



The Temporal Relationship between Exercise, Cognition, and Linguistic Abilities

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Background and Purpose

- Physical activity has a positive impact on the overall health and well-being of people of all ages, but it has also shown to specifically improve a host of cognitive processes including attention, executive function, and working memory
- Chronic exercise has long-lasting effects on cognition, even in the absence of temporally-proximate exercise. However, a review of the literature revealed no systematic investigation of acute bouts of exercise as a function of time.
- Previous studies tend to focus on children or elderly adults, while support for these findings in young adults is far less specified
- In addition, studies that have focused on young adults tend to narrowly utilize singular cognitive-linguistic tasks as dependent measures and then extrapolate using the broad term: cognition.
- This imprecise phrasing not only leads to difficulties in conducting comparative research, but also leads to difficulties in developing clinical treatment plans to benefit targeted behaviors.
- The current study seeks to enhance the precision by which exercise can be implemented as a clinical tool in the learning abilities of young adults.

Methods

Participants

- 14 college-aged students participated (average age = 23.5 years)
- All students were enrolled in graduate school for speech-language pathology
- Nine of the fourteen participants reported participating in at least 30 minutes of moderate to strenuous exercise on at least three days of the week for the past three months.

Procedures

- Two data sessions were completed for each participant.
 - One session consisted of completing the exercise protocol and immediately completing the cognitive-linguistic battery.
 - The other session consisted of completing the exercise protocol and then completing a parallel form of the cognitive-linguistic battery 2-3 hours later.
- The cognitive-linguistic battery consisted of counterbalanced, frequently utilized cognitive-linguistic tasks:
 - Stroop test (selective attention),
 - digit span (working memory)
 - Tower of London (executive functioning)
 - phonemic fluency
 - word recognition fluency.

Measures and Analyses

- The Tower of London was measured in seconds.
- Digit span was calculated as the raw number of letters recalled in reverse.
- To calculate the Stroop variable, the reaction time toward non-congruent stimuli were subtracted from reaction time toward congruent stimuli.
- Phonemic fluency was measured in words produced within one minute.
- Word recognition fluency was a composite score that was obtained via the Test of Word Recognition Efficiency – 2nd Ed. (TOWRE-2)
- Statistical analyses of the remaining values consisted of a series of paired samples t-tests between the immediate and delayed values.

Results

- Significant differences were found between
 - immediate and delayed administrations of the digit span tasks, $t(19) = 3.26, p = .006$, with immediate scores (21.71) being higher than delayed scores (17.71);
 - Tower of London tasks $t(19) = -3.76, p = .003$, with immediate scores being faster (316.86 s) than delayed scores (446.57 s)
 - Stroop task $t(19) = -2.82, p = .02$, with a more pronounced Stroop effect in the immediate condition (-11.78) than the delayed condition (-5.74).
 - No significant differences were revealed between the verbal fluency or word reading fluency tasks.

Means and standard deviations of experimental measures.

Measure	Immediate Condition	Delayed Condition
Stroop Test*	-21.64 (6.46)	-10.80 (4.17)
Digit Span*	21.71 (3.79)	17.71 (3.04)
Tower of London*	316.86 (40.16)	446.57 (134.05)
Phonemic Fluency	15.54 (2.97)	15.07 (3.65)
Word Recognition Fluency	103.43 (8.48)	103.79 (8.71)

Note: * indicates significance at the 0.05 level

Discussion

- Results indicate that the positive effects of acute exercise on the cognitive-linguistic abilities of young adults may be short-lived.
- This has serious ramifications for the individual who is attempting to utilize short-term exercise activities for their benefit in an academic setting.
- Also, the benefits of exercise might be dependent upon the type of skill which will need to be utilized in the academic setting. Tasks that do not tax working memory, executive function, and selective attention might be less affected.
- Most tasks will be reliant upon those three abilities to a degree, but some more than others. For example, the longer in duration a task (essay test, standardized test, etc.), then the more reliant it might be upon these cognitive abilities.
- These abilities serve as a means to assist in directing resources to keep the wandering mind in check. Therefore, it is possible that brief bouts of exercise could actually impact everyday academic activities such as lectures more than performance-based measures such as exams.

Limitations

- The current study would benefit from an increased sample size.
- Current results can only be inferred to actual classroom learning abilities. Future studies should consider utilizing a measure of learning as a dependent measure.

Recommendations

- Students who are seeking an additional boost prior to everyday learning activities might benefit from small amounts of exercise prior to those activities. However, the exercise must be in close proximity to the activity.
- Students who are seeking an additional boost prior to examinations, should consider studying harder.

Disclosure

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