Effect of Rock Climbing on Neurocognitive Performance and Memory

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1. Introduction

1.1 Background

Exercise is shown to improve memory and executive functioning. Prior studies show that intermediate-intensity exercise significantly increases performance on working memory tasks [1] and that certain sports led to a more significant increase in memory [2].

Since rock climbing combines exercise with cognitive problem-solving, it may significantly enhance cognitive functioning.

1.2 Problem

Our goal was to test whether exercise improved memory test scores, and whether climbing had a greater impact on scores compared to cardiovascular exercise.

We hypothesized that both rock climbing and cardiovascular exercise would increase number-recall scores, with climbing producing the greater increase.

2. Investigation

2.1 Methodology

Participants were recruited from a Bay Area high school climbing club and completed an informed consent form.

Data collection was performed over three climbing meetups at a climbing gym. For those who attended multiple meetups, their scores were counted separately for each meetup.

Participants were assigned to one of two exercise conditions by counting off in a within-subjects, crossover design. Before exercise, participants completed a baseline number memorization test: reciting a growing sequence of random digits to a partner, with the sequence's contents changing each time. The longest sequence they could recall was their score.

The first exercise group did 15 minutes minute-on, minute-off jumping jacks. The second group alternated between 1 minute of climbing and resting. After the exercise blocks were over, participants took the number recall test again, switched exercise, and took the test a final time.

2.2 Results

We gathered 25 data points over 3 sessions. The average score at baseline was 7.92 (SD 1.52). After climbing the number was 8.60 (SD 1.29), and after jumping jacks the number was 8.44 (SD 1.29) (Table 1).

A Repeated-Measures ANOVA found a statistically significant difference between all three conditions ($p = 0.017$). Paired Samples T-Tests found a statistically significant difference between the baseline score and post-cardio score ($p = 0.016$), as well as baseline score and post-climbing score ($p = 0.032$). There was no statistically significant difference

between the post-cardio and post-climbing scores ($p = 0.444$).

2.3 Discussion

In this experiment we found that exercise increased number recall ability. However, there was no statistically significant difference between climbing and cardio, suggesting that the type of exercise does not make a big difference.

3. Conclusion

3.1 Related Work

Prior research found that experienced climbers had higher accuracy on climbing-related memory tests compared to inexperienced climbers, but not on a general memory test [3]. Our data adds to this by testing the differences between climbing and cardio using number recall tasks.

3.2 Limitations

Our small sample size led to less statistical power. Participants were recruited from one school, limiting generalizability. The memory test could be subject to human error or miscounting. Furthermore, students took the baseline test first and could have developed familiarity with the test and thus scored higher, though there was no statistically significant difference between scores of individuals who attended multiple sessions despite prior exposure to the test.

3.3 Societal Impact

Our findings provide evidence that exercise improves memory. These findings could benefit adolescents' education by encouraging schools to incorporate exercise to increase cognitive functioning. Further research could determine the additional benefit of rock climbing compared to other forms of exercise.

4. References and Additional Details

4.1 References

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Table 1. Average score from all participants over all 3 study days (N=26)

Method	Baseline	Post-cardio	Post-climb
Result	7.92	8.44	8.60
Standard Deviation	1.53	1.29	1.29

Table 2. Repeated-measures, within-subjects ANOVA analysis of scores for all participants across all three conditions

	Sum of squares	df	Mean Square	F	p
RM Factor 1	6.32	2	3.16	4.42	.017
Residual	34.35	48	0.72		

Table 3. Paired Samples T-Tests between each pair of conditions for all participants

		statistic	df	p
Baseline vs. post-cardio	Student's t	-2.59	24	.016
Baseline vs. post-climb	Student's t	-2.28	24	.032
Post-cardio vs. post-climb	Student's t	-0.78	24	.444