"There's an app for that": The effect of app-based multitasking training on situation awareness and performance

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- New vehicles coming into use are more technologically complex; battlefields have more agile opponents; increasing sensor data etc, e.g. Land 400.

LAND 400 Phase 2: Rheinmetall Boxer CRV negotiating obstacles at Puckapunyal. Retrieved from images.defence.gov.au/fotoweb/archives/5003-All-Defence-Imagery/?25=CASG on 2 Nov 2019

Land 400 Phase 3: Shortlisted contenders Rheinmetall Lynx KF41 and Hanwha Redback IFV. Retrieved from www.australiandefence.com.au/news/rheinmetall-and-hanwha-shortlisted-for-land-400-phase-3 on 2 Nov 2019.

- Army wants to enhance human performance through cognitive augmentation and on-demand training.

Situation Awareness (SA)

- SA can be defined as understanding "what is going on" (Endsley, 1995c, p. 36).

- 3 levels of SA (Endsley & Jones, 2012):
  - perception of relevant information
  - comprehension of its meaning
  - prediction of future outcomes

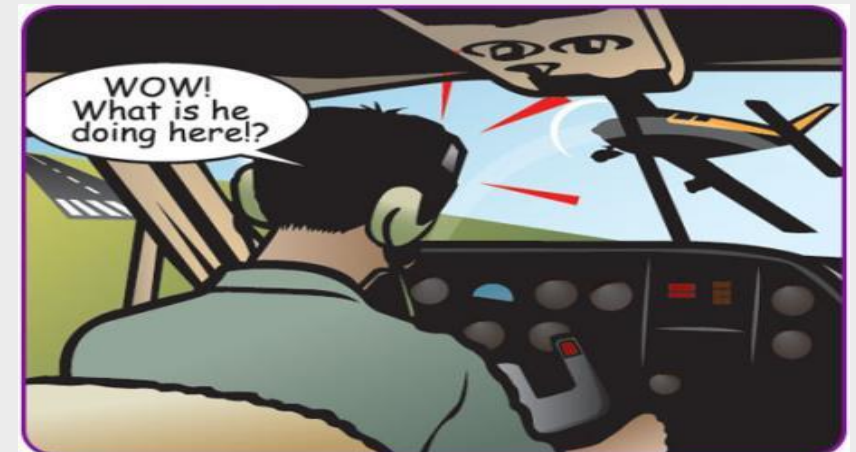- SA is distinct from task performance.
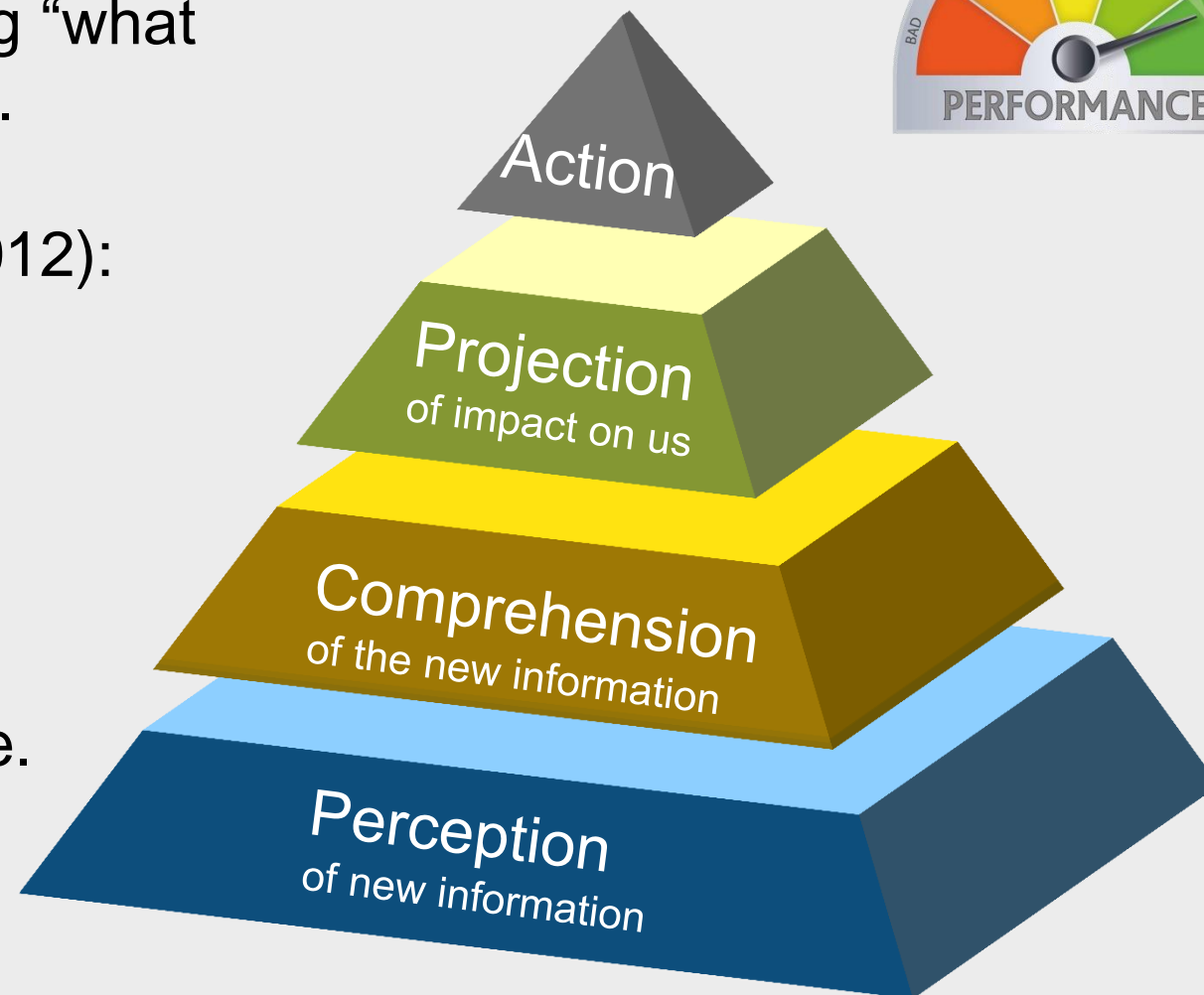
Multitasking

- ## Past work suggests SA requires multi-tasking.
  - Gugerty (2011);
  - Salvucci, Taatgen, & Borst (2009).

