamarque, 2006). He thinks of it as an "error to assume that to be genuine or intelligent work must in actuality instruct something". We can't quantify the responses of body, emotions, and assumptions of fictive characters; we can't test them. Lamarque's proposition may not be accepted so for

as the impossibility of measuring of emotions is concerned of the fictional characters. A number of studies establish a link between the reader and the character. The reader identifies himself with the fictional character (Oatley, Mar, & Djikic, 2012). After that all the events in a literary piece are especially concerned with emotions. (Green, Garst, et al 2004). Compassion is there in feelings: the occasions and activities in fiction or a literary piece of writing carry feelings; in the reader the identical feelings are stirred (Bal and Veltkamp, 2013). In other words, we may measure emotions of the fictional characters by measuring the emotions of the readers.

There is a great controversy over the number of emotions and their nature (Oatley, Keltner, & Jenkins, 2006; Plutchik, 2003; P. E. Ekman & Davidson, 1994; P. Ekman, 1992b;). There are assumptions that emphasize only two elementary states i.e. positive as well as negative. Some dwell upon a small-scale list of "basic" emotions. There are still others who believe in countless number of emotions. In spite of differences, almost all the theorists approve of valence that is an essential characteristic of emotions. "Pain and pleasure; approach and avoidance" are central around which all the emotions whatsoever revolve (Barrett, 2006; P. Ekman, 1992a; Rolls, 2005). However, most of theorists think that only two aspects are inadequate to translate diverse emotional experiences (Fontaine, et al, 2007). Darwin and his predecessors Sorabji (2000) came up with a few "qualitatively distinct emotions" which are instinctive, natural and universal in their kinds. For the sake of measuring emotions, categorized theories of emotion are more popular (P. Ekman, 1992a, 1992b). Various philosophers have developed various listing of innate emotions. Interestingly, all encompass "fear and anger", while majority of them incorporate joy along with sorrow. There are other emotions which are included by theorists e.g. surprise by (Plutchik, 2003), acceptance by (Plutchik, 2003) contempt by (P. Ekman, 1992b), interest by (Izard, 1991) and guilt and shame by (Izard, 1991).

There are several methods used by the researchers to measure emotions. Generally, emotion lists are provided to the participants by the researchers. These lists are almost standardized with different kinds of formats for the answers. These lists are aimed to get information of qualitative nature so far as the emotions experienced are concerned. Nonetheless, the utilization of fixed-response options, while guaranteeing effectiveness and evenness of data collection, has a few genuine drawbacks. One of the significant ones is the likelihood that one or a few reaction options may "prime" members, i.e. recommend reactions that they would not have picked on the other hand. The inverse issue is that a member might need to choose such an option that is not given in the rundown, in this way compelling the individual to react with the nearest substitute, or, if given, with a lingering classification, for example, "other", with the specificity and precision of the information disadvantage in both cases. Regardless of the possibility that one of the options given compares to the state experienced by the member, he or she may not be acquainted with the name picked by the researcher, being accustomed to alluding to the effective state with a close equivalent word, for instance, a more prominent or slang expression (e.g. jittery in the place of anxious) (Cozby, Worden, & Kee, 1989). Mind in the Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) showed that with increased reading of fiction, emotional empathy also grew relatively. The intensity of emotions depends upon the involvement of the reader with the text of fiction or literature (Djikic, Oatley, & Moldoveanu, 2013). Another method envisages using literature because fictional works arouse emotions in their readers or viewers, and hence such techniques can also be used in psychological experiments. One such technique tends to use clips from films (Gross & Levenson, 1995). The whole work can also be used to gauge emotions. Thus (Djikic, Oatley, Zoeterman, & Peterson, 2009) has suggested that we can see Shakespeare's Othello as a study of resentment in the play's main protagonist, Iago.

