Dimensions not diagnoses for children struggling with attention, learning and memory

Susan Gathercole

CALM workshop, 11th March 2017
Problems of diagnosis

- High prevalence of ADHD, dyslexia, language impairment and dyscalculia (1-7% population)
- Rates of co-morbidity 20-80%
- Diagnoses have:
  - high symptom variability for individuals with same diagnoses
  - high symptom overlap with other diagnoses
- Routes to diagnosis vary widely
An alternative dimensional approach

Are there a set of dimensions of disorder which can exist either in isolation or combination?

Are they useful in understanding specific learning difficulties that do not necessarily meet conventional diagnostic criteria?

CALM research clinic
common, complex, comorbid problems
of attention, learning & memory
CALM domains

<table>
<thead>
<tr>
<th>Calm Domains</th>
<th>Learning Domains</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEHAVIOUR</td>
<td>Executive functions, attention, communication</td>
</tr>
<tr>
<td>BRAIN</td>
<td>Structural MRI, diffusion-weighted imaging, resting-state</td>
</tr>
<tr>
<td>GENES</td>
<td>Saliva</td>
</tr>
<tr>
<td>Cognition</td>
<td>Attention, Episodic memory, Executive functions, Phonological processing, Processing speed, Nonverbal reasoning, Working memory</td>
</tr>
</tbody>
</table>

Risks & causal factors
The first recruits

460 children now tested since October 2014, MRI data on 216

Mean age 9;06 yrs, 5;03 -15;08 years, 88 (66%) male
Recruitment

- 1st 320: aged 5-18yrs with problems in attention, learning (reading, maths, language), and/ or memory

- 320 to present: aged 5-14 years with either ADHD or speech and language problems

- no co-morbidity exclusions except sensory impairments

- practitioner referrals
## Referral information

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<tr>
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<tr>
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<td>Paediatrician</td>
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<tr>
<td>Clinical Psychologist</td>
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<tr>
<td>Speech &amp; Language Therapist</td>
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<tr>
<td>Specialist Teacher</td>
<td>14</td>
</tr>
<tr>
<td>ADHD nurse practitioner</td>
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<td>Educational Psychologist</td>
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<td>Family worker locality team</td>
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<tr>
<td>Child Psychiatrist</td>
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<td><strong>Total</strong></td>
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<table>
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<td>Possible ADHD</td>
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<td>Dysgraphia</td>
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<td>Dyscalculia</td>
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<tr>
<td>FASD</td>
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<tr>
<td>Generalised delay</td>
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<tr>
<td>Social anxiety</td>
<td>1</td>
</tr>
<tr>
<td>Depression</td>
<td>2</td>
</tr>
<tr>
<td>Autism</td>
<td>25</td>
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<tr>
<td>PDA</td>
<td>1</td>
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<td>Tourettes</td>
<td>4</td>
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<tr>
<td>DAMP</td>
<td>3</td>
</tr>
<tr>
<td>Anxiety</td>
<td>0</td>
</tr>
<tr>
<td>OCD</td>
<td>2</td>
</tr>
<tr>
<td>Speech &amp; language</td>
<td>68</td>
</tr>
<tr>
<td>No diagnosis</td>
<td>297</td>
</tr>
</tbody>
</table>
Learning and cognitive skills: mean z-scores

- Learning: Vocabulary, Spelling, Reading, Maths
- Phonological processing: Alliteration, Rapid naming, Digit span, Backward span
- Memory: Dot matrix, Mr, Story recall, Matrix reasoning
- Fluid intelligence:
By areas of deficit: learning scores <86

- **vocab:** 34
- **reading:** 17
- **maths:** 24
- **learning scores <86:** 1
Mean z-scores for deficit subgroups
All learning z-scores >85
Reading- and maths-only deficit groups
Vocab & maths and all learning deficit groups
Pathways to learning

\[ \chi^2(38) = 45.890, \ p = .178 \]

GFI = .940; RMR = 8.501
Pathways to learning and behaviour

$\chi^2(59)=66.634, \ p=.231$

CFI = .983; RMSEA=.031
Summary

- Reading difficulties usually accompanied by maths problems
- Specific maths difficulties are relatively common
- Around 30% of the clinic sample have no detected learning difficulties
- Two cognitive dimensions linked to learning and behaviour:
  i) Phonological -> language and reading
  ii) Executive control -> maths and inattention
What next?

