EFFECTIVENESS OF HRV BIOFEEDBACK IN MEASURING THE PROFILE OF EARNEST AMONG ENTREPRENEURS

Nazrolnizah Binti Mohamad Noorzeli

Centre for Modern Language & Human Sciences
Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300, Gambang, Pahang. Malaysia.

Email: nieza_zally@yahoo.com.my

ABSTRACT

Earnest is important among entrepreneurs due to increasing the business performance. Nevertheless, previous literature showed that there are no current study which focused on the earnest nature among entrepreneurs. Thus, this study was aimed; 1) to measure the effectiveness of HRV Biofeedback in increasing the profile of earnest among entrepreneurs and 2) to improve the HRV score among participants through increased the HF coherence. A total of 35 respondents were recruited in this study. The changing nature of Heart Rate variability (HRV) of HF, LF and VLF frequencies was measured through Biofeedback Emwave training techniques. The HRV Biofeedback techniques were used to determine the emotional state and the balance ability between individual Sympathetic and Parasympathetic systems. The study showed that the technique is able to improve the characteristics of HRV to increase the profile of earnest among women entrepreneurs. Result showed that there was a positive correlation (0.80-1.00) between all the business and HRV. The results indicated that there is a very strong correlation between business data and HRV among the participants. This ensure that Emwave Biofeedback was effective to be used as an intervention program to improve the nature of earnest among the participants.

Keywords: earnest nature; women entrepreneurs; biofeedback; heart rate variability; intervention.

I INTRODUCTION

Earnest means an act to work hard or strive wholeheartedly to fulfill the purpose of the description of perseverance, diligence and determination of a person. The earnest nature refers to the act of doing a task with a vengeance and committed to the task. According to Hedley (2006), an individual is earnest to do a business because they love their business. The concept worked diligently described by Hedley (2006) can be characterized as a determination of an individual's capacity to work hard to achieve successful in life. Adam (2008), reported that the earnest nature is very important to the entrepreneur as an individual who has the passion to succeed will use internal and external ability to work vigorously to ensure that the goals that wish to achieve in business is done. In addition, a study by Jurgen and Anke (2001) found that in order to achieve a good business, entrepreneurs needed self-confidence and motivation in terms of mental, emotional and physiological. Susan (1995), reported that earnest individuals have highly self-motivation, do not give up easily and confident with the ability to be successful in life. Earnest in business can be summarizes as perseverance, diligence and determination a person to do a perfect job and focused on the efforts to achieve the business goals.

II LITERATURE REVIEW

Hedley (2006) found that earnest can be regarded as a catalyst for the success of an act. Earnest nature itself is an operational definition for assessing the seriousness of an individual in the course of business (Sujan & Harish, 1986). In Business Horizons, John G. Burch (1986), stated that an entrepreneur is a person who strives and have had the nature of a dealer who aims to succeed in business. In this study, the operational definition of the character of the participants viewed seriously by the extent of women entrepreneurs who are willing to sacrifice their time and energy to ensure the sustainability of its business running smoothly and achieving the objectives outlined. Detection of earnest nature on the individual can be measured by the personality of the individual. According to Hewlett & Luce (2006), individuals will vigorously strive in earnest in performing its duties. Rossano and Reardon, (1999) found the earnest person also have a goal to succeed in life. Measurement of this goal through the length of an individual made the effort to achieve the ultimate goal in the business of profit and minimize losses. According to Locke (1968), earnest itself giving a person highly self-confident and motivated. Self-confidence of the entrepreneurs can be measured by how the entrepreneurs take risks to expand its business or to diversify their products. For example, a cakes maker are willing to try different recipes to find the product mix variations in taste and presentation.

Gemmert and Galen, (1997) found earnest nature will make individuals always think positive and innovative. This is because they use their mind for getting an ideas on an ongoing basis, they always think positively that success can be achieved with continuous efforts and innovative thinking to diversify the types of products and services (Louis & Stephen 2009).

