



# Comparing the Activity of the Parasympathetic System in People with Secure and Insecure Attachment Style

Alaleh Ataherian<sup>1</sup>, Reza Rostami<sup>1,\*</sup>, Mahdiyeh Moin<sup>2,\*\*</sup>

<sup>1</sup> Faculty of Psychology and Education, University of Tehran, Tehran, Iran

<sup>2</sup> Department of Psychiatry, Tehran University of Medical Sciences, Tehran, Iran

\*Corresponding Author: Faculty of Psychology and Education, University of Tehran, Tehran, Iran. Email: rrostami@ut.ac.ir

\*\*Corresponding Author: Department of Psychiatry, Tehran University of Medical Sciences, Tehran, Iran. Email: moin\_drm@yahoo.co.uk

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## Abstract

**Background:** As the reciprocal effect between mind and body has been controversial since Freud's era, current research considers the relationship between the peripheral nervous system and psychological functions.

**Objectives:** The current study aimed to examine parasympathetic activity concerning attachment style. Heart rate variability (HRV) has been assessed. It takes an account as an index of the autonomic nervous system, which included high frequency (HF), low frequency (LF), and very low frequency (VLF), was assessed. It is noteworthy that HF is an indicator of the parasympathetic nervous system.

**Methods:** The study methodologically was casual-comparative. The participants included participants over 25 years-old residing in areas one to ten of Tehran. According to the agreement in casual-comparative studies, using a convenience sampling method, 36 participants opted. After missing 7 participants, 29 remained, divided into two groups based on their attachment style (12 participants in the insecure group and 17 ones in the secure group). The Persian version of Besharat's Attachment Adult Inventory (1987) and stress response evaluation (SRE) was conducted, and MANOVA performed an analysis to collect the data.

**Results:** Findings showed that although there is a significant difference based on combining scores of VLF, LF, and HF between two groups ( $F = 10.493$ ,  $P < 0.05$ ,  $\eta^2 = 0.557$ ), HF is of higher average in the insecure attachment group ( $F = 27.70$ ,  $P < 0.05$ ,  $\eta^2 = 0.506$ ).

**Conclusions:** Heart rate variability, especially HF, is an indicator of the parasympathetic branch of the autonomic nervous system that can be influenced by attachment style and early relationship.

**Keywords:** Attachment, Heart Rate Variability, Object Attachment, Parasympathetic Nervous System, Peripheral Nervous System, Psychophysiology, Psychosomatic Medicine

## 1. Background

When it comes to attachment, the types and its pathology, Bowlby is the first scientist who comes to our mind. This child's early experiences with a caregiver are internalized in the form of representations of self and others, and Bowlby entitled them Internal Working Models (1). Based on the theory, insecure attachment may lead to a complex internal world and a plethora of pathological conditions (2).

Accompanied by psychological components, there are noticeable studies that show physical components have their role in the relation between infant and

caregiver (3). The relationship between insecure attachment and physical problems was explored from four perspectives: (1) Correlation between becoming ailment and insecure attachment in childhood; (2) correlation between developing the disease and insecure attachment in adulthood; (3) correlation between symptoms of insecure attachment in childhood and disease at an older age; (4) correlation between secure attachment and health quality in children and adults (4).

Many studies have shown the relationship between attachment style and autonomic nervous system function (5). Studies in pathological development have

indicated that a child's psychophysiological reaction to insecure attachment and mother relationship consists of two different responses: Hyperarousal and dissociation (6, 7). Prolonged stress and an inappropriate relational atmosphere separate the child from the external environment and cause helplessness and hopelessness. Damaged children stare into space and passively come into dead positions (8). Steven Porges considers this stage as the prominence of the Parasympathetic system. He believes that "the rapid and abrupt transition from the unsuccessful strategy of the fight requires sympathetic system activation to being motionless with activation of the vagus nerve and parasympathetic activity" (9, 10).

Among the various available non-invasive techniques for assessing the autonomic status, heart rate variability (HRV) has emerged as a simple, non-invasive method to evaluate the sympathovagal balance (11). The HRV refers to the variation in time intervals between heartbeats (beat-to-beat intervals). Respiratory sinus arrhythmia (RSA) and high-frequency HRV (HF-HRV, in the 0.15 - 0.40 Hz range) are established measures used to quantify vagal tone and to evaluate the activity of the parasympathetic nervous system (12).

## 2. Objectives

According to the previous research, the objective of this study was to explore the parasympathetic nervous system's activity between secure and insecure attachment groups. The HRV as an index of the autonomic nervous system with HF, Lf, and VLF elements should be evaluated. Among the three indexes, HF as a representation of the parasympathetic nervous system plays a key role in the relationship with attachment style.

