

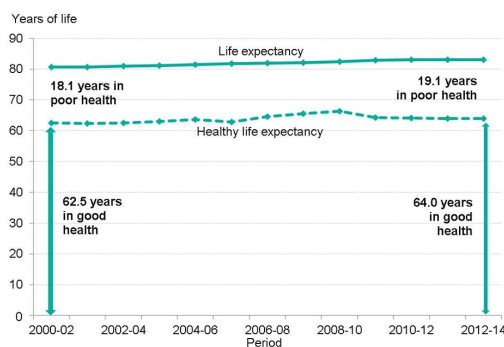
Effects of flavonoid-rich foods on cognitive function & mood in healthy children, young adults and older adults.

Prof. Claire Williams
University of Reading, UK

October 13, 2019

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Ageing and Incidence of Neurodegenerative Diseases



(data from Public Health England)

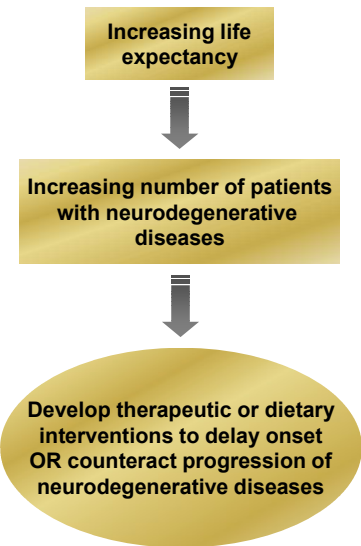
Age (years)	Prevalence of AD (%)	Prevalence of PD (%)
35-59	0.2	0.07
60-69	0.3	0.18
70-79	3.2	1.72
80-89	10.8	6.2

- Increased health care costs and general demands on the NHS (or other healthcare bodies)
- Reduced quality of life for the elderly population

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Why is there an interest in diet?

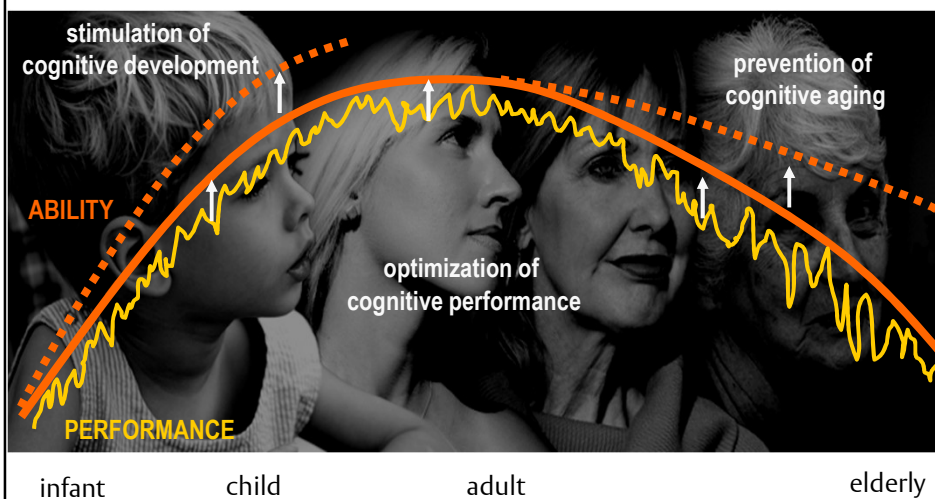


'5 portions of food & veg a day'
OR
'Eat the rainbow'

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Cognition over the lifespan



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Flavonoids & cognition: What's the evidence?

Human Epidemiology

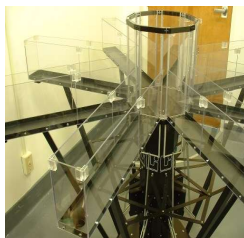


Dietary Intakes of Berries and Flavonoids in Relation to Cognitive Decline

Elizabeth E. Devore, ScD,¹ Jae Hee Kang, ScD,¹ Monique M. B. Breteler, MD, PhD,² and Francine Grodstein, ScD¹

ANN NEUROL 2012;

Rodent Research



Reversal of Age-Related Declines in Neuronal Signal Transduction, Cognitive, and Motor Behavioral Deficits with Blueberry, Spinach, or Strawberry Dietary Supplementation

James A. Joseph,¹ Barbara Stashuk-Hale,¹ Natalie A. Desrosiers,¹ Dorcas Reckziele,¹ Antonio Martin,¹ John J. McElwee,¹ and Paolo G. Bickner¹

¹Department of Agriculture, Food and Nutrition Research Center for Aging, Tufts University, Boston, Massachusetts 02111, and ²Department of Veterans Affairs Medical Center, Denver, Colorado 80202

