Lifespan Developmental Psychology Lab

Cognitive and Physical Activity Attenuate Age and Education Differences in Executive Functioning
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Abstract
There is robust evidence for aging-related declines in cognitive functioning especially for the domains of working memory, processing speed, and attention switching. Nevertheless, there is also evidence of age-related gains in executive functioning, suggesting that the benefits for executive functioning. Using the Midlife in the United States (MIDUS) survey, we investigated the role of both physical and cognitive activity in relation to performance on two tasks: the Stop and Go Switch Task (SGST), and the composite measure of cognitive functioning, the Brief Test of Adult Cognition by Telephone (BTACT). The sample included 2,876 adults (64.5% women) ranging from 32 to 84 with average education of 14.42 years. We assessed cognition using a composite variable which included episodic memory with immediate and delayed recall of word lists, speed of counting backwards, backward digit span, inductive reasoning with letter series, and verbal fluency. The sample included 2,876 adults (64.5% women) ranging from 32 to 84 with average education of 14.42 years. We assessed cognition using a composite variable which included episodic memory with immediate and delayed recall of word lists, speed of counting backwards, backward digit span, inductive reasoning with letter series, and verbal fluency.

Background
There is wide variability in the age patterns and rates of change for cognition. Moreover, there are differences in cognition tied to educational experiences, but little is known about the mechanisms that account for such variations. Our research goal is to examine behavioral factors that are associated with differences in cognitive performance.

Research Questions & Hypotheses
• We investigated the role of both physical and cognitive activity in relation to performance on:
  • An attention switching task, the Stop and Go Switch Task (SGST)
  • A broad composite measure of cognitive mechanics
• We examined whether those who have less education but engage in cognitive and physical activities would show benefits for their cognitive functioning.

Method & Participants
Midlife in the United States (MIDUS) survey
• The sample included 2,876 adults (64.5% women) ranging from 32 to 84 with average education of 14.42 years.
• Frequency of cognitive activity: how often they read, did word games, played cards or other games, attended lectures, wrote, and used the computer
  • 6-point scale ranging from ‘Never’ to ‘Daily’.
• Summary score was computed by taking the average of the six items
• Physical activity: the frequency of vigorous or moderate physical exercise on the job, at home, or for leisure in winter and summer months
  • 6-point scale ranging from ‘Never’ to ‘Severally times a week’
• Frequencies were averaged across seasons and the maximum frequency of the three domains for either vigorous or moderate activity was computed.
• Cognitive measures were assessed over the telephone using the Brief Test of Adult Cognition by Telephone (BTACT; Lachman & Tun, 2008) and the SGST (Tun & Lachman, 2008; Tun & Lachman, in press)
• Latencies for Attention Switching (SGST); Latencies were recorded for responses to the word ‘red’ with ‘stop’ and ‘green’ with ‘go’ in the congruent (normal) condition; the incongruent (reverse) condition reversed the required responses. Participants alternated between the two conditions following ‘switch’ cues that were given at random intervals of 2 to 6 trials. We assessed response latencies for the trial following a switch to the normal or reverse condition.
• BTACT Cognitive Composite: Included measures of episodic memory with immediate and delayed recall of word lists, speed of counting backwards, backward digit span, inductive reasoning with letter series, and verbal fluency.

Figure 1: Two-way Interaction of Age and Physical Activity for Switch Latency
• There was a significant age by physical activity interaction for switch latency.
• Physical exercise was not related to latencies for attentional switching for young adults, but older adults who engaged more frequently in vigorous or moderate exercise showed faster switch reaction times (see Figure 1).

Figure 2: Three-way Interaction of Education, Cognitive Activity, and Physical Activity for Switch Latency
• A three way interaction of physical exercise, cognitive activity, and education showed among those who do not engage in frequent physical activity, high frequency of cognitive activity is associated with faster switch latencies and education effects are reduced (see Figure 2a).
• The quickest reaction times were found for those with high education, high cognitive activity, and high physical activity (see Figure 2b).

Figure 3: Main Effect of Cognitive Activity on BTACT Composite
• For the composite measure of cognitive mechanics, the effects of age, education, health, and cognitive activity were significant in the expected directions, but there were no significant interactions.
• A greater frequency of cognitive activity was associated with a better cognitive composite score (see Figure 3).

Conclusions
• For cognitive mechanics, the positive relationship with frequent cognitive activity was uniform across age, sex, and education.
• For switch latency, the effects of frequent cognitive activity were more pronounced for those who do not engage in regular physical activity.
• The combination of high education and frequent cognitive and physical activity was associated with the fastest speed.
• The compensatory effects of physical exercise were seen primarily for older adults’ speed of attentional switching.
• This research has implications for understanding the role of modifiable behavioral factors for enhancing cognitive aging and reducing educational disparities.

Analyses & Results
• Significant correlations with Cognitive Composite: Age (r); Ed (r); Physical Exercise (r); Frequency of Cognitive Activity (r)
• Significant correlations with Switch Latency: Age (r); Ed (r); Physical Exercise (r); Frequency of Cognitive Activity (r)
• Including age, education, physical activity, with all interactions and covarying sex and health.

Cognitive Activity Mean BTACT Composite Score
• For cognitive mechanics, the positive relationship with frequent cognitive activity was uniform across age, sex, and education.
• For switch latency, the effects of frequent cognitive activity were more pronounced for those who do not engage in regular physical activity.
• The combination of high education and frequent cognitive and physical activity was associated with the fastest speed.
• The compensatory effects of physical exercise were seen primarily for older adults’ speed of attentional switching.
• This research has implications for understanding the role of modifiable behavioral factors for enhancing cognitive aging and reducing educational disparities.

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