Short & Long term effects of dietary habits on Cognitive Function

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• What is cognitive function?
• How can we measure cognitive function in response to dietary components?
  • Acute vs chronic effects
• Target groups
  • Lifespan - children, healthy young adults, middle aged, elderly
• Evidence & Mechanisms
  • Specific components – specific (direct) effects?
  • Indirect effects – via secondary routes e.g. Improved glycaemic regulation, reduced CVD risk parameters, obesity etc
• What do we need to find out?
  • Components, mechanisms, duration of effect, critical window....
  • Novel ingredients, anti-oxidants, isoflavones, flavonoids, vitamins etc
What is Cognitive Performance?

Perception, understanding & action

Complex tasks – operating machinery, driving, learning, making decisions

Evolved to give us control over the environment

We are all using our cognitive abilities all the time
The shape of things to come?

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Domains of Cognitive Function

Perception – attention (vigilance)
Information processing
Learning & memory
  - acquisition
  - storage & retrieval
  - recall & recognition
Problem solving
Motor control
  - reaction time:
  - tracking
Abstract Visual Pattern Learning

Series of patterns shown at fixed rate
Recognition & discrimination of original stimuli from distractors
Measures - response time, accuracy and errors
Spatial Tests

<table>
<thead>
<tr>
<th>Object Location</th>
<th>Accuracy of Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task requires memory of spatial location of objects on board and replacement of objects in correct position</td>
<td>Response Time Errors</td>
</tr>
</tbody>
</table>

**Object Location**

- Trophy
- Car
- TV
- Mobile Phone
- Glasses
- Bicycle
- Car Horn
- Pencil
- Camera
- Bed
- Phone
- Key
- Alarm Clock
- Book
- Scissors
## Spatial Tests

<table>
<thead>
<tr>
<th>Trophy</th>
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<tr>
<td>Glasses</td>
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<td>Bed</td>
<td>Book</td>
<td>Key</td>
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<tr>
<td>Bell</td>
<td>Phone</td>
<td>Clock</td>
<td>Scissors</td>
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</table>
Review

Acute effects of macronutrient manipulations on cognitive test performance in healthy young adults: A systematic research review

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Acute interventions in young healthy adults

- 31 studies
- 134 cognitive outcome measures
- Manipulations – glucose, macronutrients
- Memory
- High demand situations

- 62 measures showed significant effects

Hoyland et al. (2008)
Glucose, GI & cognitive function
Human Brain: energy

2% of body mass (~3 Ib)

- 20% energy (glucose and oxygen)
- 2-3,000 pints blood/day pass through the brain
Glycaemic Index & Cognition

Between subjects design
Biscuits or cereals

High GI Breakfast (65)
• SAG: 0.1; RAG: 42.3

Low GI Breakfast (42)
• SAG: 15.8; RAG: 39.5

Verbal memory

Benton et al., 2002

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Continuous glucose profiles before and after 5 different breakfasts

- Cereal A
- Cereal B
- Water
- Toast & Yogurt
- Cereal C

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Immediate verbal recall

**Change from baseline in immediate recall:** Breakfast * session interaction

Later in the morning: Cereal B - better recall relative to baseline than water or Cereal C. Toast/Yoghurt better recall than water or Cereal C

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Conclusions so far……

Glucose doesn’t always improve cognition

Differences - subtle

• not GI dependent
• Glycaemic response & cascade of events

Effects –

• not immediate
• Can be apparent when blood glucose levels are similar
Other times of day

Post Lunch Dip
Beat afternoon apathy

A new survey among 1,000 British office workers found many suffer from ‘afternoon apathy’, a severe after-lunch energy slump that affects brain power, output and memory. PETA BEE investigates

LIFESTYLE is almost certainly to blame for afternoon apathy, a condition estimated to cost the British economy £3.9 billion a year and cause efficiency to drop by 10 per cent.

In research carried out by Ryvita, more than half the women and more than a third of the men questioned admitted suffering from the syndrome, which is thought to affect around 1.2 million employees.

‘Most Britons eat sloshy lunches that leave them feeling lethargic,’ says nutritionist Fiona Hunter.

‘People think high-carbohydrate foods boost energy but they have the opposite effect, so you are energy-sapped when you return to work.’ Here’s how to avoid afternoon apathy:

- Deskbound: Poor diet and lifestyle can lead to lethargy after lunch

  hummus or peanut butter are great energy boosters,” says Fiona. Three breathing exercises or a brisk walk is ideal. A 10-minute walk leaves you

  British School of Complementary Therapy recommends peppermint activity but don’t overdose it as six cups or more will leave you flagging.

FAD OF THE WEEK

Pizazz Powernapping Tool

MILLIONS suffer from afternoon apathy syndrome but scientists reckon a short nap after lunch can improve memory and concentration, reduce stress and boost productivity. So if you find it difficult to switch off and even harder to wake up, a gadget called the Pizazz may be your saviour. It looks like a small MP3 player and plays random sounds to induce a relaxed state.

You can programme it to run for up to an hour – which was as long as I could stand listening to its annoying American voiceover.

The only time it really worked for me was at home in bed. I fell asleep a few minutes into the programme so I’m not sure if I derived any benefit. But I wake as soon as it finished and I definitely did not feel as tired afterwards. Shame I wasn’t going out.