The Journal of Neuroscience, September 15, 2010; 30(37):12411–12421

Human interventions



J. Agric. Food Chem. 2010, 58, 4389–4395

DOI:10.1021/jf900002

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Blueberry Supplementation Improves Memory in Older Adults¹

Robert Krikorian,^{1,2} Marcella D. Smeeta,¹ Tiffany A. Nash,^{1,2} William A. Kalin,^{1,2} Melissa S. Vincent-Turchia,^{1,2} Barbara S. Smith-Hill,¹ and James A. Joseph¹

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Sources of Flavonoids



Fruit and vegetables:
All classes of flavanoid



Tea: Flavanols

Citrus:
Flavanone



Red wine: Flavanols & Flavonols

Berries:
Anthocyanins



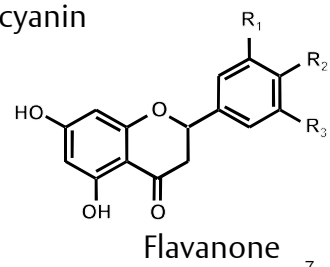
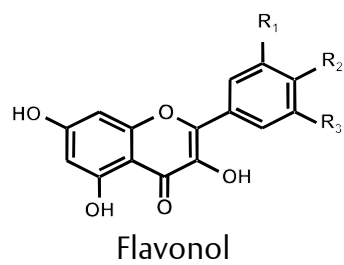
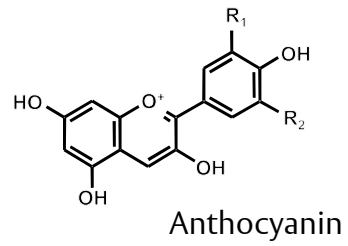
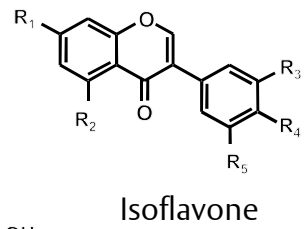
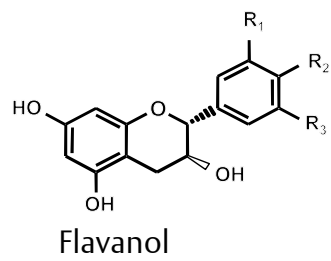
Cocoa: Flavanols and procyanidins



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Structure of Flavonoids

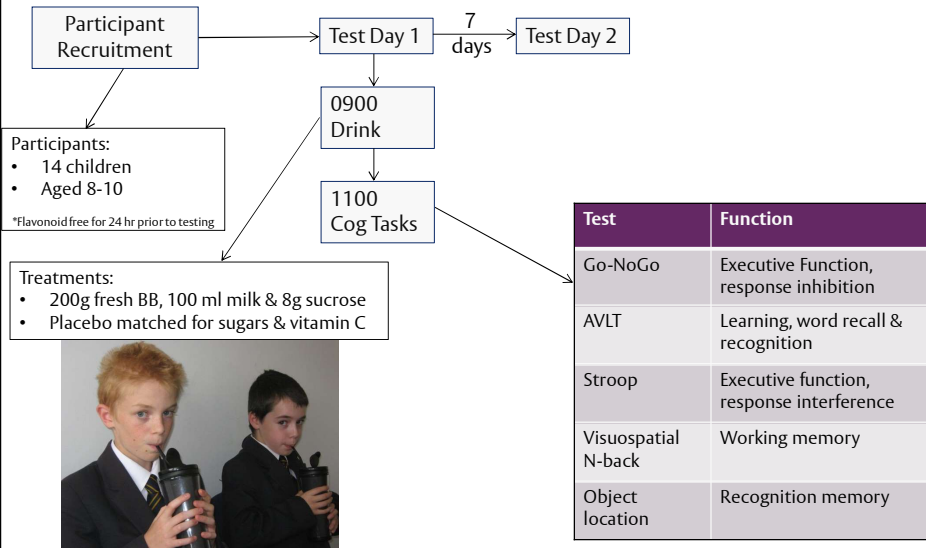


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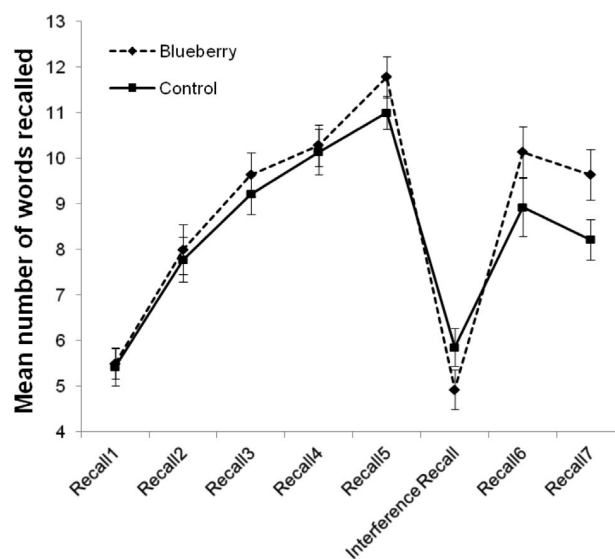
Whyte & Williams (2015)



