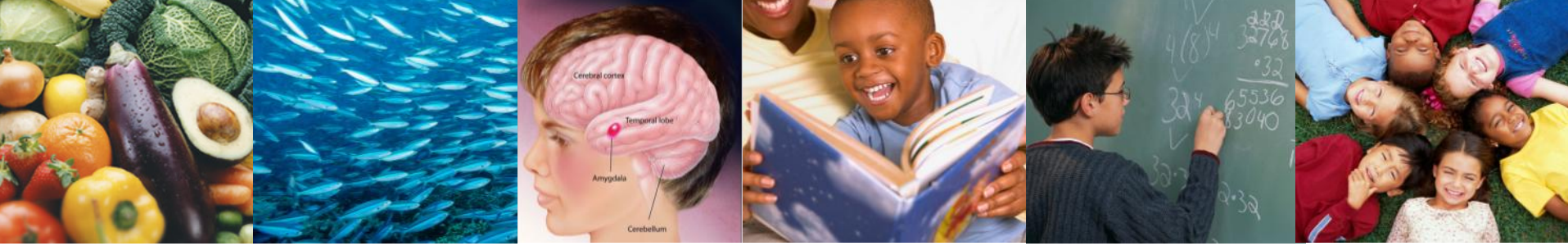


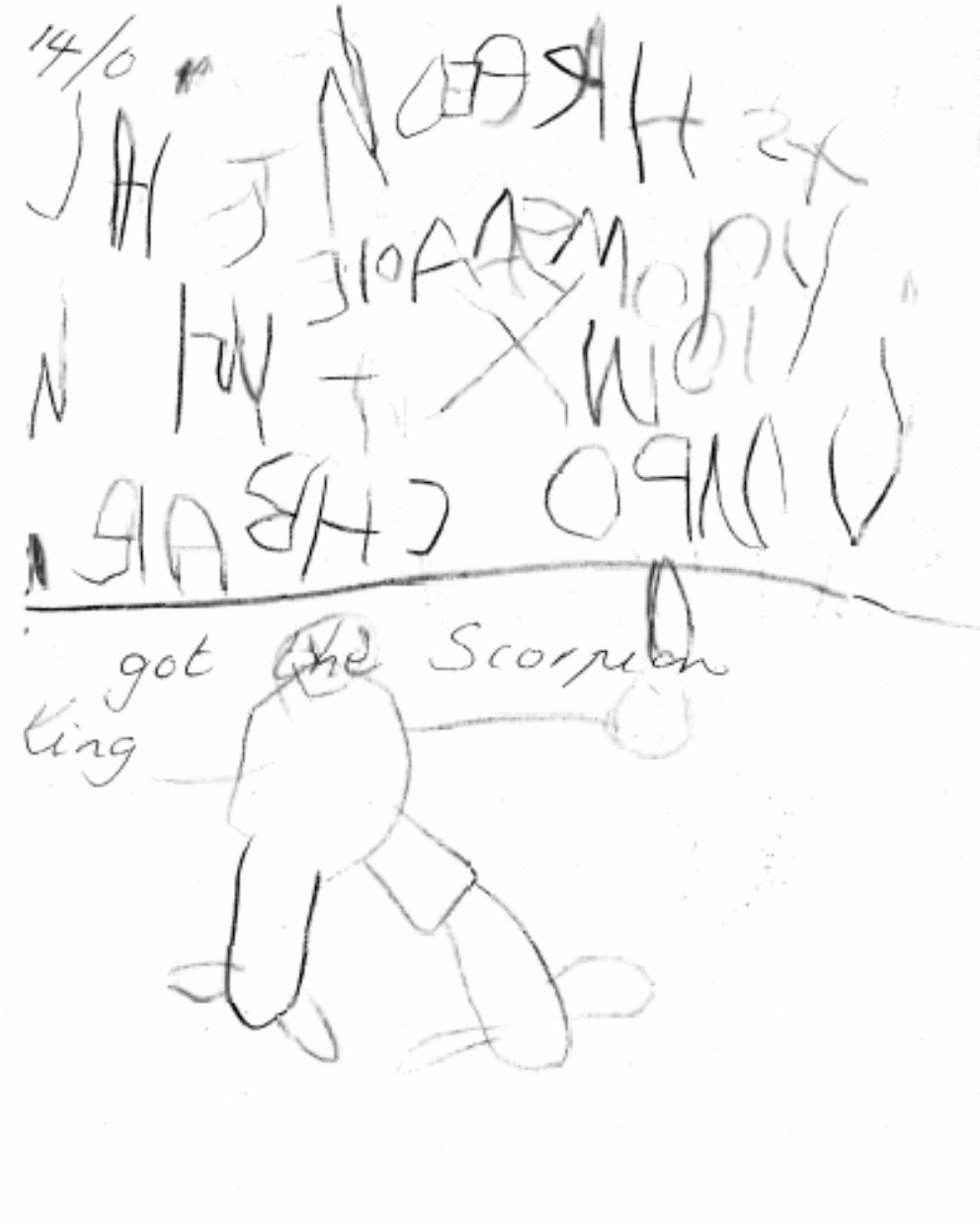
Nutritional & dietary influences on learning and behaviour

University of South Australia
Nutritional Physiology Research Centre

Paediatric Wellbeing Cluster

Natalie Sinn, PhD

"Sorry I'm so stupid. I really want to read, mum. I don't know why I can't do it"



Nicholas, 10-year old - June 2005

3-year old - ADHD

Parents:

Difficulty sustaining attention
Difficulty awaiting his turn
Always on the go
Sleep problems

Teachers:

Attention problems
Difficulty finishing his activities
Usually out of his seat
Frequently interrupts others in class

Hillary Tuckerman became ‘wildly hyperactive’ when given ampicillin for her earache.

…“Could Hillary be having a sort of psychotic reaction to the penicillin?”

Children, learning and behaviour

- 14% estimated to have mental health problem = nearly 1 in 7 children.
- ADHD most commonly diagnosed childhood disorder
- Hyperactivity; poor impulse control; inattention
- Poor self-discipline, low self-esteem
- Often carried into adulthood – 60%
- Most common treatment: Ritalin

