

# A Study on the Stress Reduction Effect of Reading Aloud the Book Using HRV

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## Abstract:

Since stress is the source of all illnesses, stress reduction is very important for modern people. Book-reading is a very effective method of reducing stress. In this paper, we tried to find out whether reading aloud the book is helpful for stress reduction and the stress reduction effect according to the reading aloud duration. The experimental method was measured before and after reading aloud the book and compared to Standard Deviation N-N Interval (SDNN), and the SDNN change was measured during reading aloud several times to confirm the relationship between reading aloud the book and stress reduction. The experimental results showed that SDNN levels increased after reading aloud the book in all experiment participants. In addition, SDNN levels increased as most experiment participants performed reading aloud several times. Through these experimental results, we confirmed that reading aloud the book is a very helpful method for stress reduction in modern people, and the longer the reading aloud time is, the more helpful it is for stress reduction.

**Keyword:** Stress, Reading Aloud, Heart Rate Variability (HRV), SDNN

## 1. INTRODUCTION

Stress is said to be the source of all illnesses. Modern society has a very complex structure and complex interests among its members. Therefore, modern people can only be stressed. Cancer, cerebrovascular disease, and cardiovascular disease are the leading causes of death in modern people, and 70% of the causes of these diseases are stress. In medicine, stress is defined as "resistance to remain stable against stimuli that break mental and physical balance and stability." Therefore, it is very important to relieve stress in order to maintain a healthy and happy life [1-3].

There are many ways to reduce stress. Healthy eating, adequate sleep, regular exercise, listening to music, deep breathing, and meditation can help reduce stress. In addition, book-reading is known to be very helpful for stress reduction, and some psychologists explain that book-reading is the most effective method of stress reduction [3-6]. Book-reading refers to "the act of reading a book to nurture the mind and body," and bibliotherapy is used for psychological healing and

psychological growth in various fields such as psychology and counseling. Book-reading has long been known to have psychological therapeutic effects. In particular, the library of Thebes, the oldest library of ancient times, introduces the library as a 'healing place for the soul' through the writing on the board. And Alexandra's library called the book 'a medicine for healing the soul'. In modern times, book-reading was used to solve complex mental problems from the United States in the 1930s, and book-reading was used to provide psychological assistance to soldiers during World War II. It became the foundation. In these historical examples, the act of book-reading seems to have greatly contributed to stress reduction [6-8].

Among the book-reading methods, reading aloud the book, which can stimulate the heart and lungs, is expected to be effective in reducing stress. In this paper, we tried to confirm whether the reading aloud the book actually helps stress reduction through Heart Rate Variability (HRV) measurement experiment. Chapter 2 describes the reading aloud the book, which is expected to help stress reduction. Chapter 3 explains the heart rate variability and stress index. Chapter 4 describes the experiment and results, and Chapter 5 concludes.

## 2. RELATIONSHIP BETWEEN READING ALOUD THE BOOK AND STRESS REDUCTION

Book-reading is the act of reading a book or writing. Book-reading can be divided into social communication and knowledge creation. In the past, when social media were not diverse, book-reading was a very important medium for social communication and knowledge creation. Social communication through book-reading means that the reader and the author communicate through the book. The act of creating knowledge through book-reading means to acquire knowledge through book-reading and to create new knowledge based on it. Psychologist Dr. Lewis explains why book-reading relieves stress: "I'm immersed in the imaginary space created by the author and escape from daily anxiety." This is interpreted as releasing stress by immersing in the author's story rather than everyday life [7-8].

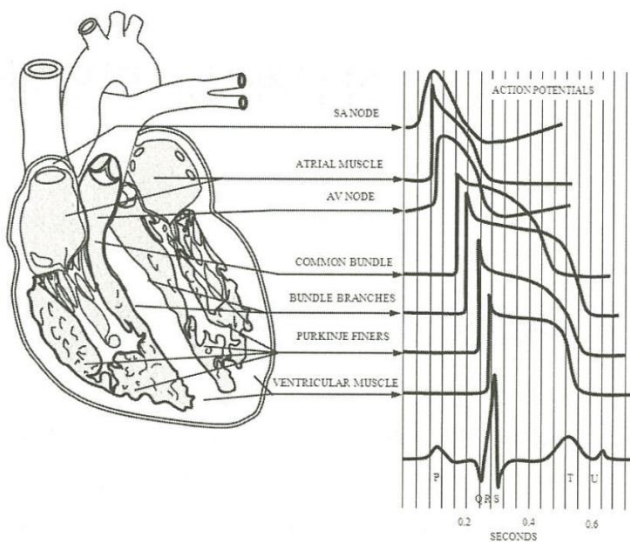
Book-reading can be classified in several ways depending on how it is read. Among them, reading aloud and silent reading