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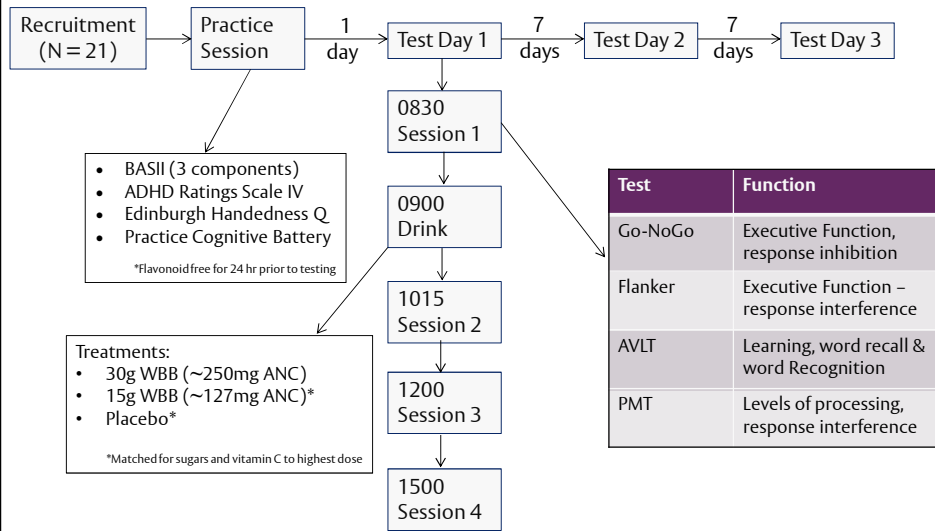
Whyte et al (2015): Better delayed recall of a list of learned words after BB treatment



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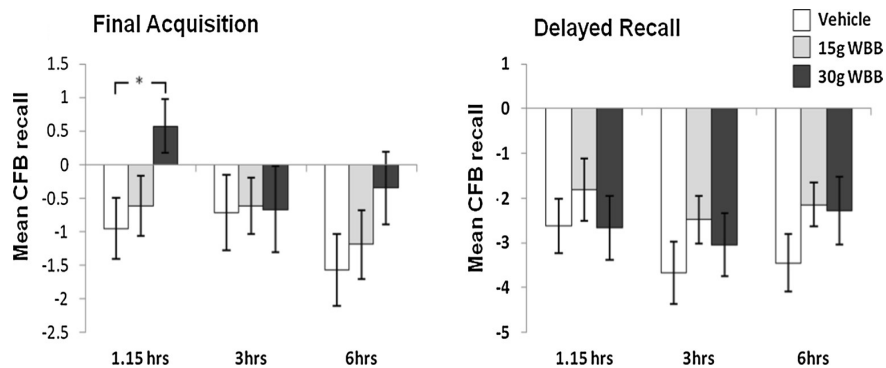
Whyte, Schafer & Williams (2016)



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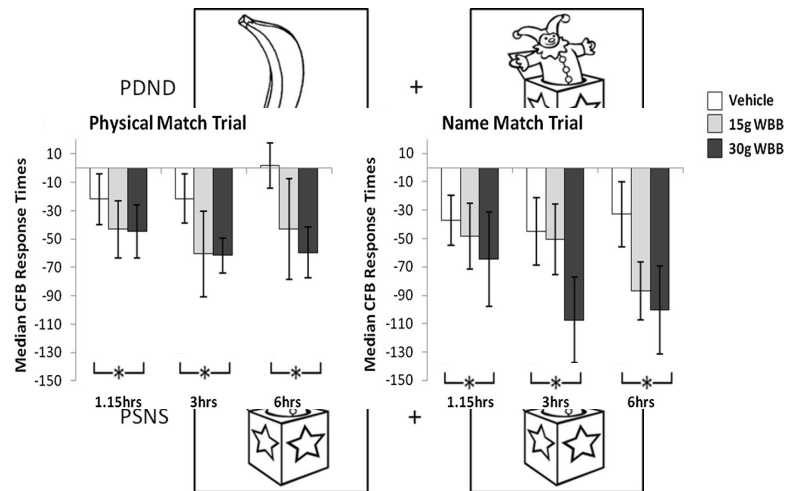
Whyte et al (2016): Similarly after WBB, we see improved word acquisition and recall



