Understanding The Effect Of Different Audio Stimuli While Performing Some Logical and Creative Mental Tasks

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ABSTRACT

The current study sought to determine whether one's cognitive function, particularly memory, may be affected by various musical environments. The examined sample consisted of 25 college students which consisted of 15 females and 10 males. The participants were asked to complete one logical and creative task while they were exposed to auditory stimuli. Similar procedures were repeated for each category of music(heavy metal, vedic traditional and no music) which are the independent variables in this study. Time and score for each exercise (logical and creative) is recorded and considered as dependent variables whereas

KEYWORDS

Cognition, Memory, Music Genres, Metal, Vedic, Silence, Gender, Logical And Creative Abilities, Attention

INTRODUCTION

Through the use of the components of rhythm, harmony, melody, and colour, music is a form of sound art that portrays concepts and feelings in meaningful ways. Your ability to perceive time may change, you may tap into primal fear, have fewer seizures, be a better communicator, be stronger, have a stronger immune system, be able to repair brain damage, be smarter, and have memories evoked by music. Additionally, it can reduce blood pressure, lessen pain, and enhance memory, mood, and the quality of sleep. Sound system vibrations travel through the atmosphere before making their way into the ear canal. The auditory nerve converts these eardrum-tickling vibrations into an electrical signal, which it then sends to the brain stem to be reassembled into sound. Different kinds of music will produce different vibrations in our body and brain. Therefore, to understand the attention span and efficiency of people while performing some

logical and creative tasks, this study will analyse the effect of three different kinds of auditory stimuli (Heavy metal, vedic and no music i.e. silence).

LITERATURE REVIEW

The first study indicated the effect of music on the human brain using Electroencephalography(EEG)). It also mentions the impact of music on our brain and our entire nervous system. Different categories of music were picked and theta and alpha frequencies of the brain were analysed. A paradigm for an experiment to determine whether music (in this case, the likes of jazz, carnatic music, and hard rock) has an impact on the rate at which the brain functions. The aim of this study is to investigate the effects of Carnatic, Hard Rock, and Jazz music on brain activity during mental workload using electroencephalography (EEG)[1].When people listen to music, their EEG power rises at the theta and alpha frequencies[2]. This gives us an idea about how the participant is feeling and behaving at that particular moment. Music has been found to be a useful tool in neurological studies for assessing the brain[3]. It also helps us introspect and gain a new perspective about our neurological functioning. Another study explains how the goal of their study was to determine if different musical environments could have an impact on one's cognitive function, particularly memory. It also brings the gender factor into consideration and tells how females score higher percentile in the mental tasks. The participants were supposed to complete a short term memory test while they were exposed to auditory stimuli. Statistically speaking, gender and certain musical genres did not correlate, but given the limits of this study, the findings still need to be further investigated.[4] Adding Gender as an independent variable backed the study and helped it gain a new perspective and analysis. One of the previous research found that People may listen to a certain style of music to improve their mood, and listeners may seek understanding from music that is similar to their own. They might listen to music that matches their mood or music they know would make them feel worse. As they also stated in the study, a lot of medical offices often choose to have classical music in the waiting area as it seems to have a calming effect, but movies use different tracks to produce different feelings in the viewers.[5] Music can be used to create an experience and that is why we use different genres to create an environment for the audience.

Another study analysed the effect of different auditory stimuli and their relationship with some logical and creative tasks. Music's "Mozart's influence" has been thoroughly researched in recent

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[1] B. Geethanjali, K. Adalarasu, R. Rajsekaran.2012. "*Impact of Music on Brain Function during Mental Task using Electroencephalography*"

[2] Sakharov D S, Davydov V I, Pavlygina R A.2005. "*Inter Central Relations of the Human EEG during Listening to Music. J Human Physiology*"

[3] Peretz I, Zatorre R. 2005."*Brain Organization for Music Processing. Annual Review of Psychology*"