• Investigating brain systems that underlie cognitive and behavioural dimensions

• Targeting interventions for specific CALM profiles

• A longitudinal phase to start in Sep 2017

• Toddler CALM – led by Joni Holmes

• A UK network

• Open Science: plan to make CALM 500 data open
  https://camcan-archive.mrc-cbu.cam.ac.uk/dataaccess/
Language problems and ADHD symptoms in the CALM sample

Joni Holmes


CALM workshop, 11th March 2017
ADHD

• 2-5% of UK school population have a diagnosis

• Conner’s rating scales widely used to measure symptoms at home and school
DSM symptoms of inattention

At least 6 of the following:
- Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities
- Often has trouble keeping attention on tasks or play activities
- Often does not seem to listen when spoken to directly
- Often does not follow instructions and fails to finish schoolwork, chores, or duties in the workplace
- Often has trouble organizing activities
- Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time
- Often loses things needed for tasks and activities
- Is often easily distracted
- Is often forgetful in daily activities
DSM symptoms of *hyperactivity/ impulsivity*

*At least 6 of the following:*

- Often fidgets with hands or feet or squirms in seat
- Often gets up from seat when remaining in seat is expected
- Often runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless)
- Often has trouble playing or enjoying leisure activities quietly
- Is often "on the go" or often acts as if "driven by a motor"
- Often talks excessively
- Often blurts out answers before questions have been finished
- Often has trouble waiting one's turn
- Often interrupts or intrudes on others (e.g., butts into conversations or games)
Prevalence of ADHD symptoms in CALM sample
Language Problems

• Two dimensions

  • Structural
    • formal use of syntax, semantics, phonology
    • important for literacy development
    • for and expressing and understanding language in communication

  • Pragmatic
    • social language use
      – appropriate to situation
      – includes non-verbal

• Pragmatic consequence of structural language problems, or arise from social/behavioural difficulties?
Language problems across disorders

- Difficulties commonly associated with developmental disorders

- Structural
  - Specific Language Impairment (SLI) / Development Language Disorder (DLD) & reading difficulties

- Pragmatic
  - Autism & ADHD

- But heterogeneity within and across disorders
Language problems in CALM sample

Literacy

- Spelling
- Reading
- Vocabulary
- Alliteration

Communication

- Speech
- Syntax
- Semantics
- Coherence
- Inappropriate Initiation
- Stereotyped Language
- Use of Context
- Nonverbal Communication

- structural
- pragmatic
Current study

• Language problems and ADHD symptoms co-occur across developmental disorders

• Aim: to establish the links between symptoms of ADHD and language problems in CALM sample
  • unique sample
  • use the data rather than diagnostic label to understand more about how these symptoms might co-occur
Participants

- 254 children referred to CALM clinic
  - included all with complete data up to May 2015
- 169 males, 85 females, mean age 9yrs (5 to 15yrs)
- 164 no diagnosis, 20 ADHD, 59 other disorders

Measures
- Conners 3 Parent Short Form
- Child Communication Checklist 2
- WIAT II Spelling & Reading
- Peabody Picture Vocabulary Test
- PhAB Alliteration
Literacy related tasks

Literacy (structural) profile does not distinguish between groups
Communication

Structural

Pragmatic

Elevated hyperactivity associated with more severe pragmatic communication problems
## Dimensions - behaviour

<table>
<thead>
<tr>
<th>Conners scales</th>
<th>Factor 1</th>
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<tbody>
<tr>
<td>Inattention</td>
<td>0.783</td>
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<tr>
<td>Hyperactivity/impulsivity</td>
<td>0.707</td>
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<tr>
<td>Executive Functions</td>
<td>0.664</td>
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<tr>
<td>Aggression</td>
<td>0.554</td>
</tr>
<tr>
<td>Peer Relations</td>
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<td>Learning Problems</td>
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## Dimensions - communication

<table>
<thead>
<tr>
<th>CCC-2</th>
<th>Factor 1</th>
<th>Factor 2</th>
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<tbody>
<tr>
<td>Interests</td>
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<td></td>
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<tr>
<td>Social</td>
<td>0.838</td>
<td></td>
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<tr>
<td>Inappropriate Initiation</td>
<td>0.835</td>
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</tr>
<tr>
<td>Nonverbal</td>
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<tr>
<td>Stereotyped language</td>
<td>0.682</td>
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<tr>
<td>Use of context</td>
<td>0.659</td>
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<tr>
<td>Coherence</td>
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<td>Syntax</td>
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## Dimensions - literacy

