

Beta Binaural Beats and its effects on the Cognition of Nursing Students in a Private Higher Education Institution

**Julie Ann Dy¹, April Ross Ladera¹, Joshua Paul Cabato¹, Monique Librando¹
Johnny J. Yao Jr^{2*}**

¹College of Nursing, Velez College, Philippines

²Research Office, Velez College, Philippines

Corresponding author: johnnyyaojr@gmail.com

ABSTRACT

Background: Studying nursing comes with a certain expectation to work hard and take a certain amount of time. A promising method called beta binaural beats is thought to improve cognitive functions.

Purpose: This study aimed to determine whether listening to beta beats is an effective method for improving cognition among nursing students.

Methods: A double-blinded experimental research design was utilized and measured the effects of the intervention towards memory, abstract reasoning and reading comprehension.

Results: A total of 89 subjects participated in this study. Only the score of reading comprehension showed a significant difference ($t=2.38$, $p=.02$).

Conclusion: The findings suggest that beta beats is an effective way in enhancing reading comprehension. However, findings show that beats aren't effective in enhancing memory and abstract reasoning. Therefore, this may be used as a method to enhance learning.

Keywords: Beta Binaural Beats; Cognition; Memory; Reading Comprehension; Abstract Reasoning; Nursing Students.

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BACKGROUND

A student carries a lot of responsibilities and one essential key of responsibility is to study. Many students enter college expecting good times, friendship and a good sense of direction. However, that is not always the case, students later figure out how challenging and struggling college life is. A study from [Dy et al, \(2015\)](#) entitled “Stressors and Stress Responses of Filipino College Students” stated that out of 258 students, 72% manifested cognitive stress responses due to academic stressors.

Moreover, studying nursing comes with a certain expectation to work harder on average than most other students. They deal with lectures and practical taking up a great deal of time. In addition, nursing is considered to be one of the most stressful career choices. It entails student to gain knowledge and skill through classroom lectures, long exam, return demonstration and rotating shift works in the hospital and participate in community programs ([Mann et., al 2017](#)).

A nurse is required to know anatomy and physiology, biology, pharmacology and other areas of nursing science. However, nursing students have difficulty in remembering too much information. A study conducted by [Potter et al \(2005\)](#) stated that nurses who have lower working memory capacity are more likely to make medical errors.

Furthermore, at often times most students read and highlight terms or definitions they don't even understand ([Conca, 2010](#)). Although remembering concepts are significant, it is highly important to be able to comprehend as well since nurses play a huge role in providing patient education. According to [Zeng-Treitler \(2008\)](#) prior studies show that many patients do not fully understand or recall the instructions received from the nurse.

As early as their first year, nursing students are introduced to abstractly think outside the box. They are trained and practiced to develop critical thinking skills. Nurses are faced with decision-making situations in patient care, and each decision they make impacts patient outcomes. Nursing critical thinking skills drive the decision-making process and impact the quality of care provided ([Vest, n.d. as cited in Ericksen, 2017](#)).

As students in the chosen profession for the present study, the researchers have witnessed the need for improving cognitive processes: memory, reading comprehension and abstract reasoning. Students often complain on how to attain memory retention while being able to comprehend medical terms and as to how to choose the best answer in situational questions during long exams.

Based on literature, there is a promising tool used to enhance cognitive functions called binaural beats. Binaural beats, discovered by Heinrich Wilhelm Dove, is the difference between two pure tones with different frequencies introduced to each ear separately that is perceived by the brain ([Oster, 1973](#)). It has shown to entrain brainwaves from one state to another. Binaural beats is thought to exert effect on cognitive functioning and mood ([Lane et al, 1998](#)) specifically beta binaural beats. A study conducted by Garcia-Argibay (2017) revealed significant findings of beta frequency binaural beats amounting to 20 hertz to the subjects who performed free recall and recognition tasks. Exposure to beta frequency binaural beats yielded a great proportion of correctly recalled words and a higher index in recognition tasks. Another study on the effects of beta binaural beats conducted on college students showed a significant increase in their memory ([Kennerly, 2013](#)).