Barry and James (1995), reported that earnest entrepreneurs will vigorously strive to increase knowledge in areas related to business.

As a conclusion, earnest nature or nature vigorously means determination, perseverance, diligence and determination of a person with committed and focused on the efforts to achieve the targets based on the goals and business vision.

Biofeedback Module Intervention

According to The Association for Applied psychophysiology and Biofeedback (AAPB), Biofeedback Certification International Alliance (BCIA) and The International Society for Neurofeedback and Research (ISNR), provides a definition of Biofeedback in 2008 as:

"It is a process that enables an individual to learn how to change physiological activity to improve health and performance. Use the right equipment to measure physiological activity such as brain waves, liver function, breathing, muscle activity, and skin temperature. Using of this equipment with fast and accurate action will give 'feedback' on the information to the user. "

Biofeedback is a process for the realization of an individual's physiological functions by using equipment that gives information about the activities of the same system, with the goal of manipulating the information in question as a response. The process can be controlled include brainwaves, muscle, skin conductance, heart rate and the perception of pain. Biofeedback can be used to improve health, improve performance and measure physiological changes of thought, emotion and behavior. This becomes even more apparent when one examines the two basic words consisting of Biofeedback word of "bio" refers to the aspects of biological therapy and "feedback" (feedback) and it is a stimulus to encourage individual behavior change internally.

Measurement Of Earnest and Increasing Of HRV VLF, LF and HF Spectrum

Proper breathing produced *Heart Rate Variability* (HRV) at a maximum level. Proper breathing techniques allowing respiratory oxygen supply at the optimum level during breathing longer than exhale (Gevirtz & Lehrer, 2003). It will increasing the physiological system and balancing the heart rate (HR), emotional, hormonal and autonomic functions. Andreassi (2007) reported that HRV responsed reflects a person's ability to adapted stress and environment. Normal HRV characterized by regular rhythmic, associated with various reflex concerned with the physiological regulation including respiratory reactions (Task Force, 1996) . Increased in HRV means a better interaction between Sympathetic and Parasympathetic in Autonomic nervous system, and potentially lead to an increase in the function of a body systems. According to Lehrer et al. (2000), Biofeedback can mediate homeostatic conditions in the body because it

enables the cardiovascular system featuring continuous rhythmic variations. Biofeedback display the process of breathing, respiratory rate, and respiration amplitude.

Maximum control of HRV can be achieved by most individuals after four sessions of training (Lehrer, 2007). According to Moss and Shaffer (2004, 2009), respondents can maximize the HRV to create a calm mental state, positive emotions and breathing correctly at a rate of about 5-7 breaths per minute. The respiration rate is important as breathing induces heart rhythm, coupled with positive emotions to maximize the HRV in the LF range because it affects the respiratory, autonomic activity and blood pressure regulation. When respiration occurs heart rate (HR) in sync with the breathing. At the end of inhalation, heart rate reaches a maximum and at the end of exhalation heart rate reaches a minimum. In the context of earnest nature, people are able to make a good control of VLF seriousness earnest than people who are not able to control the VLF.

III   PROBLEM STATEMENT

1) **What is the HRV Biofeedback profile among entrepreneurs who has highly profit and income?**
2) **What is the relationship between the participants who has good income and good score of HRV HF?**

IV   RESEARCH OBJECTIVE AND HYPOTHESIS

Research hypotheses of this study were as follows:
1. The successful participants obtained lower score of VLF spectrum than those who are less successful.
2. Participants who are less successful obtained HF spectrum score lower than the participants who have highest profit.
3. There is a strong relationship between highest profit participants with the HRV HF spectrum.
4. There is a strong relationship between lowest profit participants with the HRV VLF spectrum.

V   METHODOLOGY

This part will be explained on research methodology which consisted of the selection of respondents, procedures and data analysis.

Measurement of HRV data

Measurement of HRV data through scores of respondents to measured the earnest nature, through the detection of a relationship between HRV and business profitability.

