The effects of acute aerobic exercise on memory and cognition in healthy, young adults

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Introduction

Many previous studies have shown that higher levels of physical fitness are associated with higher levels of cognitive performance (Themanson et al., 2008; Colcombe and Kramer, 2003). While most of the exercise intervention studies have focused on chronic exercise paradigms, a growing body of work in human populations has started to explore the effects of acute exercise (typically 30 minutes to 1 hour) on cognitive functions. While the overall findings have been mixed, a recent meta-analysis by Chang et al., (2012) suggests that there is a small positive effect of acute exercise on cognition with the possibility for larger effects when specific exercise parameters are used. To try to identify the tasks that are most sensitive to an acute bout of exercise, we explored the effects of one hour of exercise on a stationary bike on a range of cognitive tasks, focusing on tasks that tap frontal lobe functions. We also asked how long the cognitive effects of acute exercise might last, examining delay intervals after exercise from 30 minutes to 2 hours. These findings are a first step in a program of work designed to identify the optimal exercise and cognitive/behavioral testing parameters that maximize the exercise effects on cognition in humans.

Methods

Experimental Design

<table>
<thead>
<tr>
<th>Exercise (N=41)</th>
<th>Control (N=40)</th>
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<tbody>
<tr>
<td>30 min aerobic exercise at 85% of max heart rate on a stationary bike</td>
<td>60 minutes watching an action packed TV show</td>
</tr>
<tr>
<td>60 min aerobic exercise at 85% of max heart rate on a stationary bike</td>
<td>90 minutes watching an action packed TV show</td>
</tr>
<tr>
<td>120 min aerobic exercise at 85% of max heart rate on a stationary bike</td>
<td></td>
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Cognitive Testing

- Hopkins Verbal Learning Test
- Stroop Color and Word Test
- Symbol Digit Modalities
- Controlled Oral Word Association Test

Neuropsychological Tests

- Hopkins Verbal Learning Test
- Stroop Color and Word Test
- Symbol Digit Modalities
- Controlled Oral Word Association Test

Participant Demographic Information

<table>
<thead>
<tr>
<th>All (N=81)</th>
<th>Exercise (N=41)</th>
<th>Control (N=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender: 48 female</td>
<td>20 female</td>
<td>28 female</td>
</tr>
<tr>
<td>Age (years): 22.37 (SD=4.20)</td>
<td>22.17 (SD=3.76)</td>
<td>22.57 (SD=4.65)</td>
</tr>
<tr>
<td>Education (years): 12.98 (SD=1.92)</td>
<td>15.15 (SD=1.96)</td>
<td>14.80 (SD=1.88)</td>
</tr>
</tbody>
</table>

Results

I. All Delays Combined

- Stroop Color Word
- Symbol Digit Modalities

II. Individual Delays

- Hopkins Verbal Learning Test
- Stroop Color Word

Summary & Conclusion

- A single bout of aerobic exercise results in significant improvement on frontal lobe dependent tasks in healthy, young adults.
- These improvements may last for up to 120 minutes after the bout of exercise.
- The controls’ decline in performance on the HVLT after the intervention suggest that TV watching may have a detrimental effect on performance on this task.

Frontal lobe dependent tasks are highly sensitive to the effects of just an hour of aerobic exercise.

Future Directions

We are currently exploring the EEG signals associated with these cognitive effects of acute exercise.

References


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