[4] Dimitrios-Phaedon Kevrekidis, Pavlos Pavlidis, Maria Sofologi, Grigorios Trypsiannis and John Nimatoudis. 2020. "*Gender Differences in Short-term Memory Related to Music Genres*"

[5] Christopher Rea, Pamelyn Macdonald, Gwen Carnes. 2010. "*Listening to classical, pop, and metal music: An investigation of mood*" (Christopher Rea, Pamelyn Macdonald, Gwen Carnes)

years. It was discovered that the activity of the visual brain can be impacted by auditory background stimulation. While participating in a simple visual task while listening to Mozart's music, students showed more cohesive brain activity, whereas when participants conducted the tasks silently, there was a decoupling of brain areas. Heavy metal music is criticised for having an adverse effect on listeners' health and wellbeing, particularly on young enthusiasts. Metal music's supporters respond that it is a harmless kind of entertainment whereas some young adults can work very well under metal music. In a study conducted, "A Study on Effect of Indian Classical Music on Brain Activity Using EEG Signals", they found out that music has an effect on alpha waves. According to their findings, listening to music one like causes an increase in alpha wave amplitude and a decrease in[6]. This study proved that Indian classical music improves concentration, produces a calmer effect and synchronises the sensory inputs.
Another famous theory can be incorporated here known as "Flow theory". It focuses on intense and focused concentration on what one is doing in the present moment, distortion of temporal experiences and experiencing the activities that are intrinsically rewarding. When we are doing any task with full concentration and in the "flow", we tend to forget about external stimuli[7]. It can be related to music or any audio stimulus as well. While listening to music the theory can be implemented and the mental activities will break the flow and this study aims to understand the participants response to it.

Gaps found in these papers and studies were doing a comparative study of music as a stimuli on how it affects the efficiency while doing creative and logical tasks. There is not that much research on the impact of metal music on people's moods, or how classical Indian music helps people concentrate and calm down. Effect of gender is also a significant factor on how music helps females do better mental tasks. All these papers are taken as the foundation on the idea of using different music as a stimulus while doing logical and creative tasks. Gender provides another variable to the study and see effects in more details. The study aims to analyse how different audio stimuli contribute to some mental tasks(logical and creative). Taking time as a factor to examine the results based on gender will provide a base to build on this research. College students are taken as participants for this study. Additionally, this study will also help understand the relationship with silence(no sound) and cognitive tasks.

OBJECTIVE

The objective of the study is to analyse how a person's attention and focus changes while performing some logical and creative tasks when they are exposed to any auditory stimuli. Three different music categories are picked i.e. heavy metal, vedic traditional music and no music. The

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[6]Dr Satish Kumar, Mrs. Pavana Krishnamoorthy, Dr Shwetha.Rao, Mrs. Divyashree, Mr. Santhosh Kumar "A Study on Effect of Indian Classical Music on Brain Activity Using EEG Signals"

[7] Mihaly Cziksentmihalyi Harper. 1990. "*Flow – The Psychology of optimal experience"*

objective is to analyse how attention of participants changes while working with each category of music.

METHODOLOGY

Design Of The Experiment

The objective of the current experimental investigation was to investigate the potential effects of various auditory stimuli on memory ability. There may be a difference depending on the style of music, as well as the presence or absence of music as an external stimulus. The influence of gender on memory function was also investigated. Three different genres of music were picked

- Heavy metal (Pantera-Domination, 2009) this music is loud and could be disturbing when a participant is performing a mental task.
- Vedic traditional music (Kafi Raga, 2019) The degree of relaxation brought on by the music may vary depending on the subject, but for the vast majority of them, the effect is positive and relaxing. The results of a study on the use of relaxing music to promote relaxation showed that it has more effective calming effects on participants' physiological behaviour.
- No music- Creating an environment where participants were exposed to no sound.

And, the other independent variable is Gender. It aims to analyse how the music is affecting the accuracy of correct answers and attention across different genders. Different logical and creative tasks were picked and tested simultaneously with music. For the analysis, two-way ANOVA can be used to check the interaction between these independent variables.