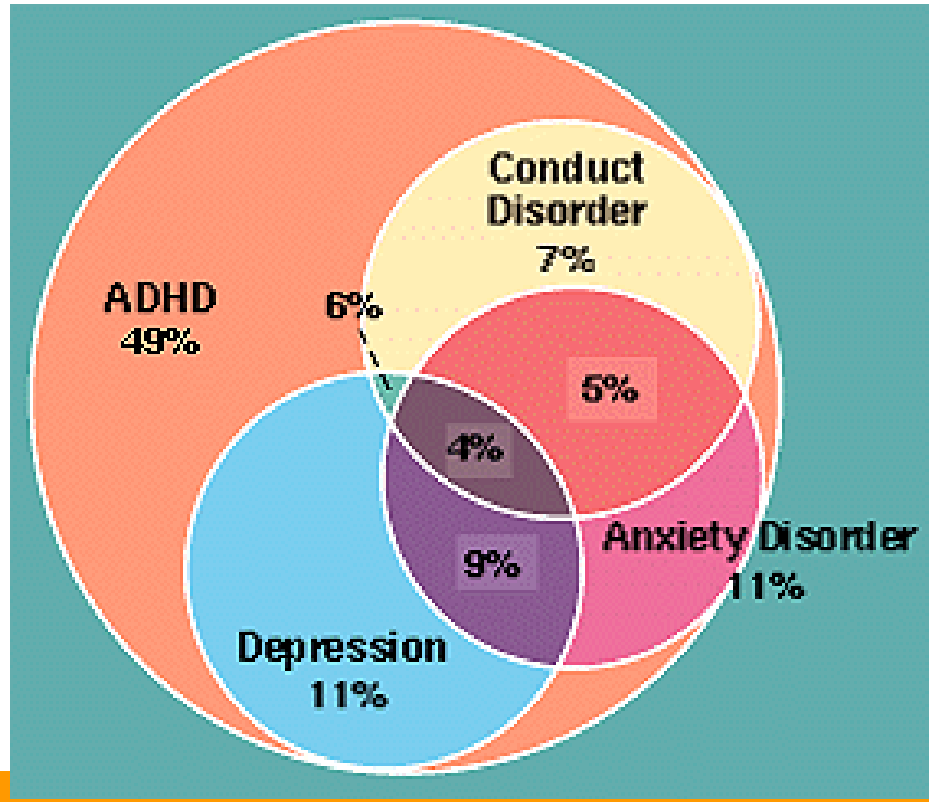
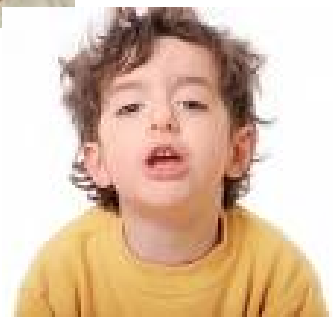


Illustration from Joseph Biederman & Stephen Faraone, Harvard Mahoney Neuroscience Institute Letter, Winter 1996

Zinc and ADHD

- Lower zinc levels in children with ADHD compared with controls (Arnold, 2005)
- Two clinical trials: significant improvement in symptoms, one in medicated children, one as a monotherapy (Akhondzadeh et al 2004, Bilici, 2004).
- Evidence in challenge studies that zinc levels affected by food additives (Ward, 1990; 1997)

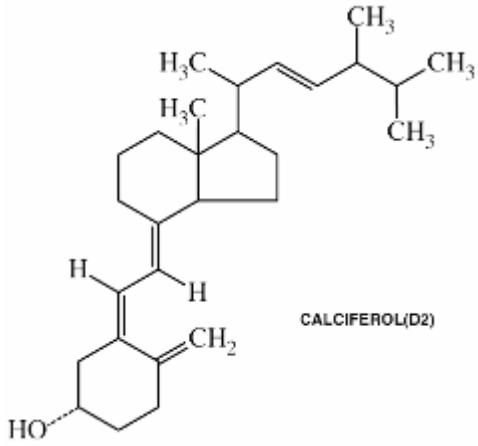


Iron & ADHD

- Iron levels twice as low in 53 non-anaemic children with ADHD compared to 27 controls; associated with more severe symptoms
- Uncontrolled pilot study with 14 non-anaemic 7-11 year old boys: 30 days of iron supplementation: decreases in parent ratings of behaviour but not teacher ratings
- Double-blind, placebo-controlled trial with 23 non-anaemic children with ADHD & low iron levels: **improvements in symptoms & restless legs**

Konofal et al, 2004; Sever et al, 1997; Konofal et al, 2005; Konofal et al, 2008

Vitamin D



- Best source is from sunlight
- Important for bones; deficiency associated with rickets
- Found in brain tissue of developing babies; increases nerve growth factor; various Vit D receptors in brain
- Sunlight associated with serotonin production
- Linked with seasonal affective disorder, schizophrenia & possibly neurodevelopmental disorders, e.g. autism

Garcion 2002, Holick 2007, Eyles 2005, Gloth 1999, www.vitamindcouncil.com

Pharmacological food intolerances

- Food intolerances different to allergies
- Symptoms include neurological and behaviour problems
- Some evidence for impact on CNS
- Common intolerances: salycilates, amines, wheat, dairy, MSG, food additives
- Elimination diet: Feingold

Review & meta-analysis have confirmed

role of food & additives in hyperactive behaviour

Feingold 1973; Weiss 1982; Swain 1985; Schab & Trinh, 2004, Kaplita & Triggle 1982; Breakey et al 2002; Arnold 1999; Schab 2004; McCann et al 2007

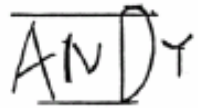
1) During an early phase of the test

Drawing

Handwriting

2) As the testing progressed

Drawing



Handwriting

3) During peak of test

Refused to draw

Handwriting

4) Ten minutes after the neutralization dose

Drawing

Handwriting

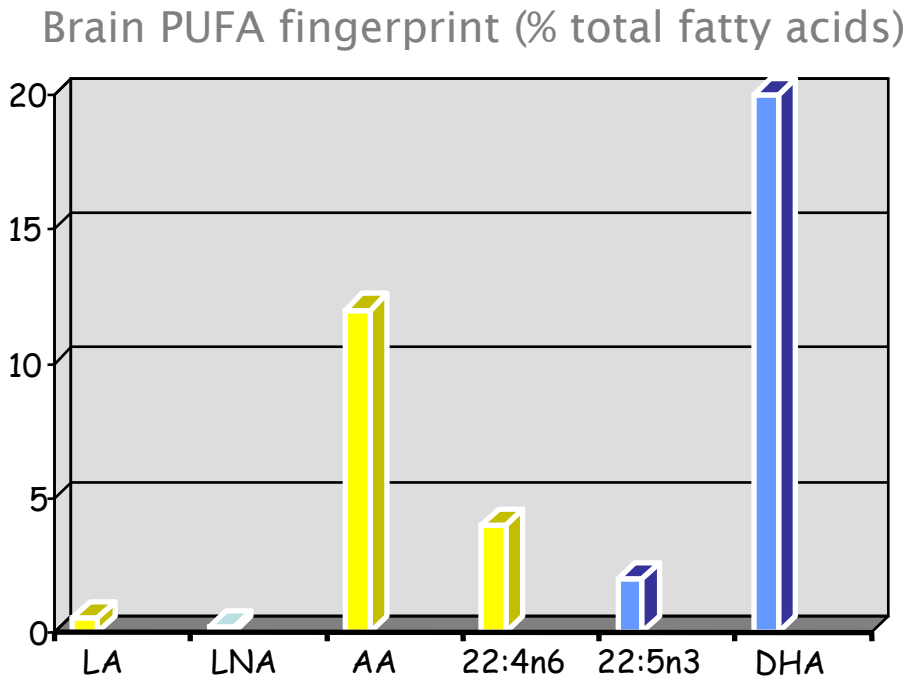
Changes in a child's drawing and handwriting during the four phases of acute reaction to offending food.

Rapp 1996 *Is This Your Child's World? New* York, NY: Bantam Books.

From Nature's Way fish oil advertisement

Omega-3 fatty acids in the brain

- 60% of the brain composed of lipids
- **DHA** (docosahexaenoic acid) – particularly concentrated in neural membranes & synapses.
- **EPA** (eicosapentaenoic acid) also important in brain: anti-inflammatory, anti-thrombotic, vasodilatory
- Assist in cell signalling activities, involving neurotransmitters such as dopamine & serotonin
- Cerebral blood flow, ion channel & enzyme regulation, gene expression



Crawford & Sinclair, unpublished

Omega-3s and child development

- DHA critical for infant brain development.
  Lauritzen et al 2001; Martinez 1992
- DHA associated with enhanced cognitive development in childhood
  Yehuda et al 1998; Lauritzen et al 2001
- Brain develops throughout childhood & adolescence Thatcher 1991; Toga et al. 2006
- Some evidence for role of omega-3 PUFA in developmental disorders.