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<th>Literacy measures</th>
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<td>Spelling</td>
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<tr>
<td>Vocabulary</td>
<td>0.528</td>
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<tr>
<td>Alliteration</td>
<td>0.505</td>
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Associations between dimensions of behaviour and language

<table>
<thead>
<tr>
<th></th>
<th>Behaviour</th>
<th>Literacy (structural)</th>
<th>Communication - pragmatic</th>
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</thead>
<tbody>
<tr>
<td>Literacy (structural)</td>
<td>−0.091</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication - pragmatic</td>
<td>−0.617 **</td>
<td>0.168 *</td>
<td></td>
</tr>
<tr>
<td>Communication - structural</td>
<td>−0.322 **</td>
<td>0.456 **</td>
<td>0.656 **</td>
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## Associations between behaviour and language

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<td>0.168 *</td>
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<tr>
<td>Communication-structural</td>
<td>−0.322 **</td>
<td>0.456 **</td>
<td>0.656 **</td>
</tr>
</tbody>
</table>
Summary

- Children with high levels of high hyperactivity are distinguished by pragmatic communication skills but not structural language abilities.

- A dimension of hyperactivity, unsociable behaviour, and pragmatic communication problems is evident.

- Poor functioning on this dimension extends beyond children diagnosed with ADHD to the much larger group showing high levels of hyperactivity.
Questions?
CCC-2 items

Speech
Leaves off beginnings or ends of words, e.g. says “roe” instead of “road” or “nana” instead of “banana”. Speaks clearly so that the words can easily be understood by someone who doesn’t know him/her very well.

Syntax
Gets mixed up between he/him or she/her, so might say “him is working” rather than “he is working”, or “her have a cake” rather than “she has a cake”.
Produces sentences containing “because” such as “John had a cake because it was his birthday”.

Semantics
Mixes up words that sound similar, e.g. might say “telephone” for “television” or “magician” for “musician”.
Uses abstract words that refer to general concepts rather than something you can see – e.g. “knowledge”, “politics”, “courage”.

Coherence
Doesn’t explain what s/he is talking about to someone who doesn’t share his/her experiences; for instance, might talk about “Johnny” without explaining who he is.
Talks clearly about what s/he plans to do in the future (e.g. what s/he will do tomorrow, or plans for going on holiday).
CCC-2 items

Social Relations
• Appears anxious in the company of other children.
• Shows concern when other people are upset.

Interests
• Shows an interest in things or activities that most people would find unusual, such as traffic lights, washing machines, lamp-posts.
• Reacts positively when a new and unfamiliar activity is suggested.
Inappropriate Initiation
Talks to people too readily: e.g. without any encouragement, starts up a conversation with a stranger. Keeps quiet in situation where someone else is trying talk or concentrate (e.g. when someone else is watching TV, or during formal occasions such as school assembly or a religious ceremony).

Stereotyped Language
Repeats back what others have just said. For instance, if you ask, “what did you eat?” might say “what did I eat?” When answering a question, provides enough information without being over-precise.

Use of Context
Ability to communicate varies from situation to situation – e.g. may cope well when talking on-to-one with a familiar adult, but have difficulty expressing himself/herself in a group of children. Realises the need to be polite – would pretend to be pleased if given a present s/he did not really like, and would avoid making personal comments about strangers.

Nonverbal Communication
Stands too close to other people when talking to them. Makes good use of gestures to get his/her meaning across.
## Sample - diagnoses

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>m</th>
<th>f</th>
<th>total</th>
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<tbody>
<tr>
<td>None</td>
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<td>59</td>
<td>164</td>
</tr>
<tr>
<td>ADD</td>
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<tr>
<td>ADHD</td>
<td>16</td>
<td>4</td>
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<tr>
<td>ASD</td>
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<td>12</td>
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<tr>
<td>DAMP</td>
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<td>3</td>
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<tr>
<td>Depression</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dysgraphia</td>
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<td>0</td>
<td>1</td>
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<td>Dyslexia</td>
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<td>18</td>
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<td>Global Delay, Dyspraxia</td>
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<td>OCD</td>
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<td>Social Anxiety Disorder, Depression</td>
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<td>1</td>
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<td>Tourettes</td>
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Sample - reason for referral

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<tr>
<td>Literacy</td>
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<td>41</td>
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<tr>
<td>Maths</td>
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<td>3</td>
<td>9</td>
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<tr>
<td>Language</td>
<td>16</td>
<td>7</td>
<td>23</td>
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<tr>
<td>Poor academic progress</td>
<td>53</td>
<td>41</td>
<td>94</td>
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<tr>
<td>Memory</td>
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<td>8</td>
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<tr>
<td>Anxiety</td>
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**Sample – referral route**