Mental Tasks

Both logical and creative tasks were considered for understanding the cognition level for different individuals and their ability to work with different audio stimuli. Logical tasks consisted of some mental ability questions with basic maths and language knowledge. Creative exercises included some complete-the-figure exercises and it examined the creative thinking ability of the participant to come up with unique and creative objects/products and scenarios.

Sampling Technique

The sampling technique used is non probabilistic convenience sampling. Due to the limitations on funds and time required to the experiment, the sample was majorly based on convenience. The sample is taken from college students in Yelahanka from the age group 19-27. This age group allows samples to be from both UG and PG backgrounds, which provides diversity in the study. This sample helps conduct the study on a group which uses a lot of music as their stimuli when working on some tasks.

15 men and 15 women are used as sample size, so that there is ease of classification when we add gender as a variable to analyse the study.

Procedure

The study is divided into 3 experiments, where 3 different genres of music are used as the stimuli

- Experiment 1: Metal music used as stimuli- Pilot study was conducted individually with 2 participants. For the actual study, 13 females and 13 males voluntarily agreed to participate and a well-lit room was selected for the experiment. A comfortable environment was selected and metal music played for 2 minutes. After that, they were instructed to complete a logical and creative task. Logical tasks were given to them in the form of a google form and creative tasks were conducted on a sheet for each category. Time limited was noted and based on that the genre of metal was analysed. After this experiment they were asked to write a reflection based on their experience of the exercise and given a break of 2 minutes.
- Experiment 2: Vedic music- Similar experiment was conducted for Vedic traditional music as well which was followed by a reflection and a 2 minute break.
- Experiment 3: No music- During the last experiment, no music was exposed and silence was used as a medium to conduct the study.

  All these conditions ranging from a high stimuli environment to silence will give different results and help us understand a participants interpretation of working under different exposures/environments.