## 3. Methods

### 3.1. Study Design

The study was a fundamental causative-comparative conducted in Tehran, Iran, during winter 2020. Subjects were gathered by the Convenience Sampling method. Sample numbers were according to an agreement as to at least the number of sampling in causative-comparative studies.

### 3.2. Participants

A total sample of 29 participants (17 secure attachment, mean age: 31.11, SD: 3.29) (12 insecure attachment, mean age: 34.71, SD: 3.63) were recruited.

The education data was mentioned in Table 1. Inclusion Criteria were a minimum age of 25, university grade at least bachelor, participant's agreement to participate in the study. They were excluded if they were diagnosed with a chronic physical disease such as MS, Cancer, or severe psychological illness like psychotic or mania symptoms, a background of hospitalization due to suicidal attempts or other psychological problems, diagnosed with Trauma Brain Injury and epilepsy, and abusing drugs or alcohol. Using caffeine materials such as tea, coffee 8 hours before doing the stress response evaluation (SRE) test, taking any psychological medicine in general, and pain killer 8 hours before doing the SRE test was abandoned.

### 3.3. Measures

#### 3.3.1. Demographic Characteristics Checklist

The researchers developed the checklist and used it for the patient's demographic characteristics, including education, gender, marital status, job, and history of psychotic or hospitalization due to the family's psychological problems.

#### 3.3.2. Adult Attachment Inventory

Adult Attachment Inventory (AAI) is a self-reported questionnaire with 25 items that Hazan and Shaver designed to classify adult attachments into secure, avoidant, and anxious/ambivalent clusters. Participants responded to the items using a five-point Likert-type scale ranging from 1 (very little) to 5 (very much). The AAI has adequate internal consistency and test-retest reliability. Cronbach alpha coefficients for the secure attachment style, avoidant attachment style, and ambivalent attachment style were respectively 0.91, 0.87, and 0.90. The temporal stability was 0.82 for secure attachment style, 0.78 for avoidant attachment style, and 0.75 for ambivalent attachment style (13).

#### 3.3.3. Stress Response Evaluation

Stress Response Evaluation is a tool for assessing autonomic nervous system components. It is made by Thought Technology Company which contained software and hardware parts (188 Pinellas Lane, Cocoa Beach FL, 32931). The hardware part includes Flexcomp, TT-USB, EEG-Z, HR/BVP, Skin Conductance, Skin Temperature, Respiration sensors. The software part is Neuroinfiniti.

### 3.4. Procedure

**Table 1.** Demographic Data for Insecure and Secure Attachment People <sup>a</sup>

Variables	Secure (n = 12)	Insecure (n = 17)
<b>Education</b>		
Bachelor	6 (35.3)	7 (58.3)
Master	10 (58.8)	3 (25.0)
PhD	1 (5.9)	2 (16.7)

<sup>a</sup> Values are expressed as No. (%).

All participants announced their consent before beginning. To determine their attachment style, they were asked to complete AAI. Respiration rate, skin conductance, temperature, and EEG sensors were installed to assess heart rate variability. The sensor for heart rate variability was installed in the middle finger. The assessment period was 5 minutes eye-opened without any stimulus in the isolated room. The ethics committee approved the current study of the University of Tehran, Iran.

### 3.5. Statistical Analysis

For statistical analysis of the collected data, descriptive statistics, test for checking the normality of data distribution by Kolmogorov-Smirnov, Levene's test to calculate the homogeneity of variances was conducted. MANOVA was applied to assess the difference in HRV elements between secure and insecure attachment groups. The two-tailed significance level was set at 0.05. Statistical analyses were performed by SPSS version 24.

## 4. Results

The demographic data was mentioned in Table 1. At first, descriptive indexes of research variables separately into two groups: (1) Secure, and (2) insecure, were submitted (Table 2). Before exploring the significance of these differences, data normality using Kolmogorov-Smirnov and homogeneity of variances by the Levene's test were assessed. According to the former test, the normality of data was accepted. Levene test results for VLF ( $P = 0.513$ ,  $F = 0.439$ ) and HF ( $P = 0.906$ ,  $F = 0.014$ ) suggested accepting homogeneity of variances. Of course, despite VLF Levene test significance ( $P = 0.021$ ,  $F = 5.968$ ), on the recommendation of Tabachnik and Fidel (2013), due to the approximately equal volume of both groups (less than 4 to 1 ratio), a more considerable variance can be divided into minor variance. If the result were less than 10, the analysis result of the variance would be reliable. Hence, the result was 4.48, which is an indicator of homogeneity of variances. Before analyzing,

the assumption of homogenizes of a variance-covariance matrix was assessed by BOX test ( $F = 1.428$ ,  $P = 0.200$ ).