Modern devices though primarily meant for medical field can be used for measuring emotions. A number of imaging methods to the human body exist today. Imaging strategies in the light of various physical standards incorporate single photon emission computed tomography (SPECT), positron emission tomography (PET), functional MRI (fMRI), magnetic resonance imaging (MRI) and computer tomography (CT). The body of electrobiological estimations include electrooptigraphy (EOG, eye dipole field), electrogastrigraphy (EGG, stomach), magnetoencephalography (MEG, brain), electroencephalography (EEG, brain), (EMG, muscular contractions) and electrocardiography (ECG, heart) (Teplan, 2002). There is a well-known research that focused on measuring HF-HRV by means of operative neuroimaging. It was the first study that involved emotions. After recognizable proof of rCBF particular to feeling, it was analyzed "how the fundamental impact because of feeling related to the covariation of feeling- exclusive rCBF with HF-HRV." The research dwelled upon empirical examination of the neural parallels for HF-HRV. The results match the hypothesis that "the average visceromotor system is a last normal course by method for which cognitive and emotional capacities initiate autonomic bolster (Lane et al., 2009).

Keeping in mind the end goal to survey the impact on cerebrum, Speer, Reynolds, Swallow, and (Speer, Reynolds, et al, 2009) watched individuals in an MRI (fMRI) machine reading a short story. The moment they read that the character was doing the movement of getting a handle on something, the same portion of their cerebrum connected with getting a handle on with a hand was triggered. At the point when the character moved to another scene, the part of the peruser's cerebrum connected with interpreting visual scenes was stimulated. Speer et al. talked about their discoveries as far as perusers running a reproduction of occasions they read about (Djikic and Oatley, 2014). Neuro-imaging is a comparatively new method to measure cognitive approaches in literature (Mar, 2004). This technique has offered promising evidence for the notion of simulation, embedded within theories of embodied cognition (Barsalou, Simmons, Barbey, & Wilson, 2003). The embodied cognition approach discusses that conceptual knowledge is partly represented in modality-specific regions of the brain like motor areas and sensory areas. According to this notion, action verbs related to emotional expressions activate the facial musculature that subsequently can shape emotional judgments (Tettamanti et al., 2005). Action words particularly cast effects on areas of the motor cortex linked to the body part used to render each action (Hauk, Johnsrude, & Pulvermüller, 2004). Research work in this domain has just commenced to

embrace full-length narratives. For instance, (Speer et al., 2009) discovered that multiple brain areas appear to track various dimensions of a short story which the volunteer readers as a sample are reading, and these regions simultaneously react to the regions activated when participant does or notices similar activities. Other works of research on neuro-imaging studies have tended to expose the differences between narrative comprehension and sentence-level comprehension (Xu, Kemeny, Park, Frattali, & Braun, 2005). Further, this technique also takes into account how the brain makes up models of a story (Wallentin et al., 2011). Interestingly, this has been replicated over many studies, and the findings show that areas of the brain concerned with the comprehension of narrative overlap with areas concerned with theory of mind and comprehending other people (Mar, 2004). This is an interesting new area of research that tends to be important for future of cognitive approaches to literature. Notwithstanding, this field should be investigated. The measurement of emotions in a literary piece with the assistance of present day contraptions, machines and gadgets offers colossal chances to get an immaculate investigative examination of the happenings in the brain and heart during perusing a drama, or a piece of verse, or any scholarly discourse so far as it is concerned. Alongside the other present day strategies, Biofeedback may likewise be utilized for measuring emotions. "Mind-body method is involved in Biofeedback where people figure out the way to adjust the functioning of their bodily parts with the end goal of enhancing physical, mental, enthusiastic and spiritual wellbeing. Same like physical therapy, dynamic interest with respect to patients and frequently standard practice between instructional spells are required by biofeedback training" (Frank, Khorshid, Kiffer, Moravec, and McKee, 2010).