can be classified according to phonation. Reading aloud is a way to read a book aloud, and silent reading is a way to read a book silently. In addition to the view that psychologists' psychological stability on book-reading has an effect on stress reduction, the act of loud book-reading itself can also help stress reduction. Given the correlation between stress and autonomic nervous system regulation, the phonation of reading books aloud will stimulate the lungs and heart. This can be expected to help stress reduction by improving the control ability of the autonomic nervous system involved in the operation of each organ. In particular, human phonation is a complex signal that reflects the resonance characteristics of lungs and other organs, and can be said to effectively stimulate each organ involved in phonation. Therefore, reading aloud the book is expected to help stress reduction in physical as well as psychological aspects [4-5][8-9].

### 3. HEART RATE VARIABILITY AND STRESS INDEX

#### 3.1 Heart rate variability (HRV)

Heart rate is a heart beat for 1 minute. In general, heart rate corresponds to the pulse rate measured in the artery. HRV refers to the degree of change in heart rate over time. Figure 1 shows the electric potential waveform of the heart rate as the heart moves [10].



**Fig 1.** Electric potential waveform of the heart rate as the heart moves [10]

Heart rate varies with age, sex, activity level, and surroundings. The average heart rate is 60 to 70 beats/minute for healthy adult men and 70 to 80 beats/minute for healthy adult women. In

general, if your average heart rate is too fast (more than 100 beats/minute), it's called tachycardia. If it's too slow (less than 60 beats/minute), it's called bradycardia. Tachycardia can also cause arrhythmia. Heart rate is affected by sympathetic and parasympathetic nerves. Heart rate accelerates as the sympathetic nerve becomes active and slows as the parasympathetic nerve becomes active. The sympathetic and parasympathetic nerves, which affect the heart movement, are autonomic nervous systems that operate somewhat independently of the cerebral dominance. The autonomic nervous system plays a role in maintaining the homeostasis of our bodies by affecting the movement of various organs, and has a dual nerve governing structure of sympathetic and parasympathetic nerves. When our body is healthy without stress, the sympathetic and parasympathetic nerves are activated to change the state of various organs rapidly in the internal and external changes of the body. In other words, when the stress is low, the organs of the body change the state of movement according to the internal and external environment, and the heart rate changes rapidly. Therefore, when the change in heart rate is large, the stress is low, and when the change in heart rate is small, the autonomic nervous system is deactivated due to the high stress. The heart rate variability according to the change of the heart movement state can be confirmed, and HR Tachograph, HR Distribution, HR Histogram, SDNN (Standard Deviation N-N Interval) can be obtained through heart rate variability[10-12].

#### 3.2 Stress index (SDNN)

In 1996, "Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology" presented guidelines for the analysis and standards of heart rate variability (HRV-heart rate variability). The stress index used here is SDNN (Standard Deviation N-N Interval) that can be known through HRV. SDNN means the standard deviation of the N-N interval during the five stages of the pumping cycle of the heart and can be obtained as shown in Equation (1). If the stress is small, the change in the heart rate is large and the value of the SDNN is large. If the stress is large, the change in the heart rate is small and the value of the SDNN is small. The correlation between SDNN and stress is shown in Table 1 [11-12].