Voigt 2001, Stevens et al 1995, 1996, 2002, Richardson & Puri, 2002, Amminger et al 2007, Bell et al 2004, Bu et al 2006, Johnson et al 2003, Stordy 2000, Taylor 2000, Richardson 2000, 05, 06

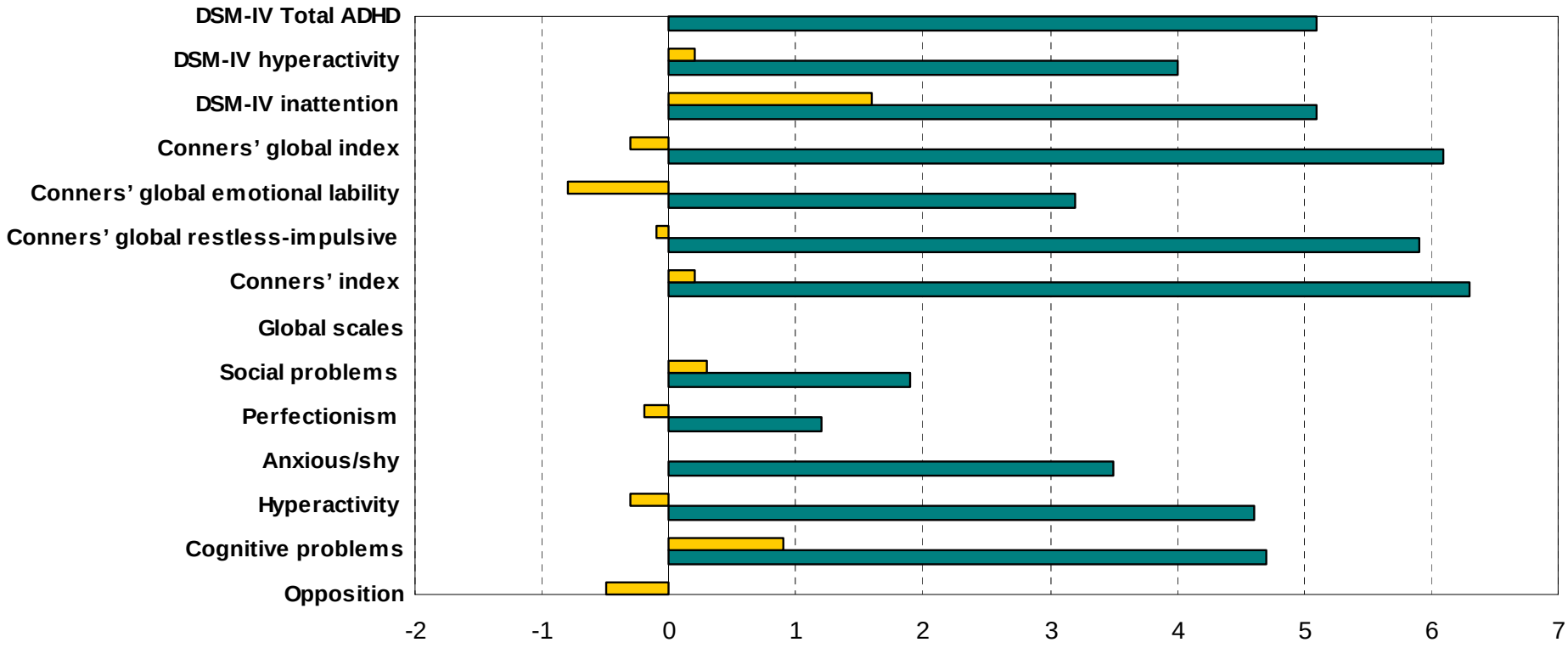
Omega-3s & dyspraxia: Durham Trial

- 117 children aged 5-12 with dyspraxia (Developmental Coordination Disorder), unmedicated.
- 1/3 with ADHD symptoms > 90th percentile
- Randomised placebo-controlled trial
- Motor function, teacher ratings of behaviour (Conners' index), literacy
- EPA 552mg, DHA 168mg, GLA 60mg, Vit E 9.6mg

1-3 months	PUFA	Placebo
3-6 months	PUFA	PUFA

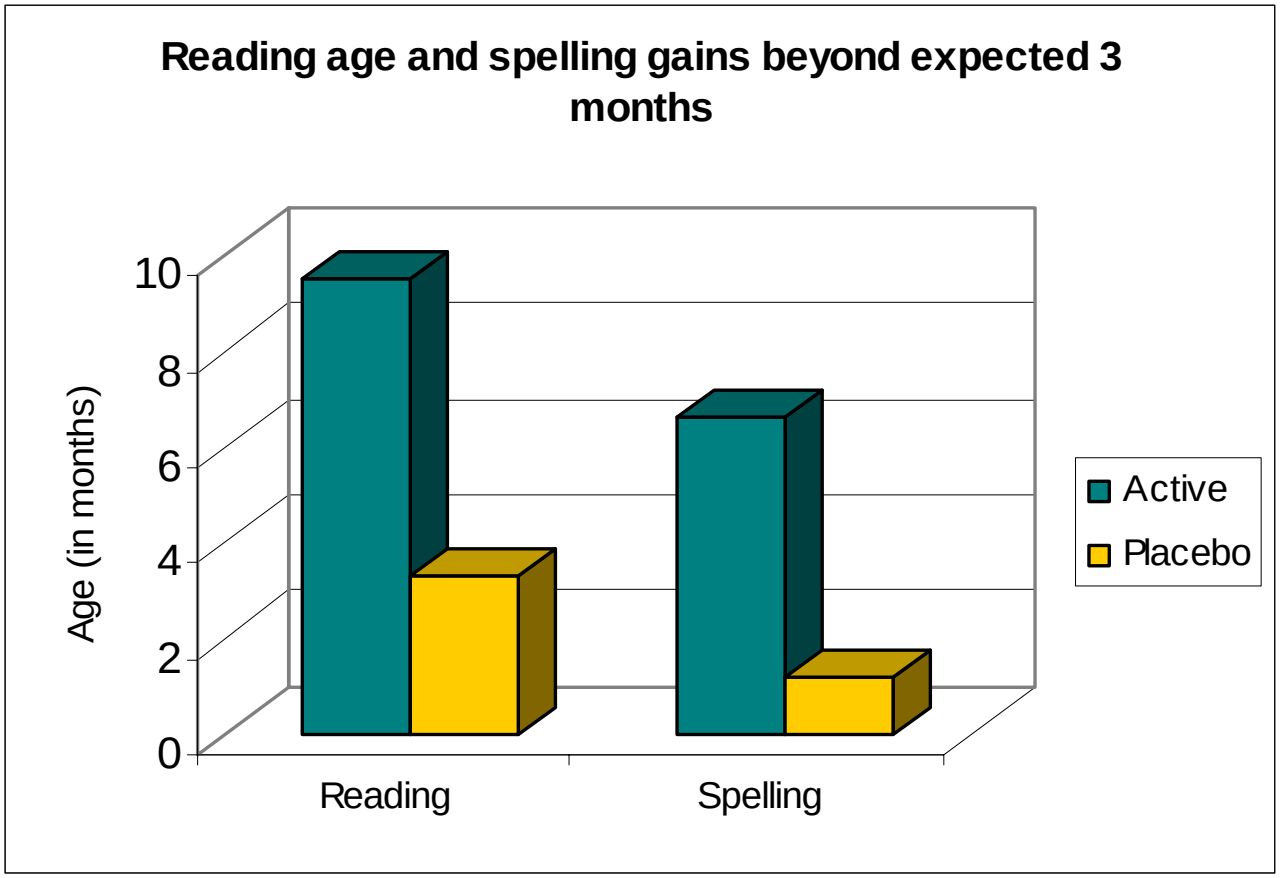
Richardson & Montgomery, 2005

Changes from baseline to 3 months



Richardson & Montgomery, 2005

Literacy: mean increases over 3 months



- **Reading** (~ 1 year below chron. age)
  - Active: 9.5 mo (SD: 13.9);
  - Placebo: 3.3 mo (SD: 6.7) *P* = .004.
- **Spelling**:
  - Active: 6.6 mo (SD: 11.4)
  - Placebo: 1.2 mo (SD: 5.0) *P* = .001.

