



Australian Government
Department of Defence
Science and Technology

Can the Human Microbiota Enhance Cognition for the Warfighter? A Scoping Study

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Biotech and the warfighter

- Enhancing warfighter cognitive and physical performance & resilience is a priority areas for Army.
- Biotech is a focus – EDTAS
- Emerging biotechnologies may be utilised to assess and/or enhance human cognitive performance.



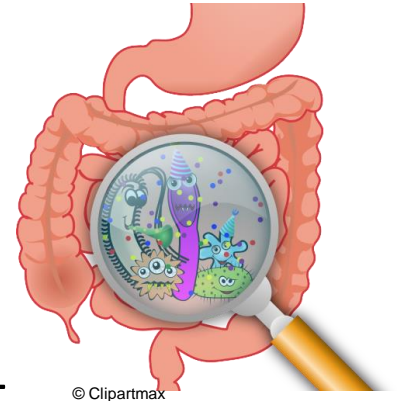
EDTAS
EMERGING DISRUPTIVE TECHNOLOGY
ASSESSMENT SYMPOSIUM



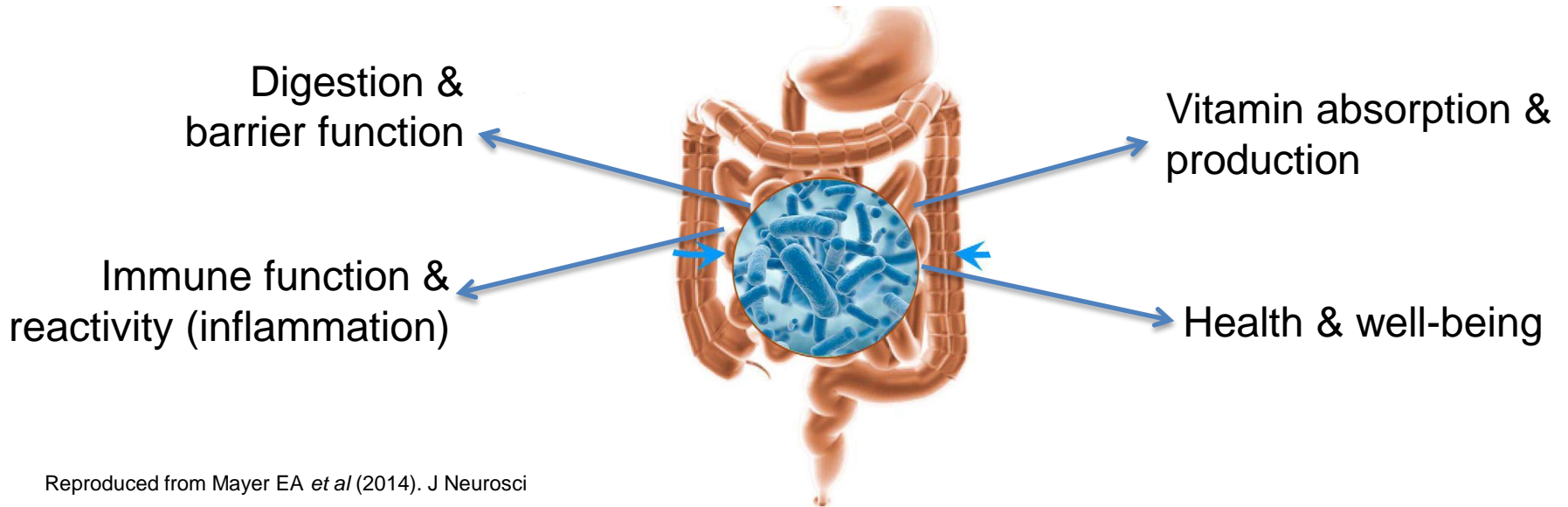
HUMAN BIOTECHNOLOGIES

The Human Gut Microbiota

- Emerging biotechnology for the enhancement of the future warfighter.
- What is the gut microbiota?
 - Microbials that live in the gut
 - Comprised of bacteria, viruses, pathogens and DNA fragments.
 - ‘microbiome’ refers to the genetic material that comprises this community.



Why is the microbiota important?



Reproduced from Mayer EA *et al* (2014). J Neurosci

Gut Microbiota and Cognition

- Sensitive to change:
 - Diet, environmental & chemical stressors, sleep, illness, medicines, etc.
 - The effect of ADF life and work on the gut microbiota and cognition?