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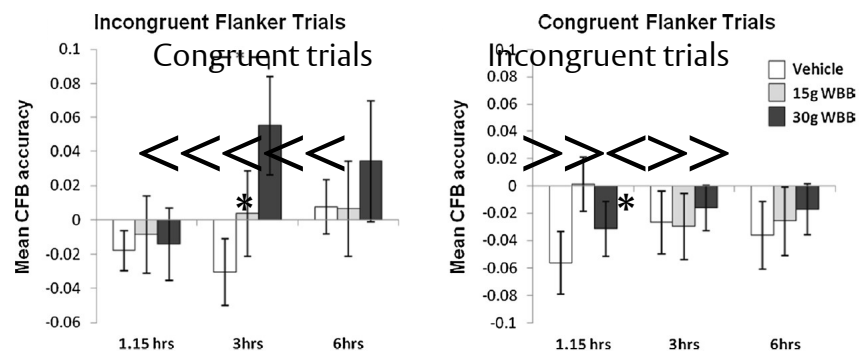
Whyte et al (2016): Improved picture-match Performance, particularly on the harder task



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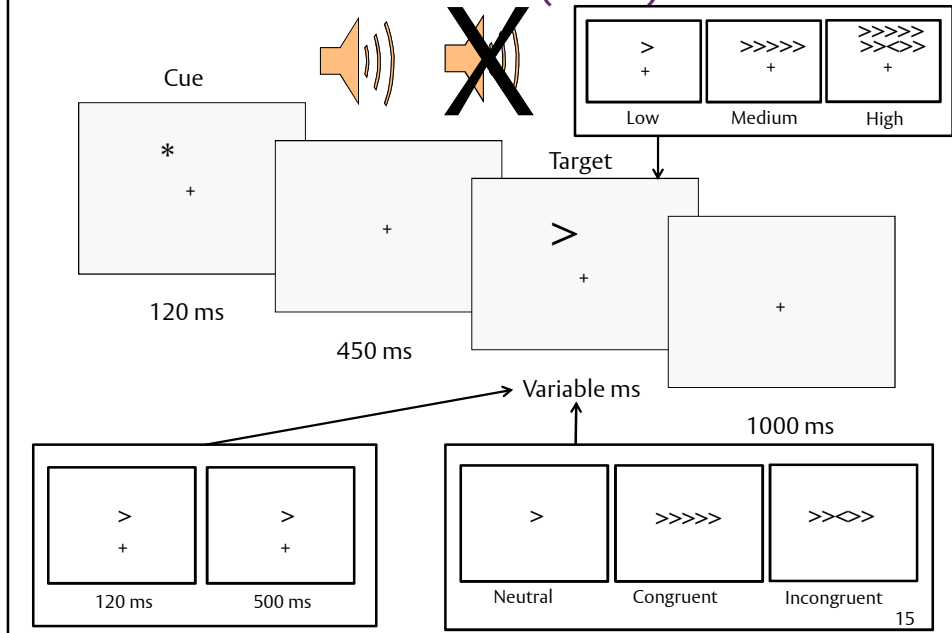
Whyte et al (2016): WBB also boosted EF, particularly on cognitively demanding trials



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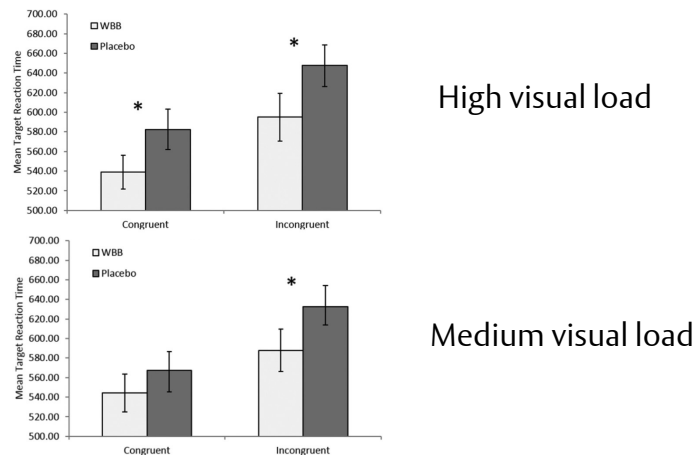
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Attention Network Task (ANT)



