Comparing the Effects of Resistance Exercise to Aerobic Exercise on Cognitive Processing Speed in Young Adults

Jamie A. Ambriz, Amber M. Shipherd, Ph.D., CMPC., Robert J. Kowalsky, Ph.D., ACSM-CEP

Human Performance Laboratory, Department of Health & Kinesiology

Texas A&M University–Kingsville, Kingsville, TX

TEXAS A&M UNIVERSITY KINGSVILLE®

TEXAS A&M UNIVERSITY KINGSVILLE®

MCNAIR SCHOLARS PROGRAM

INTRODUCTION

- Processing speed is the progression by which an individual takes in information, begins to understand it, and then responds to it (Salthouse, 1996), and has been found to affect academic performance (Mulder et al., 2010).
- A positive relationship has been established between exercise and processing speed (e.g., Haverkamp et al., 2020).
- Further, even an acute bout of exercise as short as 10 minutes can improve processing speed, with the largest improvements occurring when processing speed is assessed 11-20 minutes following exercise (Chang et al., 2012; Salerno et al., 2020).
- Unfortunately, levels of exercise often decline when a student begins college (Keating et al., 2005). Therefore, increasing levels of exercise in college students is crucial.
- Much of the research investigating processing speed has focused on aerobic exercise, though research examining the impact of resistance training on cognitive processes have still found promising results (Chang et al., 2012).
- However, the literature has largely focused on using resistance machines (e.g., Chang & Etnier, 2009), establishing a need to explore more feasible options, such as body weight resistance exercise.

PURPOSE

- The purpose of this study was to explore if an acute bout of body weight and resistance band strength-based exercises compared to aerobic exercise for improvements in cognitive processing speed in a college-age population.

METHODS

Study Design

- Repeated measures design with one control and two experimental conditions (aerobic, resistance). Visits took place at least 48 hours, but no more than 72 hours apart. Participants were required to abstain from caffeine, nicotine, alcohol, and moderate-to-vigorous physical activity 8 hours prior to each visit.

Participants

- N = 15 (*n*Male = 8, *n*Female = 7) between 20 and 25 years old. Participants identified as Hispanic/Latino (*n* = 11), African American (*n* = 3), and Caucasian (*n* = 1). See Table 1 for additional participant characteristics.

Procedures

- Following institutional review board approval, individuals who were healthy enough to engage in moderate-to-vigorous exercise and had no visual impairments were recruited to participate.
- Baseline measurements (resting HR, height, weight) were obtained on the initial visit after 10-min of sitting, then participants' baseline processing speed was assessed.
- During the two experimental conditions, participants completed a 10 minute bout of moderate intensity aerobic or resistance exercise after a 6 minute warm-up, then finishing with 5 minute cool down.
- Intensity was assessed throughout the exercise bouts every 2.5 minutes by recording participants' heart rate and rating of perceived exertion.

Instrumentation

- Borg Rating of Perceived Exertion (RPE; Borg, 1982)
- Symbol Search subtest from the WAIS-IV (Wechsler, 2008; see Figure 1), administered via Inquisit software 11 minutes post activity.

METHODS, cont.

Table 1: Participant Characteristics

Variable	Mean	SD	Range
Age	21.93	1.39	20 – 25
Height (cm)	170.40	9.05	153 – 184
Weight (lbs)	183.87	45.97	123 – 282

Statistical Analysis

- A repeated measures ANOVA was conducted using SPSS v. 26 to assess differences in processing speed across the conditions (control, aerobic, resistance).
- An alpha level of .05 was used for indication of statistical significance.

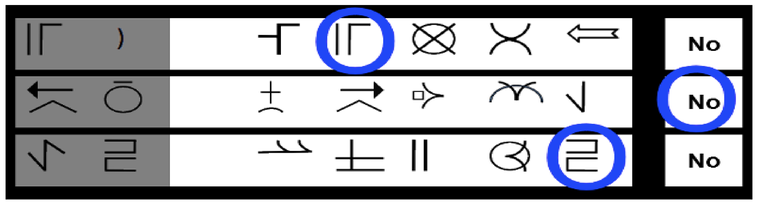

Figure 1: Symbol Search Test

RESULTS

- Independent samples *t*-tests were next calculated to assess for any differences in processing speed by gender or order (whether participants completed aerobic exercise or resistance exercise the second day of data collection). No significant differences were found.
- Paired samples *t*-tests were also conducted to assess for differences in exercise intensity (HR and RPE) between exercise conditions. No significant differences were found.

