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The effect of glycaemic index of breakfast cereal on children's cognitive performance

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British Psychological Society
Developmental Conference
Edinburgh, September 2005

Background



- Rising demand on cognitive and intellectual performance



- Imbalanced diet



- The effects of *diet* on cognitive performance



- The effects of *breakfast* on children's cognitive performance

Background



- Iowa Breakfast Studies.
Tuttle et al (1949; 1950; 1952; 1954)



- Indicate that the consumption of breakfast can enhance cognitive performance



- Surge of research into the effects of breakfast on cognitive performance



Background



- Skipping breakfast has detrimental effects (e.g. Smith et al, 1994)



- Consumption of breakfast has positive effects (e.g. Pollitt et al, 1998)



- Wesnes et al (2003)

- 9- to 16-year-olds
- Cheerios, Shreddies, glucose drink or no breakfast
- Computerised tests of attention and memory
- Prior to and at 30, 90, 150 and 210 minutes after breakfast



Background



- Glucose Drink & No Breakfast:

Decline in Focused Attention and
Episodic Memory



- Cheerios & Shreddies:

Decline seen in Focused Attention and Episodic
Memory was significantly reduced



- Breakfast in the form of cereal can have a
positive effect on cognitive performance in
school children



Background



- Breakfast compared to *no* breakfast



- *Composition* of breakfast

- The brain's main source of energy is glucose



- Increased blood glucose has positive effect on cognitive performance

(e.g. Martin & Benton, 1999; Sunram-Lea et al., 2002)



Background



- The body's main source of glucose is carbohydrates
- Carbohydrates exerts its effects on blood glucose in two ways

Background



- High Glycaemic Index ($GI > 70$)
- Low Glycaemic Index ($GI < 40$)