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<td>58</td>
<td>161</td>
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<td>Specialist Teacher</td>
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<tr>
<td>Educational Psychologist</td>
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<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Speech and Language Therapist</td>
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<tr>
<td>Clinical Psychologist</td>
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<tr>
<td>Paediatrician</td>
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</table>
The importance of brain connections for learning to read and do maths

Joe Bathelt
CALM conference
MRC Cognition & Brain Sciences Unit
11th March 2017
How common are reading and maths problems in children?

- 4-6% of children fall into the very low ability range on reading or maths¹
- problems in reading and maths often co-occur¹,²
- deficits may have negative long-term consequences on academic attainment and ultimately employment³

Brain development in childhood

- processing in the brain is mostly carried by networks of brain cells
- individual brain cells have long appendages (axon) to connect to other brain cells
- these are wrapped with an insulating myelin sheath for faster transfer of electric pulses (action potential)
Brain development in childhood

- myelination is an important process of brain development during childhood and adolescence

The CALM sample

cognitive assessment

brain scan

- this analysis included data from **139 children** between **6 and 18 years** who were assessed at the CALM and participated in the brain scan part of the study

- their **literacy and numeracy skills were assessed** using the Wechsler Individual Achievement Test (WIAT) Word Reading and Numerical Operations subtest
The CALM sample

Expected Reading

<table>
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<tr>
<th>age [y]</th>
<th>expected raw score</th>
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<tbody>
<tr>
<td>16</td>
<td>Read &quot;plethora&quot;</td>
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<tr>
<td>15</td>
<td>Read &quot;plethora&quot;</td>
</tr>
<tr>
<td>14</td>
<td>Read &quot;topography&quot;</td>
</tr>
<tr>
<td>13</td>
<td>Read &quot;vicinity&quot;</td>
</tr>
<tr>
<td>12</td>
<td>Read &quot;ridicule&quot;</td>
</tr>
<tr>
<td>11</td>
<td>Read &quot;treacherous&quot;</td>
</tr>
<tr>
<td>10</td>
<td>Read &quot;cleanse&quot;</td>
</tr>
<tr>
<td>9</td>
<td>Read &quot;deputy&quot;</td>
</tr>
<tr>
<td>8</td>
<td>Read &quot;ajar&quot;</td>
</tr>
<tr>
<td>7</td>
<td>Read &quot;during&quot;</td>
</tr>
<tr>
<td>6</td>
<td>Name letters</td>
</tr>
<tr>
<td>5</td>
<td></td>
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</tbody>
</table>

Expected Arithmetic

<table>
<thead>
<tr>
<th>age [y]</th>
<th>expected raw score</th>
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</thead>
<tbody>
<tr>
<td>16</td>
<td>$\frac{2}{3} - \frac{1}{2}$</td>
</tr>
<tr>
<td>15</td>
<td>$14 - 0.72$</td>
</tr>
<tr>
<td>14</td>
<td>$10^3$</td>
</tr>
<tr>
<td>13</td>
<td>$\sqrt{49}$</td>
</tr>
<tr>
<td>12</td>
<td>$744 \div 6$</td>
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<tr>
<td>11</td>
<td>$705 - 489$</td>
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<tr>
<td>10</td>
<td>$7 \times 6$</td>
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<td>9</td>
<td>$8 \times 4$</td>
</tr>
<tr>
<td>8</td>
<td>$10 - 6$</td>
</tr>
<tr>
<td>7</td>
<td>$4 - 2$</td>
</tr>
<tr>
<td>6</td>
<td>Count to 8</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
The CALM sample

- the children in this sample showed a wide range of abilities in reading and maths included deficits in either or both domains as well as age-typical abilities
How is white matter development linked to learning?

- diffusion imaging:
  - measures the diffusion of water
  - in highly organised tissues like white matter fibres, diffusion is stronger along the fibres than perpendicular to them
  - this information can be used to reconstruct white matter pathways in the brain
How is white matter development linked to learning?

- reconstruction of white matter from one child
What changes in children’s brains as they learn to read and write?

- each **node** represents a **brain region** and each **connection** represents a **white matter pathway**
What changes in children’s brains as they learn to read and write?