In summary, most of the studies focus on memory alone however the researchers wanted to study a wider scope of cognitive processes including memory, reading comprehension and abstract reasoning. The researchers would want to test whether listening to binaural beats is an effective method for improving cognition among fourth year nursing students.

OBJECTIVE

This study aimed to determine whether listening to beta beats is an effective method for improving cognition among nursing students.

METHODS

Design

An experimental research design was utilized in the study wherein an intervention or treatment was introduced. Experimental studies are designed to test causal relationships to test whether the intervention caused changes in or affected the dependent variable ([Polit & Beck, 2017](#)). The dependent variables are the quality of memory, reading comprehension, abstract reasoning and the independent variable is the use of binaural beats. The researchers aimed to determine whether there are correlations in the following variables binaural beats and memory, binaural beats and reading comprehension, binaural beats and abstract reasoning.

Research Locale

The study was performed in an institution offering five programs of study: Nursing, Medical Technology, Physical and Occupational Therapy and Biology. The subjects were from the fourth-year nursing students. Experiment was done in an Arts and Sciences Building on a Saturday for section A and Friday for section B. The room can accommodate up to 50 people and is air conditioned and well ventilated. During data collection, Section B had a number of subjects who were tired from the day's activities of having long hour classes and quizzes. This caused them to be quite restless. Section A, however, was more lenient. The research instructor gave further instructions and the class was not as tired with the day's activities.

Research Subjects and Data Collection

The researchers decided to utilize the total population of the fourth-year nursing students, which is a total of 100 subjects excluding the researchers. They are divided into two sections. Section A has 52 students while Section B has 48 students that were enrolled during the first semester S.Y. 2018-2019. Only 89 subjects participated (45 for experimental group, 44 for control group) in the study since eight of these students had another important school activity to attend to, two of the students had an important family event and one was excluded from the study due to a heart problem (premature ventricular contractions). The subjects were screened first with a researcher made screening tool which required them to write their names and age. A yes or no question screening tool was given since there were certain conditions which were contraindicated with binaural beats such as seizure, individuals with pacemakers and heart problems and to know if the subjects had their own earphones and smartphones. The researchers lent smartphones and earphones for those who didn't have.

Research Instruments

To test for memory, a researcher made tool was given in which 20 random medical-related words were mentioned for a maximum of five minutes and then the research subjects were asked to write as much as they can remember after they took the reading comprehension exam. For reading comprehension the International English Language Testing System will be the instrument used. It is the most appropriate instrument to measure the variable. The IELTS is an international standardized test of English language proficiency. IELTS has four parts which are the following: listening, reading, writing which are completed in one sitting and speaking. Only the reading part of the IELTS was utilized by the researchers. It is composed of 13 items in which they have to answer questions regarding the story or article they have read. For abstract reasoning, the Non-Verbal Figurative Test by GetmyUni was

used. It is composed of 15 items in which they were to choose from the choices on which figure was missing. The scores were interpreted by getting the mean score for each test and then standard deviation was used to measure how scores differ from the mean score. The greater the standard deviation the farther it is to the mean score and the lesser the standard deviation the nearer it is to the mean score.

Data Analysis

Statistical analysis was done using SPSS with $p < 0.05$ as the significant value. Demographic data were processed using descriptive statistical analysis. In addition, the differences between and within groups were analyzed using the paired t-test, and independent t-test

RESULTS

A total of 89 subjects participated in this study. They were allocated into two groups. The control group (n=44) received the delta binaural beat while the experimental (n=45) received the beta binaural beat.

Table 1. Demographic profile of fourth year nursing students

Profile	F	%
Age*		
18	1	1.12
19	37	41.57
20	39	43.82
21	7	7.87
22	4	4.50
23	1	1.12
Gender		
Male	15	16.85
Female	74	83.15

Note: *Mean= 19.76; SD= 0.88

As observed in Table 1, in a total number of 89 subjects, they ranged from about 18-23 years old. The average age is 20 years old.