- ## Most SA errors are multi-tasking failures.
  - Adams, Tenney & Pew (1995);
  - Endsley (1995);
  - Murray, Ensign, & Yanagi (2010).

- ## Multi-tasking training holds promise.
  - Dux, Tombu, Harrison, Rogers, Tong, & Marois (2009);
  - Garner, Tombu, and Dux (2014);
  - Bender, Filmer, Naughtin, & Dux (2017);
  - Filmer, Lyons, Mattingley, & Dux (2017);
  - Garner, Matthews, Remington, & Dux (2015);
  - Liepelt, Strobach, Frensch, & Schubert (2011);
  - Ruthruff, Van Selst, Johnston, & Remington (2006);
  - Strobach, Liepelt, Pashler, Frensch,& Schubert (2013).

Flight Crew 4 U. Retrieved from http://www.flightcrew4u.co.uk/ blogs?aid=13089 on 2 Nov 2019.

Transport Canada. Retrieved from https://www.tc.gc.ca/eng/ civilaviation/publications/tp185-3-2011-flight-operations-6143.htm on 22 July 2018.
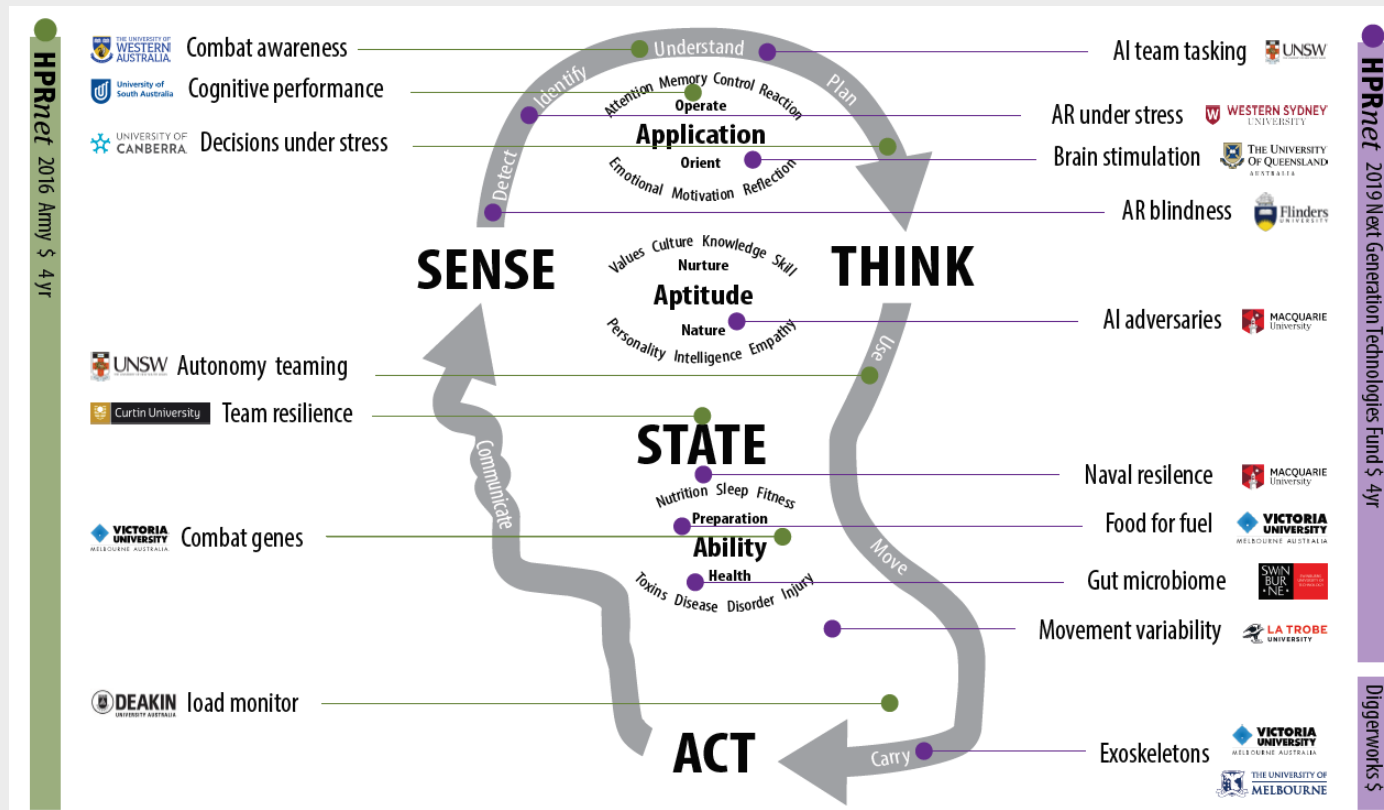
- Can performance and situation awareness be enhanced through a mobile app-based training intervention?

Selection, training and intervention strategies to improve warfighter situation awareness

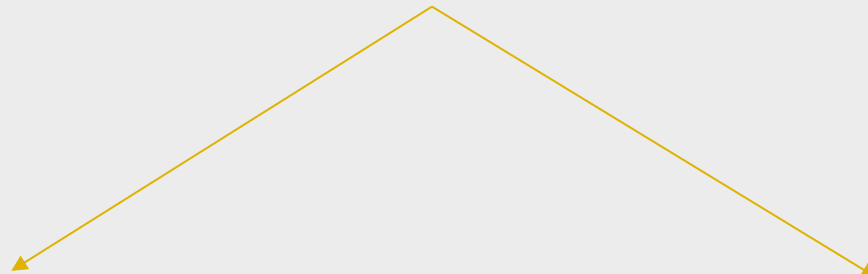DSC 2294 HPRnet science poster. Retrieved from https://www.dst.defence.gov.au on 31 October 2019.