Richardson & Montgomery, 2005

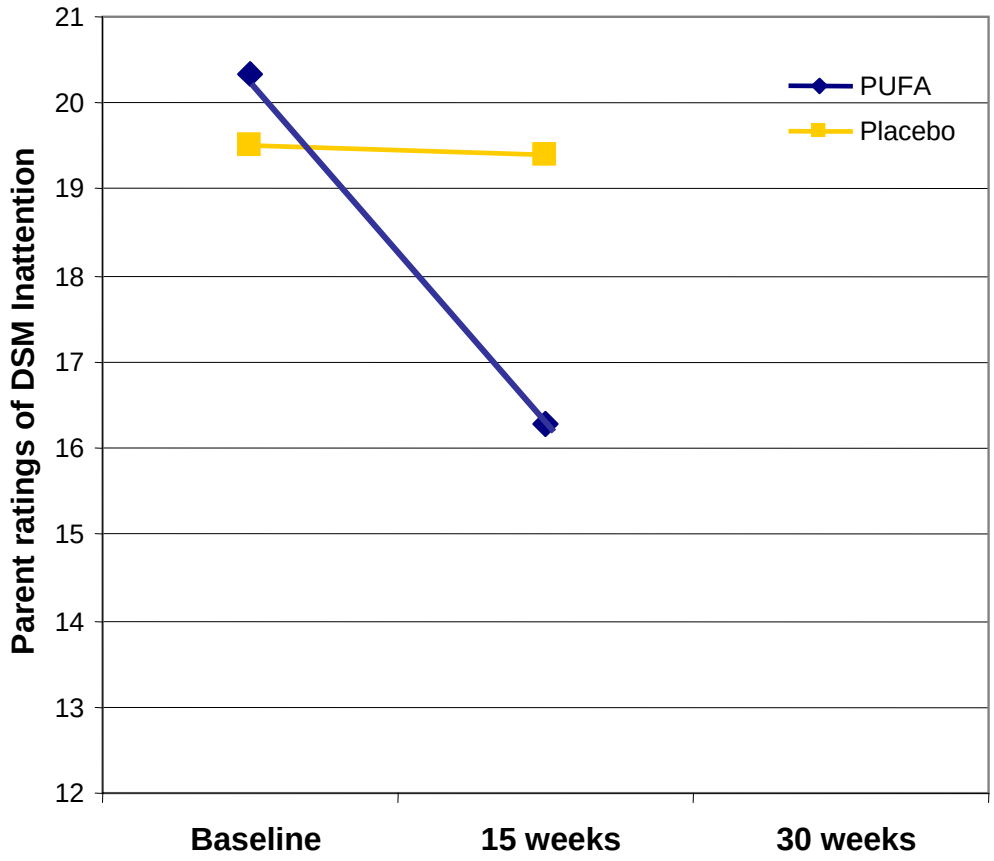
Omega-3s & ADHD symptoms: Adelaide Trial

- 132 children aged 7-12 (2/3 boys) for 15 weeks
- 104 children from 16-30 weeks
- Selection criteria: score on upper end of Conners' ADHD Index; not on medication.
- Effect of omega-3 and multivitamin/mineral (MVM) supplementation on inattention, hyperactivity, impulsivity (parent & teacher ratings), cognitive outcomes (neuropsychological assessments)
- Randomised, placebo-controlled, double-blind trial, one-way crossover
- EPA 552mg, DHA 168mg, GLA 60mg, Vit E 9.6mg

1-15 weeks	PUFA	PUFA + MVM	Placebo
16-30 weeks	PUFA + MVM	PUFA + MVM	PUFA + MVM

Sinn & Bryan, 2007

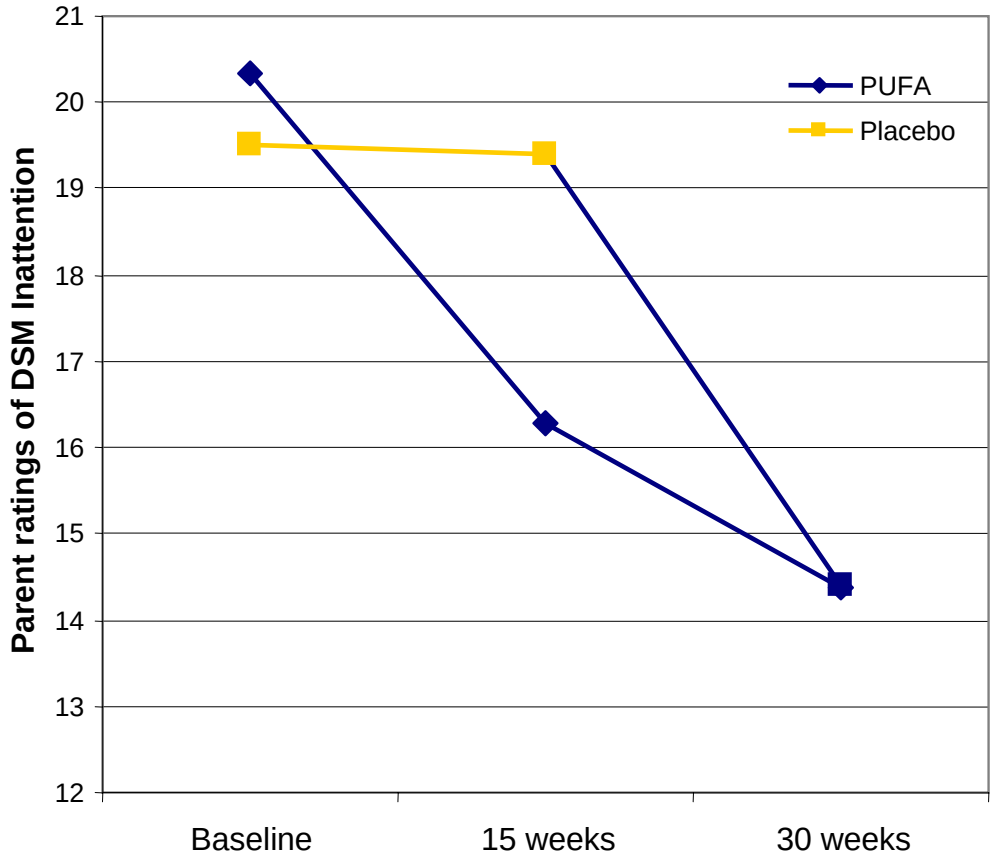
Reductions in inattention



$F = 11.24$, $p < .01$ (Effect size .61)