The automated recognition of human physical and mental movement is an essential part of imminent specialized wellbeing backing and intervention frameworks. As opposed to physical action mental action is not a straightforwardly recognizable physical reality. It requires observing of physiological procedures identified with inference on the stimulant. The adoption of the human natural signs (PT, GSR, EMG and HRV) have been demonstrated to establish a sign of the mental enactment of a man. sEMG sensors (Surface electromyography), which identify the electrical action required in muscle recession, might be utilized for customers with constant pain issue or headache due to tension. Temp (Temperature) biofeedback, in which a little thermistor records temperature of a finger, is utilized as an associate of vein narrowing. Biofeedback of this sort is regularly utilized as a part of customers with hypertension or headaches and is a decent broad pointer of general unwinding. SC (Skin conductance) biofeedback, in some cases named as GSR (galvanic skin reaction), measures sweat organ action on the palms. Being sweat organ movement is exceptionally connected with musings and feelings, for nervousness issues, SC biofeedback is regularly utilized (Benson, 1976). HRV (Heart Rate Variability) is among the few different systems utilized as a part of Biofeedback to quantify the changes related to psychophysiology in the human beings. The ANS (Autonomic Nervous System) results are changed with the variation in mental or emotional results, which thusly brings about variation to heart rate cadence from the beat to beat. The objective of HRV examination is in this way to work backward and explore a subject's full of feeling state by means of the ANS, making deductions, from a beat to beat time arrangement of the heart rate design (Benson et al., 1982; Rosen and Jerdee, 1976)". HRV (Heart Rate Variability) is a measure of cardio-pulmonary reverberation. When we breathe in, our heart beat builds somewhat to help our heart in pumping oxygenated blood; when we exhale, our heart beat eases back marginally to permit carbon dioxide to enlarge our veins for more viable circulation. HRV biofeedback variability is the sound ascent and fall in heart rate. At the point when our breath and heart work together productively, the parasympathetic branch of the autonomic nervous system is initiated, making the "relaxation response" (Benson et al., 1982) and permitting our body to get to a remedial and nurturing state.

Keeping in view the working of Autonomic Nervous System, we may manipulate it to the measurement of emotions in the readers of literature using HRV Biofeedback. Parasympathetic branch of ANS is activated when the person feels relaxed. On the other hand, Sympathetic branch of ANS is triggered while the person is feeling stressed. These activities of ANS are represented through HF and VLF values respectively on the emWave screen which is used to record HRV of the subject.

2. Methods

2.1 Participants

Six male students were selected randomly from the Boys Hostel KK1 of UMP. They were the students registered in different Masters and Doctoral programmes at UMP. Two of them were registered in the English studies at CMLHS (Centre for Modern Languages and Human Sciences); two were from the Computer Science Department while the remaining two belonged to the Mathematics and Biotechnology departments each. Regarding their nationalities, four of them were from Pakistan while one each from Algeria and Afghanistan. Although the subjects belonged to the different nationalities yet special consideration was given to their ethnic background in their selection for the experiment. All the subjects selected were Muslims. Their age group was 27-32 years. Their verbal consent to participate in the experiment was taken. Before the experiment, the subjects were briefed about the whole procedure. They were informed that in this experiment the impact of literature towards readers' emotions would be recorded by measuring the emotions scientifically through HRV biofeedback. They were also briefed about the major themes of the plays. All the subjects, one at a time, would have to read silently the two scripts of the plays synthesized by the researcher.

2.2 Instruments

For the purpose of this study, physiological measurements were recorded from emWave desktop coherence training software version 2.2.4.4893, developed by Heartmath LLC. This instrument was used in all sessions to record HRV of the subjects in the Pilot Study. A 16-inch laptop screen presented beat to beat curve, instantaneous heart rate, and spectrum of heart rate, as biofeedback information of the subjects. The cardiovascular data was obtained from

photoplethysmograph ear sensor. Data was collected by attaching the photoplethysmograph sensor to the ear lobe of the subject. Heart rate measures were recorded from beat to beat intervals.



Figure 1. (a) emWave's USB key with the pulse sensor plugged in (b) Photoplethysmograph Ear Sensor

2.3 Tools

In the pilot study two scripts of the plays “Dr. Faustus” and “Waiting for Godot” were used. The Scripts were prepared with care and those parts of the Original Texts of these two plays were selected which might convey the overall message of the plays to the readers and resultantly produce the desired effect on the readers’ emotions. Moreover, it was impossible for the participants to read the whole texts of these plays as it would have taken a lot of time to complete them. It was also impracticable for the purpose of this study to give the participants only a specific part of the texts as they could not get the total effect of the plays. These limitations of the reading time of the texts and the total effect of the texts culminated in the preparation of the Scripts of these two plays which were conveying almost the same message as the original texts and at the same time could be completed within a reasonable time. The total words of these two scripts were around 1050, allowing the students to complete one script in 7-8 minutes. Original text of the plays was not used; rather its paraphrase in English was used for the better comprehension and resultantly for better arousal of emotions.