Document Analysis

To obtain the characteristics of entrepreneurs in term of esarnest in business management. Through document analysis, analysis of sales and purchase ledger is collected to identify the entrepreneur daily profit, gain or income earned to classified as profit or lose. Next, the financial management of debit and credit ledger balance showing no capital leakages and wastage does not occur. The perfect stocking ensure enough stock and meet the needs and requirements of the clients.

Statistical Analysis

Pearson Correlation test was utilised in order to calculate a numerit value of strength and direction of relationship between two variables. The correlation coefficient used when analyzing the relationship between the two variables i.e Y and X. It is often used in root cause analysis using fishbone diagram. Variable Y stands for problem, while the variable X is one of the causes of the problems. Therefore, the relationship to determine whether X is the real cause of the problem or not can be determined by evaluating the correlation of reading media. In this study, the Spearman rank correlation type has been used.

Biofeedback training session

Emwave training sessions were conducted in a quiet room. Each participant attends a training session at the same time and same day each week. Training was provided to the participants after a brief training before each session. Biofeedback training protocol by Lehrer (2000) adopted in this study. Participants are introduced to Emwave Biofeedback equipment, training methods and protocols. Participants also advised to breathe in a relaxed state of mind and breathe in a resonance frequency to measured the heart rate variability (HRV). They were instructed to breathe with 6.5, 6, 5.5, 5 and 4.5. for about 2 minutes to find their resonance frequency at the highest score (Lehrer et al. 2000).

VI   PREVIOUS STUDIES ON BIOFEEDBACK PERFORMANCE ENHANCEMENT

Biofeedback measured nature of depressed (Stress)

According to Zaichkowsky and Fuchs (1988), Biofeedback detecting and enhancing the physiological process of converting difficult information to the useful information in term of meaningful, timely, accurate, and consistent. Griffiths (1981) reported that earnest individuals using Biofeedback training to reduce the symptoms of stress. Griffiths (1981) found that anxiety associated with improved performance. With increasing pressure, the performance of complex tasks is enhanced (Kirkcaldy, 1984; Diane & Cindra L.G., 2010). Meanwhile, Cooper C.L.

(1988) and Wayne J. Pitts (2007) reported stress is a part of the lives of individuals who are working. Earnest individuals use Biofeedback training as a tool to avoid feeling depressed and found stress fade away after Biofeedback training (Ruth O'Hara (2006).

Biofeedback enhanced sport performance

According to Wenz and Strong (1980), Biofeedback is a training to overcome the individual's stress response. Timothy T. H. and Lara K.D., (2003) found Biofeedback training conducted vigorously effectively helped athletes concerned about their sports performance. Biofeedback enables athletes to increase muscle movement and increase the performance of individual sports (Y. Maryn et al., 2006). David M. and Konno J. (2009), reported that Biofeedback training seriously improved the performance of individuals who suffer from stress and anxiety on athletic performance. The basic training is to mobilize athletes external locus of control to an internal locus of control. Whereas Feltz (1988); and Bradley D. L. (2011), found when athletes strive for Biofeedback training, they managed to coped with problematic situations and increase their self-confidence. Biofeedback training increased individual stamina and improve athletic performance (Fitzsimmons & Landers, 1991).

Biofeedback enhanced education Performance

According to Vitasari (2011) in her study entitled "The Effect of Biofeedback Intervention Programme on Anxiety Among Engineering Students at Universiti Malaysia Pahang", found Biofeedback training method are useful to engineering students at UMP reduced anxiety and increased of focus on their studies. Biofeedback techniques been used successfully increased the level of concentration of students and improved their results in academic achievement. The study showed that students are able to improve the performance of Cumulative Grade Point Average, improve study skills, manage their time well and reduce nervousness when presenting a proposal.