- Portable & readily accessible

  ➜ Supports on-demand training

- Relies on available technology

  ➜ Minimises costs & maximises availability

- Trains a general cognitive skill
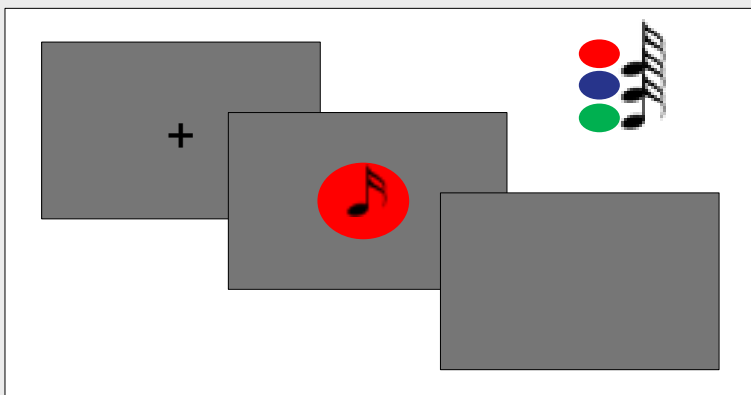
  ➜ Augment performance across tasks?

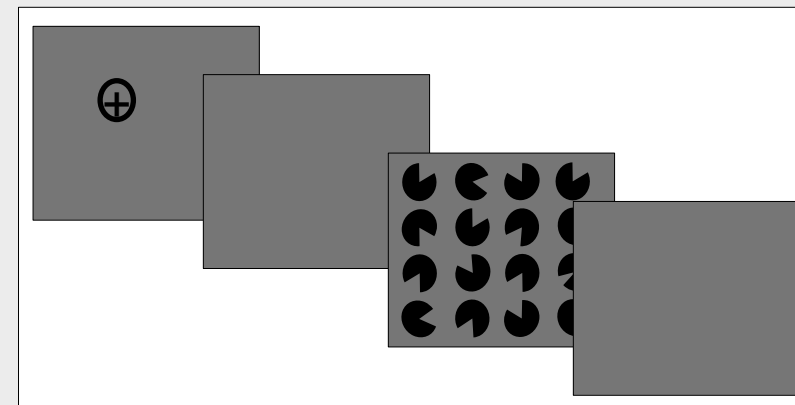128 undergraduate student participants recruited

Experimental (Training)

Adapted from Bender, Lipp, Loft, Visser, 2018. Improving Warfighter Situation Awareness: Selection, Training and Intervention Strategies to Increase Battlefield Performance and Survivability. DST.
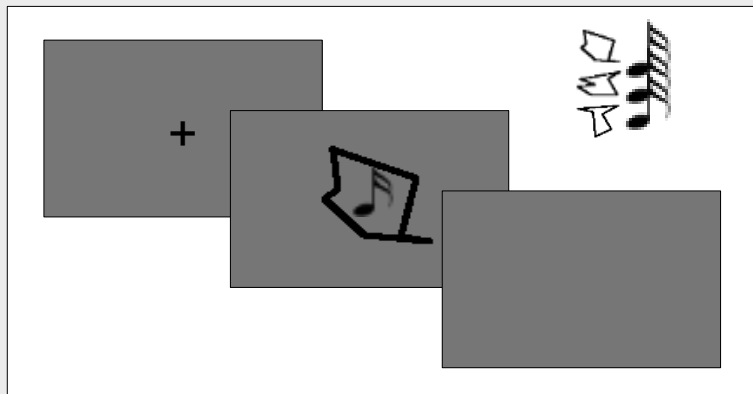Based on the task from Filmer et al. (2017).

Control Group

Adapted from Di Lollo, V., Enns, J. T., & Rensink, R. A. (2000). Competition for consciousness among visual events: The psychophysics of reentrant visual processes. Journal of Experimental Psychology: General, 129(4), 481.
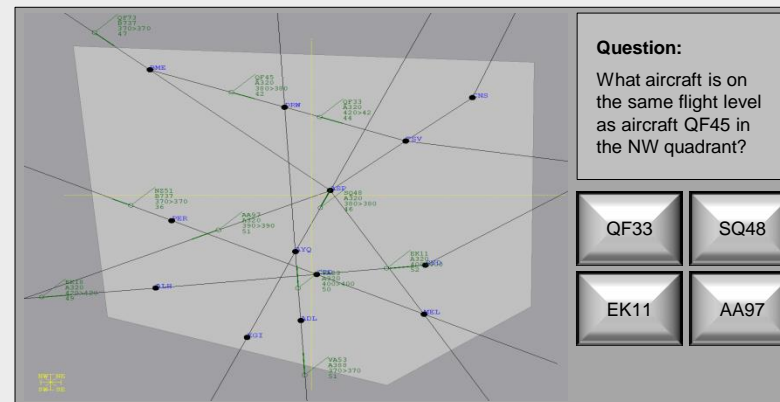
Near Transfer Task

Adapted from Bender, Lipp, Loft, Visser, 2018. Improving Warfighter Situation Awareness: Selection, Training and Intervention Strategies to Increase Battlefield Performance and Survivability. DST.
Based on the task from Garner et al. (2015).

Far Transfer Task + SPAM

Loft, Hill, Neal, Humphreys, Yeo (2004). ATC-lab: An air traffic control simulator for the laboratory. *Behavior Research Methods, Instruments, & Computers, 36*(2), 331–338.
SPAM based on Durso, F., & Dattel, A. (2004). SPAM: The real-time assessment of SA. In S. Banbury & S. Trembley (Eds.) *A cognitive approach to SA: Theory, measures and application* (pp. 137–154). New York, NY: Aldershot.

- Demographics

- Subjective SA (SART; Taylor, 1990)

- Subjective Workload (Weighted NASA TLX; Hart, 2006)

Qualtrics SART Questionnaire. Based on Taylor (1990); Salmon et al. (2009).

Qualtrics NASA TLX Questionnaire. Based on Hart & Staveland (1988); Hart (2006).

