

# ***The Impact of Alpha Wave Music on Employee Productivity in Real Work Environments***

**Wenbo Zhao<sup>1,a,\*</sup>**

<sup>1</sup>*Project Management, Boston University Metropolitan College, Boston, MA 02215, USA,  
a.zhaow617@bu.edu*

*\*corresponding author*

**Abstract:** In recent years, it has been discovered in some brainwave studies that alpha waves are one of the four basic brainwaves that effectively activate the left hindbrain region. Therefore, a type of music has emerged that can trigger these brainwaves, collectively known as Alpha wave music. This article aims to demonstrate whether Alpha Wave Music can make employees more productive so companies can increase their effectiveness affordably and efficiently. This study fills a gap in the application of Alpha wave music in practical application scenarios and builds a data model on the relationship between performance and employee competencies. After investigating the needs of technology companies for employee competencies this year, by linking performance with mathematical computation, concentration, and creativity, a controlled experiment was conducted to conclude that this type of music does have the ability to enhance employee performance. If there is the ability to conduct another more in-depth study in the future, the influences that are more specific to the internal factors of the employees can be modeled, and the final model based on a combination of external and internal factors can be obtained in the most total, and then the influence of Alpha wave music on performance can be further established.

**Keywords:** Alpha wave, business management, work efficiency, productivity, agile management, music, working habit

## **1. Introduction**

As members of society, we must adapt. It forces us to keep working with others as individuals and as registered company members. For this reason, as supervisors or leaders of projects or groups, we always want the members of the group to produce the highest performance in their field, with the same principle that affects the level of functioning of a company or a country is the difference in productivity, which can be explained as the difference in the output of goods and services per unit of labor input [1]. Moreover, the company's progress depends on the efficiency of the individuals in the organization, which indicates that the company's wealth depends on the people involved [2]. Thus, it is concluded that the direct reflection of considering the improvement of the organization's core competencies is the improvement of individual output within a defined period.

In biomedicine, many studies on brain waves have appeared in recent years. Brain waves are classified into four types. As one of the basic waveforms, Alpha waves effectively generate incremental electrical transmission between neuronal synapses in the left hindbrain region [3,4,5]. In medicine, it is generally believed that the left hindbrain of humans mainly affects mathematical and logical

thinking ability [6], consequently if alpha music stimulates the brain to release alpha waves to make employees' analytical thinking and arithmetic ability rise, can it help employees' productivity increase, if it does, then it will find a simple and effective way for companies focusing on data development or technological innovation to increase employees' productivity.

The current paper, therefore, has two main contributions: First, instead of relying on instruments for measurement, Alpha Music is applied to real-life scenarios to quantify and collect data on the specific performance of volunteers; it fills the lack of practical applications in Alpha Music; Second, this experiment provides evidence that chronic listening to music while working does not affect the impact outcome.

## **2. Part 1-An in- Depth Look at Constraints**

In the last decade, as the web has grown, companies have used big data to serve their companies. Ten of the most in-demand positions in Internet technology companies are all related to programming and math [7]. In related projects, companies often require employees not only to have proficient programming skills but also to have effective communication and cooperation skills [8], especially in companies that apply the Agile management model [9], which requires a high degree of teamwork and mutual understanding of the project they are responsible for. As you can see, these competency requirements can be divided into three parts: mathematical and calculation skills, concentration, and creativity. Therefore, upgrading an experiment to quantify these three capability values is necessary.

In some studies, it has been pointed out that age management is becoming increasingly important in company management, especially in some technology companies, because much of the competition in the present era comes from the competition of talent and skills [10]. Therefore, most of the so-called talents come from a younger workforce. Because technology companies have high requirements for professionalism only, the subjects of this experiment were set 2 restrictions, firstly, high school education and above, and secondly, age 20-45 years old.

Companies often expect employees to be able to do more work in less time and with greater accuracy. Therefore, the experiment must limit the time to test the above three abilities. For the sake of portability, the time limit in this experiment is 1 minute. At the same time, to prove the experiment's validity, it is necessary to conduct a comparison test while controlling the variables. This experiment requires each volunteer to run two tests and complete the test in a quiet environment versus a test while listening to them Alpha music.

Considering the above, the study will cover four principal areas: math skills, concentration, creativity, and work habits questionnaire. In the first three tests, a test time of 1 minute will be set, and the following data will be collected separately:

RQ1: How much work was completed

RQ2: How many errors are there in the finished work

This experiment will complete the above three parts twice in a quiet environment and with Alpha music. A questionnaire is then administered to assess the intensity of the test and to collect information on the work habits of the experimenters.