Table 2: Heart Rate, RPE, and Processing Speed (mean ± SD)

Condition	Heart Rate	RPE	Processing Speed
Control	--	--	36.53 ± 9.66
Aerobic Exercise	141.92 ± 4.80	11.33 ± 2.00	41.93 ± 11.23
Resistance Exercise	144.70 ± 7.63	11.58 ± 1.26	44.67 ± 10.74

- A significant effect was found ($F(2,28) = 22.34$ $p < .001$, $\eta_p^2 = .615$) between conditions on processing speed.
- Follow-up pairwise comparisons revealed participants performed better on processing speed following aerobic exercise compared to no exercise and performed better following resistance exercise compared to no exercise (see Table 2 for means and standard deviations).

This work was supported by the McNair Scholar Program

DISCUSSION

- Statistically significant differences were found in processing speed between the control (no exercise) condition and the aerobic exercise condition, and between the control condition and resistance exercise condition.
- Participants saw improvements in cognitive processing speed after performing either a 10-minute acute bout of aerobic or bodyweight resistance training followed by an 11-minute rest period. This supports the existing research that has found acute bouts of both aerobic (Salerno et al., 2020), and resistance (Chang et al., 2012) exercise can be beneficial for processing speed.
- Existing research on resistance exercise and cognitive functioning has primarily used free weights or machines and followed a more traditional approach to resistance training that required a larger input of time (Stassnig, 2015). The current study utilized a brief bout of body weight and light resistance band exercises, which may be a more attractive strategy for college students who often report time as a barrier to exercise and may not have access to free weights or machines.

Limitations:

- Small sample size
- 3 participants failed to follow study requirements, causing them to be rescheduled for the next day

Conclusions:

- The 10-minute bout of moderate intensity body weight and light resistance band exercises improved processing speed as well as a bout of aerobic exercise.
- Thus, healthy college-aged adults are recommended to not only engage in regular physical activity, but also engage in a short bout of moderate intensity aerobic or body weight and resistance band exercise prior to cognitive tasks, such as exams.

REFERENCES

- Borg, G. A. (1982). Psychophysical bases of perceived exertion. *Medicine & Science in Sports & Exercise, 14*(5), 377-381. https://doi.org/10.1249/00005768-198205000-00012
- Chang, Y. K., & Etnier, J. L. (2009). Exploring the dose-response relationship between resistance exercise intensity and cognitive function. *Journal of Sport and Exercise Psychology*, *31*(5), 640-656.
- Chang, Y. K., Labban, J. D., Gapin, J. I., & Etnier, J. L. (2012). The effects of acute exercise on cognitive performance: A meta-analysis. *Brain Research*, *1453*, 87-101.
- Haverkamp, B. F., Wiersma, R., Vertessen, K., van Ewijk, H., Oosterlaan, J., & Hartman, E. (2020). Effects of physical activity interventions on cognitive outcomes and academic performance in adolescents and young adults: A meta-analysis. *Journal of Sports Sciences*, *38*(23), 2637-2660.
- Keating, X. D., Guan, J., Piñero, J. C., & Bridges, D. M. (2005). A meta-analysis of college students' physical activity behaviors. *Journal of American College Health*, *54*(2), 116-126.
- Mulder, H., Pitchford, N. J., & Marlow, N. (2010). Processing speed and working memory underlie academic attainment in very preterm children. *Archives of Disease in Childhood-Fetal and Neonatal Edition*, *95*(4), F267-F272.
- Salerno, E. A., Rowland, K., Hillman, C. H., Trinh, L., Kramer, A. F., & McAuley, E. (2020). Dose-response effects of acute aerobic exercise duration on cognitive function in patients with breast cancer: a randomized crossover trial. *Frontiers in Psychology*, *11*, 1500.
- Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review*, *103*(3), 403-428.
- Strassnig, M. T., Signorile, J. F., Potiaumpai, M., Romero, M. A., Gonzalez, C., Czaja, S., & Harvey, P. D. (2015). High velocity circuit resistance training improves cognition, psychiatric symptoms and neuromuscular performance in overweight outpatients with severe mental illness. *Psychiatry Research*, *229*(1-2), 295-301.
- Wechsler, D. (2008). *WAIS-IV Administration and Scoring Manual.* The Psychological Corporation.