Experiment Schedule

Day 1	Days 2, 3, 4	Day 5
Pre-Training Online Questionnaires Cognitive Computer Task Air Traffic Control Simulation	**2 Mobile App Training Sessions** Experimental Group: Single vs. Dual Task Control Group: Visual Search Task	**1 Mobile App Training Session** Experimental Group: Single vs. Dual Task Control Group: Visual Search Task
1 Mobile App Training Session Experimental Group: Single vs. Dual Task Control Group: Visual Search Task		**Post-Training** Cognitive Computer Task Air Traffic Control Simulation Online Questionnaire

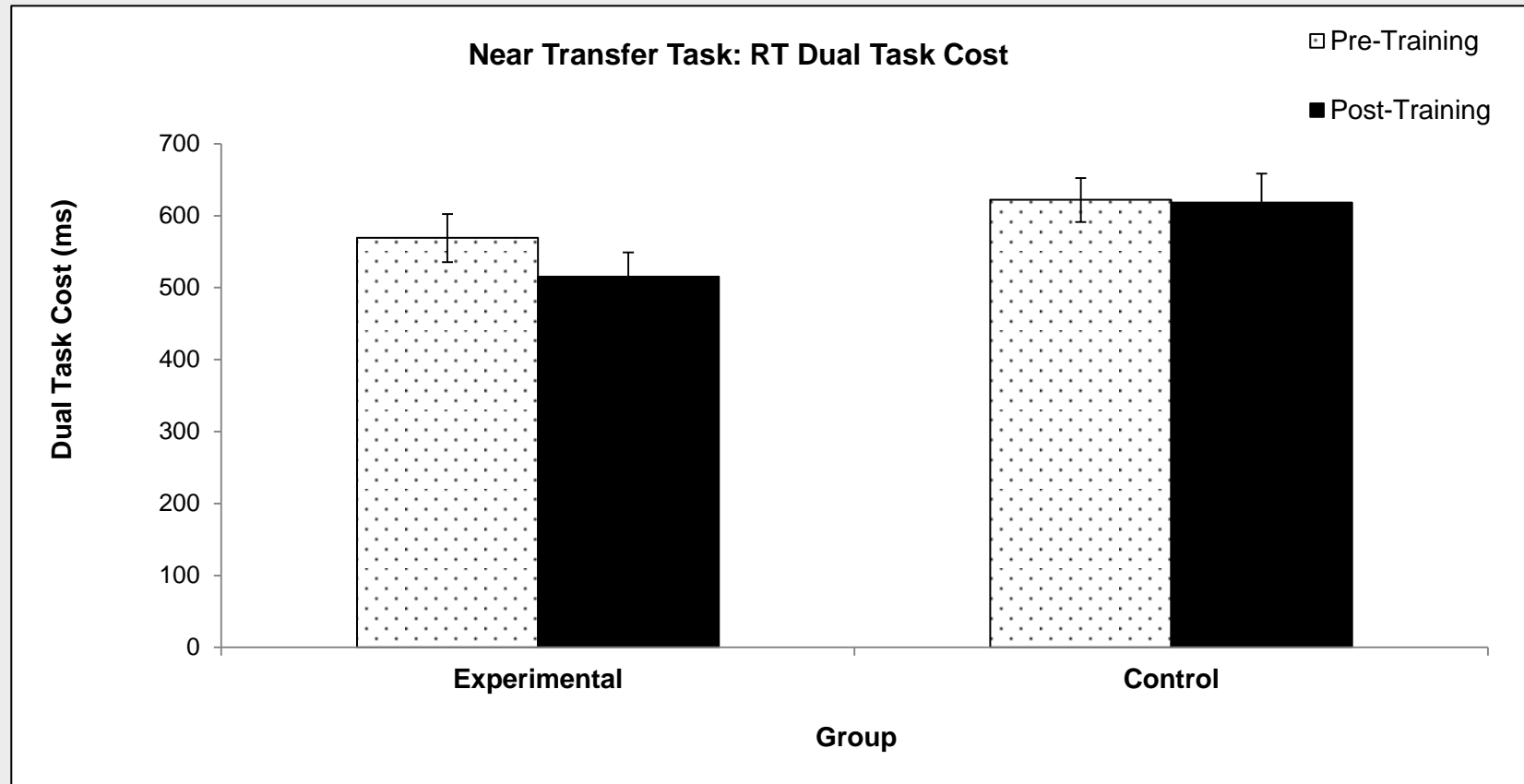- Performance for experimental and control groups improved with training.
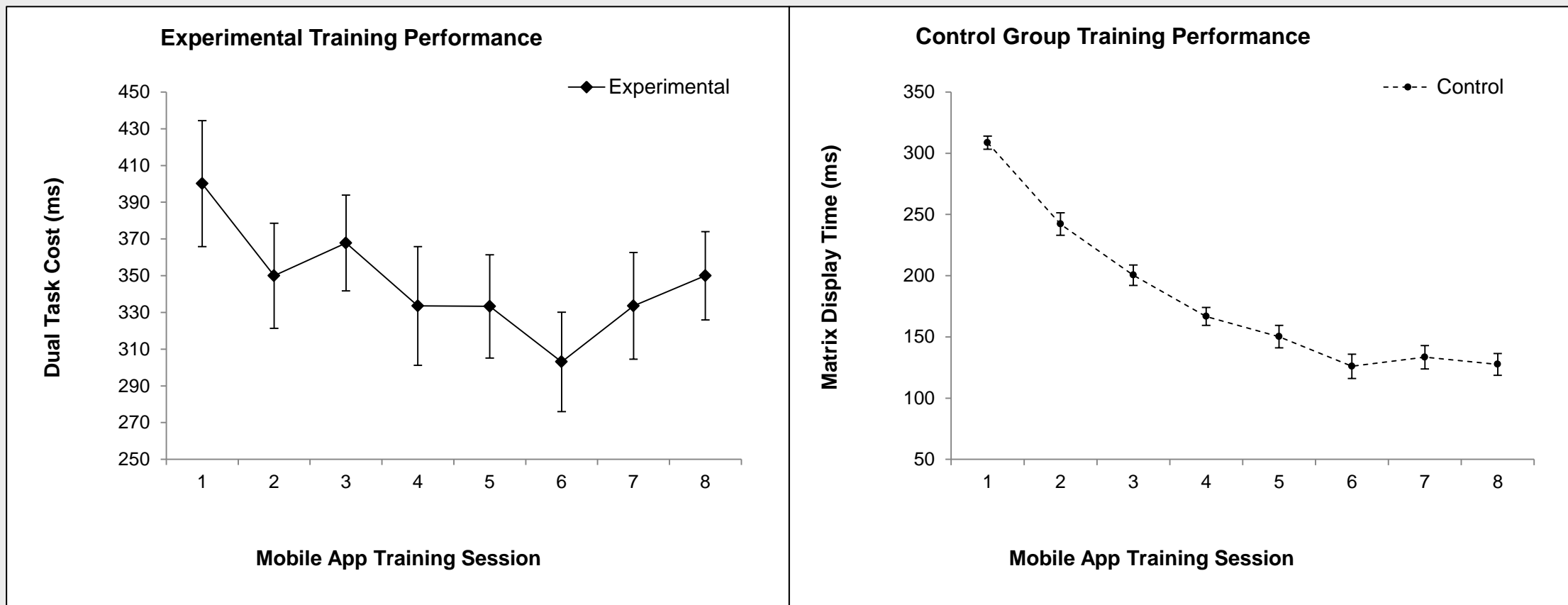
- Experimental group saw greater benefit to multi-tasking performance on near-transfer task.