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Whyte et al (2017) & Barfoot et al (2018): Better performance after WBB is dependent on cognitive demand of the trial

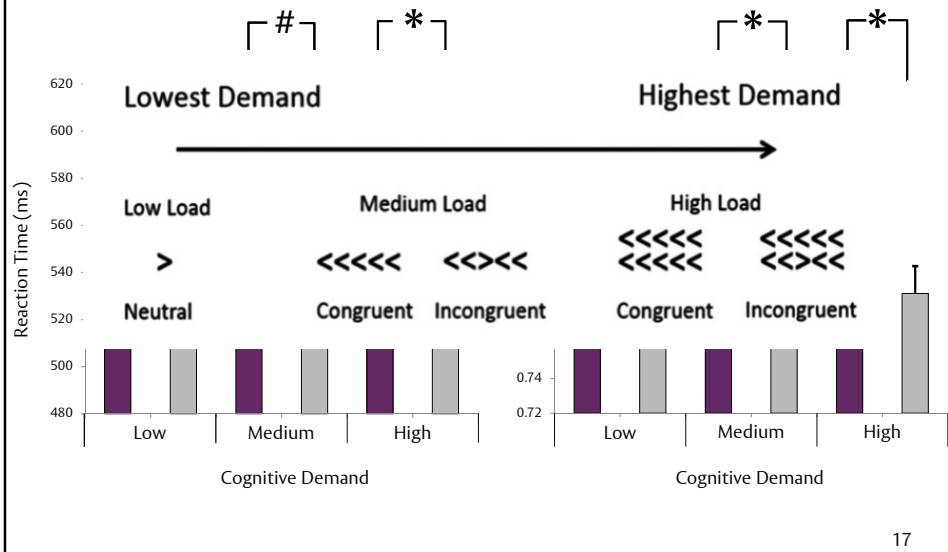


Data shown from Whyte et al (2017)

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Unpublished data: Similar benefits of WBB are seen in children with ADHD



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Summary

- Blueberry treatment can produce significant benefits to episodic memory and executive function in 7-10 year old children following acute administration
- Importantly:
 - Cognitive effects occur at physiologically relevant intakes (1-2 portions/day)
 - Cognitive demand of the task is critical with impact of WBB becoming greater as demand increases

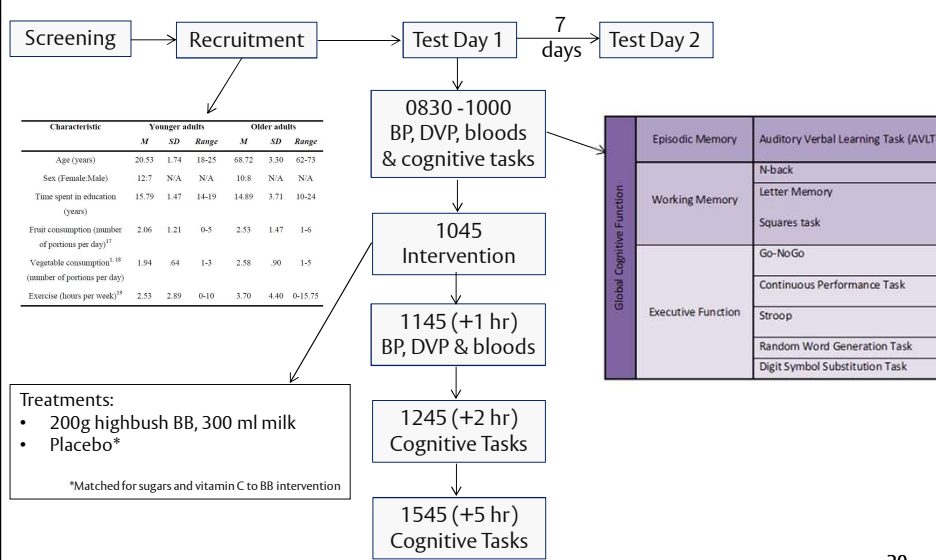
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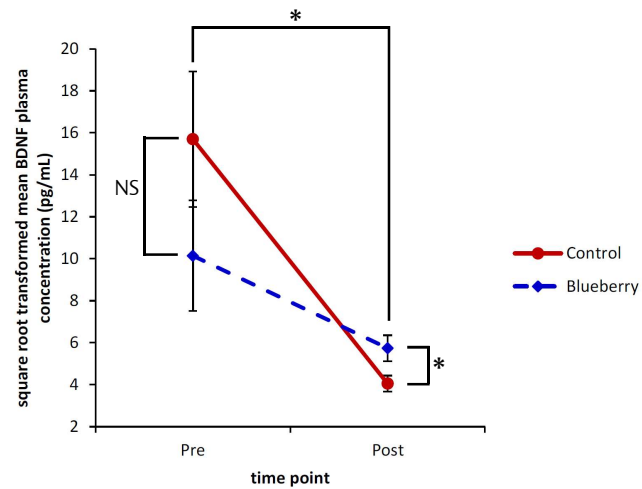
Dodd, Williams, Butler & Spencer (2019). Nutrition & Healthy Ageing - older adult data