Sinn & Bryan, 2007

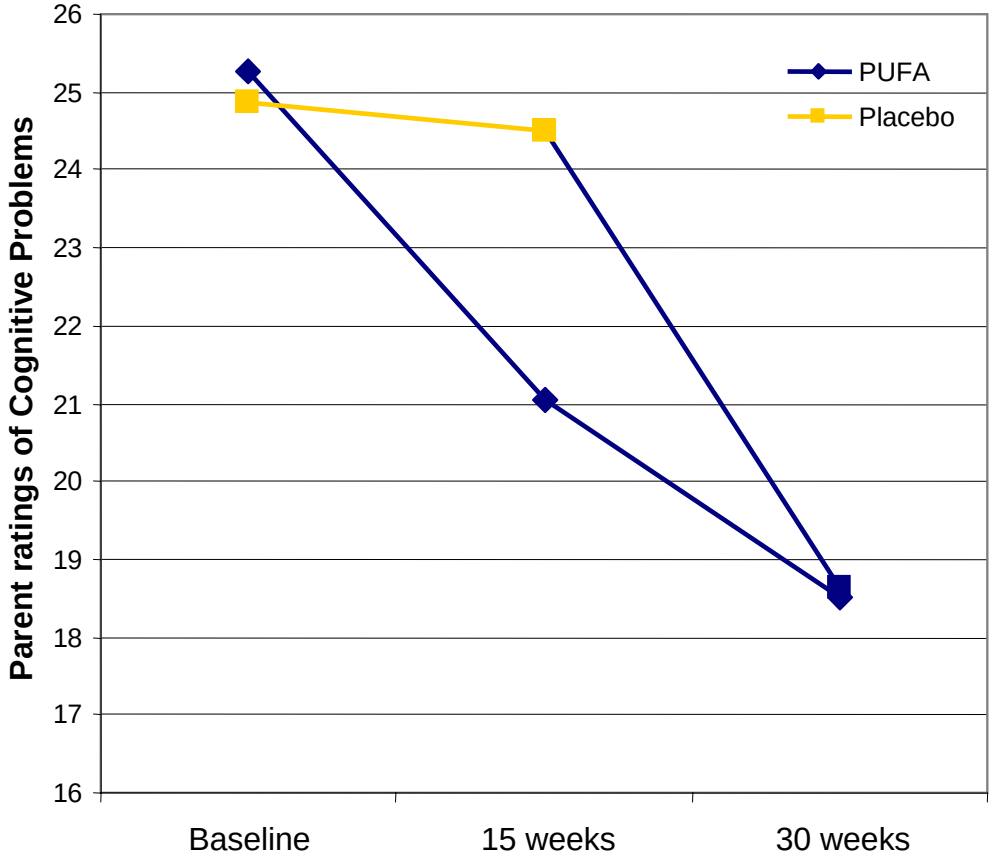
Reductions in inattention



$F = 11.24$, $p < .01$ (Effect size .61)

Sinn & Bryan, 2007

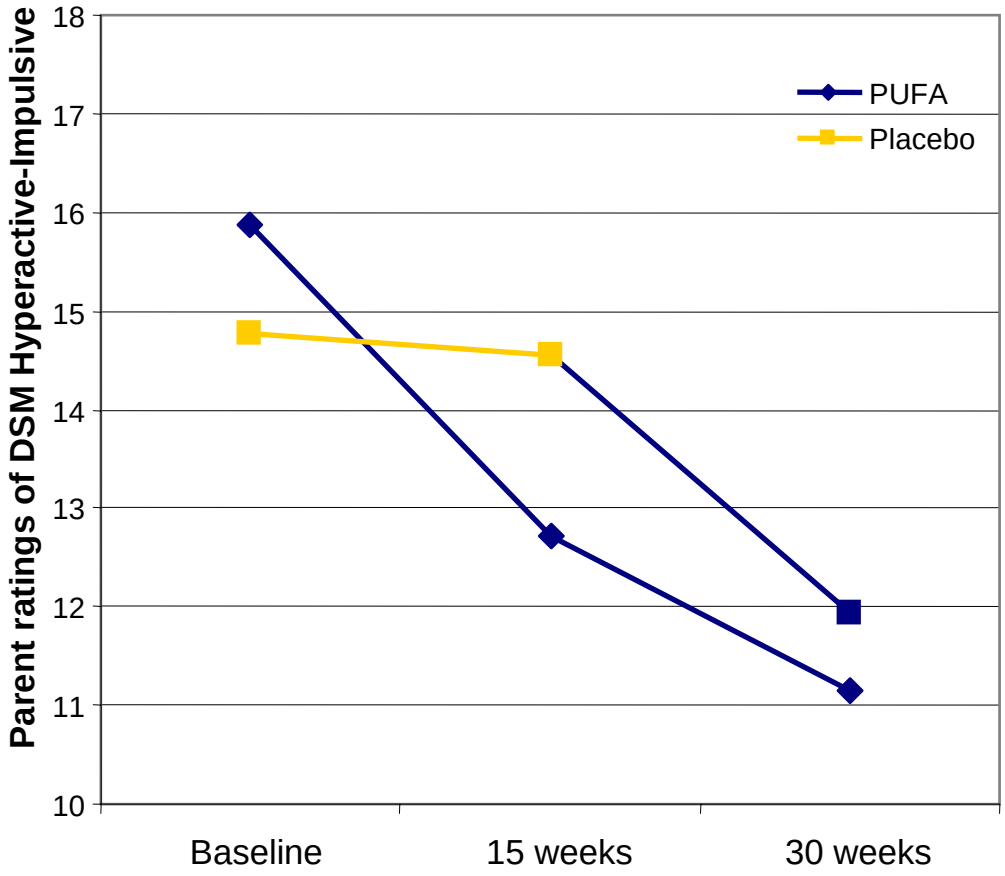
Reductions in cognitive problems



$F = 10.06$, $p < .01$ (Effect size .52)