Near Transfer Task: RT Dual Task Cost

- No change in Acceptance RTs

Far Transfer: Acceptance RT
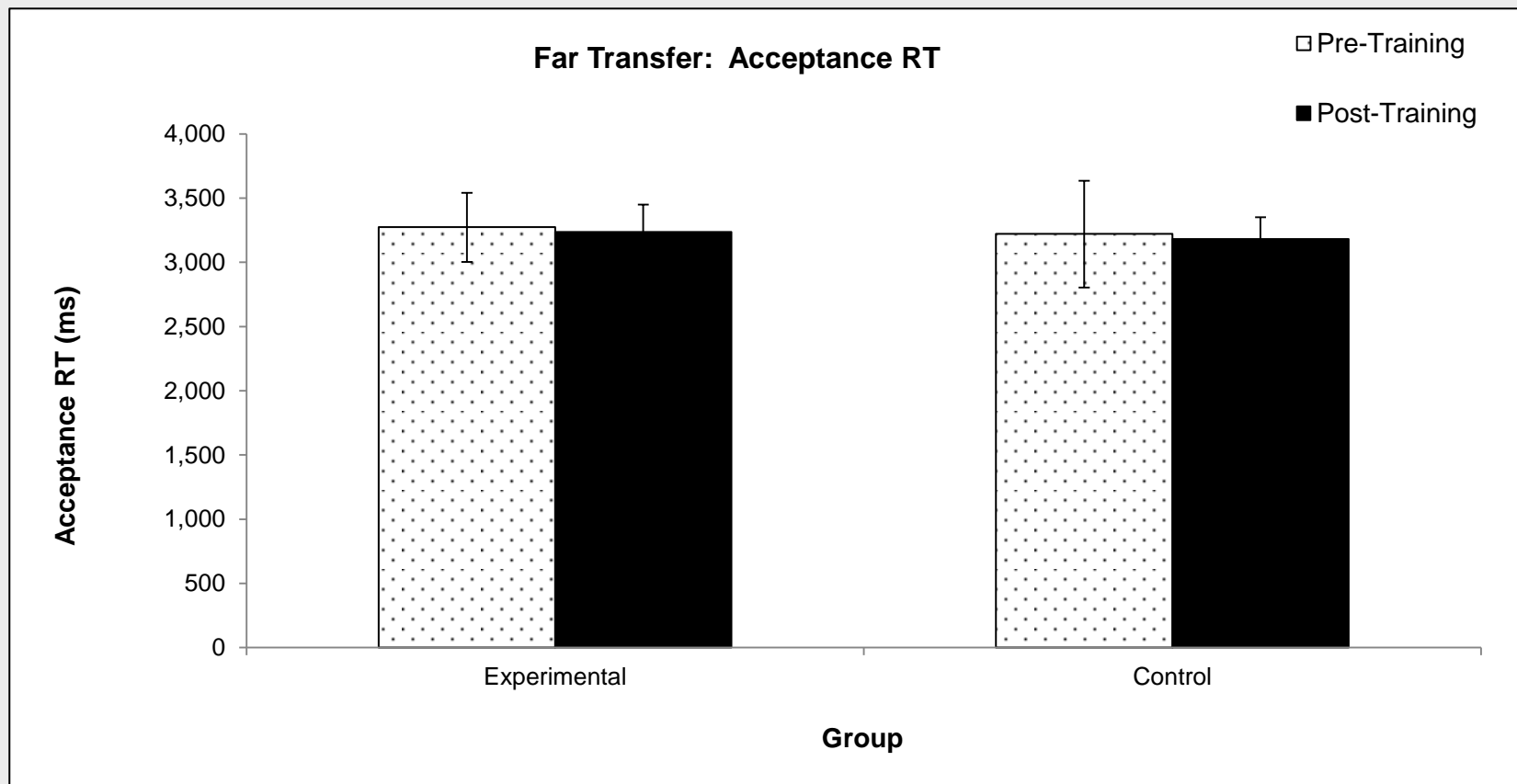
Far Transfer Task (ATC): Aircraft Handoffs