- many connections are associated with maths and reading performance
- perhaps, it is something about the general efficiency of the network?
Quick aside: graph theory

- graph theory is a mathematical framework to describe properties of networks
- in our case, the network represents brain regions (nodes) and their white matter connections (edges)
- we are interested in how efficient the network is
Quick aside: graph theory

- Graph theory is a mathematical framework to describe properties of networks.
- In our case, the network represents brain regions (nodes) and their white matter connections (edges).
- We are interested in how efficient the network is:
Quick aside: graph theory

- graph theory is a mathematical framework to describe properties of networks
- in our case, the network represents brain regions (nodes) and their white matter connections (edges)
- we are interested in how efficient the network is:
Quick aside: graph theory

- Graph theory is a mathematical framework to describe properties of networks.
- In our case, the network represents brain regions (nodes) and their white matter connections (edges).
- We are interested in how efficient the network is:

Network A

Network B is more efficient
What changes in children’s brains as they learn to read and write?

- the shorter the path between two brain regions, the more efficient the network
- when the average path length between brain regions is shorter, then the maths and reading scores are better
- a more efficient structural network is related to better maths and reading skills

Bathelt, J., Butterfield, S., Gathercole, S.E., Astle, D.E. (submitted): The role of the structural connectome in literacy and numeracy development in children
Conclusion

- children’s literacy and numeracy skills are related to the efficiency of their structural brain network
- this is in contrast to other research that showed that very specific, localised brain differences are associated with learning problems
- this may provide some insight into the high comorbidity of learning difficulties
- longitudinal research will be needed to understand the causal relationship between brain organisation and educational attainment
The effect of poverty on cognition, the brain and education

Duncan Astle
MRC Cognition and Brain Sciences Unit
Understanding systems in development

Targeted cognitive interventions

Altered Neurotransmitters (e.g. methylphenidate)

Genetics

Structural and functional brain systems

SES
SES PREDICTS COGNITIVE DEVELOPMENT

Performance gap between children from disadvantaged and advantaged backgrounds in just about every measure of cognitive development

- **Language**
  - E.g. Noble 2005,
  - Jednorog 2012

- **Executive Functions**
  - E.g. Farah 2006,
  - Sarsour 2011

- **Attention**
  - E.g. Stevens 2009,
  - Lipina 2013

- **Working Memory**
  - E.g. Evans 2009,
  - Kishiyama 2009

- **Emotion Regulation**
  - E.g. Kim 2013,
  - Gianaros, 2008

- **Long Term Memory**
  - E.g. Noble 2006,
  - Farah 2006

- **IQ**
  - E.g. Smith 1997,
  - Hanscombe, 2012
INEQUALITY IN THE EARLY COGNITIVE DEVELOPMENT OF BRITISH CHILDREN IN THE 1970 COHORT

Feinstein et al. 2003
INEQUALITY IN THE EARLY COGNITIVE DEVELOPMENT OF BRITISH CHILDREN IN THE 1970 COHORT

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Feinstein et al. 2003
REFLECTED IN SCHOOL ASSESSMENTS

Percentage of pupils in Cambridge who attained level 4 or above in KS2 assessments

Percentage %

<table>
<thead>
<tr>
<th>Subject</th>
<th>FSM</th>
<th>Non-FSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>65%</td>
<td>90%</td>
</tr>
<tr>
<td>Writing</td>
<td>60%</td>
<td>85%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>55%</td>
<td>80%</td>
</tr>
</tbody>
</table>

‘Children growing up in poverty in Cambridgeshire achieve less well at school than almost anywhere else in the country’ ²

1. Office for national statistics, 2012-2013
PILOT DATA

- 310 KS2 children aged 7-11
- Cattell: Fluid IQ
- Woodcock Johnson: reading and maths
<table>
<thead>
<tr>
<th>Test</th>
<th>Mean FSM</th>
<th>Mean N-FSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattell Series</td>
<td>6.93</td>
<td>8.41</td>
</tr>
<tr>
<td>Cattell Classifications</td>
<td>5.90</td>
<td>6.86</td>
</tr>
<tr>
<td>WJ Reading</td>
<td>29.01</td>
<td>35.76</td>
</tr>
<tr>
<td>WJ Maths</td>
<td>33.72</td>
<td>48.23</td>
</tr>
</tbody>
</table>
## PILOT DATA