Sinn & Bryan, 2007

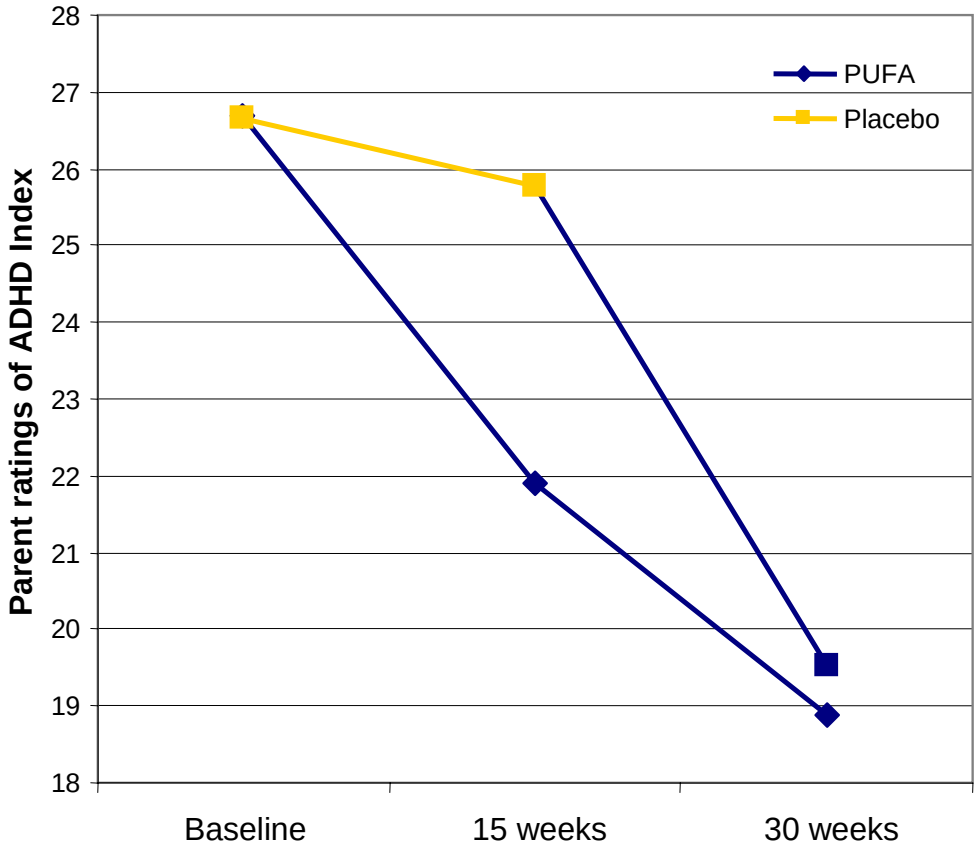
Reductions in hyperactivity-impulsivity



$F = 7.68$, $p < .01$ (Effect size .20)

Sinn & Bryan, 2007

Reductions in ADHD ratings



$F = 9.09$, $p < .01$ (Effect size .59)

Sinn & Bryan, 2007

Cognitive Assessments

- Inspection time – *speed of processing*
- Coding – *conscious speed of processing*
- Creature counting – *control & switch attention*
- RAVLT – *learning & memory*
- Block design & vocabulary – *IQ estimate* (full IQ r = .906)
- Knock & tap – *impulse control*
- Stroop colour-word test – *executive functioning*
- Digits forward & backward – *working memory*

Results: Improvements after supplementation on creature counting and vocabulary scores (N = 142)

Sweden – preliminary results

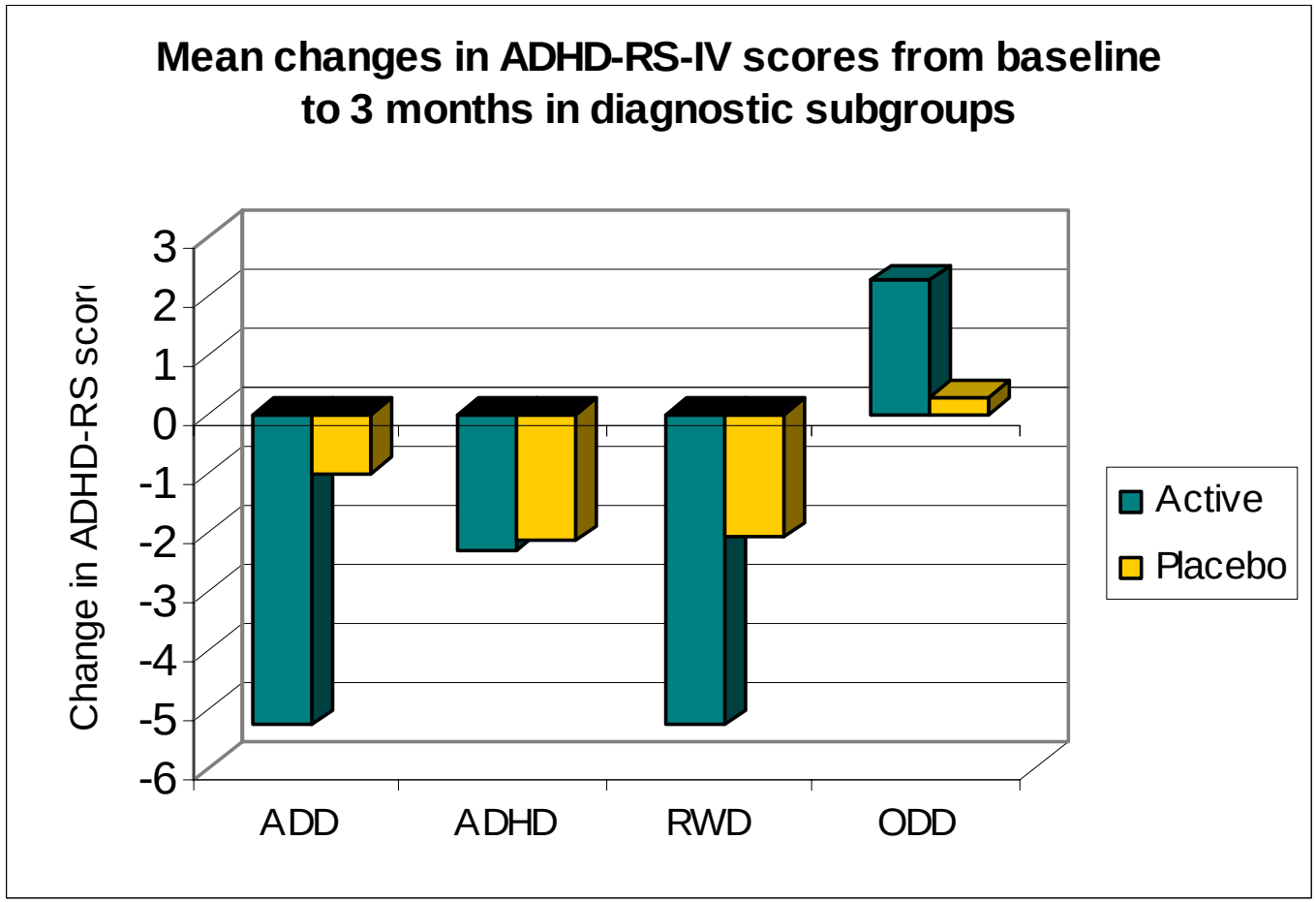
- Randomised controlled trial: 75 children 8-18 yrs old
- One-way crossover at 3 months – Active supplement: EPA/DHA/GLA
- ADHD diagnosis with various comorbidities
- ADHD Rating Scale-IV-Parent Version; Clinical Global Impression (CGI) scale
- 26% clinically meaningful improvement (25% reduction in symptoms) over 3 months
- Nearly half over 6 months

1-3 months	Placebo	PUFA
3-6 months	PUFA	PUFA

Johnson, Östlund et al. 2007

Sweden – preliminary results

- 1/8 showed more than 50% reduction: Inattentive sub-type, dyspraxia, reading/writing difficulties, autistic symptoms