- No change in Handoff RTs

- Conflict resolution RTs decreased after training. Trend for larger decrease in experimental group
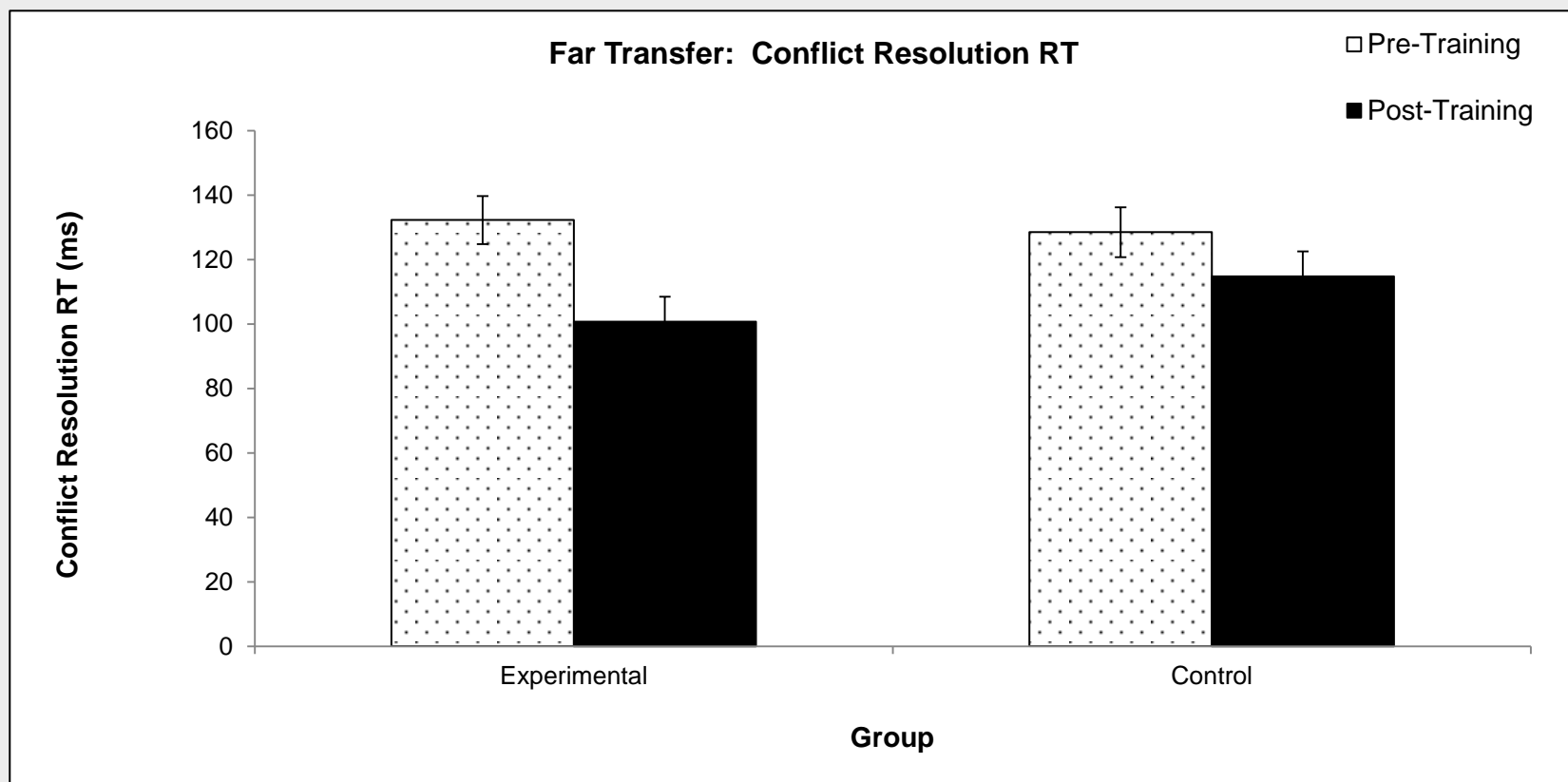
- No increase in Objective SA (SPAM RT) following training
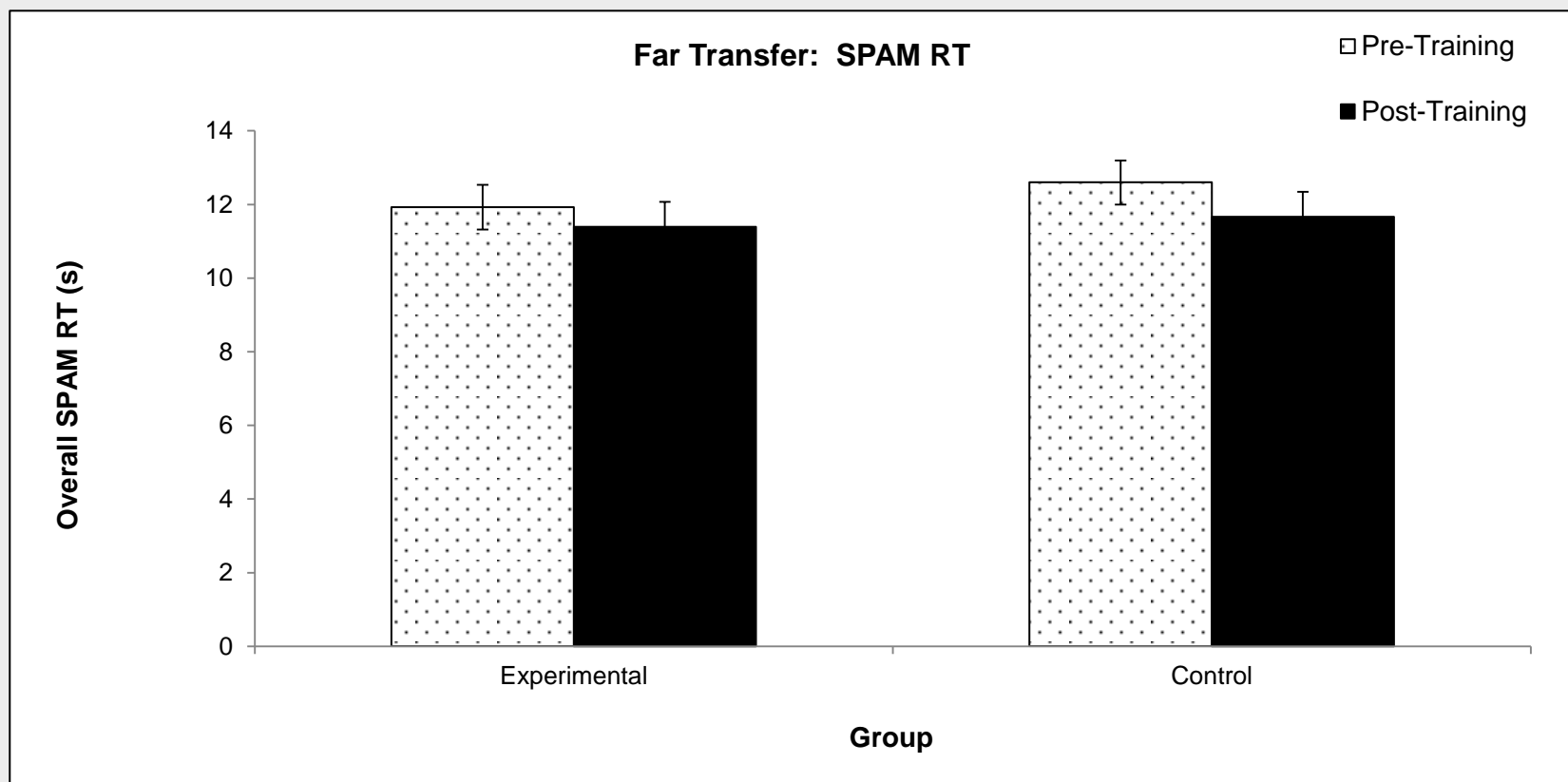
- Subjective SA increased following training. Trend for larger increase in experimental group