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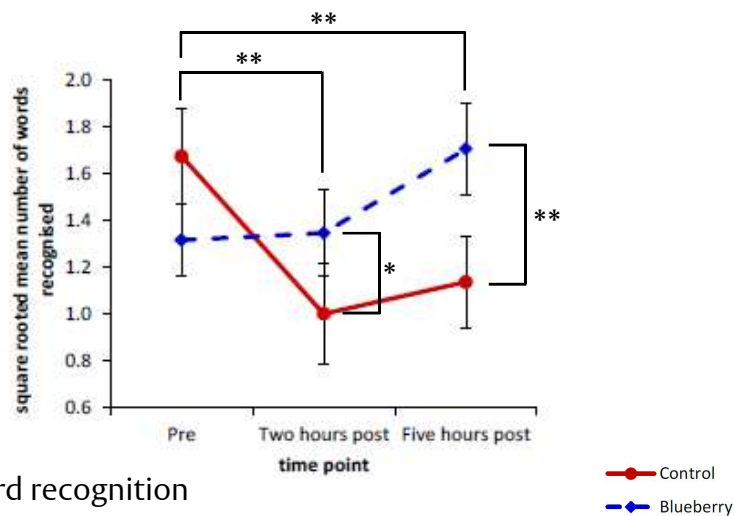
Older adults fail to show changes in vascular measures, but a significant smaller decrease in BDNF levels were seen following BB



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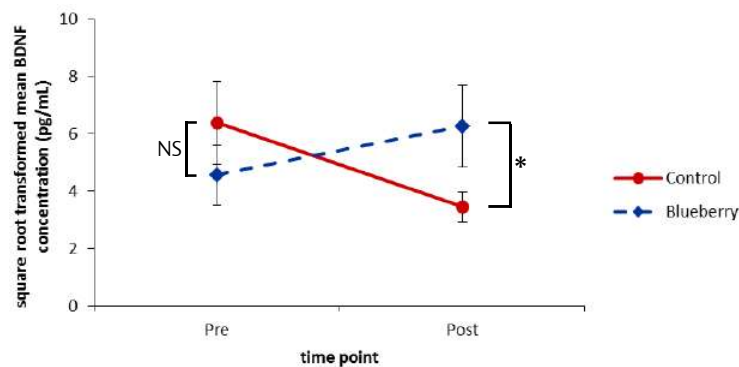
No changes in global cognitive function were seen in Older Adults, but episodic memory was significantly improved



i.e. AVLT Word recognition

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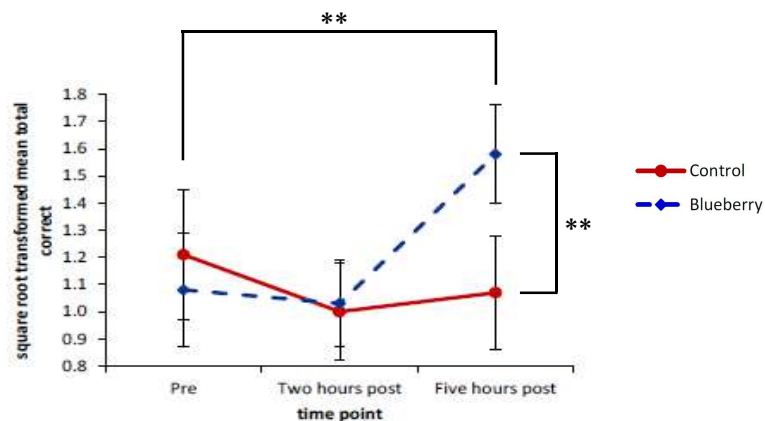
Similarly, young adults do not show any effect on vascular measures, with a significant increase in BDNF levels following BB