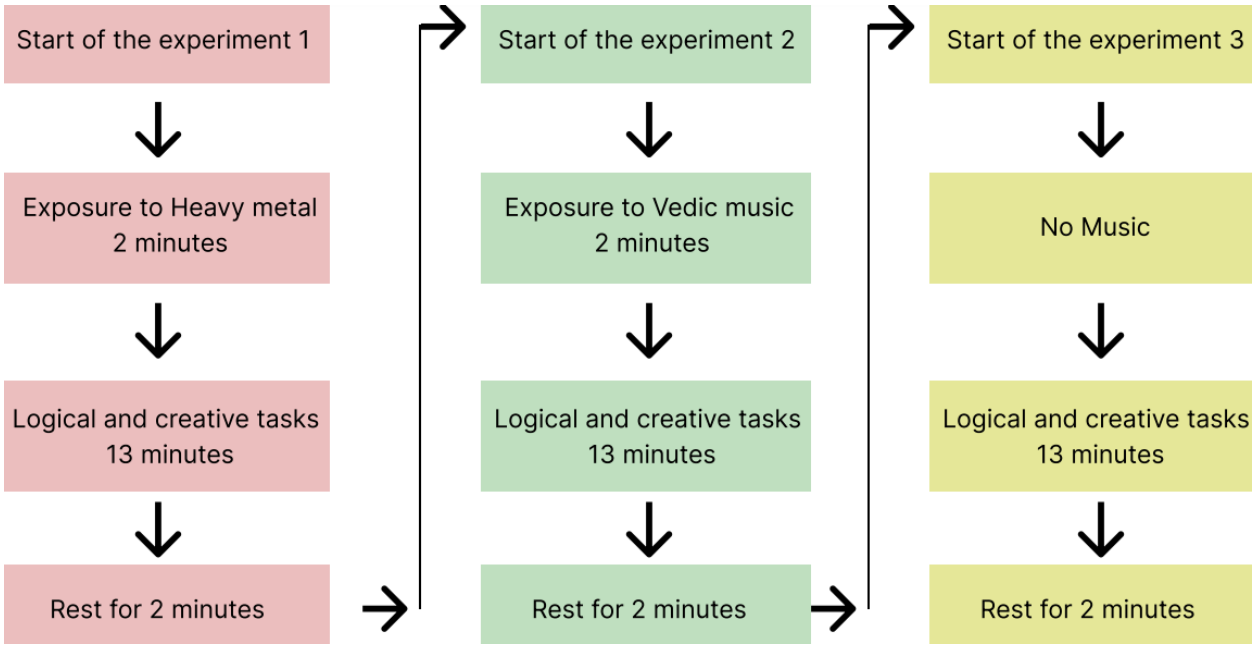


Image 1

Statistical analysis

On three conditions for with and without mental task while listening to three different types of music, a one-way analysis of variance (ANOVA) test was conducted and all analyses were conducted with a significance level of p 0.05. Music category was taken as an independent variable. Time, logical Score and creative score were considered as dependent variables. Several hypotheses were proposed-

1. **Null Hypothesis:** There is no significant difference in time on solving questions when exposed to three different audio stimuli.

```
y
> mydata1=read.csv("C:/Users/saman/Documents/ANL/ATTDATA.csv")
> fit<-aov(TIME~STI,data=mydata1)
> summary(fit)
            Df Sum Sq Mean Sq F value  Pr(>F)
STI          1  183.7  183.75   13.78 0.00036 ***
Residuals   88 1173.4   13.33
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

image1

Result: P value is < 0.05, which means the null hypothesis is rejected and alternate hypothesis is accepted.

Alternate Hypothesis: There is no significant difference in time on solving questions when exposed to three different audio stimuli.

2. **Null Hypothesis:** There is a significant difference in creative score while solving questions when exposed to three different audio stimuli.

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> fit<-aov(SC~STI,data=mydata1)
> summary(fit)
            Df Sum Sq Mean Sq F value Pr(>F)
STI          1   4.82   4.817   4.389  0.039 *
Residuals   88  96.57   1.097
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Image 2

Result: P value is < 0.05, which means the null hypothesis is rejected and alternate hypothesis is accepted.

Alternate Hypothesis: There is a significant difference in creative score while solving questions when exposed to three different audio stimuli.

3. **Null Hypothesis:** There is no significant difference in logical score while solving questions when exposed to three different audio stimuli.

```
> fit<-aov(SL~STI,data=mydata1)
> summary(fit)
            Df Sum Sq Mean Sq F value  Pr(>F)
STI          1   44.2    44.2   9.828 0.00234 **
Residuals   88  395.8     4.5
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Image 3

Result: P value is < 0.05, which means the null hypothesis is rejected and alternate hypothesis is accepted.

Alternate Hypothesis: There is a significant difference in logical score while solving questions when exposed to three different audio stimuli.

Two-way anova was also conducted to study the interaction effect of gender on Score and time.

1. **Null Hypothesis:** There is no significant effect of gender on time while solving questions when exposed to three different audio stimuli.

```
> fit<-aov(TIME*G~STI,data=mydata1)
> summary(fit)
            Df Sum Sq Mean Sq F value Pr(>F)
STI          1    411   410.8   5.888 0.0173 *
Residuals   88   6140    69.8
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Image 1

Result: P value is < 0.05, which means the null hypothesis is rejected and alternate hypothesis is accepted.

Alternate Hypothesis: There is a significant effect of gender on time while solving questions when exposed to three different audio stimuli.

2. **Null Hypothesis:** There is no significant effect of gender on creative score while solving questions when exposed to three different audio stimuli.