- The ‘So What?’ For Defence
 - Is there a Microbiota signature linked to enhanced cognitive performance?
 - Can an intervention be employed to enhance desirable cognitive processes and therefore performance?

Aim

- Review research investigating the link between cognition (and associated brain behaviours) and the human gut microbiota

Why?

- Identify what is currently known about *enhancing* cognition via the microbiota
- The review will shape future Defence research programs

Methods

- Scoping review approach*
 - Grey literature (SearchLight) search (Title ONLY) + other known sources
 - published from Jan 2010 to 01 Nov 2018
 - Gut microbiota and influence/link to **cognition + brain structure and function** **

| Microbiota | Cognitive / Brain behaviour |
|--|--|
| <i>Lactobacillus, Bifidobacterium, probiotic, prebiotic, psychobiotic, microbiota, gut-brain-axis, gut microbiota, commensal bacteria, vaccae, lactobacilli, mycobacteria, immunomodulation, proinflammatory cytokine, gut permeability, microbial, microbiome, neurome.</i> | <i>Cognition*, memory, vigilance, decision making, attention, visuo-spatial, executive function, task-switching, emotion*, behaviour*, recognition, resting-state, salience, anxiety*, mood*, depression*, PTSD, stroop, go-nogo, n-back, functional state, neuroscience, psychobiology.</i> |

* Hilary Arksey & Lisa O'Malley (2005) . Int J Soc Res Method, 8:1, 19-32

** review also considered emotional, stress and depressed state, not reported

SEARCH

SearchLight Search items found
(n = 1678)Additional items from other
sources (n = 87)