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Young adults show no change in global cognitive function but benefits to WM & EF were seen following BB



i.e. Letter Memory Updating

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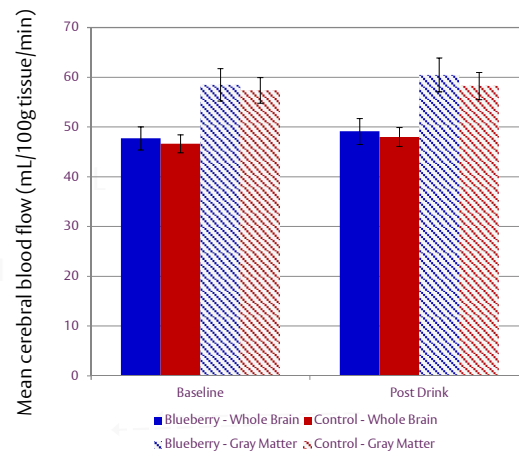
Pilot Study: Brain Imaging

- Aim
 - To investigate the whether BB supplementation could alter cerebral blood flow (CBF)
- Methodology
 - Randomised, controlled, cross-over intervention study
 - N= 12 healthy younger adults aged 18-25
 - Blueberry (579mg anthocyanidins) vs control
 - Scanned at baseline and 1 hour post-intervention
 - Arterial Spin Labelling to measure CBF

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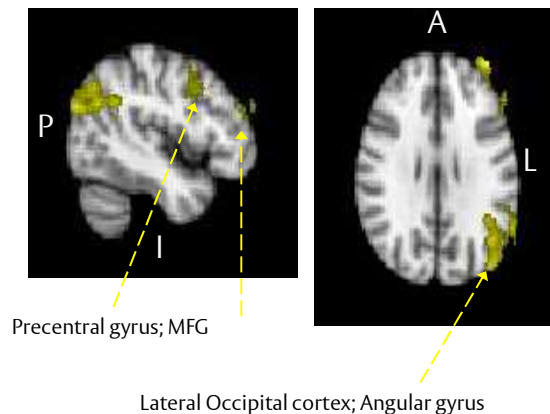
Brain Imaging: Global CBF



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Brain Imaging: Regional CBF



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Summary and Discussion

- No effect of acute BB supplementation
 - On vascular function (BP, SI)
 - On global cognitive function
- Some aspects of cognition were boosted by acute BB
 - Improved letter memory updating & DSST performance (young adults)
 - Improved immediate word recall & word recognition (older adults)
 - BDNF levels were raised in both groups? Needs follow-up
- Regional changes in CBF following acute BB supplementation
 - Supports behavioural findings of younger adult study
 - Increased blood flow to angular gyrus and precentral & MFG
- Acute BB treatment improves some cognitive abilities due to impact on cell signalling pathways (BDNF-mediated?), in addition, to vasodilatory properties and CBF increases

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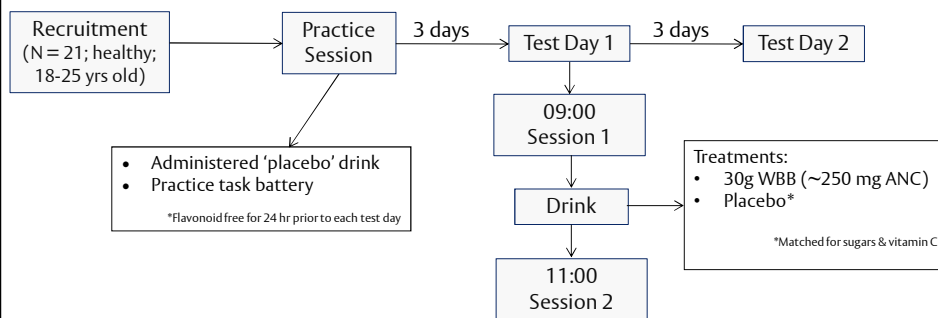
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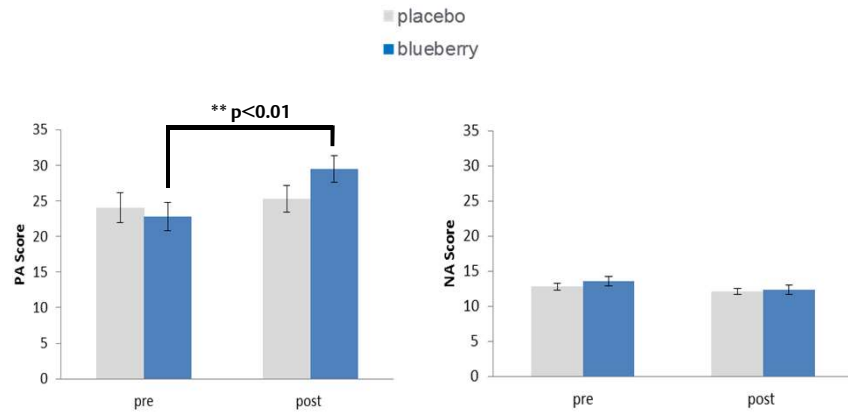
Khalid et al (2017)