Pizazz costs £24.75 including P&P and comes with a 30-day money-back guarantee. Details: 0890 781 2401 www.pizazz.com
Effect of high & low GI at lunch on Post Lunch Dip

3 meals
cognitive performance, subjective state & appetite in relation to the post-lunch dip

A - HGI - CHO
B - LGI - CHO
C - HGI - HP
Blood glucose after each meal does not relate to mental performance
Blood glucose after HGI & LGI meals alters experience of the Post Lunch Dip

Mental alertness after HGI-CHO, LGI-CHO & HP meals

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Snacking
Snacking

Accounts for substantial proportion of EI

• Memory improved 20mins after mid-morning snack (Benton et al., 2001)

• Confectionary snack mid-morning – better attention (Busch et al., 2002)

• High CHO snack mid-afternoon – improved verbal memory, vigilance, attention & arithmetic (Kanarek & Swinney, 1990)

• Mid-afternoon snack improved spatial memory in male UGs and school boys but not attention (Mahoney et al., 2007)
The proportion of items correctly recalled in the map task for the confectionery group and the placebo group.

The proportion of countries left blank in the map task for the confectionery group and the placebo group.

Mahoney et al., 2007
Novel foods/ingredients

Lots of interest in:

- Blueberries
- Isomaltulose
- Gingko biloba
- Ginseng
- Flavonoids
- Soy
- Curcumin
- Goji berry
- Red wine!!

And many others……….
Polyphenols & Cognitive Function

Polyphenols – micronutrients in plant derived foods

Wine & tea – dual effects on health & cognitive function

- Possible increase in cerebral blood flow
- ECGC (tea) associated with neuroprotection
- Reduced risk of cognitive decline/dementia
Blueberry Supplements reverse deleterious effects of ageing on motor behaviour

Reading study - first in humans
Acute - no effects

prevent behavioural deficits in mice
- antioxidant effect
(Joseph et al., 2003)

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Rats are not little humans & humans are not big rats
Effects of Chocolate, wine and tea on cognitive function
Nurk et al., (2007)
Future Directions

• Changing nature of diet, health & population
  • Understand effects of altered eating patterns
  • Effects of under & overnutrition
• Cognitive benefits could be conferred directly –specific nutrients or overall intake
• Or via other effects on health e.g. better gluco-regulation, reduced triglycerides or other markers
• Important to preserve cognitive capacity in ageing

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Long term dietary advice – beneficial for health
But less likely to be of interest to industry

• Product & Ingredient Claims – short term effects
• EFSA regulations:
  • A health claim is any statement on labels, marketing or advertising that health benefits can result from consuming a given food, for instance that a food can help reinforce the body’s natural defenses or enhance learning ability.

• EFSA approval – goal is to be fair to the consumer
EU Regulation on the use of nutrition and health claims for foods introduced December 2006.

- aims to ensure that any claims made about foods are clear, accurate and substantiated by scientific evidence.

- Establishing an EU-wide list of permitted health claims
- Article 13 -generic health claims
- Article 14 -disease reduction/claims relating to children
- Assessed on a case-by-case basis – many rejected already!
## Current EFSA opinions relating to cognition

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Claim</th>
<th>Opinion</th>
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</thead>
<tbody>
<tr>
<td>Manganese</td>
<td>Normal cognitive function</td>
<td>Negative</td>
</tr>
<tr>
<td>Selenium</td>
<td>Normal cognitive function</td>
<td>Negative</td>
</tr>
<tr>
<td>Inositol</td>
<td>Normal cognitive function</td>
<td>Negative</td>
</tr>
<tr>
<td>Iron</td>
<td>Normal cognitive function</td>
<td>Positive</td>
</tr>
<tr>
<td>Zinc</td>
<td>Normal cognitive function</td>
<td>Positive</td>
</tr>
<tr>
<td>5-HTP</td>
<td>Attention</td>
<td>Negative</td>
</tr>
<tr>
<td>Vitamin B5</td>
<td>Mental performance</td>
<td>Positive</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Mental performance</td>
<td>Negative</td>
</tr>
<tr>
<td>Phospholipids</td>
<td>Memory, learning capacity &amp; attention</td>
<td>Negative</td>
</tr>
</tbody>
</table>

These are accepted/rejected on the basis that a cause and effect relationship can/can't be established.

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Some key issues

Dietary Component
Dose range or daily serving, measurable, well characterised?

Cognitive Functions
Specific domains assessed by appropriate and suitably demanding tasks for the target population

Desired outcome
Prevention of impairment
Enhancement of performance

Duration of effect
Short, medium or long term

Target population
General healthy, elderly, children, patients e.g. diabetic

Cause & effect established?
Thank You!

BioPsychology Group

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Alexa Hoyland
Dan Lamport
Fiona Croden
Diana Camidge

Claire Hill
Maria Bryant
Mechanism of Action

Ingested Dietary component

Physiological change in central process

Improved Health e.g. Reduced BP, Obesity, improved Glycaemic control

Cognitive Function

Known?
Biomarkers - potential vs known
Time course of action
Age/gender dependent effects - soy IF