SCREENING

n = 592 items to review **

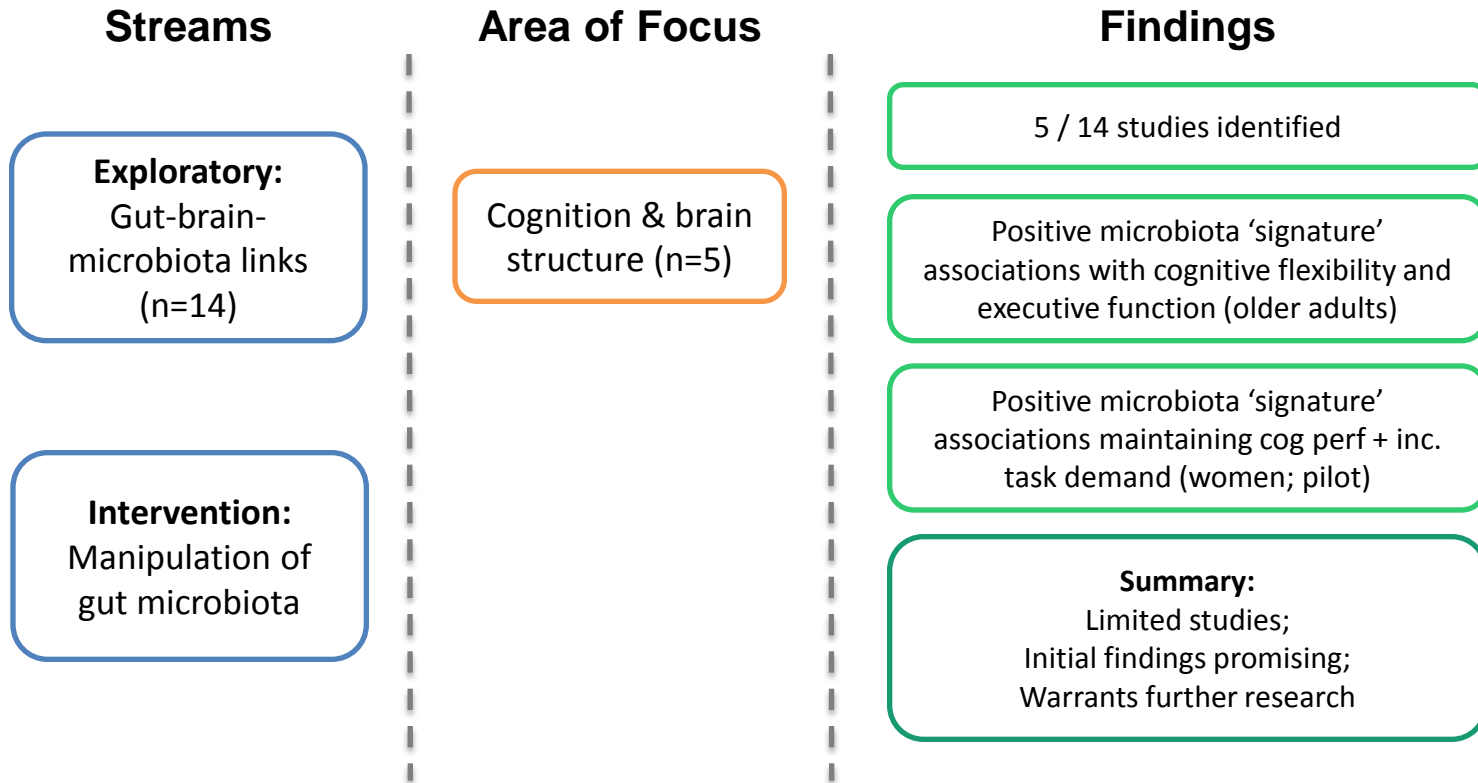
**post duplicates removed

Items Screened: Title (1) and
Abstract (2)Total Excluded
(n = 384)

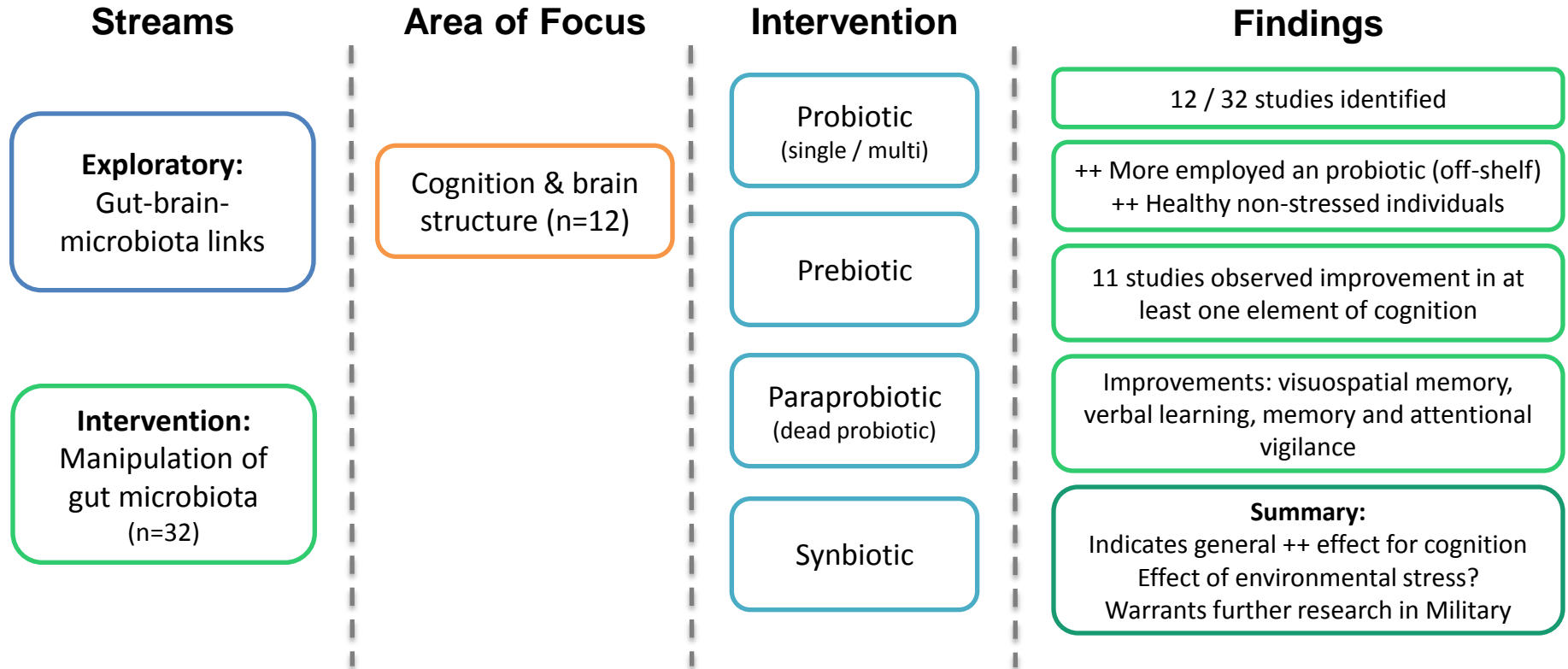
ELIGIBLE

Full-text assessed for eligibility
n=209Human research (n=49) &
Systematic literature review (n=10)Animal research &
narrative reviews
(n = 158)