$$SDNN (\sigma) = \sqrt{\frac{\sum_{k=1}^N (x_k - \mu)^2}{N}} \quad (1)$$

where  $x_k$  is k's N-N Interval, and  $\mu$  is N-N Interval's Mean

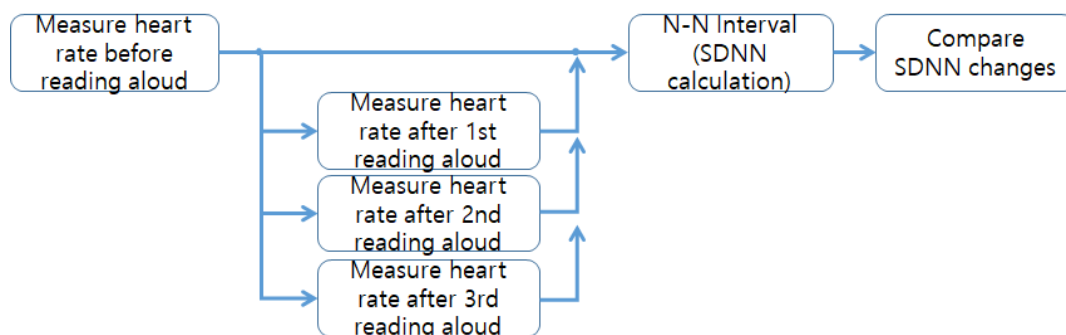
**Table 1.** Correlation between SDNN and stress [12]

SDNN	Stress condition
50 or more	Very good. "Autonomic nervous system regulation function" and "Ability to cope with stress" are good.
35~50	General. "Autonomic nervous system regulation function" and "Ability to cope with stress" are normal.
20~35	Lowness, Risk of developing stress-related diseases. Weakening of autonomic nervous system function.
20 or less	Very low. There is a high risk of chronic stress disorders associated with dysfunction of the autonomic nervous system.

**4. EXPERIMENTS AND RESULTS**

To determine the effect of reading aloud the book on stress reduction, a heart rate measurement experiment was conducted. The experiment participants consisted of six healthy adult males in their 20s and 40s. The experimental method measured the heart rate of the experiment participants before reading aloud, and after reading aloud the book selected by each of the experiment participants for more than 3 minutes, took a break and measured the heart rate. In order to confirm the change of stress index according to the reading aloud duration, each

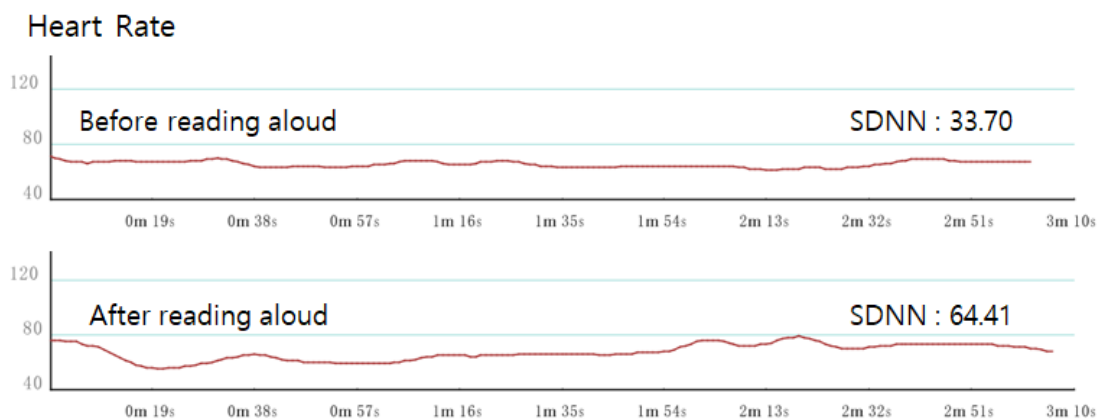
experiment participants conducted three consecutive experiments to measure heart rate after reading aloud. In order to minimize the noise of the signal when measuring the heart rate, the experiment participants measured the heart rate in the state of being silent and not moving. To calculate the HRV, the change in heart rate must be recorded continuously. The change in heart rate was measured and recorded by using a portable Puls Oximeter that can transmit data to a smartphone via Bluetooth and record the change. The procedure comparing heart rate measurement and SDNN changes is shown in Figure 2.



**Fig 2.** Heart rate measurement and SDNN comparison procedure

Figure 3 shows how the change in the heart rate of one of the experiment participants occurs before and after the reading aloud. In Figure 3, before reading aloud, SDNN was measured

to be 33.70 because there was little change in heart rate. However, after reading aloud, the SDNN was measured to be 64.41 due to the large change in heart rate.



