Introduction

Working memory (WM) as introduced by Baddely and Hitch (1986) is the component of our cognition responsible for our short term memory and a majority of our learning capabilities. As a result, humans have become curious of the ways to improve WM performance. This includes attempting to maximise attention in an effort to enhance WM function. In relation, it is a popular belief that listening to instrumental music may be beneficial for attention during a cognitive task. In this paper I will discuss the study of the idea 'music has a negative impact on auditory tasks, but may provide some benefits for visual tasks'

The WM model consists of 3 main components. The Central Executive is the portion responsible for control decisions including attention and allocation of tasks, visuospatial sketchpad accounts for the short term storage of visual memory and it's manipulation and lastly the phonological loop is in charge of auditory information, and the articulatory process (Baddely and Hitch, 1986). With the knowledge of this model, it is reasonable to think that music should not inhibit tasks which mostly require use of the visuospatial sketchpad; since the unwanted auditory information from the music would only be held in the phonological loop. On the contrary, tasks requiring the phonological loop should indeed be impacted negatively.

In a study conducted by Handy and Broadbent (1987), the effect of unattended speech on working memory more specifically the phonological input store was shown. They suppressed the articulatory process of rehearsal in order to magnify the effect of the i.v [unattended speech] in the experiment. The results identified that WM performance is indeed compromised due to the presence of unattended information; providing further evidence for Baddely's WM model. In consequence to this observation, music containing lyrical information should negatively impact the articulatory process of rehearsal and as a

result allow for lesser performance of cognitive tasks requiring use of the phonological loop.

In Correspondence, Thomas R. Alley & Marcie E. Greene (2008) conducted a study to specifically identify the relation between WM and music. In this study, the independent variables of Silence, verbal Music, nonverbal music and irrelevant speech were tested to observe their impact performance of a digit span task. The task showed the best results under silence and worst with verbal music/irrelevant speech. This further solidifies Handy and Broadbent's study and allows us to conclude that vocal music should negatively impact tasks requiring use of the phonological loop.

Proverbio et al (2015) conducted a study to test whether music would be able to positively impact visual memory by inducing arousal in the brain. Their results show that music classified as 'emotionally touching' enhances performance in facial recognition, providing evidence that the performance of the visuo-spatial sketchpad should be positively impacted with the presence of music which induces arousal.

In retrospect to the studies discussed, the general idea that music only provides benefits to visual tasks still need to be studied specifically. In order to conduct this study, we will make additions to the study conducted by Iwanga and Ito (2002) on the performance of the phonological loop and the visuospatial sketchpad under influences of different types of sounds.

Proposed Method

Overview

This experiment will follow a within-subject design on two different test groups; an auditory task group and a visual task group. The subjects will be given tasks to do under three conditions; verbal/non-verbal music and silence. Since the two groups will be

randomly sampled, their performance will show which type of task (portion of working memory) is susceptible to improvement/disturbance under the influence of music.

The independent variables in the experiment will be the type of music being played, and the task group. The dependent variable in the experiment will be the performance in the given task under the conditions (type of music/group).

Subjects

The subjects will be undergraduate students from the university of Toronto with an approximated expected age of 20. From a pool of 200 students, each task group will be randomly allocated 100 students.

Procedure

The tests will be conducted electronically with a tablet for each subject. For the visual task group, they will be shown a sequence of 8 images in a specific order with 2 second intervals, and then asked to answer 'true/false' to a sequence of images presented whether they are the same images in order. This will be repeated for 10 sequences and the number answered correctly will be recorded.

The auditory task group will be tested with a similar task but instead tested with a sequence of 8 words with 2 second intervals in a specific order, and then asked to answer 'true/false' to a sequence of words presented whether they are the same words in order. The number of words correctly identified will be recorded.

For both groups, a one tailed t-test should be conducted between each of the independent variables and the control variable of silence, the null hypothesis being ‘The given condition does not negatively/positively impact WM performance’ (negative for the auditory group, positive for the visual group).

Predicted Results

In the auditory task group, as shown in various previous experiments including the one conducted by Iwanga and Ito, I predict that both under the conditions of non-verbal and verbal music the performance of the task will be worse than when performed under silence, the worst being with verbal music. This will be the case because of the preoccupation of the phonological loop with irrelevant information when attempting to complete the task. If the results show that there is no significant difference between the condition and silence (p value > 0.05), this will contradict my hypothesis.

For the visual task group I predict that music that the performance of the tasks for both types of music will be better compared to a silent condition. This will be because while the subjects will be able to benefit from the positive effects of music such as arousal of the brain without inhibition of the visuo-spatial sketchpad which is required for the task. If the results show that there is no significant difference between the conditions and silence (p value > 0.05), this will contradict my hypothesis.

Discussion of Limitations

This experiment is limited in some ways. To begin, all of our subjects being from the University of Toronto, may include some unwanted factors in our experiment. This could possibly be that a greater capacity of working memory is present in the students relative to society, which may allow the students to reap the benefits of music since their WM will not suffer from the access unwanted information provided. This may lead to a future study, in order to identify the effects of music on individuals with a high threshold of WM, in contrast to low. A solution to this would be to sample a completely random group from society; which is a difficult process.

Also, since the design being within-subject the performance of the task under the various conditions may not be independent from each other. For example, the presence of

music in the one activity may affect the activity with a lack of music. This could potentially lead to a study testing whether music has a lasting effect on WM. The solution to this issue would be to convert to a between-subject design for both groups, randomly sampling a specific number of subjects for every noise condition.

References

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