```
> fit<-aov(SC*G~STI,data=mydata1)
> fit<-aov(SC*G~STI,data=mydata1)
> summary(fit)
            Df Sum Sq Mean Sq F value Pr(>F)
STI          1     16   16.02     0.8  0.374
Residuals   88   1762   20.02
```

Image 2

Result: P value is > 0.05, which means the null hypothesis is accepted.

3. **Null Hypothesis:** There is no significant effect of gender on creative score while solving questions when exposed to three different audio stimuli

```
> fit<-aov(SL*G~STI,data=mydata1)
> summary(fit)
            Df Sum Sq Mean Sq F value Pr(>F)
STI          1     58   58.02   3.006 0.0865 .
Residuals   88   1698   19.30
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
```

Image 3

Result: P value is > 0.05, which means the null hypothesis is accepted.

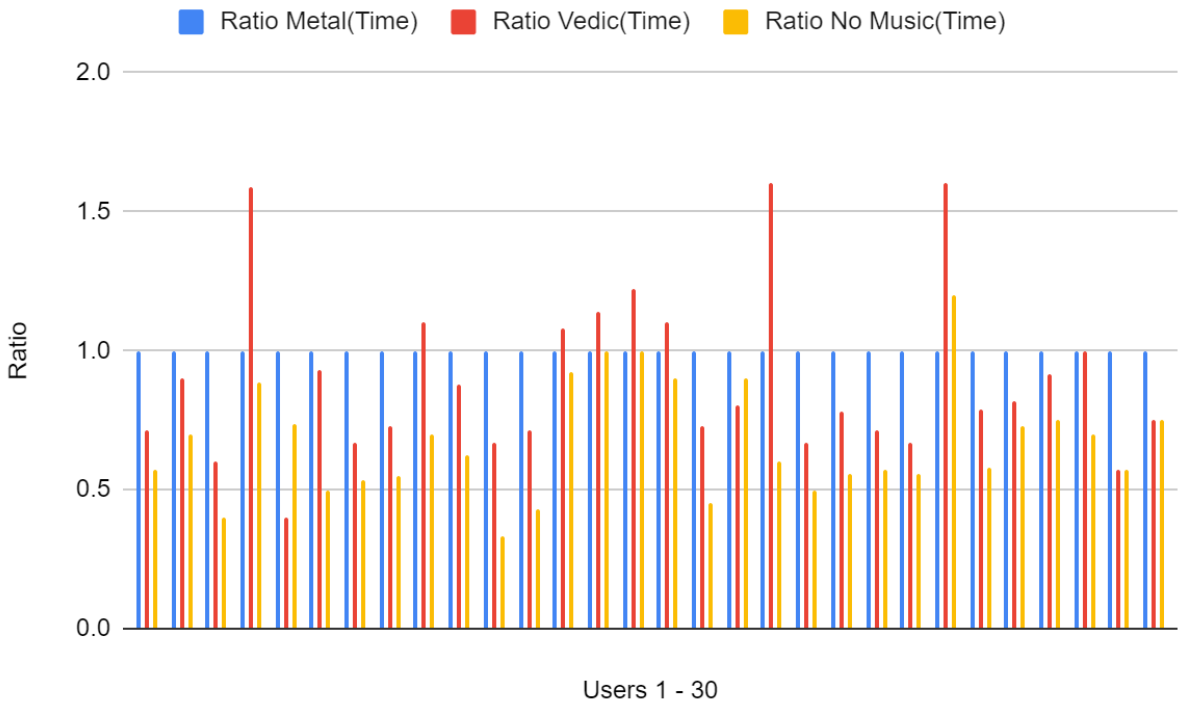
Comparative Analysis of Attention Span under different types of stimulus

The following graphs show the comparison of attention span under different types of stimulus. Three variables are taken to measure attention span i.e.

- Time
- Logical task score
- Creative task score

In the following graphs, ratio is taken in the context of metal score, where all three data for a single person are divided by metal data of the corresponding variable. The graph then shows proper differences on how different music has affected the respective person's attention span using the corresponding variable.

1. Time as a variable of attention span

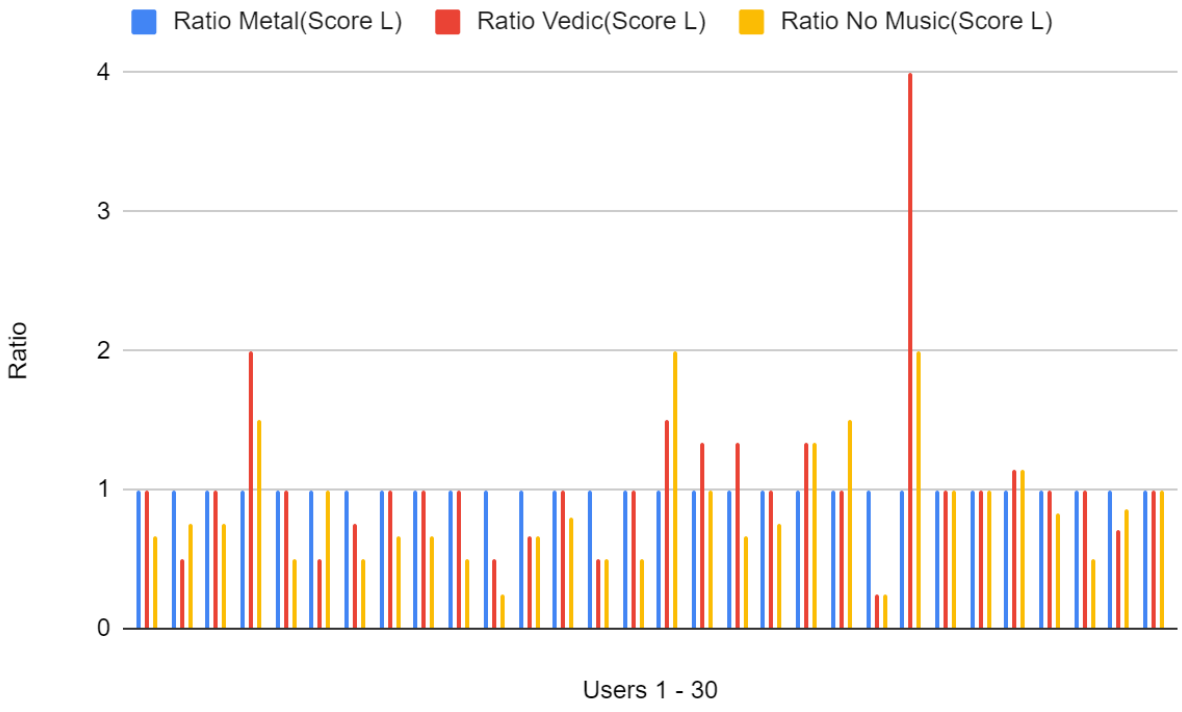


Graph 1

In respect to metal music, only 8 people while listening to vedic music took more time to complete the exercises, while only 1 person took more time without music.

In respect to time, metal music is the stimulus which causes the exercise to take the most amount of time.