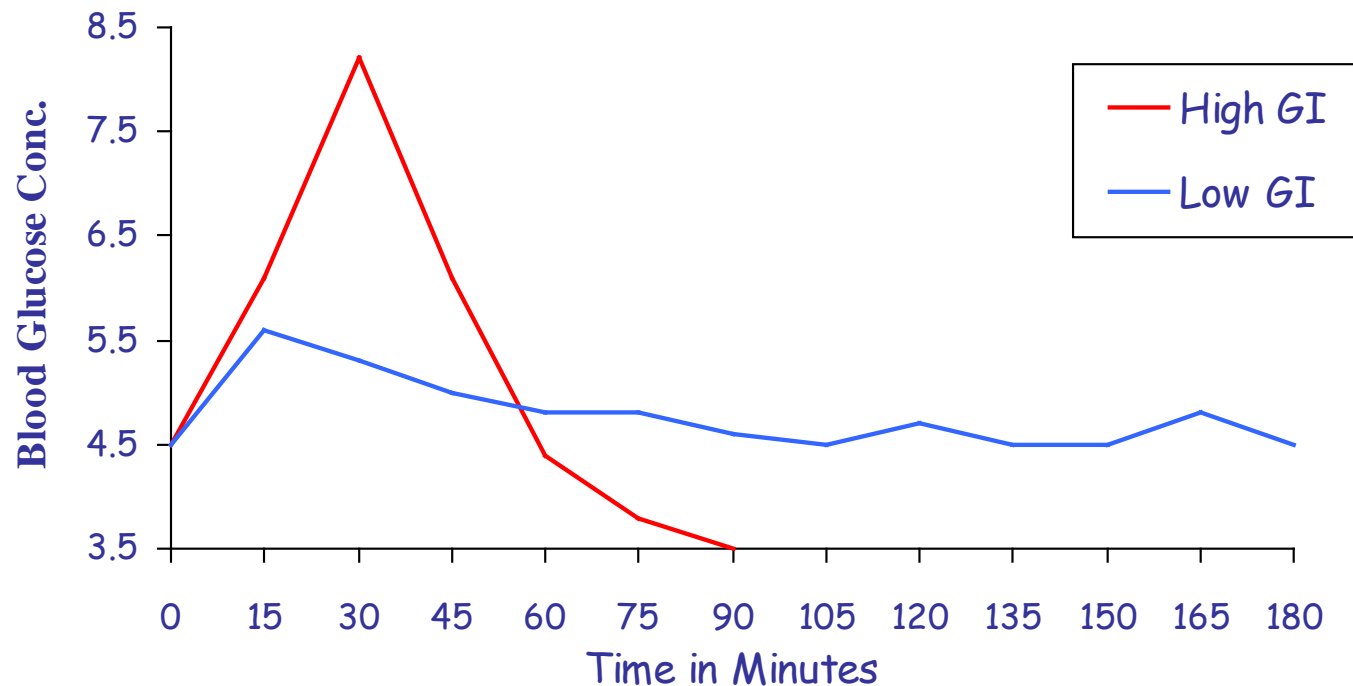


Fig. 1: Blood glucose response after intake of high and low GI carbohydrates

Present Study



Aims

- a) Does the glycaemic index of breakfast have an effect on cognitive performance?



Prediction: low rather than high GI breakfast more beneficial to performance, particularly in late morning



- b) Are the effects found across all cognitive functions or restricted to particular processes?



Participants



- 6- to 11-years (N = 64)
Mean age 9:3 (range 6:8 -11:7); 38 females, 26 males



- Three age groups:

7-year-olds (N = 18)

Mean age 7:2 (range 6:3-7:11); 10 females, 8 males



9-year-olds (N = 23)

Mean age 9:1 (range 8:2-9:11); 10 females, 13 males



11-year-olds (N = 23)

Mean age 11:0 (range 10:0-11:7); 18 females, 5 males

Procedure



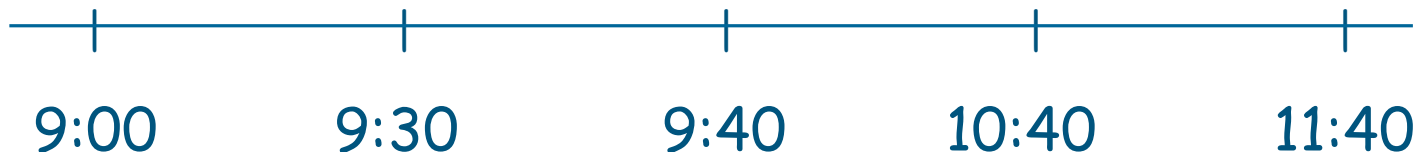
- Two consecutive days
- High GI: Coco Pops
(35g with 125ml semi-skimmed milk)



- Low GI: All Bran
(35g with 125ml semi-skimmed milk)



Baseline Breakfast Test 1 Test 2 Test 3



Procedure



Cognitive Drug Research (CDR)
Computerised Assessment Battery (Wesnes et al, 2003)



Word Presentation
Immediate Word Recall
Picture Presentation
Simple Reaction Time
Digit Vigilance
Choice Reaction Time
Spatial Working Memory
Numeric Working Memory
Delayed Word Recall
Delayed Word Recognition
Delayed Picture Recognition



Fig. 2: CDR Test Battery

Analysis of Data



- Focused Attention



- Sustained Attention

- Working Memory



- Episodic Memory

- Speed of Memory



Analysis of Data



- Change from Baseline

Test 1/2/3 - Baseline



- (3 x 2 x 3) ANOVA
(assessment x breakfast x age group)