3. Procedure

3.1 Phase 1: Pre-start

Script 1 was the play “Waiting for Godot” while Script 2 was the play “Dr. Faustus”. According to the HRV biofeedback protocol, their health condition was checked by examining their physical appearance and by asking them questions whether they were suffering from any medical problem or not. Only healthy subjects were included in the study. While they were sitting calm and quiet at the desk, photoplethysmograph sensor was attached to their one of the earlobes which was connected to the emWave Desktop-PC software to record their HRV. The proper functioning of the software was checked before the actual experiment was started. In the actual experiment one subject underwent the reading/HRV recording process at one time.

3.2 Phase 2: HRV Biofeedback Data Collection

3.2.1 Step 1: Baseline

When the actual data collection was started, they were asked to relax. That was the first relaxing. For relaxing, they were asked to make Zikar or think about the happy moments in life or take slow breathing or just vacate their minds from all thoughts. The basic purpose of Relaxing 1 was to determine the Baseline values for VLF, HF and LF of the subjects so these values may be compared with the new values of the same variables after reading Script 1 and Script 2. The Heart Rate Variability of the participant for Baseline was recorded in the emWave desktop software. The HRV for Relaxing 1 was recorded for 2-3 minutes. The participants were not reading anything except relaxing with the techniques they were instructed.

3.2.2 Step 2: Reading of Script 1 “Waiting for Godot”

After 2-3 minutes of Relaxing 1, the participants were given Script 1 – the play “Waiting for Godot”—which they read silently. Their HRV was recorded. The objective for Script 1 Reading was to record the Heart Rate Variability of the subjects while they were reading the text which contained the ideas against their religious ideology. More specifically, the emotions of the Muslim readers were noted through their Psychophysiological changes using HRV Biofeedback while they were reading such a text which conveys the message that God does not exist.

3.2.3 Step 3: Relaxing 2

After the completion of the reading of Script 1, the emWave software was stopped. The participants were requested to relax again for 3 minutes. That was Relaxing 2. The purpose of Relaxing 2 was to help normalize the emotional state of the subjects which was affected by Script 1 Reading. Moreover, Relaxing 2 values of HRV were needed to be compared with the HRV values of Script 2 Reading to find the difference. After 3 minutes the readings of HRV were recorded for Relaxing 2 which lasted for 2-3 minutes.

3.2.4 Step 4: Reading of Script 2 “Doctor Faustus”

The Script 2 which was synthesized from the play “Doctor. Faustus” was given to the participants. Their HRV was recorded for this session in the same way as it was taken for Script-1. The objective for Script 2 Reading was to record the Heart Rate Variability of the subjects while they were reading the text which contains the ideas that support their religious ideology. More specifically, the emotions of the Muslim readers were noted through their Psychophysiological changes using HRV Biofeedback while they were reading such a text which conveys the message that God does exist.

4. Data analysis

Data was analyzed, using mean values, with the help of Statistical Package for the Social Sciences (SPSS Version 17.0). ANOVA-one way analysis of variance –was applied for the comparisons. Less than 0.05 P-values were considered significant.