Table 2. Pretest Scores of Experimental and Control Group

Variable	Control		Experimental		<i>t</i>	<i>p</i>	CI	
	M	SD	M	SD			LL	UL
Memory	6.27	2.20	6.33	2.71	.12	.91	-.98	1.10
Reading Comprehension	5.95	2.01	6.04	2.24	.20	.84	-.81	.99
Abstract Reasoning	9.18	2.04	8.73	2.30	-.97	.33	-1.36	.47

Note: M=mean, SD=standard deviation, CI=confidence interval, LL=lower limit, UL=upper limit

An independent t-test further revealed that there is no significant difference in pretest scores of both groups for memory ($t = .12, p = .91$), reading comprehension ($t = .20, p = .84$) and abstract reasoning ($t = -.97, p = .33$).

Table 3. Pre-test and Post-test Scores of Experimental and Control Group

Variable	Pretest		Post-test		t	p	CI	
	M	SD	M	SD			LL	UL
Experimental								
Memory	6.44	2.83	7.28	3.30	-1.62	.11	-1.90	.21
Reading Comprehension	5.95	2.35	6.95	2.19	-2.33	.03*	-1.87	-.13
Abstract Reasoning	8.82	2.32	8.69	2.37	.30	.76	1.73	.99
Control								
Memory	6.20	1.81	6.86	3.19	-1.17	.25	-1.80	.48
Reading Comprehension	6.03	2.08	5.71	1.71	.75	.46	-.53	1.16
Abstract Reasoning	9.40	2.05	8.66	2.93	1.37	.18	-.36	1.85

Note: M=mean, SD=standard deviation, CI=confidence interval, LL=lower limit, UL=upper limit

*p<0.05

To test if there is a significant difference between the experimental and control group's pretest and post test scores, a paired t test was done. The paired t-test revealed that there is no significant difference in the control group in terms of memory ($t = -1.17, p = .25$), reading comprehension ($t = .75, p = .46$) and abstract reasoning ($t = 1.37, p = .18$). On the other hand, the experimental group showed a significant difference in reading comprehension ($t = -2.33, p = .03$).

Table 4. Post-test Scores of Experimental and Control Group

Variable	Control		Experimental		t	p	CI	
	M	SD	M	SD			LL	UL
Memory	7.05	3.32	7.04	3.18	.001	0.99	-1.37	.37
Reading Comprehension	6.00	1.84	7.00	2.11	2.38	.02	.16	1.84
Abstract Reasoning	8.59	2.67	8.51	2.31	-.15	.88	-1.13	.97

Note: M=mean, SD=standard deviation, CI=confidence interval, LL=lower limit, UL=upper limit

*p<0.05

An independent t-test further revealed that there was no significant difference in post-test scores of both groups for memory ($t = .001, p = 0.99$) and abstract reasoning ($t = -.15, p = .88$). However, there is significant difference in the post test score for reading comprehension ($t = 2.38, p = .02$).

Table 5. Adverse effects experienced by the research subjects

	Experimental	Control	Total
Headache	2	4	6
Ringing of ears	2	3	5
Both	2	2	4

None	39	35	74
Total	45	44	89

As seen in the table above, a total 15 people experienced adverse effects. Six people experienced headache, five people experienced ringing of the ears, and four people experienced both.

DISCUSSION

The researchers have observed that there are more women than men who took up the nursing course. According to the Philippine Commission on Women, more women have enrolled in the higher education compared to men. As stated by PCW, “...during the school year 2005-2006, females accounted for more than half of the total 2,483,645 enrollees at 54.48 percent compared with males at 45.52 percent.” (PCW, 2014). Nursing has also been stereotypically viewed as a profession for women. Due to this constant view, nursing remains to be predominantly taken up by women. (everynurse.org, 2011). It also observed that most of the subjects are 20 years of age. This is because the subjects were not affected by the recent K-12 implementation. According to Department of Education, the high school graduate class of 2015 is the last batch that will not be affected by the K-12 implementation (DepEd, n.d).

The pre-test scores between scores indicates that both, the experimental and control group, are more or less likely of the same level in terms of cognition specifically in memory, reading comprehension as well as abstract reasoning. This would reflect a successful randomization of subjects between the two groups. Randomization pertains to the random selection of each subject to a group of either experimental or control with its primary function to secure comparable groups for equality with respect to extraneous variables. It is considered to be the most effective method of controlling extraneous variables and eliminates selection bias in which the random selection of subjects to either the experimental or control group is not achieved (Polit & Beck, 2017).