EFFECTIVENESS OF BIOFEEDBACK HRV

Biofeedback technology has proven its effectiveness in improving the performance of humanities systems worldwide. Various benefits have been derived from previous studies using Biofeedback technology. In Malaysia Auditya (2010); Vitasari (2011) and Wang Jing (2013) reported in their thesis that Biofeedback has proven effective in improving performance. Vitasari (2011) found Biofeedback techniques have been successfully used to increase the level of focus and thus improve the results in academic achievement of the students. While Auditya (2011) reported Biofeedback training methods have been effective in improving cognitive performance of women factory production operator in Kuantan, Pahang. Results showed that there is a significant change in the improvement of cognitive performance of female employees when using Emwave Biofeedback training. In addition, Wang Jing (2013), in her research entitled "An Investigation On Devoutness Islamic Prayer Among Female College Students Through

Biofeedback." Reported Biofeedback helped women students in college improved their concentration in prayers.

While in business, research by Bagozzi et al. (1999) found that setting business goals is more achievable for individuals when using Biofeedback training. Brown, Robert and Peterson (1994) reported an increased on sales and positive attitudes by sales people who undergoing Biofeedback training. in accordance with Biofeedback and Hans HB and Isabel Martin (2009), an Adaptation of the increased in sales helped increased in profits for Biofeedback training individuals (Isabel Martin, 2009). As a conclusion, based on previous studies described above, the use of Biofeedback training is effectiveness in various fields to enhance human performance among individuals who undergoing the training.

VII   FINDING AND RESULT

The study showed that the technique is able to measure HRV and increase the earnest nature among entrepreneurs. These data are compared with the findings of the correlation analysis to find the relationship between the respondents, the data sample and the results of HRV analysis of financial data in terms of profitability. From the findings, given that the correlation found showed a strong positive correlation between all of the business data and HRV data obtained of between 0.80-1.00 (Highly strong correlation), the findings shows that there are significant to meet the strong relationship between participants business data with the HRV data in terms of the cumulative score, HRV HF and LF. As a conclusion the results of the study are as follows:

1) Participants who have profile of earnest has good performance in very low frequency (VLF), low frequency (LF) and high frequency (HF) score in HRV results.
2) Participants who have good profile of earnest obtained good HRV profile.
3) Participants who have good profile of earnest scoring the HRV VLF coherence lower than HF.
4) Participants who have good profile of earnest scoring the HRV HF higher than VLF.
5) Participants who have highly performance in HRV HF score also has the characteristics of a better determination.

Table 1: The range of the amount of profit

CATEGORY	THE RANGE OF THE PROFIT (RM)	NUMBER OF PARTICIPANTS	PERCENTAGE OF PARTICIPANTS (%)
1	0.00 – 3,000.00	6	17%
2	3,000.01 – 6,000.00	23	66%
3	6,000.01 – 9,000.00	6	17%
TOTAL		**35**	100%

Table 1 above shows the range of the amount of profit divided into 3 categories, which is 17% (n = 6) at the high level income (RM6000 to RM9000), followed by 66% (n = 23) of modest profit (RM3000 to RM6000) and by 17% (n = 6), the lowest profit of about RM3000 for a period of 6 months. Data showed that the highest percentage (66%) is moderate. Referring the above description, this study analyzes the business profile of earnest among entrepreneurs can be measured in terms of business success.

Table 2: Results Of HRV High Frequency

	HRV HF		
SESSION	MIN	VARIANCE	STANDARD DEVIATION
SESSION 1	20.17	214.15	14.63
SESSION 2	31.66	261.06	16.16
SESSION 3	50.40	401.54	20.04
SESSION 4	82.20	38.40	6.20
SESSION 5	83.20	33.16	5.76

Note: M = Min, V = variance and SD = Standard Deviation

Table 2 above shows the results of means value, variance and standard deviation for sample in HF HRV spectrum scores from session 1 to session 5. Findings showed that reading scores coherence HRV Biofeedback is M = 20:17, V = 214.15, SD = 14.63 in session 1 followed by session 2 which is M = 31.66, V = 261.06, and SD = 16:16. Next in 3rd sessions HRV sample readings continue to rise in value of M = 50.40, V = 401.54, SD = 20:04 and followed by the fourth session which is M = 82.20, V = 38.40, and SD = 6:20. In the last session the means value is shown as M = 83.20, V = 33.16, and SD = 5.76. In summary, there is an increase in the means value of samples from session 1 to session 5, indicating that the sample coherence scores continue to rise. The following table shows the results of the five HRV cumulative score session had been conducted.