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean FSM</th>
<th>Mean N-FSM</th>
<th>Cohen's D</th>
<th>Cohen's D scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattell Series</td>
<td>6.93</td>
<td>8.41</td>
<td>0.67</td>
<td>large</td>
</tr>
<tr>
<td>Cattell Classifications</td>
<td>5.90</td>
<td>6.86</td>
<td>0.50</td>
<td>medium</td>
</tr>
<tr>
<td>WJ Reading</td>
<td>29.01</td>
<td>35.76</td>
<td>0.45</td>
<td>medium</td>
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<tr>
<td>WJ Maths</td>
<td>33.72</td>
<td>48.23</td>
<td>0.73</td>
<td>large</td>
</tr>
</tbody>
</table>
1) The factors that make up a person’s SES are highly complex

...yet treat SES as a single number

2) We can’t treat children of the same SES level as one group

...yet treat as one group
3) Cognition is broad and multifaceted...

...but let’s just use IQ

4) Very few studies include brain measures...
OUR STUDY

What puts these children at risk?

What gives these children resilience?

SES

Cognitive

Neural

Educational attainment
FIRST VISIT: CHILD

Outside scanner:
- IQ: WASI
- Working memory: AWMA
- Phonological processing: PhAB
- Academic: Woodcock-Johnson

Inside scanner:
- Resting state
- working memory and attention task
- phonological processing oddball
FIRST VISIT: PARENT

Extensive questionnaires to assess SES and other environmental variables that we believe are important

Areas:
Several standardised measures of SES
Family dynamics
Home environment
Health
Other key areas
SECOND VISIT: MRI

T1 weighted image

DTI
THE SAMPLE

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG</td>
<td>96</td>
<td>52</td>
</tr>
<tr>
<td>Behavioural</td>
<td>96</td>
<td>52</td>
</tr>
<tr>
<td>MRI</td>
<td>87</td>
<td>44</td>
</tr>
</tbody>
</table>

Age: Mean = 9.89, Range = 6.97 - 12.77
How are cognitive skills related to educational outcomes?

**Maths**

![Feature Importance Chart]

- Fluid IQ: 0.25
- Verbal WM: 0.20
- VS STM: 0.15
- VS WM: 0.10
- Verbal STM: 0.05
- Naming Speed: 0.00
- Vocabulary: 0.00
- Gender: 0.00
- Alliteration: 0.00

88%
Predicting academic achievement in maths

But do the same relationships hold for different SES groups?

Feature Importance for high SES

90%

Low SES: 12%

VS STM  Fluid IQ  Verbal WM  VS WM  Vocabulary  Naming Speed  Verbal STM  Gender  Alliteration
Predicting academic achievement in reading

How are cognitive skills related to educational outcomes?

Feature Importance for high SES

92%
Low SES: 43%
• The ‘cognitive predictors’ of educational success might not be the same in children from low-SES backgrounds.

• In order to design decent interventions we need to better understand what drives the variability in educational outcome within low-SES groups, and it may not be the same as in high-SES groups.
Which aspects of SES are important?

Parents completed various questionnaires about home life (over 200 questions)

Gives rise to 21 different ‘home life’ factors

Attitude to child education
Time with family and friends
Subjective Family Relationship Quality
No. siblings
No. adults
Hours per week for current job of primary caregiver
Child health
Parent health
Discipline
Rules

Technology use (for fun)
Language
Reading
Attitude to neighbourhood (e.g. sense of ownership, friendliness etc)
Neighbourhood SES (from postcode)
Social resources from acquaintance skills
Social resource from personal skills
Subjective SES (Ladder)
Equivalised income (Net income adjusted for household)
Parent average education (8 point scale)
Parent average occupation score (NS-SEC)
Defining outcomes

Introduce outcome measures

Outcome 1) Maths performance
Outcome 2) Literacy performance
Outcome 3) Behavioural control
Outcome 4) Conduct / hyperactivity problems
Outcome 5) Emotional and peer problems

Standardised measures from the Woodcock-Johnson
BRIEF
SDQ – Externalising
SDQ – Internalising

Cognition

‘Home life’
Machine learning to look at relationships

LASSO – a method for selecting the important predictors of our outcomes

E.g. Maths:
Machine learning to look at relationships
Machine learning to look at relationships

Next steps: thinking about risk and resilience
Next Steps…

Brain relationships with our outcome measures...

Reading

SDQ - Externalising

BRIEF

SDQ - Internalising
SUMMARY

• SES strong predictor of cognitive and academic ability

• *But SES is more than one thing.* We want to know which factors are best predictors of key educational and behavioural outcomes.

• We then want to explore whether and how some of these might act as protective factors and others as risk factors.