Johnson, Östlund et al. 2007

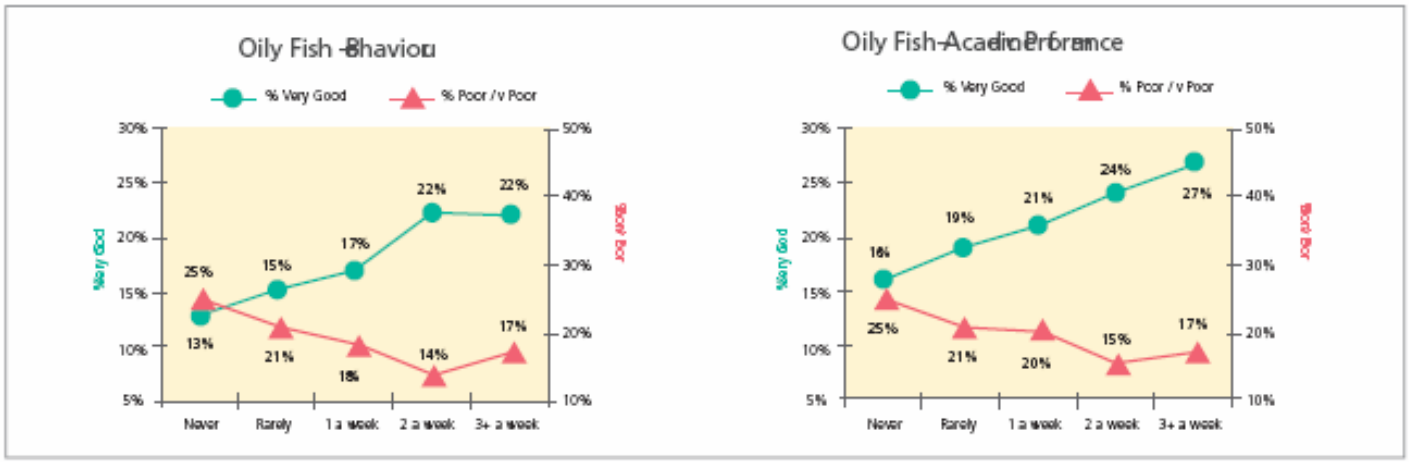
Implications

- Some children with ADHD-related attention and behaviour problems may benefit from omega-3s: up to 50% over 30 weeks
- Which children benefit?
- Longer term outcomes
- Blood samples
- Biological mechanisms
- Further investigation of other nutrients

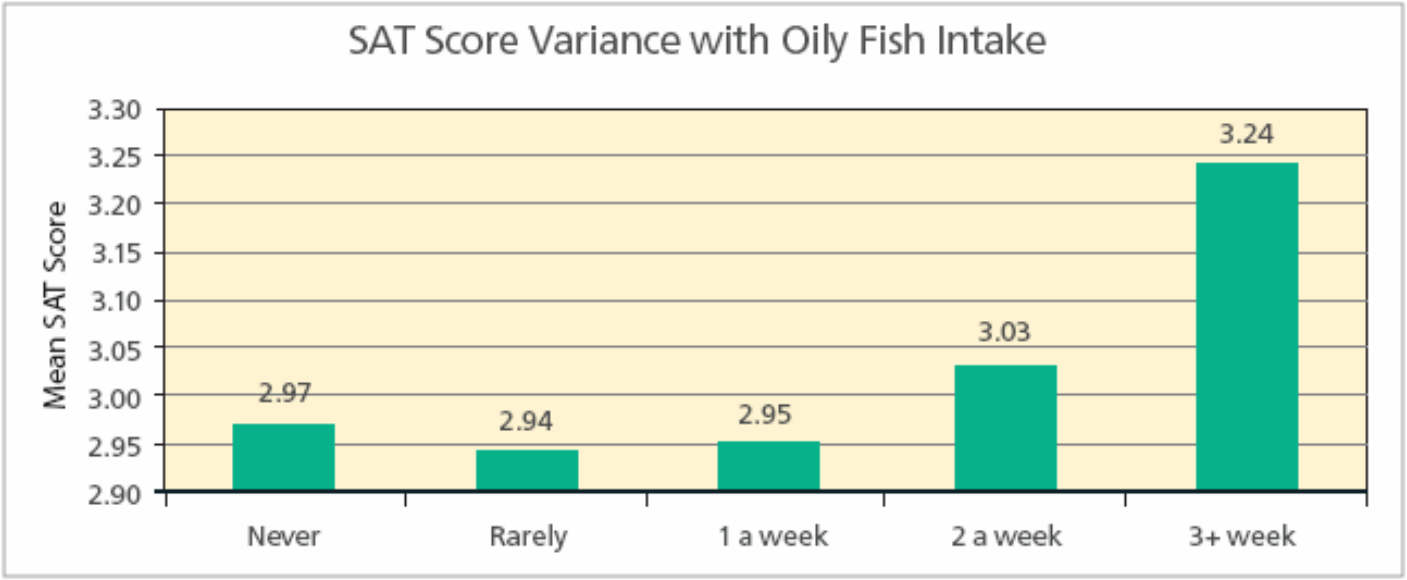
New study 2007-08: UniSA & QUT – 7-12 year old children with ADHD & LD

9.11 Oily Fish

Oily fish such as salmon, tuna, mackerel or sardines



Children who regularly eat oily fish are more likely to be well behaved and have higher academic performance.



High consumption of oily fish is associated with a 9% increase ($p<0.001$) in mean SAT scores.

School Food and the Whole School Approach

- Prof Derek Colquhoun, Jo Pike – University of Hull, UK
- Free Healthy School Meals (Eat Well Do Well): 25,000 school children
- Improved performance on letter-recognition in the afternoon
- Gap between eligible and non-eligible disappeared
- "Children are more relaxed in school as a result of the scheme. Breakfast clubs are having an impact on settling children to work in the morning and there are reports of improved behaviour … schools are CALMER"

Hillary Tuckerman became ‘wildly hyperactive’ when given ampicillin for her earache.

…“Could Hillary be having a sort of psychotic reaction to the penicillin?”

…”Could it be the pink stuff they use to colour the suspension?”

3-year old - ADHD

Parents:

Difficulty sustaining attention
Difficulty awaiting his turn
Always on the go
Sleep problems

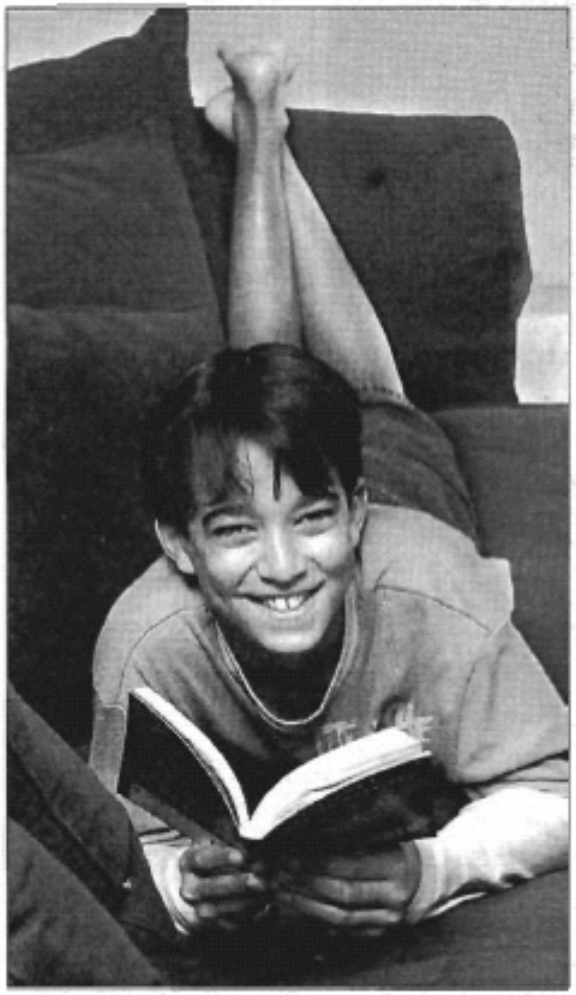
Teachers:

Attention problems
Difficulty finishing his activities
Usually out of his seat
Frequently interrupted others in class

Low serum ferritin (iron) levels

"Sorry I'm so stupid. I really want to read, mum. I don't know why I can't do it"

A new chapter



Happier: Stephen Vandenberg used to have difficulty with reading. Picture: BILL McAULEY

Kamahl Cogdon

THREE months ago, Stephen Vandenberg would have struggled to read even the simplest words on this page.