Table 3: Results Of HRV Cumulative Scores

SESSION	TOTAL SCORE OF HRV		
	MIN	VARIANCE	STANDARD DEVIATION
SESSION 1	14.91	96.02	9.80
SESSION 2	23.14	160.95	12.69
SESSION 3	36.37	189.59	13.77
SESSION 4	46.91	189.61	13.77
SESSION 5	58.11	218.63	14.79

Note: M = Min, V = variance and SD = Standard Deviation

The results showed that the cumulative score of reading HRV Biofeedback is M = 14.91, V = 96.02, SD = 9.80 in 1st session following by 2nd session, the findings showed the value of M = 23:14, V = 160.95, SD = 12.69. Next in 3rd sessions HRV sample readings continue to rise in value of M = 36.37, V = 189.59, SD = 13.77 and followed by the fourth session which is M = 46.91, V = 189.61, SD = 13.77. In the last session the means value is shown as M = 58.11, V = 218.63, SD = 14.79. As a results, there is a continuous increase in the means value of the cumulative score, indicating that the sample managed to control their HRV very well when HRV Biofeedback training repeatedly.

Reviewing the significant relationship between business data and the findings of HRV data

Correlation is a statistical term that expresses the linear relationship between two or more variables. The correlation coefficient used when analyzing the relationship between the two variables i.e Y and X. Therefore, the relationship to determine whether X is the real cause of the problem or not can be determined by evaluating the correlation of reading media. In this study, the Spearman rank correlation type has been used.

Table 3: Interpretasion the value of r (Pearson)

| r	Interpretasion
0	not correlate
0.00-0.20	Very low
0.21-0.40	low
0.41-0.60	enough
0.61-0.80	high
0.81-1.00	very high

Sugiyono (2007)

Below were the results of a statistical Correlation using the Spearman rank correlation type had been used in the study to examine the relationship between HRV score and business profitability.

Figure 1: Correlation of HRV HF in session 5 with the amount of profit of sales = 0.920
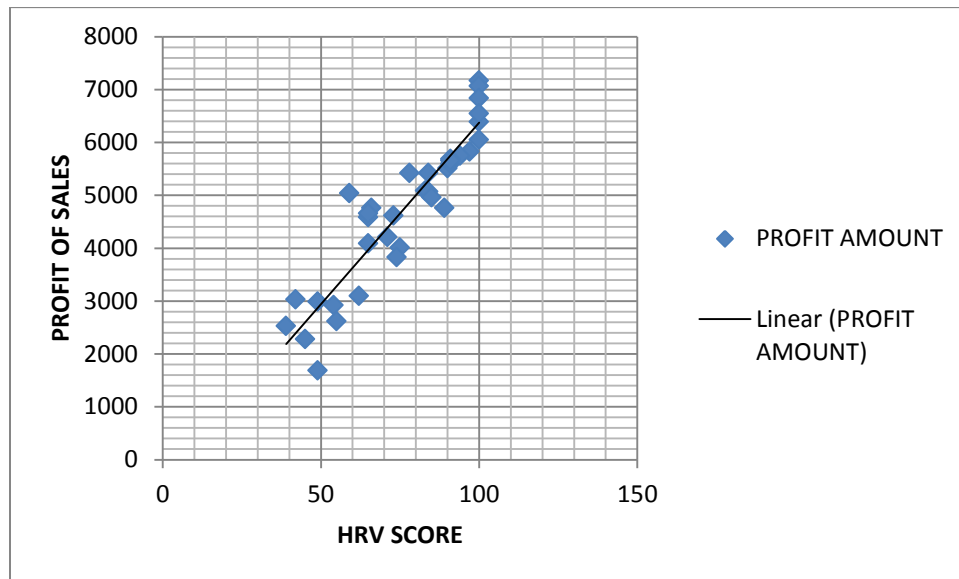
Correlation values found a very strong positive correlation between HRV HF in session 5 with the amount of sales profit which is 0.920.