• *To practitioners: what would you want to find out with these kinds of data???
THANK YOU

Amy Johnson
Gemma Crickmore
Erin Hawkins
Joe Bathelt
Mengya Zhang
Joe Rennie
Sinead O’Brien
Dan Akarca
Promoting mental health and building resilience in adolescence: investigating mindfulness and attentional control

Darren Dunning
MRC Cognition and Brain Sciences Unit
11th March 2017
MYRIAD
My resilience in adolescence
What is mindfulness?

• Focusing attention in a sustained and intentional way on the present while calmly acknowledging and accepting intrusive feelings and thoughts

• Maintaining mental focus in the face of distraction

  • e.g. Focussing on the now rather than brooding about the past or worrying about the future

“Mindfulness means paying attention in a particular way; On purpose, in the present moment, and non-judgmentally.”

Jon Kabat-Zinn
Research Questions

- Does mindfulness training in adolescence have the potential to shift the population away from psychopathology and toward improved mental health?
Why use mindfulness training to improve mental health?

- **Treatments (e.g. CBT, Antidepressant Medication)**
  - Work well for those who are symptomatic
  - Don’t work as preventive interventions

- **Mindfulness Training**
  - Designed for prevention
  - Attempts to change a core vulnerability of mental health
    - In depression and anxiety, deficits in executive control manifest as a difficulty in regulating cognition and behaviour in the face of intrusive negative thoughts
  - Has been shown to prevent recurrence of depression in adults
  - Early studies with children show promise (Kuyken, et al., 2013)
Rationale: why mindfulness training?

- Can be used in schools
- Is for everyone
- Socially acceptable
Rationale: why focus on adolescence?

- The annual cost of mental health in the UK is estimated to be at least £70 billion
- Mental health problems most commonly start during adolescence

13-15 years
MYRIAD’s main themes

1. A large-scale cluster-randomised controlled trial
2. Mechanisms and moderators study
3. Longitudinal cohort study
The RCT

I. When delivered in school is mindfulness training effective in:
   I. Reducing/preventing depression
   II. Improving wellbeing
The RCT

- 76 schools recruited across the UK
- 25,000 children assessed at baseline
- 5,700 pupils randomised to mindfulness training or teaching as usual
- Immediate, one year and two year follow-up
- Primary outcomes
  - Risk for depression (CES-D)
  - Teacher-rated Strengths and Difficulties (SDQ)
  - Wellbeing (WEMWBS)
The RCT

Figure 2. Mindfulness training hypothesised to shift the population of risk/resilience
Mechanisms and Moderators

I. What are the cognitive mechanisms that underlie the effects of mindfulness training in adolescence?

II. Are the effects of mindfulness training moderated by developmental stage (age and puberty) and gender?
Mechanisms and Moderators

480 Adolescents randomised to either:
- Mindfulness training (.b)
- Psych-ed (Student Success Skills)

- Mindfulness skills
- 8 weeks, 1hr/week + homework
- Group sessions
- School based
- Aimed at 11-16 year olds

- Academic, social and emotional skills
- 8 weeks, 1hr/week + homework
- Group sessions
- School based
- Aimed at 11-16 year olds
Mechanisms and Moderators

- Adolescents complete:
  - A range of tasks that test executive control in the face of motivationally compelling distractions in affective and social contexts.
  - A series of questionnaires (mindfulness, depression, wellbeing, SDQ, Demographics, Pubertal stage)

- Following intervention
  - Assessed on the same tasks as at pre-2 months after training to evaluate maintenance of gains
I. What are the cognitive and neural mechanisms that underlie the effects of mindfulness training in adolescents at risk of depression?

II. Does mindfulness training benefit adolescents at risk of depression via different mechanisms than cCBT?
Longitudinal Study

- Participants from the RCT will be followed up over a 20 year period
- Is mindfulness training cost-effective over the longer term?
Thank you for listening

“Live each moment. Practice being mindful. Be present in... Hold on, I have to take this.”
PTSD: Identifying and supporting very young children following a trauma

Benjamin Goodall
MRC Visiting Scientist & Clinical Psychologist
MRC Cognition and Brain Sciences Unit

CALM Workshop, 11th March 2017
DSM-5

- 2013 – 5
- Two sets of criteria:
  - Adults, adolescents and children over 6 years
  - Children under six years (Preschoolers)
- Criteria
  - A. Exposure
    - Directly
    - Witnessed
    - Learned about it
    - Repeated or extreme exposure
DSM-5