According to the not meaningfulness of BOX test, the Wilks Lambda was applied for comparing the groups. The test showed a significant difference between secure and insecure attachment in terms of combined scores of HF, LF, and VLF ( $F = 10.493$ ,  $P < 0.05$ ,  $\eta^2 = 0.557$ ). The results of the test were presented to determine the differences based on dependent variables in Table 3. The results represented that the insecure group showed a higher average of HF and LF than the secure attachment group. And the low-level average of VLF in the insecure attachment group.

Due to the significant age difference between the two groups, the effect was controlled using multivariate analysis of covariance, and the differences between the two groups in the three research variables were recalculated after controlling it. The results were that secure attachment group had higher average in LF ( $F = 14.518$ ,  $P < 0.05$ ,  $\eta^2 = 0.358$ ). On the other hand, as to HF, the insecure attachment group showed a higher average ( $F = 25.031$ ,  $P < 0.05$ ,  $\eta^2 = 0.491$ ). Moreover, in terms of VLF, there were no significant differences between the two groups.

## 5. Discussion

The present study aimed to examine the proposal that the parasympathetic system's function is different between secure and insecure attachment groups. As to the purpose, Heart Rate Variability with their elements, which were indicators of the sympathetic and parasympathetic systems, was assessed.

The results showed that there is a significant difference as of HF between secure and insecure attachment groups. The average of activity of HF is higher in the insecure attachment subjects. The finding is consistent with previous researches such as Schore and Perry's ones. They explained that early interactions of infant and caregiver not only affect psychic structures

**Table 2.** Mean and Standard Deviation of Research Variables <sup>a</sup>

Variables	Secure (n = 12)	Insecure (n = 17)
VLF	18.09 ± 5.75	12.46 ± 4.57
LF	37.97 ± 8.94	28.17 ± 4.22
HF	37.13 ± 6.92	50.69 ± 6.7

Abbreviations: VLF, very low frequency; LF, low frequency; HF, high frequency.

<sup>a</sup> Values are expressed as mean ± SD.

**Table 3.** Analysis of Very Low Frequency, Low Frequency, High Frequency in Two Attachment Groups

Dependent Variables	Sum of Squares	df	Mean Squares	F	Sig.	Effect Size
VLF	223.232	1	223.232	7.937	0.009	0.227
LF	675.808	1	675.808	12.379	0.002	0.314
HF	1292.895	1	1292.895	27.701	0.001	0.506

Abbreviations: VLF, very low frequency; LF, low frequency; HF, high frequency.

but also on a structure of peripheral and central structures (14).

Perry believed that two reactions will occur as a consequence of prolonged arousal. One of them is high arousal and the other one would be dissociation. In the latter, one is separated from his surroundings and immersed in the inner world. This state of isolation is a parasympathetic regulatory strategy that occurs in a state of despair and helplessness. When a deep and long psychological distance occurs between the child and the external object, the parasympathetic system would be openly activated (15). Putnam called the reaction "escape when there is no way to escape" (15). Porges believes that rapid and sudden transition from the unsuccessful fighting strategy, which requires sympathetic activation to an inactive state of energy storage, is associated with activity of the Vagus nerve's dorsal nucleus (16).

Schore suggested that synaptic relationships and orbitofrontal ability in coordinating and integrating the sympathetic and parasympathetic systems will be destroyed in insecure attachment conditions (12). A high level of arousal leads to high cortisol levels and sympathetic activity. However, a high level of cortisol will result in cell death. Therefore, in order to survive, conserving energy and reducing activity will be crucial. Thus, when an arousal would be chronic, increase in the parasympathetic activity and predominance of the dorsal motor part of the Vagus nerve will be increased. In the same way, chronic arousal in insecure attachment leads to a dominance of the parasympathetic system (5).

### 5.1. Conclusions

The present result is consistent with theoretical and empirical evidences. According to this study, the average of Hf, which is indicator of parasympathetic nervous system function, is significantly higher in insecure attachment group.

This study had some limitations. Because of the low sample size, a generalization of the results to other individuals and age groups should be made cautiously. Since the heart rate variability index was measured from a finger sensor, the probability of measurement error increased. It is also suggested that future research evaluate a broader geographical scope to provide coherent and consistent findings on variables under study. Also, other tools that can assess HRV based on chest and without medium and interview for attachment can be applied. Also, in future researches, brain mediators of this process can be explored.

### Footnotes

**Authors' Contribution:** A. A. designed and conducted the study. R. R. was the technological and physiological advisor and evaluating physiological parts. M. M. was a psychological advisor and helped with revising the manuscript.

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**Data Availability:** The dataset presented in the study is available on request from the corresponding author during submission or after publication.

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