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Changes in Working Memory Performance with Various Simultaneous External Stimulation

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Introduction

Physical activity has been shown to reduce risk of many diseases and overall improve quality of life (Dunstan et. al, 2012). As such, active workstations have been developed to increase physical activity levels for those in an otherwise sedentary workspace. However, little is known about the efficiency of completing cognitive tasks while simultaneously completing exercise. Previous studies have observed a positive effect in working memory performance after participants complete a bout of physical activity (Tsukamoto et. al, 2017). These studies looked at chronic exercise instead of acute bouts of exercise. If there was found to be an effect, positive or negative, of completing cognitive tasks while exercising, this could suggest whether offices and schools should utilize active workstations to encourage physical health. Cognition has many facets, but we chose working memory as this is easily tested using the N-Back 2 test (Gajewski et. al 2018). Working memory is the ability to recall information while working with it, this aids greatly in decision making. Listening to classical music has been found to not have an effect on working memory so this was used as a bias control (Lehmann & Seufert, 2017). This study hypothesized that physical activity would increase working memory performance. It also hypothesized that music would have no effect on working memory.

PURPOSE

To explore the effect of simultaneous low-intensity exercise on working memory, as shown with N-back 2 test scores, compared to at rest, and while music is playing.

Method

N = 18
Female: 17
Male: 1

All participants were recruited from Hope College

Age
20 ± 1 year

Lode bike set at 70 watts

N-Back 2 Test

Polar heart rate monitor

Forms
PAR-Q, informed consent, health history

Familiarization
Practice N-Back 2, pedaled on bike, and use heart rate strap

Music Session
Completing the N-Back 2 test while listening to music, sitting on the bike

1 Week +/- 24 hours

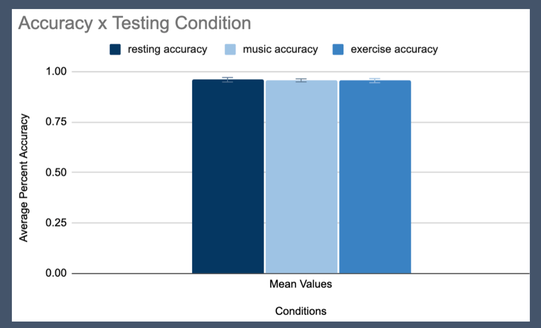
Exercise Session
Completing the N-Back 2 test while pedaling on the bike, staying within 30-50 % max heart rate

1 Week +/- 24 hours

Rest Session
Completing the N-Back 2 test while quietly sitting on the bike

Randomized Order

Results



- **Accuracy: correctly responding or not responding to the stimuli**
- **No effect of exercise or music on accuracy**

- **Misses: failing to respond to repetition of stimuli**
- **No effect of exercise or music on percent misses**

- **Reaction time: time taken to respond to the stimuli**
- **No effect of exercise or music on reaction time**

Conclusion

The purpose of this study was to examine potential effects of physical activity and music on working memory performance. Findings for our primary hypothesis was not supported. However, the secondary hypothesis was supported. While this study did not find positive effects of physical activity on working memory, it also did not find negative effects. This study looked at a specific part of cognition, working memory, so does not represent all cognitive function and potential effects of exercise on them.

LIMITATIONS

- Lack of time
- Sample: this was a small sample and contained mostly Caucasian women.
- Mood and events of the day: we could not control for a participant coming in stressed or having used a lot of cognition before testing.
- Time during test: we did not control for the time taken between trials of the N-Back 2 tests.
- Inability to adjust the desk height.

IMPLICATIONS

- Since there was no negative effect of simultaneous physical activity on working memory performance found, it can be suggested that workers and student can use cycle desks in their normally sedentary tasks.
- Thus far, findings do not support our hypotheses. However, more research would be needed to explore all the aspects of cognition with exercise.
- This study helps to validate music as a bias control with no effect on working memory.

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