Results



- Older children perform better than younger children

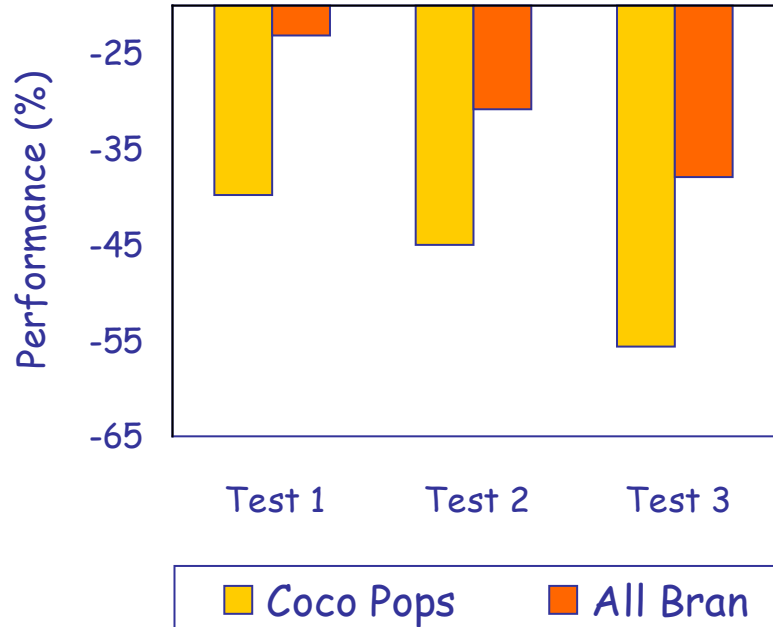


- Decline in performance throughout the morning



Results

Episodic Memory



Main effect of Breakfast
 $F(1,61) = 5.313, p < 0.05$

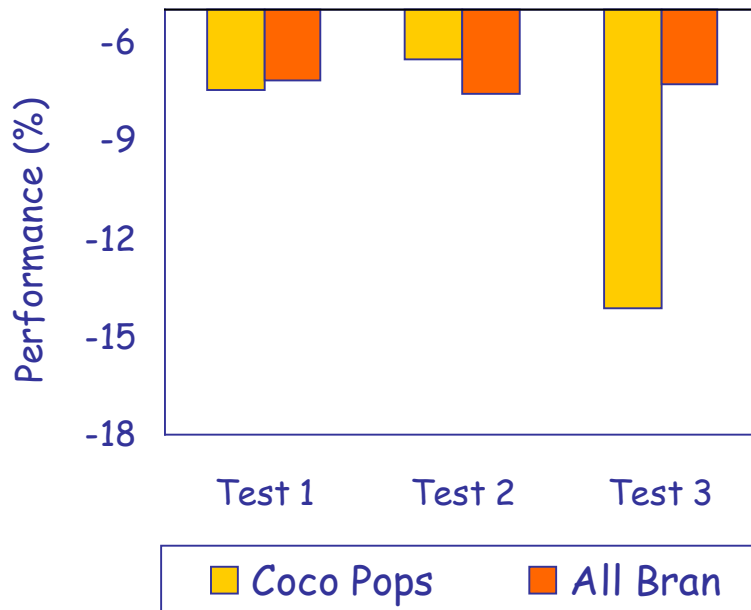
Significantly smaller decline in performance after consumption of low GI All Bran compared to high GI Coco Pops

Fig. 3: Performance on Episodic Memory

Results



Sustained Attention



Breakfast * Assessment Time
 $F(2,122) = 3.820, p < 0.05$

Significantly decline in performance on Test 3 after consumption of high GI Coco Pops compared to low GI All Bran

Fig. 4: Performance on Sustained Attention

Discussion



Aims

- a) Can the Glycaemic Index of breakfast affect children's cognition?
- b) Are the effects found across all cognitive functions or restricted to particular processes?



Discussion



- Significantly less decline on Episodic Memory and Sustained Attention across the morning after consumption of Low GI (All Bran) compared to high GI (Coco Pops)
- Changes in cognitive performance may be a reflection of changes in blood glucose levels, in this case triggered by glycaemic index

Discussion



- Effect of GI may be different for different cognitive processes



- Micronutrients and other macronutrients can also influence cognitive performance (Lieberman et al, 1986)



Plans for Future Research:

- To investigate the effects of lunch and mid-morning snack



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