Figure 2: Correlation Score of session 5 between HRV LF score with amount of retained profit = 0.984
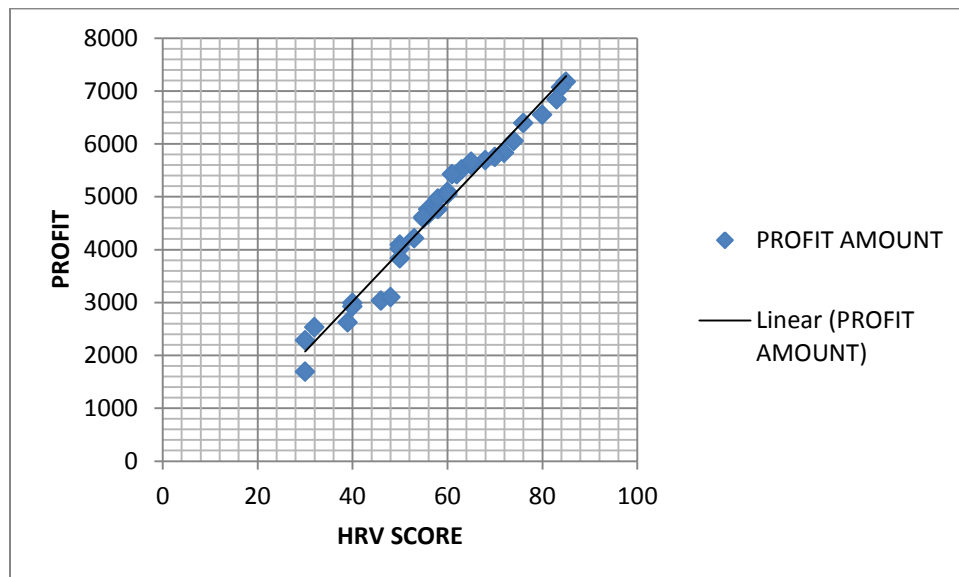
Correlation values showed a very strong positive correlation between HRV LF session 5 score with amount of retained profit which is 0.984.

Summary of results

Results of the correlation above showed that there is a very strong positive correlation between all of the business profitability data and HRV scores between 0.80-1.00 (Highly strong correlation), it's means the results shows that there were significant and strong relationship between participants business profit and sales with the results of HRV scores in terms of the cumulative score, Total score, HRV HF and HRV LF spectrum.

VIII   RECOMMENDATION

Implemented the Biofeedback Emwave module would helped entrepreneurs enhanced earnest nature that is within them to enhance the success of the business. This technique should be implemented in daily life to improve individual internal physiological conditions through psychological changes. Training and implementation modules of Biofeedback could be a tool for measuring entrepreneurs business improvement to enhance their business successful.

Further research of this promising intervention is warranted in larger and heterogeneous samples and may assign different experimenters. With respect to experimental procedure, to obtain more reliable and complete HRV data, physiological stress profile should be administered over ten minutes with each period of measurement taking a minimum five minutes recording. Longer time recording also allows analyzing the relationship between changes in physiological, psychological and performance.

As a result, relationship between changes in physiological and performance enhancement can be explored further. Furthermore, it is also important to examine the effects of HRV biofeedback between sessions not only in physiological measures but also in psychological parameters. Following a study by Lehrer et al. (2003), it may be necessary to evaluate all these parameters at minimum three sessions. As this study was relatively short follow-up period, more attention should be given to conducting long term follow-up. Finally, underlying mechanism on the role of autonomic nervous system regulation in improving performance still needs further investigation.