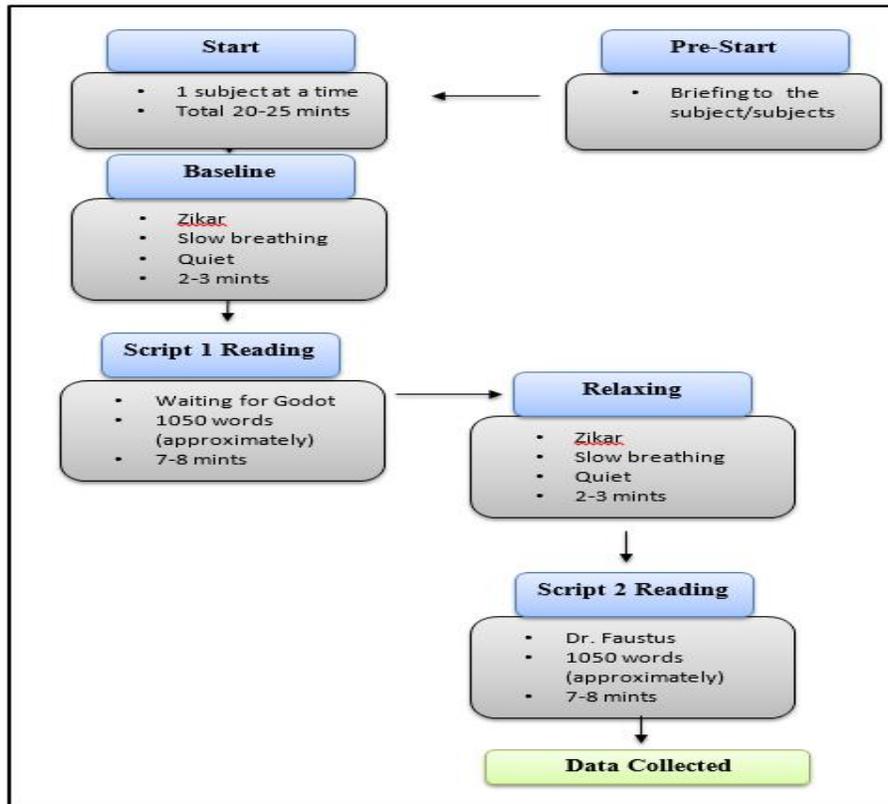


Figure 2. Methodology flow chart of pilot study

5. Results

5.1 Descriptive Results

Table 1. Descriptive analysis of the data of the pilot study

Variables	Number	Minimum	Maximum
Baseline VLF	6	7.00	78.00
Baseline HF	6	10.00	41.00
Baseline LF	6	9.00	68.00
Script 1&2	12	35.00	65.00
Script 1&2 HF	12	13.00	38.00
Script 1&2 LF	12	4.00	43.00
Script1&2LF/HF Ratio	12	.13	3.31
Coh_Script1&2	12	.70	1.20
HR_Script1&2	12	72.00	85.00
DurationScript1&2	12	5.00	11.00

5.2 Inferential Results

Table 2. Inferential analysis of the data of the pilot study

Variables	Script 1 Mean + S.D n = 6	Script 2 Mean + S.D n = 6	p-value
VLF	56.33+ 9.39	46.83 + 7.96	0.088
HF	25.16 ± 4.49	28.16 + 9.57	0.653
LF	18.50± 10.19	26.00±9.52	0.217
Coherence	.78 + .11	.93 +.22	0.178
Heart Rate	78.33 ± 3.26 8.33± 1.36	77.83 + 4.35 7.16± 1.16	0.827 0.143
Reading Duration LF/HF Ratio	.77± .45	1.21± 1.06	0.371

5.2.1 Comparison of VLF for Script 1 and Script 2

Table 3. Comparison of VLF for Script 1 and Script 2

	Script 1 Mean + S.D n = 6	Script 2 Mean + S.D n = 6	p-value
VLF	56.33+ 9.39	46.83 + 7.96	0.088

The overall mean VLF value for Script 1 was 56.33+ 9.39 and for Script 2 it was 46.83 + 7.96. No significant difference was observed in the mean VLF value of the two Scripts (p=0.008).

5.2.2 Comparison of HF for Script 1 and Script 2

Table 4. Comparison of HF for Script 1 and Script 2

	Script 1 Mean + S.D n = 6	Script 2 Mean + S.D n = 6	p-value
HF	25.16 ± 4.49	28.16 + 9.57	0.653

The overall mean HF value for Script 1 was 25.16+ 4.49 and for Script 2 it was 28.16 +9.57. No significant difference was observed in the mean HF value of the two Scripts (p=0.653)

5.2.3 Comparison of LF for Script 1 and Script 2

Table 5. Comparison of LF for Script 1 and Script 2

	Script 1 Mean + S.D n = 6	Script 2 Mean + S.D n = 6	p-value
LF	18.50± 10.19	26.00±9.52	0.217

The overall mean LF value for Script 1 was 18.50+ 10.19 and for Script 2 it was 26.00 + 9.52. No significant difference was observed in the mean LF value of the two Scripts (p=0.217).

5.2.4 Comparison of Coherence for Script 1 and Script 2

Table 6. Comparison of Coherence for Script 1 and Script 2

	Script 1	Script 2	p-value
	Mean + S.D	Mean + S.D	
	n = 6	n = 6	
Coherence	.78 + .11	.93 + .22	0.178

The overall mean Coherence value for Script 1 was .78+.11 and for Script 2 it was .93 + .22. No significant difference was observed in the mean Coherence value of the two Scripts ($p=0.178$).