That was before his mother started him on an omega-3 fish oil and evening primrose oil supplement.

Now the grade 5 student is reading about dragons, tackling grade 6 books and even rattling off the street signs he passes in the car with his relieved parents.

His behaviour at home and school has improved greatly and calm has replaced his frequent frustrated outbursts.

"The change in him has been amazing," mother Julie said. "I used to wake up every morning with tears in my eyes because I could see my son was being crippled and I didn't know how to help him."

Ms Vandenberg said her youngest son's learning and attention problems were evident from the day he started school.

But teachers and doctors were at a loss to explain why Stephen was slipping further and further behind.

Ms Vandenberg said Stephen's self-esteem also suffered to the point he once wrote a letter saying: "Sorry I'm so stupid. I really want to read, mum. I don't know why I can't do it."

Ms Vandenberg said she and husband Paul tried everything they could think of to help Stephen, who doctors suspected suffered from a form of dyslexia.

But nothing worked and even as he went into grade 5 at Heatherton Christian College this year, 10-year-old Stephen struggled to read words like "what", "how" and "the".

Then, flicking through a magazine in a doctor's surgery, Ms Vandenberg came across an advertisement for a supplement called eye q, which purported to help children like Stephen.

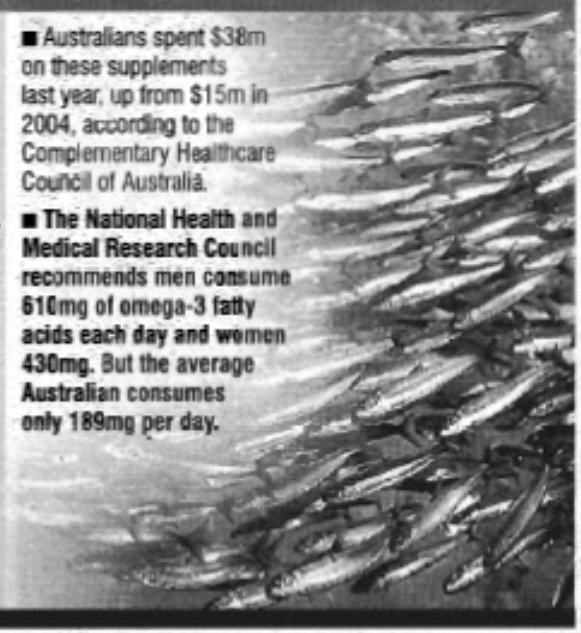
Other children no longer needed remedial reading lessons and brought home letters from their teachers praising the turnaround in their behaviour.

In the largest clinic-based study of its kind, a third of the children took eye q, a second group took eye q and a low-dose multi-vitamin, and the third group took a placebo.

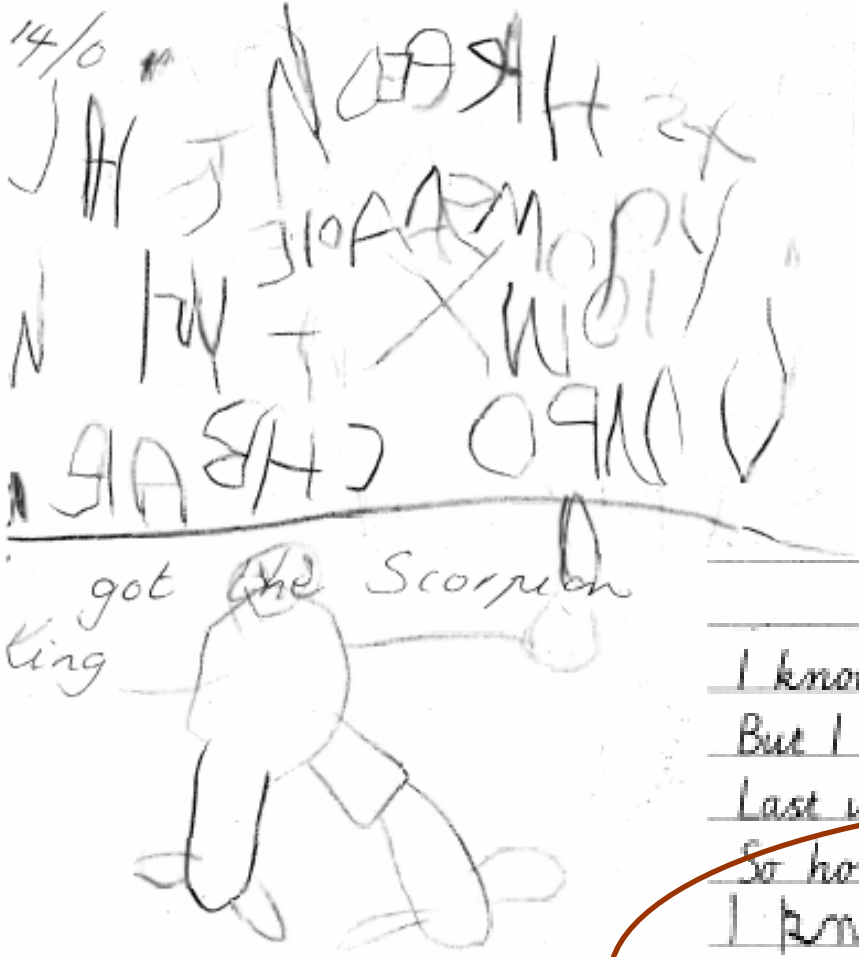
Their parents were surveyed about their behaviour at 15 weeks and 30 per cent of those on eye q had shown strong

THE GOOD OIL ON OMEGA-3

- Omega-3 fish oil is found in sardines, pilchards, anchovies, tuna and salmon.
- **Omega-3 is also added to a range of supermarket products including bread, margarine and infant formula.**
- The oil's fatty acids play an important role in the body, improving the function of cells, lowering cholesterol, and helping reduce inflammation and relieve joint swelling.
- **Fish oil capsules and other omega-3 supplements are the fifth-highest selling products on the alternative health market.**
- Australians spent $38m on these supplements last year, up from $15m in 2004, according to the Complementary Healthcare Council of Australia.
- **The National Health and Medical Research Council recommends men consume 610mg of omega-3 fatty acids each day and women 430mg. But the average Australian consumes only 189mg per day.**



HK Herald Sun 23/6/06



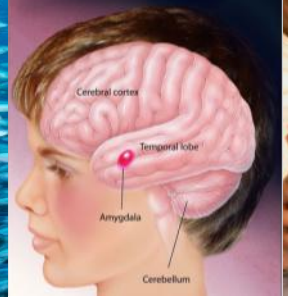
A MOST UNUSUAL HEN

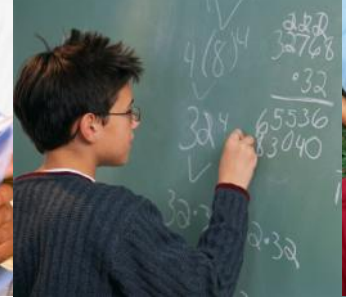
I know you will believe it,
But I swear that it is false.
Last week I sold a brand old hen
So home with him I flew.
I know you won't believe it.
But I swear that it is true.
Last week I bought a

Nicholas, 10-year old - June 2005

Same boy, June 2006






Are we doing enough?