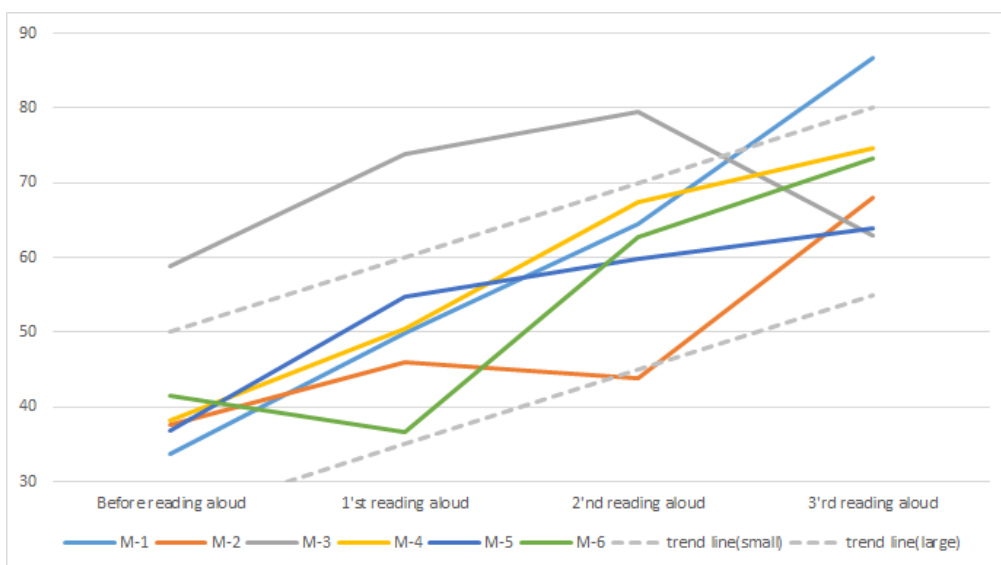
**Fig 3.** Comparison of changes in heart rate between work and before/after reading aloud the book

Table 2 shows the measurement results for six experiment participants. N-N Interval was calculated from heart rate data

before and after reading aloud the book, and SDNN was calculated through this.

**Table 2.** SDNN calculation result

Experiment participants	Before reading aloud the book	1st after reading aloud	2nd after reading aloud	3rd after reading aloud	SDNN changes compared to before reading aloud
M-1	33.7	49.84	64.41	86.68	52.98
M-2	37.55	45.97	43.79	68.09	30.54
M-3	58.94	73.77	79.49	62.99	20.55
M-4	38.16	50.43	67.5	74.66	36.5
M-5	36.8	54.75	59.84	63.87	27.07
M-6	41.47	36.72	62.66	73.29	31.82



**Fig 4.** Changes in SDNN between before/after reading aloud the book

Figure 4 is a graph showing the change of SDNN values by experiment participants. Figure 4 shows that the SDNN levels increased after the reading aloud for all the experimental participants. In the case of M-6, the stress index immediately after 1st st aloud was lower than before reading aloud, but after 2nd and 3rd aloud, SDNN levels were higher than before aloud. The increase in the SDNN level of all the experiment participants indicates that stress was reduced. In particular, SDNN levels increased as the reading aloud duration of most experiment participants increased.

## 5. CONCLUSION

Since stress is the source of all illnesses, it is very important to relieve stress in order to enjoy a healthy and happy life. There are many ways to relieve stress, and book-reading is known to be very helpful for stress reduction.

In this paper, we tried to find out the effect of book-reading which is known to be helpful for stress reduction. The experiments were performed by reading aloud the book, which is expected to greatly help stress reduction among book-reading methods. As a result of the experiment in Chapter 4, it was confirmed that all the experiment participants improved their stress after reading aloud the book. One of the experiment participants showed a decrease in SDNN levels immediately after the reading aloud than before the reading aloud, but soon after the 2st and 3rd reading aloud. This shows that the stress improved during the reading aloud the book. It is noteworthy that SDNN levels increase as experiment participants generally continue reading aloud the book, and the stress improves as reading aloud the book continues. Experimental participants increased their SDNN by an average of 10 as they repeated the reading aloud the book. These results indicate that reading aloud the book is helpful for stress reduction and that reading

aloud over 10 minutes is more helpful for stress reduction than short reading aloud.

As the reading volume of the experiment participants was different in the experiment, and the stress reduction pattern was different, we want to investigate the degree of stress reduction according to the reading volume in the future study.

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