Far Transfer: SART Score
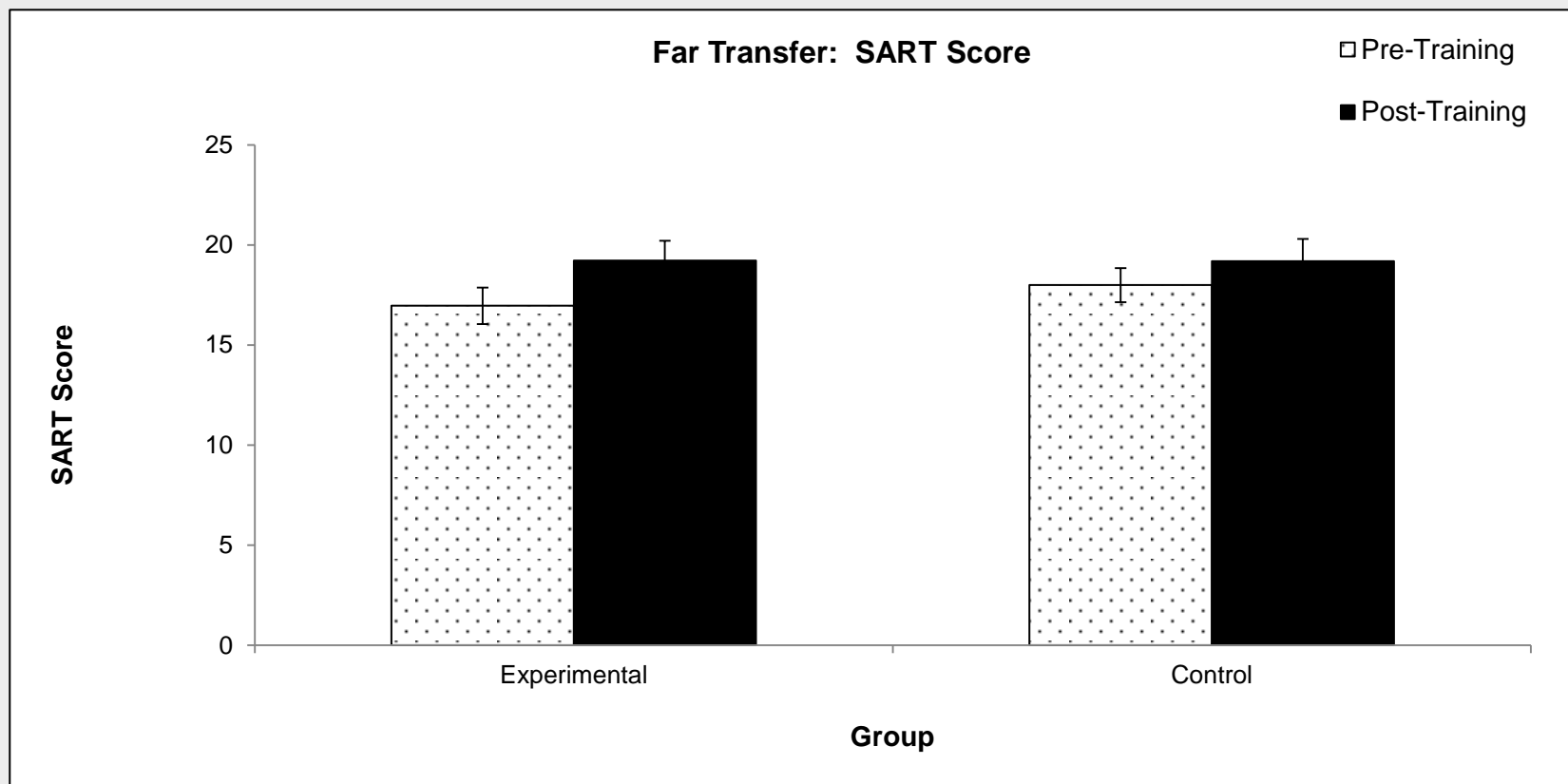
- Subjective workload decreased for both training groups.
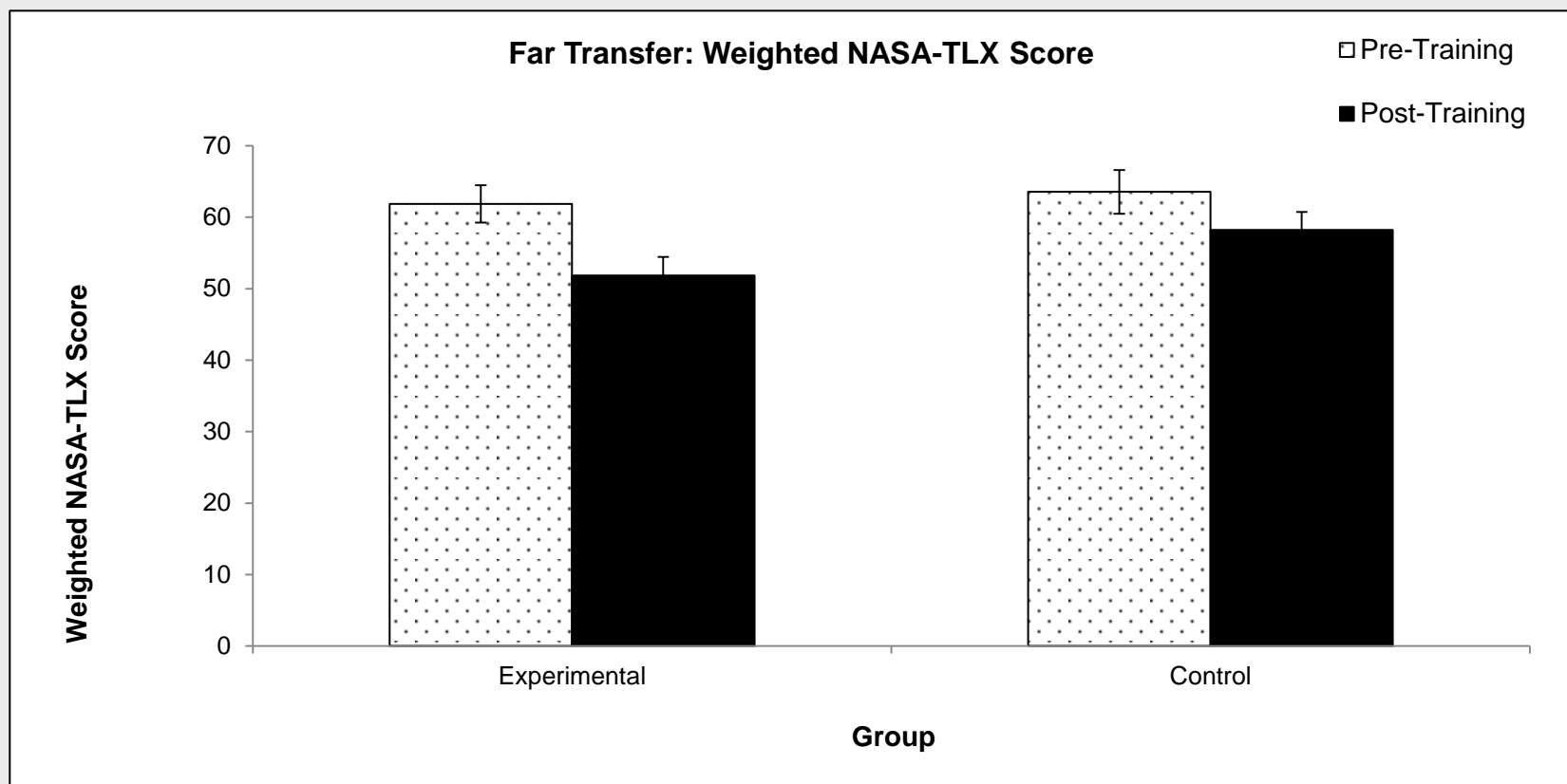
- Multitasking is trainable with a mobile app.