5.2.5 Comparison of Heart Rate for Script 1 and Script 2

Table 7. Comparison of Heart Rate for Script 1 and Script 2

	Script 1	Script 2	p-value
	Mean + S.D	Mean + S.D	
	n = 6	n = 6	
Heart Rate	78.33 ± 3.26	77.83 + 4.35	0.827

The overall mean Heart Rate value for Script 1 was 78.33 + 3.26 and for Script 2 it was 77.83 + 4.35. No significant difference was observed in the mean Heart Rate value of the two Scripts ($p=0.827$).

5.2.6 Comparison of Reading Duration for Script 1 and Script 2

Table 8. Comparison of Reading Duration for Script 1 and Script 2

	Script 1	Script 2	p-value
	Mean + S.D	Mean + S.D	
	n = 6	n = 6	
Reading Duration	8.33± 1.36	7.16± 1.16	0.143

The overall mean Reading Duration value for Script 1 was 8.33 + 1.36 and for Script 2 it was 7.16 + 1.16. No significant difference was observed in the mean Reading Duration value of the two Scripts ($p=0.143$).

5.2.7 Comparison of LF/HF Ratio for Script 1 and Script 2

Table 9. Comparison of LF/HF Ratio for Script 1 and Script 2

	Script 1	Script 2	p-value
	Mean + S.D	Mean + S.D	
	n = 6	n = 6	
LF/HF Ratio	.77± .45	1.21± 1.06	0.371

The overall mean LF/HF Ratio value for Script 1 was .77 ± .45 and for Script 2 it was 1.21 + 1.06. No significant difference was observed in the mean LF/HF Ratio value of the two Scripts ($p=0.371$).

5.3 Correlations

- i. Significant inverse correlation was observed between VLF and LF ($r= -0.738$, $p=0.006$), showing that as VLF increases LF decreases and vice versa.
- ii. Significant inverse correlation was observed between HF and Coherence ($r= -0.672$, $p=0.017$), showing that as HF increases Coherence decreases and vice versa.
- iii. Significant positive correlation was observed between LF and Coherence ($r=0.746$, $p=0.005$), showing that as LF increases Coherence also increases and vice versa.
- iv. Significant inverse correlation was observed between Script 1 VLF and Script 1 LF ($r= -0.898$, $p=0.015$), showing that as Script 1 VLF increases Script 1 LF decreases and vice versa.
- v. Significant inverse correlation was observed between Script 2 HF and Script 2 Coherence ($r= -0.884$, $p=0.019$), showing that as Script 2 HF increases Script 2 Coherence decreases and vice versa.
- vi. Significant inverse correlation was observed between Script 1 VLF and Script 2 VLF ($r= -0.846$, $p=0.034$), showing that as Script 1 VLF increases Script 2 VLF decreases and vice versa.
- vii. Significant inverse correlation was observed between Script 1 LF and Script 1 VLF ($r= -0.898$, $p=0.015$), showing that as Script 1 LF increases Script 1 VLF decreases and vice versa.
- viii. Significant inverse correlation was observed between Script 1 LF and Script 2 VLF ($r= 0.871$, $p=0.024$),

- showing that as Script 1 LF increases Script 2 VLF decreases and vice versa.
- ix. Significant inverse correlation was observed between Script 2 HF and Coherence Script 2 ($r = -0.884$, $p = 0.019$), showing that as Script 2 HF increases Coherence Script 2 decreases and vice versa.
 - x. No significant correlation was observed between VLF and HF, VLF and Coherence, VLF and Average Heart Rate, VLF and Reading Duration, HF and Average Heart Rate, HF and Reading Duration, LF and Average Heart Rate, LF and Reading Duration, Coherence and Average Heart Rate, Coherence and Reading Duration, $p > 0.05$ respectively.

6. Discussion

The results of the Pilot Study revealed that there was significant correlation in the HRV of the participants while reading both the scripts. Red color indicates VLF (Very Low Frequency), Blue color represents HF (High Frequency) and Green color is a sign of LF (Low Frequency) on the screen of emWave software. The Mean value of VLF for Baseline was 48.6667 that increased to 56.33 for Script 1 while it decreased to 46.8333 for Script 2. The mean value of HF for Baseline was 21.3333 which was increased to 25.1667 for Script 1 and further increased to 28.1667 for Script 2. The mean value of LF for Baseline was 30.0000 which decreased to 18.5000 for Script 1 and 26.0000 for Script-2.