2. Logical task score as a variable of attention span

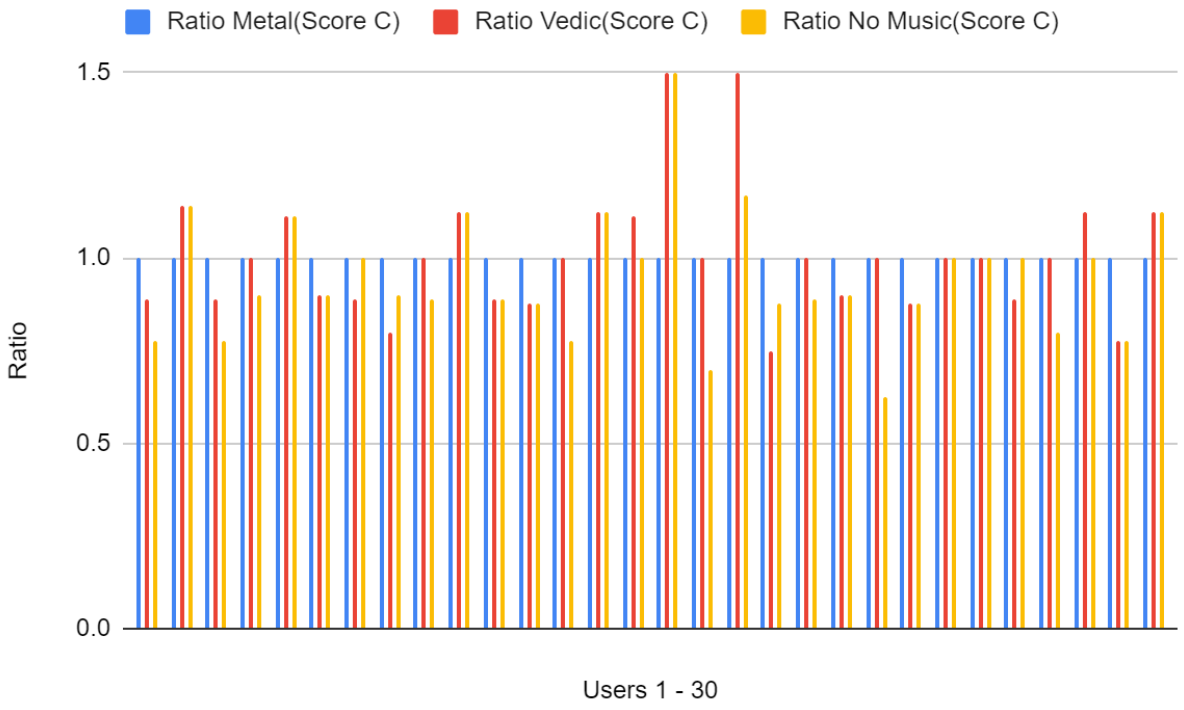


Graph 2

In respect to metal music, 7 people listened to vedic music and had a higher score in logical questions , while 6 people had a higher score in logical questions.

In respect to logical score, vedic music is the stimulus which has the highest score.

3. **Creative task score as a variable of attention span**



Graph 3

In respect to metal music, 9 people listened to vedic music and had a higher score in creative questions , while 7 people had a higher score in creative questions.
In respect to creative score, vedic music is the stimulus which has the highest score.

FINDING AND DISCUSSION

After conducting the logical and creative ability exercise, the participants were asked to write a short reflection of their experience while attempting the exercise. The reflection explains very

briefly how the participants were feeling while listening to each music. 23 out of 30 participants reported that it was quite disturbing and did not allow them to focus while some others mentioned that they were quite productive under heavy metal. This result was clearly proved by the statistical data shown in graph 1, graph 2, graph 3. Some responses also mentioned how their attention varies from logical to creative within a particular category of music. Considering the aspect of gender, females do not tend to enjoy heavy metal as much as males. For the vedic track, almost all the participants agreed that the track was very soothing and calming. 28 out of 30 participants mentioned that it was very helpful for solving the logical tasks. 4 participants were not very comfortable with the track while solving creative tasks.

CONCLUSION

After conducting the research one way ANOVA helped lead to the conclusion that music has a significant effect on the attention span of people. Different types of music have different impacts on people, as everyone has their own preference. The conclusions shown in statistical analysis are taken as a group and don't represent individual people. As the sample size was relatively less i.e. 30 people, the results may vary with a different size and demographic. Moreover, 2 way ANOVA proved that gender has a significant interaction effect on time as a variable of attention span with different music stimuli.

As shown in graph 1, graph 2, graph 3, metal music makes people take more time in completing the exercise while vedic music helps do the tasks more accurately and quickly as compared to metal music.

PRACTICAL IMPLICATION

One of the practical implications could be that music can be used as a tool for children with ADHD to facilitate their attention span. It can also be used to help people concentrate and meditate.

SCOPE FOR FUTURE RESEARCH

This study was conducted with 30 participants and thus the data gathered through the limited number of samples might not do justice to the research. The study can be scaled and a large data set can be collected to analyse the results for future references. It can also accommodate the age factor into consideration to evaluate the presence of another independent variable. Also, we can

gather some problem statements from the participants which they encounter while listening to music and come up with some unique solutions. The study can be expanded into various domains and can be carried forward.

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