Exploratory stream findings:



Intervention stream:



Possible high research pay-off areas for Army

- Microbiota ‘signatures’
 - Identify ‘signatures’ of enhanced cognition – job relevant?
 - Effect of repeated/accumulated stress – ‘at risk’ individuals
- Intervention / manipulation
 - Preferentially enhance cognition of the modern warfighter
 - Assessment of combination therapies (now and future)
- Positively augment other body systems
 - Physical, inflammation, immune, nutrient absorption & health

Recent Advances

- Swinburne (Dr. M Cooke) - HPRnet
 - Successful research proposal: *'Targeting the Gut Microbiome to Enhance the Health, Performance and Resilience of the Australian Warfighter'*
- Food & Nutrition (DST)
 - Future food products and interventions
- International Collaboration (US, CAN, UK, AUS, NZ)
 - the microbiota recognised as an avenue to enhance cognition



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ANY QUESTIONS

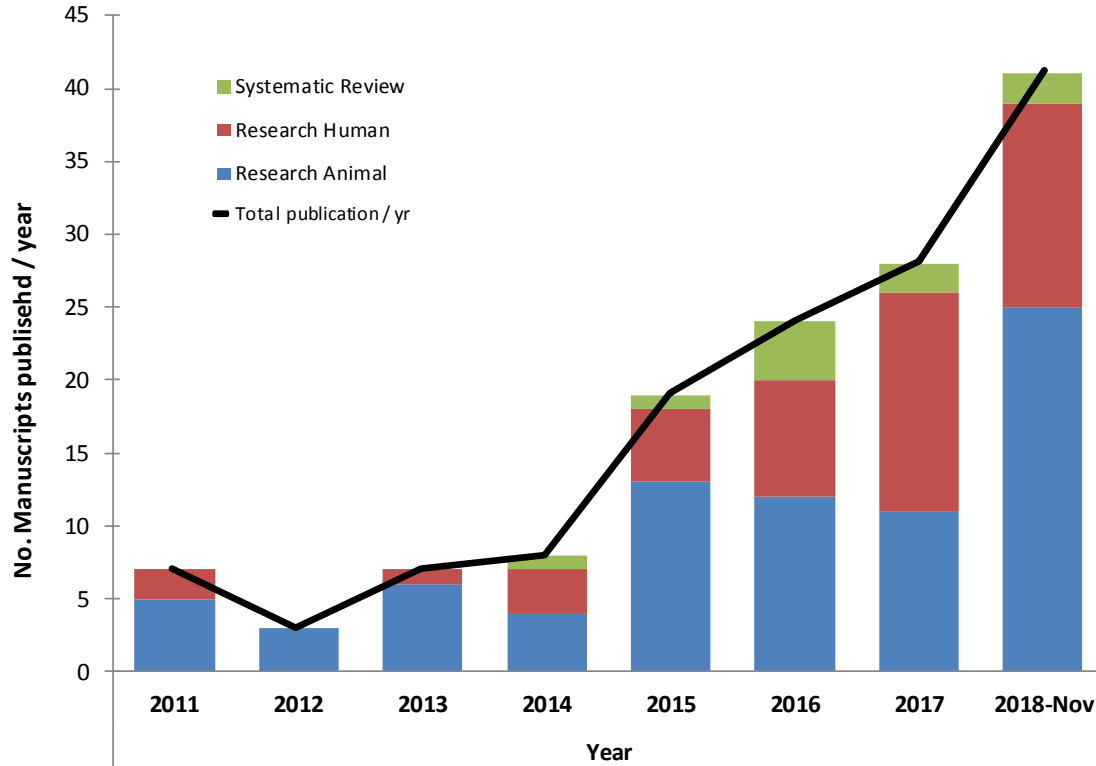
For further information please contact:

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Thanks for listening

Extra slides if appropriate

Results: Research frequency since 2010



Conclusion and Future Directions

- Enhancing (or preserving) cognitive performance of the warfighter in stressful and contested environments is a priority research area for Army.
 - The human gut-brain-microbiota axis is one avenue of research which can support this need.
- Understanding of the gut microbiota to enhance cognition should be a focus for the Army moving forward.