## **3. Part 2- An Indirect Relationship Between Constraints and Performance**

In modern business, the importance of graphics and data is coming to the fore. In most cases, specific business scenarios must be quantified to reflect the business situation. These data can be used to quantify the analysis or form a graphical presentation for the customer [11]. It is also possible to use data not only to study business conditions but also to measure competitors and market share, helping companies to grow in a long-term and rational way [12]. The company's requirements for employee

skills show that companies have high requirements for mathematical calculation skills, so the weight of mathematics should be adjusted to 40% in this experiment.

Agile management is a new style that has become widespread in technology companies in the last two decades [13]. It requires project teams to engage customers and collect feedback as the project iterate on the project based on the input. Therefore, this management model requires team members to work together to maximize communication and collaboration skills. Therefore, employees must always be creative in responding to customer feedback on projects. Therefore, creativity is an essential consideration in this experiment; it accounted for 30% of this experiment.

Focus has been proven in numerous business studies to improve employee productivity [14,15,16]. Furthermore, it is also necessary for employees in a team to focus on the content of their work for a long time. The longer they can maintain a higher concentration, the more efficient they will be. Therefore, attention will be set at 30% weighting in this experiment.

Summarizing the above variables, we can conclude that performance is the sum of three capabilities. In this test, the performance obtained by completing the test in a quiet environment and the performance obtained by completing the test with Alpha music will be calculated separately and compared, and the following hypotheses will be made.

H1. Performance at work is built on mathematical calculation, creativity, and concentration, and Alpha Music will enable employees to improve their performance by stimulating their brains.

In psychology, there is a condition of perceptual fatigue, in which people gradually become less sensitive to a particular environment if exposed to it for a long time [17]. It is inferred whether one's work habits are affected as well as perceptions, from which the following hypothesis can be formulated.

H2. Employees who often listen to music while working are likelier to be influenced by Alpha Wave music.

#### 4. Method

There are 20 experimenters aged 20-45 years old with a high school education or higher who were invited to participate in the experiment. Depending on environmental factors, the investigation set to complete the test in a quiet environment as Effector 1 and listen to Alpha wave music during the test as Effector 2. The sequence of experiments is shown in Table 1.

In the mathematical test section, the experiment simulates honest employee feedback about their work. In modern companies, employees must have specialized technical skills to perform tasks, so these tasks should be within the capabilities of professionals and relatively easy for them. And considering that the education requirement for the experimental group is only high school education or above, it is not required for everyone to fully master complex linear algebra or calculus. Therefore, in the experiment, simple mathematical calculation problems will be designed, adding and subtracting random two-digit numbers.

First, the quiet environment was set to Effector 1, and the experiment was set to complete as many calculations as possible within 1 minute and correctly. After the analysis, the number of completions and errors are counted. Afterward, select the test to Effector 2 while listening to Alpha music, repeat the above experiment, and collect the information.

The concentration test focuses on the employee's mental focus in handling simple and repetitive tasks as quickly and correctly as possible, simulating the handling of many duplicative documents in a real job. This experiment reduces such work to a transcription test, in which 400 capital letters are randomly generated in a grid. The test participant is asked to transcribe as many as possible and correctly in the same format in a blank grid within 1 minute. As in the math test, the environmental factors were set to Effector 1 and 2, and the number of transcriptions and errors were recorded separately.

In the creativity test, the employees' ability to describe and present unrealized projects in the workplace is simulated. In Agile projects, there is a need to iterate on the project based on the customer's description of the project and feedback, and the ability to turn a project that does not yet exist into reality based on the report is an important capability. In this test, we will simulate such work situations as much as possible and simplify them by completing the drawing according to the description and completing five questions in 1 minute with as much detail and accuracy as possible. Because the experimenter's descriptive skills must be examined in the test, employees should not be asked to complete too many. Still, they should instead focus on describing the topic in as much detail as possible in the test. Second, the test results produced in this test are graphical and therefore need to be quantified. The evaluation criteria are shown in Table 2. As with the two experiments above, they were divided into Effector 1 and 2 according to environmental factors, and the number of completions and scores were recorded separately.

At the end of the experimental test, feedback on the experiment was collected from the participants, as shown in Table 3.

## 5. Quantitative Measure

This experiment was divided into Effectors 1 and 2 according to the environmental impact factors to become a comparison test, specific key Performance Indicator as shown in Table 4. The total score in the math section is quantified as the number of completions (MC) minus the number of errors (ME). The total score on the concentration test equals the number of completions (CC) minus the number of errors (CE). The total score on the creativity test is equal to the number of completions (CRC) multiplied by the evaluation score (CRE) for each question. Finally, the total performance score of effectors 1 and 2 as the two environmental factors was calculated based on the percentage of the three types of tests; the details are shown in Table 5.