- B. Intrusions
  - Intrusive memories
  - Distressing dreams
  - Dissociative reactions (flashbacks)
  - Psychological Distress at reminders
  - Physiological Distress at reminders
DSM-5

- C. Avoidance/Negative cognitions
  - Memories/thoughts
  - External reminders
  - Increased negative emotional states
  - Diminished interest in play
  - Social withdrawal
  - Reduced expression of positive emotions

- C. Avoidance
  - Memories/thoughts
  - External reminders

- D. Negative cognitions
  - Inability to remember part of event
  - Negative view of self, others or world
  - Blame
  - Increased negative emotional states
  - Diminished interest in play
  - Social withdrawal
  - Reduced expression of positive emotions
DSM-5

- **D./E. Alterations in arousal**
  - Irritability/anger
  - Recklessness/Self-destructive behaviour
  - Hypervigilance
  - Exaggerated startle response
  - Problems concentrating
  - Sleep disturbance

- **E./F.**
  - Longer than a month

- **F./G.**
  - Disturbance in daily living
  - i.e. Relationships with parents, siblings, friends or school vs. Social, occupational or other

- **G./H.**
  - Not attributable to substance/medication
Course over time

Trauma

1 month 3 months 6 months 20 years 40 years

Acute stress disorder

Acute PTSD

Chronic PTSD

Delayed-onset PTSD
Clinical Challenges

- **Single incident PTSD** – Children, adolescents and adults
- **Complex PTSD** – children, adolescents and adults
- Different presentations
Types of Trauma

- Single incident
- RTA’s
- Medical Emergencies
- Burglary
- Dog attack
- Riding – Horse, Bike, Motorised Vehicle
- DV
- Witnessing attacks, accidents, emergencies
- PTSD as main diagnosis
Treatment

Trauma-Focused Cognitive Behaviour Therapy (TF-CBT)

• Nice guidelines
• Good evidence
• Target 3M’s:
  • Memory – nature of the trauma memory
  • Meanings – peri- and post- trauma appraisals
  • Management - maladaptive coping
Memory
Brewin, Dalgleish & Joseph, 1996
Dalgleish, 2004
Meiser-Stedman, 2002
Memory quality

2-4 weeks post-trauma

- ASD
- No ASD

6 months post-trauma

- PTSD
- Non-PTSD

Meiser-Stedman et al., 2007, 2009, J. Abnormal Psychology
Trauma narratives

Salmond et al., 2011, *J. Child Psychology, Psychiatry*
Meanings
I’m going crazy

Nowhere is safe

I’ll never feel better

I can’t trust anyone

Brewin, Dalgleish & Joseph, 1996
Dalgleish, 2004
Meiser-Stedman, 2002
Three types:

- Meanings about the trauma
  - Concurrent: e.g. I’m going to die; I can’t escape N.B. Trapped in the memory
  - Retrospective: e.g. I should have fought back; I should have been able to prevent it

- Meanings about the symptoms
  - I’m going crazy, if I talk about it I’ll lose control

- Global Meanings
  - About the self: e.g. I am permanently damaged; I am weak; I am doomed
  - About the world: e.g. the world is dangerous; bad things will always happen; people cant be trusted
Management
Management

• **By the child**
  - *Behavioural avoidance*
  - *Safety behaviours*
    - e.g. not going to sleep at night;
  - *Cognitive management*
    - Rumination
    - Thought suppression
    - Distraction

• **By the parent (and others)**
  - *Collusion with behavioural avoidance*
  - *Collusion with safety behaviours*
  - *Managing their own distress/discomfort*
Analogue sample: Both correlate with PTS, $r_s (252) > .38$, $P_s < .001$. 
Working on the 3 Ms - an RCT of trauma-focused CBT for PTSD in children and adolescents

![Graph showing PTSD severity over time with pre-treatment, post-treatment, and 6/12 FU points.]

Smith et al., 2007, JAACAP
Presentation

**Presentation**

- Recurrent distressing thoughts
- Increased nightmares, not just trauma related
- Extreme difficulty falling asleep or frequent night-waking
- Anxiety or physical distress at reminders
- Avoidance – harder as younger children have less free choice
- Decreased play, separation, play reenactment
- Changes in emotional expressivity
- Refusal to eat or trouble keeping food down
- Or changes in responsiveness to an adults efforts to soothe them that may include responding with heightened irritability, fearful expressions, crying or blank expressions under circumstances that do not normally produce these effects (i.e. face to face play or efforts to comfort)
• Questions?