These results indicate the tendency that the stress level of the participants was increased while they read the Script 1-“Waiting for Godot”- which conveys the message that ‘there is no God’. At the same time it indicates another tendency that the relaxed level of the participants was increased when they read the Script 2-“Dr. Faustus”-with the message that ‘God does exist there’. A critical theory offers a comprehensive and extensive critique of issues across the table the readers face in the modern day world (Shaikh, 2016). “This interpretation of the Muslim students of the two plays is supported by the literary theory “Interpretive Communities” by Stanley Fish”(Yousaf, Nubli, Ashikin, & Iqbal, 2016). Stanley Fish was trying to give the answer to the two questions; why do the different readers interpret the same text in the same way and why do the same readers interpret the different texts in the different ways. He found that the answer was only one “the interpretive communities”(Fish, 1976). Every reader is the member of a community and every community has its own norms, system of belief and values. The meaning does not lie in the text or in the reader but in the community from which the readers belong to (Fish, 1976). Thus the Muslim students, having a belief in the existence of God feel irritated when they read script 1 “Waiting for Godot” which, for them, expresses the skepticism about the existence of God. This irritation is reflected in the high value of VLF which means the sample is stressed. On the other hand, when the same reader is reading script 2 “Dr. Faustus”, he feels relaxed as the play is in accord with his belief system i.e. God does exist. This relaxed state of the reader is indicated in the high value of HF. Very Low Frequency (VLF), in the HRV Power Spectrum, indicates that the sympathetic branch of the ANS (Autonomic Nervous System) is activated and the person is feeling stressed. On the other hand, High Frequency (HF) shows that the parasympathetic branch of the ANS (Autonomic Nervous System) is triggered and the person is feeling relaxed. Low Frequency (LF) is Sympathetic as well as Parasympathetic activity of the Autonomic Nervous System (Yousaf, Nubli, Ashikin, & Iqbal, 2016).

Almost a similar study was conducted at Taibah University, Madinah Munawwarah, Saudi Arabia. In this study three versions of the Scripts were prepared; Original Text, Paraphrase and Arabic Translation for the maximum understanding and resultant maximum emotional arousal of the students. Excellent grade holders were given Original Text, very good students paraphrase and fair students Arabic Translation of the plays “Waiting for Godot” and “Dr. Faustus”. The results are almost the same as the present study “ for Script 1-Waiting for Godot- the VLF increases while the Coherence, Achievement, HF, LF, LF/HF Ratio decrease. On the other hand, for Script 2-Dr. Faustus- the Coherence, Achievement, HF, LF, LF/HF Ratio increase and the VLF decreases” (Yousaf, Nubli, Ashikin, & Iqbal, 2016).

7. Limitations

The results of this study should be interpreted with care due to small number of the subjects. It’s rather impossible to conduct the experiment with the complete play. It would have taken a lot of time to complete the experiment. Keeping in view this difficulty, the researcher has synthesized the script of the plays which may be read within 7-8 minutes. “Dr. Faustus” is written in blank verse which was a common medium of writing plays in the Elizabethan Age. It’s a common phenomenon that poetry is difficult to understand. To overcome this problem the paraphrase in simple English of the selected parts of the plays is given in the scripts. In this way, it has been tried to make it possible for the readers of these scripts to comprehend it without any external aid like a dictionary. But there is a little doubt that this paraphrase may not arouse the same emotions which are expected to be the result of the original text. Certain artifacts were observed during the experiment e.g. occasional noise in the room where experiment was conducted, unnecessary movement of the body of the subjects and chewing or eating something by them. These distractions may affect the result. In the future experiments following this model, it is recommended to try to eliminate or minimize the artifacts to get clean data.

8. Conclusion

This study was aimed to the measuring of the emotions of the readers of literature. “Waiting for Godot” and “Dr. Faustus” were used as tools of this study. HRV Biofeedback was the technique to measure the emotions of the readers. The differences in the relevant results of the two plays with the opposite themes may be explained with the help of the literary theory “Interpretive Communities” by Stanley Fish. HRV Biofeedback is used for the first time in measuring the emotions of the readers of literature which is a non-invasive technique and can be managed easily. Moreover, the results indicate that HRV Biofeedback may successfully be used for measuring emotions in the future literary studies.

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