## 6. Results

The data were collected and analyzed according to the above experimental steps to obtain the total performance scores of the 20 experimenters corresponding to the two different Effectors 1 and 2, as shown in Tables 6 and 7.

Table 1: Description of the summary data in effector 1.

KPI	Min	Max	Average	Median	Stand Error
Number of Math Complete (MC)	8	40	23.2	24.5	1.94
Number of Math Error (ME)	0	6	2.5	2	0.41
Math Total Score (MTS)	8	38	20.7	21.5	1.76
Number of Concentration Complete (CC)	31	72	45.85	45.5	2.21
Number of Concentration Error (CE)	0	12	2.15	2	0.63
Concentration Total Score (CTS)	24	72	43.7	43	2.53
Number of Creativity Complete (CRC)	1	5	3.6	3.5	0.32
Evaluation of Creativity (ECR)	2	8	5.1	5	0.49
Creativity Total Score (CRTS)	2	40	20.7	15	3.23
Total Performance Score (TPS)	19.5	40.9	27.6	27.65	1.19

Table 2: Description of the summary data in effector 2.

KPI	Min	Max	Average	Median	Stand Error
Number of Math Complete (MC)	15	45	26.2	25	1.97
Number of Math Error (ME)	0	5	1.7	1	0.39
Math Total Score (MTS)	11	44	24.5	25	1.92
Number of Concentration Complete (CC)	18	76	48.75	50.5	3.11
Number of Concentration Error (CE)	0	16	2.25	1	0.82
Concentration Total Score (CTS)	2	76	46.5	48.5	3.65
Number of Creativity Complete (CRC)	1	5	4.3	5	0.26
Evaluation of Creativity (CRE)	3	9	6.25	7	0.41
Creativity Total Score (CRTS)	3	45	28.4	35	2.8
Total Performance Score (TPS)	16.3	41.3	31.88	33.55	1.58

The correlation of all Variables with Performance in Effector 1 and 2 is shown in Figures 6 and 7, respectively. Correlation analysis refers to the study of two or more elements of variables that correlate with measuring the closeness of correlation between two variable factors [18].

Table 3: Correlation Analysis in effector 1.

	MC	ME	CC	CE	CRC	CRE	TPS
MC	1.00						
ME	0.54	1.00					
CC	0.13	-0.01	1.00				
CE	0.09	0.32	-0.40	1.00			
CRC	-0.59	-0.28	-0.02	0.13	1.00		
CRE	-0.59	-0.54	0.00	0.04	0.78	1.00	
TPS	0.16	-0.20	0.72	-0.33	0.34	0.47	1.00

Table 4: Correlation Analysis in effector 2.

	MC	ME	CC	CE	CRC	CRE	TPS
MC	1.00						
ME	0.21	1.00					
CC	0.26	0.52	1.00				
CE	-0.32	-0.32	-0.58	1.00			
CRC	-0.10	-0.11	-0.16	0.23	1.00		
CRE	-0.07	-0.34	-0.39	0.29	0.75	1.00	
TPS	0.66	0.28	0.69	-0.45	0.26	0.18	1.00

The two tables above show the correlation between all variables and the total performance changes under the influence of environmental factors. In Effector1, the coefficient of the relationship between TPS and CC is 0.72, which is the most significant. Still, the relationship coefficient between TPS and MC is 0.16, the lowest among all Variables. The correlation analysis in Effector 2 shows that the relationship coefficient between TPS and MC is 0.66, and the coefficient between TPS and CC is 0.69, the two most significant Variables. Unlike Effector 1, the coefficient of the relationship between

TPS and MC is shown to increase under the influence of Alpha wave music in Effector 2, which laterally indicates that The correlation between TPS and MC increased.

Overall, the correlation analysis showed that the most significant correlation for TPS came from the CC values. Further studies combined with Effector 2 showed that TPS had a substantial relationship with MC values.

After multiple regression of all KPIs, it can get the data model under different environmental factors as follows; the details are shown in Tables 5 and 6.

Table 5: Description of the multiple regression model on effector 1.