IX   LIMITATIONS AND FUTURE RESEARCH

This research is limited to the measurement of earnest among participants of AIM and not focused on other scope or other entrepreneurs. This study was limited in several ways which would decrease the ability to generalization issue in other settings. The samples only involved AIM women entrepreneurs and limited to the district town. First of all, the results of the current study may be limited to the sample size and characteristics. Thus the findings are limited to the

scope of the small sample size of 35 people. Although several studies using HRV Biofeedback (Lehrer, 2003) have revealed that there are long-term changes associated with this technique, the results of this study cannot be generalized to long-term changes in HRV. It is still unclear whether the training effects of HRV Biofeedback enlarge, decrease, or remained consistent over time.

Another limitation of the study was the difficulty to demonstrate a direct relationship between Biofeedback training and earnest nature particularly if assessed in terms of quantity or quality of entrepreneurs. Future studies may consider the use of other diversity indicators to assess the nature of conscious entrepreneurs as well as using this Emwave Biofeedback training. Nonetheless, HRV Biofeedback training may not be applied as a "stand alone" strategy, it will yield much better outcomes particularly in terms of organizational outcome, i it works as an adjunctive intervention. Although several studies using HRV Biofeedback (Lehrer, 2003) have revealed that there are long-term changes associated with this technique, the results of this study cannot be generalized to long-term changes in HRV. It is still unclear whether the training effects of HRV Biofeedback enlarge, decrease, or remained consistent over time. To the best our knowledge, this is the first randomized control trial examining the effect HRV Biofeedback on both objective and subjective performance measurement.

In summary, despite the limitations of this study, resonant frequency breathing in Biofeedback training demonstrates promise for the new training approach for enhancing earnest nature among entrepreneurs. Data suggested that subjects learned successfully to shift their HRV toward LF range as well as regulate their respiration rate in a relatively short time period. Similar to these findings, previous researches indicated that maximal control over HRV at the resonant frequency can be obtained in most people after approximately four sessions of training (Lehrer et al., 2003).

X   CONCLUSION

The present study is among the first to examine the effects of HRV Biofeedback training on measurement theprofile of earnest nature among entrepreneurs. This study used resonant breathing strategy which is aimed to teach the subjects breathe correctly following their resonant frequency. During resonance breathing, real time heart rate and respiration form a perfect phase relationship such that subjects inhale until their heart rate peaks and exhale as it falls, until it begins to rise again (Vaschillo et al., 2004). Result showed that improved autonomic nervous system or homeostatic regulation was noted in the training group after attending five sessions of HRV Biofeedback training.

In addition, the findings of qualitative and quantitative analysis of the results shows that to achieve the objectives and hypotheses of the study. The result analysis shows that there is a strong positive correlation between all of the business data and HRV data obtained of between 0.81-0.99 (very strong correlation), the findings showed that there were significant results of analysis and strong relationship between business profit and sales performance with the HRV scores in terms of cumulative score, Total scores, HRV HF and HRV LF.

Moreover, the quantitative results did support most of the hypotheses. The Biofeedback training participants showed significant improvement in percentage of LF activity and breathing rate. Participants also displayed significant improvement in attention, memory, and focused. It indicated that HRV Biofeedback training indeed show potential to be applied as entrepreneurs performance enhancement strategy inbusiness. To produce better observable outcomes, HRV Biofeedback might be combined with any other intervention either individual or organizational-based. Future studies are warranted in larger and heterogeneous sample to further clarify the interrelationship among autonomic functioning and business performance.

To conclude, HRV Biofeedback as a performance enhancement tool offers immense opportunities for Entrepreneurs to correct their arousal levels and improved their business performance. HRV Biofeedback as a tool measured the profile of earnest among entrepreneurs to increase the performance of the humanities system is most relevant.

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