Function	Task
Executive function	Modified Attention Network Task (MANT)
Mood	Positive & Negative Affect Scale (PANAS)

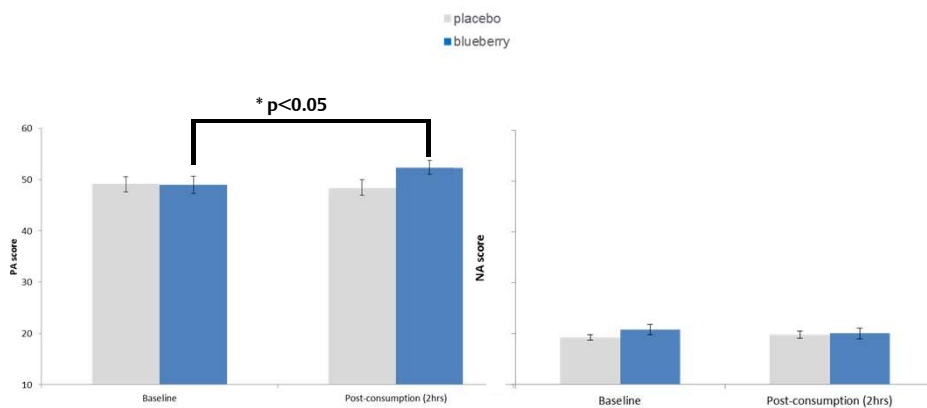
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BB treatment produces a boost in short-term positive affect



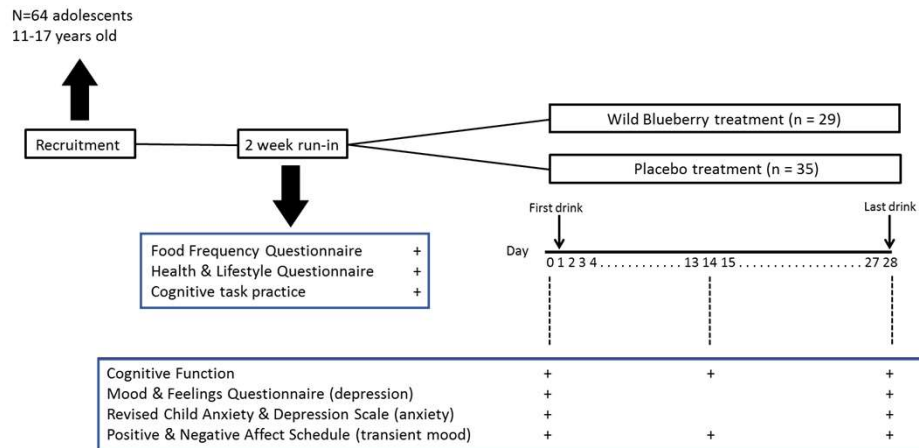
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Interestingly, we see the same boost to positive mood in children aged 7-10



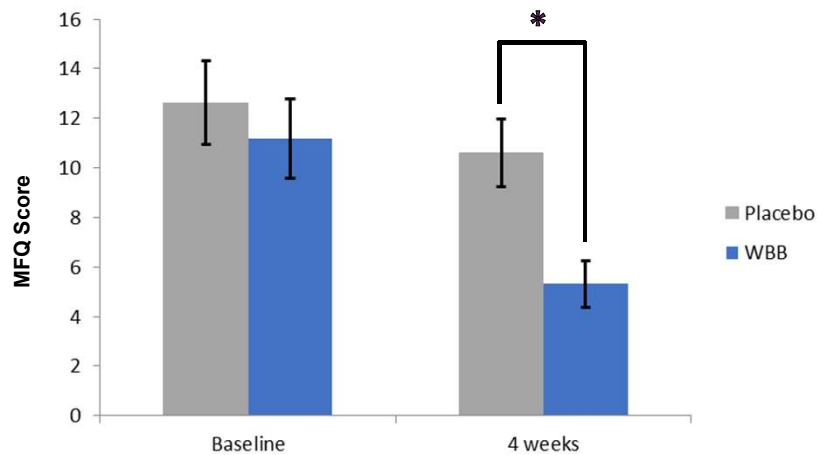
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Can we see sustained change in positive mood from repeated daily intake?



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No changes in anxiety, but there is a decrease in depressive symptoms after BB



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Summary

- BB treatment produces short-term (2 hour) increases in transient positive affect in both children and young adults
- Repeated daily dosing for 4 weeks produces decreases in perceived depressive symptoms, but not anxious symptoms, in adolescents

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Acknowledgements



Wild
Blueberries™

BBSRC
bioscience for the future

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