Those in the experimental group had higher scores in reading comprehension compared to the control group. This suggests that the beta binaural beats is effective in reading comprehension. This is in line with the Helmholtz's theory which states that a frequency following response is made by the brain to match the frequency of the stimuli which entrains the brain into a beta brainwave pattern. Beta brainwaves is associated with attention. Moreover, it is said that the higher the attention span, the more likely it is for reading comprehension to increase (Educationcorner, 2018; Yildiz, et. al., 2017). This suggests that the beta binaural beats is effective in reading comprehension.

Studies show that an enhanced reading comprehension skill improves reading fluency. It increases the accuracy of word recognition and would allow you to understand structured sentences clearly while skimming and scanning. These studies have also stated that reading comprehension is associated with attention. As per verbalized by one of our subjects, “For me, I was able to answer more properly because I was more focused after listening to the beats.” In line with that, studies have shown that beta binaural beats can increase attention (Sarnson, 1999; Vendoza, 2013; Colzato, et. al., 2017 and Cvijetic, 2017).

However, the paired t-test in the experimental group revealed that there is no significant difference for memory ($t=1.62, p=.11$) and abstract reasoning ($t=.30, p=.76$). This is contradicting to several studies which stated that beta binaural beats is an effective method in facilitating memory. (Argibay M., et. al., 2017; Huang & Charyton 2008; Kennerly, 2018). No studies have been found with regards to the effects of beta binaural beats on abstract reasoning. The researchers imply that there may be no significant difference

possibly due to a small sample size since a small sample size decreases statistical power and increases the margin of error ([Deziel, 2018](#)).

After the intervention was done, the scores of the experimental group in terms of reading comprehension improved. Improving reading skills will reduce unnecessary reading time and enable a person to read in a more focused and selective manner. The person will also be able to increase their levels of understanding and concentration. Among other studies, an effective result in memory was shown after using beta binaural beats as an intervention ([Argibay et. al, 2017](#); [Hwang and Charyton, 2008](#); [Kennerly, 2013](#)). On the other hand, no studies were found about the effects of beta binaural beats on abstract reasoning.

There are different potential risk when using binaural beats, it can trigger seizure in those who have epilepsy, and it can cause a mild headache and anxiety. It may also alter heart rhythms so people with heart problems and with pacemakers may experience unwanted side effects. ([Servidio, 2013](#)). Ringing of the ears was a side effect based on experience by the subjects. However, studies show that binaural beats can actually heal tinnitus (David et. al., 2010; American Hearing Aid Association 2011; British Tinnitus Association, n.d.). On the other hand, studies have also shown that people with tinnitus exhibits a decrease delta activity and an increase beta activity. This means that a person may experience tinnitus if the brain activity is altered into frequency level. (Osinska, et al. 2013). For the subjects who experienced adverse effects, they were given the choice whether they would want to continue to participate in the study. The researchers assessed the characteristic and severity of the adverse effects. Medication was given to those who couldn't tolerate the pain. They were also advised to sleep. In the event that the adverse effect would not subside after sleeping, the researchers assured the subjects that they would be accompanied to the clinic and all medical funds would be shouldered by the researchers. However, all 15 subjects who experienced adverse effect claimed that they were relieved after sleeping.

There may be some potential limitations to this study. Only the 4th year nursing students were included in the study since there were no enrollees for school year 2017-2018. Therefore, a larger population may increase the significant relationship. The study was conducted in the afternoon wherein the subject was already exhausted due to their morning classes. Lastly, there are unavoidable external noises that may have altered the result of the study. Although only reading comprehension showed a significant difference and a few of the research subjects experienced certain adverse effects, the researchers imply that the environment and the situation they are in may have altered the way they answered the questionnaire.

CONCLUSION

Nursing students had improved their reading comprehension while using beta binaural beats. It is effective in reading comprehension, but not in memory and abstract reasoning. Therefore, beta binaural beats may use as a way of boosting cognition specifically reading comprehension.

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