Impact of a 12-week fitness training program on associative memory and attentional control processes in older adults

Ashley S. Bangert, Ph.D., Sandor Dorgo, Ph.D., CSCS², Rebecca Reed-Jones, Ph.D.²,³, Nazanin Heydarian¹, Rachel Montes¹, & Chandra Sekhar Bulusu, MHS(PT)²

¹Department of Psychology, ²Department of Kinesiology, ³Physical Therapy Program, Department of Rehabilitation Sciences, The University of Texas at El Paso

Introduction

Aging leads to declines in associative memory (Naveh-Benjamin, 2000) and the ability to use controlled attention to maintain task goals and minimize the influence of task irrelevant, prepotent information on performance (Castel et al., 2007). Aging is also associated with increases in intra-individual variability (Hultsch, MacDonald & Dixon, 2002); the latter may index the integrity of attentional control systems (Duchek et al., 2009).

Increased physical activity benefits executive cognitive functions in older adults (Colcombe & Kramer, 2003) and over several months is linked to increased hippocampal blood flow (Burdette et al., 2010) and increased brain volume in frontal and temporal cortices (Colcombe et al., 2006).

Higher levels of self-reported physical activity are associated with better timing accuracy for supra-second durations thought to require controlled attention and working memory (Szabo et al., 2012).

Therefore, the current study explores the impact of fitness training on associative memory (linked to hippocampal function) and tasks thought to require attentional control in community-dwelling older adults.

Method

Participants

- 45 Older Adults (OA): 68 (±6) years of age
  - 27 females, 18 males

Fitness Training

- 12-week exercise training program; two 90-minute sessions per week
  - Exercises focused on muscular strength and endurance, power, balance, cardiovascular fitness, and flexibility.
  - Assessments: 30-second chair stand, arm curl strength, hand-grip strength, 8-foot up-and-go agility, gaiton transfer

Cognitive Tasks — administered pre- and post- fitness training

1) Pair-Binding (associative memory)
   - Learned 24 unrelated word pairs
   - Tested on 12 intact, 12 rearranged, and 12 new pairs

2) Simon (spatial attention)
   - Arrow presented on the right, center or left side of the screen
   - Button press to indicate arrow’s direction

1/3 congruent trials / 1/3 incongruent trials / 1/3 neutral trials

3) Process Dissociation Procedure (PDP)
   - Incidental learning of word pairs
   - Each test trial involved an initially presented word (target or foil) or string of symbols followed by a word pair consisting of an intact cue and a fragmented target word.
   - Ex. STABLE - AR
   - Fragment had to be completed with the target word initially studied as part of the pair
   - Assessed contributions of recollection and familiarity

Purpose

- To evaluate the impact of a 12-week fitness training intervention involving cardiovascular, strength, and flexibility exercises on memory and attentional control in community-dwelling older adults.

Results

Fitness Performance

- Significant improvements on all assessments were seen at post-test (all p < .05, one-tailed)

Pair-Binding

- CV was reduced from pre-test (CV = .42) to post-test (CV = .42) this change did not reach significance (p = .279, one-tailed).
- Error bars are ± 1 standard error.

Simon

- CV was reduced from pre-test (CV = .31) to post-test (CV = .24).
- Error bars are ± 1 standard error.
- Note that *p < .05, one-tailed.

PDP

- Probability Estimate

Conclusions

- After fitness training, participants showed improvements in associative memory accuracy and reaction time especially when participants had to verify intact associations. They also showed an increased reliance on recollection processes in memory.

- Participants showed improved accuracy and reduced reaction times in the Simon task condition requiring suppression of irrelevant information. They also showed improved accuracy in their continuous reproductions of the 1500 ms duration.

- Although participants showed intra-individual variability reductions for the Simon task, reductions were not found for the pair-binding and continuous tapping tasks.

- These results support the view that a 12-week dynamic fitness intervention may lead to improvements in older adults’ physiological health, associative memory, and controlled attention processes.

- We are currently collecting data from a control group participating in 12 weeks of socially-engageing activities.

References


DOI:10.1080/13825585.2012.715625

For additional information contact: asbangert2@utep.edu