- There is effective near transfer of the training.
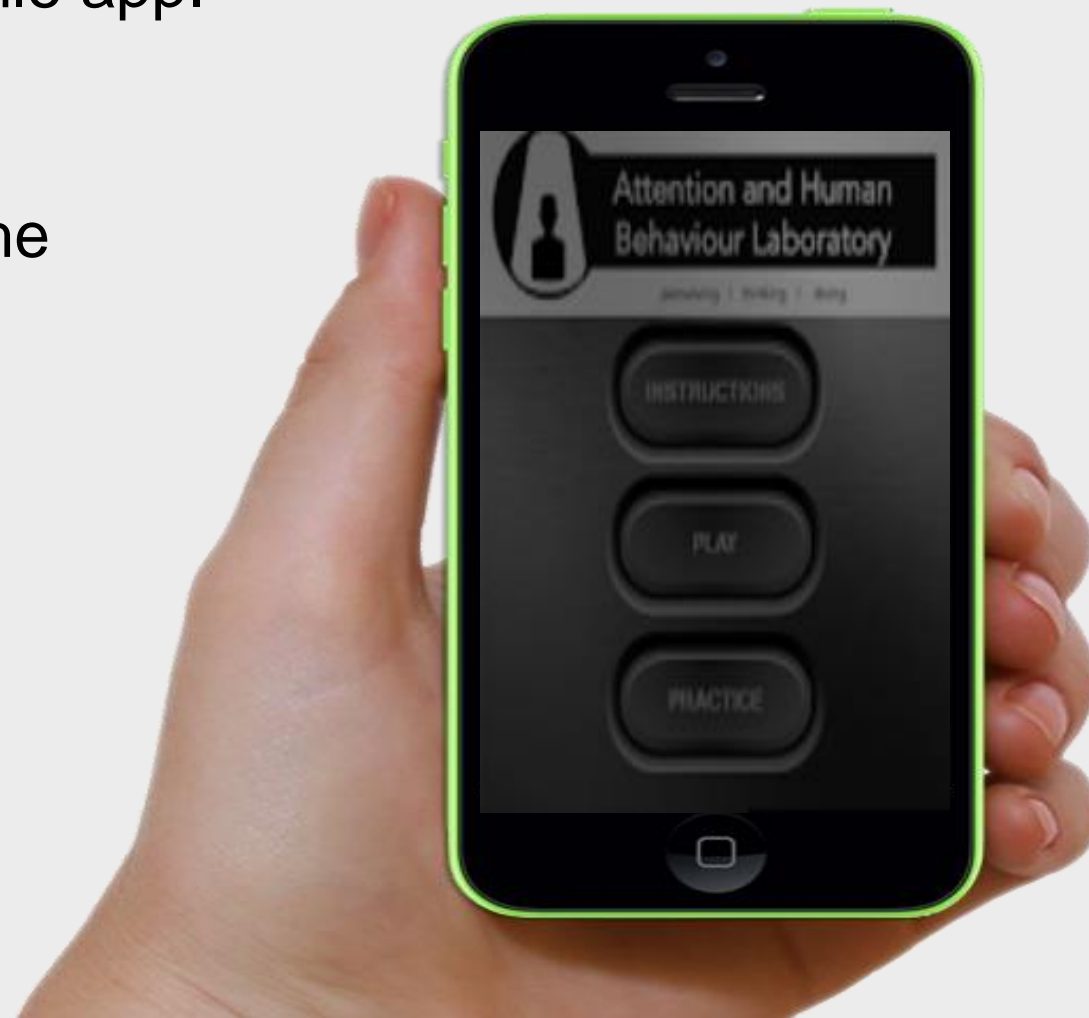
- Study not designed to make inferences about longevity of training effects

- Active control only (visual search task)

Limitations of Cost Accounting. Retrieved from
https://freebcomnotes.blogspot.com/2016/04/limitations-of-
cost-accounting.html on 3 Nov 2019.

Puckapunyal Military Area. Retrieved from https://www.speedproindustries.com.au/
puckapunyal-army-barracks on 21 July 2018.

- Mobile app training to improve job-relevant cognition is a realistic option

- Portable and benefits transfer across military roles

- research may also assist in training Australia's workforce:

Evans & Ryan. From Breitenfeld to Baghdad: Combined Arms Warfare. Retrieved from https://www.army.gov.au/our-future/australian-army-research-centre/australian-army-research-centre-publications/working-39 on 21 July 2018.
This Giant Autonomous Dump Truck Doesn't Have A Front Or Back. Retrieved from https://www.gizmodo.com.au/ 2016/09/this-giant-autonomous-dump-truck-doesnt-have-a-front-or-back/ on 21 July 2018.
Online Driving Courses Can Get You on the Road Faster. ImpreAutos. Retrieved from http://www.impreautos.com/auto-blog/online-driving-courses-can-get-you-on-the-road-faster/ on 21 July 2018.
Help wanted: Experienced air traffic controllers. General Aviation News. Retrieved from https://generalaviationnews.com/2018/03/16/help-wanted-experienced-air-traffic-controllers-2/ on 21 July 2018.

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Thank you

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