Factor	R Square		Adjusted R Square	
Effector 1	0.99		0.986	
Variables	t Stat	P-value	Stand Error	Coefficients
Intercept	-5.51	0.0001010933	1.06	-5.84
MC	17.74	0.0000000002	0.02	0.43
ME	-2.66	0.0198043603	0.11	-0.30
CC	17.97	0.0000000001	0.02	0.30
CE	-6.16	0.0000341996	0.06	-0.39
CRC	5.97	0.0000469447	0.18	1.09
CRE	11.63	0.0000000303	0.13	1.47

Table 6: Description of the multiple regression model on effector 2.

Factor	R Square		Adjusted R Square	
Effector 2	0.96		0.94	
Variables	t Stat	P-value	Stand Error	Coefficients
Intercept	-3.66	0.0028901	2.84	-10.39
MC	9.01	0.0000006	0.047	0.42
ME	-1.46	0.1691072	0.26	-0.39
CC	10.03	0.0000002	0.04	0.39
CE	-0.30	0.7723027	0.13	-0.04
CRC	1.60	0.1340980	0.52	0.82
CRE	4.24	0.0009636	0.36	1.51

Effector 1:

$$TPS1 = -5.84 + 0.43 \cdot MC - 0.30 \cdot ME + 0.30 \cdot CC - 0.39 \cdot CE + 1.09 \cdot CRC + 1.47 \cdot ECR$$

Effector 2:

$$TPS2 = -10.40 + 0.42 \cdot MC - 0.39 \cdot ME + 0.39 \cdot CC - 0.04 \cdot CE + 0.82 \cdot CRC + 1.51 \cdot ECR$$

In the effector 1 model, the p-value of all variables was less than 0.05, implying that the data validity was 95% and statistically significant. The adjusted R-squared obtained in the multiple regression equals 0.98, indicating statistically substantial reliability regarding the regression line applied to the data. The regression line in Effector 2 shows that the p-values of the same variables as in Effector 1 are not all less than 0.05, with the p-values of ME, CE, and CRC being more significant than 0.05, implying that these three variables do not significantly affect the dependent variable in a statistically significant way. However, the Adjusted R Square of Effector 2 is 0.94, indicating that the overall model has high confidence.

The comparative total performance scores under the two environmental influences are shown in Figure 1.

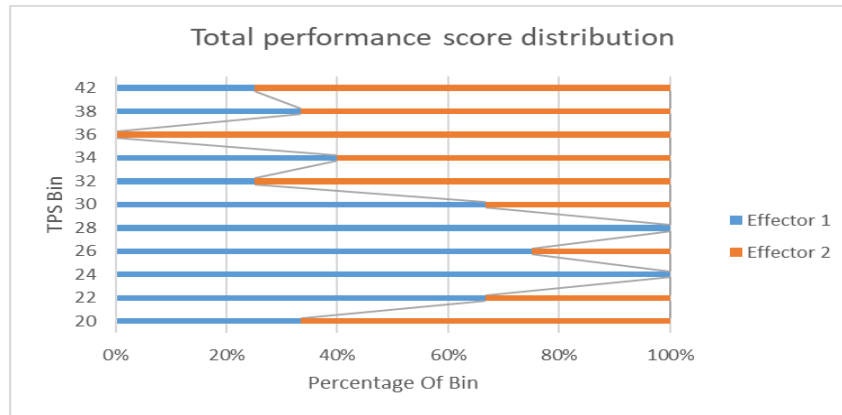


Figure 1: Total performance score distribution.

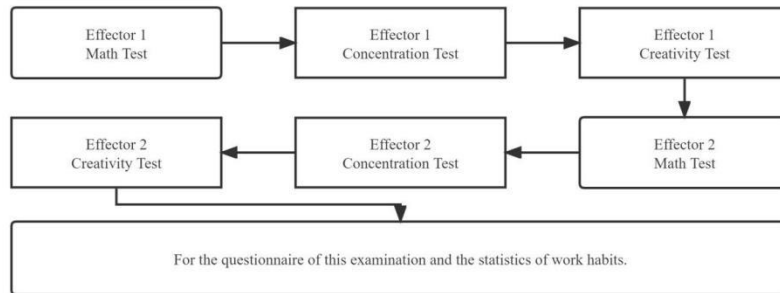


Figure 2: Experimental procedure.



Figure 3: Composition of the total performance score.

Under the two environmental factors, respectively, with a total performance score between 20-30, Effector 1 has 15 data, and Effector 2 has 5 data. With a full performance score between 30-42, Effector 1 has 5 data, and Effector 2 has 15 data. Comparing the actual performance scores of the two groups can be obtained, as shown in Table 7.

Table 7: Summary of the differences generated in effector 1 and 2.

Data Type	Min	Max	Average	Median	Stand Error
Difference of TPS between effector	-12.1	12.8	1.46	6.2	6.52
Percentage of Enhancement	-0.43	0.52	0.17	1.46	0.06

In the experiment, additional data on work habits were collected from the subjects using a questionnaire, which simply asked whether they had the habit of listening to music while at work. The

data were classified again as Effector 3 for those who do not listen to music at work and Effector 4 for those who listen to music at work. The total performance due to Effector 1 and 2 was again classified and compared according to the difference between Effector 3 and 4. Detailed data are shown in Table 8.

Table 8: Summary of the differences generated in effector 3 and 4.

Factor	Average of TPS in Effector 1	Average of TPS in Effector 2	Difference between Effector 1& 2	Percentage of Enhancement
Effector 3	29.43	34.11	4.68	16%
Effector 4	26.10	30.05	3.95	15%

Table 9: The evaluation criteria.

Scoring criteria	Score
Completed 5 questions in the allotted time	1
Each painting can reveal the subject matter required by the question	5
Having a clear outline in each painting	5
Each painting has 3 or above characteristic details for each item in the question.	5
Total Score	16

Table 10: Content of the survey.

1. You feel that the overall difficulty of this exam is high
2. Which test did you like better in this exam
3. You listen to music a lot while you are working
4. You like to listen to softer or relaxing music
5. You think you did very well on this test
6. Do you think it is more relaxing to take the test when there is music

Table 11: Explanation of Variable(continued).

KPI	Description
Number of Math Complete (MC)	Number of mathematical calculation problems completed
Number of Math Error (ME)	Number of calculation errors generated in mathematical calculations
Math Total Score (MTS)	Total performance points earned in the math section
Number of Concentration Complete (CC)	Number of letters completed in the transcription test
Number of Concentration Error (CE)	Number of incorrect letters generated in the transcription process
Concentration Total Score (CTS)	Total performance score obtained in the concentration test
Number of Creativity Complete (CRC)	Number of completed paintings
Evaluation of Creativity (ECR)	Assessment of the details of the painting scores
Creativity Total Score (CRTS)	Total performance score of the creativity test
Full Performance Score (TPS)	Total performance score in 3 parts of the test



Table 11: (continued).

Effector 1	Complete the test in a quiet environment
Effector 2	Complete the test with the Alpha Waves Music
Effector 3	Not in the habit of listening to music at work
Effector 4	In the tradition of listening to music at work

## 7. Conclusion

This study compared the total performance scores generated by different environmental factors. The frequency distribution analysis showed that the number of performance scores between 30 and 42 was much higher for the Alpha wave music than for the quiet environment. The difference between the total performance scores generated by Effector 1 and 2 was then analyzed, and the mean value of the difference was 1.46. The full performance score generated by Effector 2 is higher than that of Effector 1, which indicates that Effector 2, Alpha wave music, can have a positive effect and especially proves that H1 is valid. Alpha wave music can increase staff efficiency in a realistic situation. The experiment results also demonstrate that Alpha Wave Music can increase employee productivity by 17% in real-world environments.

According to the data in Table 10, the mean change in TPS due to the change in Effector 1 and 2 was 34.11 in Effector 3 and 30.05 in Effector 4. Comparing the growth ratios produced in Effector 3 and 4 are 16% and 15%, respectively, indicating that the results produced in Effector 3 and 4 are too close to be significant and therefore deny the conjecture of H2. At work, having the habit of listening to music does not affect the Alpha wave music to improve employee productivity.

Returning to the theme of the paper, this experiment completed the proof that Alpha wave music can improve employee productivity with an effect of 17%, which can help companies to enhance productivity in the long-term impact and thus achieve productivity improvement. Since music can be transmitted in space, it is not just a single effect on an individual. Still, it can also affect multiple people through a single medium. From a practical perspective, having employees listen to Alpha Wave music at work is a cost-effective way to improve employee productivity. The study also confirmed that the effect of Alpha music on improving productivity is not affected by work habits, whether to listen to music at work. Therefore, it is more universal to all employees.

If more internal influences are added in future studies, the accuracy of the model can be further increased. These internal factors can include the employee's perception of the difficulty of the test and the type of music preferred, allowing for a more detailed derivation of the effect of music on ability values. If the missing internal factors are further correlated with external factors, the proportion of Alpha music's influence on performance can be further amplified.

In summary, Alpha wave music, which has been studied in recent years, has been proven to improve employee productivity in a real-world environment significantly and works without the restriction of movement habits is universal and is cheaper to apply than long-term and expensive professional training. It is believed that Alpha music will be more widely used in company management in the future.

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