Attention: What is it, how do we measure it and why should we measure it?

Dr. Tom Manly
Medical Research Council Cognition and Brain Sciences Unit
Cambridge, UK
SN5 1LLAS
www.mrc-cbu.cam.ac.uk
myweb@mrc-cbu.cam.ac.uk

Who am I?

• Clinical Psychologist
• Clinical Neuropsychologist
• Lead author on the TEA-Ch and TEA-Ch2
• Research Programme Leader at the University of Cambridge MRC Cognition and Brain Sciences Unit
• …and that is?

Medical Research Council

Applied Psychology Research Unit

How do you best organise a war room?

Why do radar operators miss important signals when this is all they have to do?

What sequences can people best remember?

Overview

• What is attention?
• Development of attention
• Cognitive neuroscience of attention
• Assessment of Attention
• Test of Everyday Attention for Children2 (TEA-Ch2)

How do you best organise a war room?

Why do radar operators miss important signals when this is all they have to do?

What sequences can people best remember?
30/06/17

Fredrick Bartlett        Alan Baddeley               Dorothy Bishop              John Teasdale
Tim Shallice and Paul Burgess              Emily Holmes                       Sue Gathercole

“everybody knows what attention is”  
(William James, 1891)

Attention!

“nobody knows what attention is”  
(almost everyone who writes on the topic)
Exercise
1. What is the difference between seeing/hearing/touching something and paying attention to it?
2. Think of someone with good attention and someone with poor attention – what is the difference (e.g. in what they do?)

Moving beyond introspection…
(morning fun with attention!)

? 
Attending to a location prioritizes information from that location.
It is easier to attend to a location when there is something there.
We do not have full, goal directed control over attention. When something captures our attention it appears to go off-line for a moment.

It is hard to attend to two locations but not in-between.

We sometimes miss enormous changes going on around us (if slow or onset masked).

- We can identify and throw out goal irrelevant info incredibly quickly
- When we detect a target our system is off line
- We have capacity limits when information is too fast
• When something is distinct it ‘pops out’ from the background
• When it is not we have to search one object at a time

Mackworth clock test
Sustained Attention to Response Test

The Sustained Attention to Response Test (SART) Robertson, Manly et al., 1997

• Less fun with attention…
• Mackworth clock test
• Sustained Attention to Response Test…

• We have capacity limits when information is too slow
• And when having to impose our attention on a task that is repetitive and has little inherent interest
Tap with your left hand if the number is <5
Tap with your right hand if the number is >5

4

Tap with your left hand if the number is Red
Tap with your right hand if the number is Blue

4

Switching our attention between two goals can be difficult, especially when those goals are in competition with each other.

? •

Switching from our habitual pattern, or even from the last thing we did can be difficult.

Attention boosts information at that location.

We cannot fully control our attention – and when it is ‘captured’ it is unavailable for a while.

Can’t easily attend to two locations.

Competition in response

BLUE
RED
GREEN
YELLOW
GREEN
BLUE
RED

We think we are paying attention when we are not…

Can sometimes identify and exclude irrelevant info remarkably well.

So

Switching from our habitual pattern, or even from the last thing we did can be difficult.

So
**How is this (are these) done?**
The Neuroscience of Attention (Clinically dominant model)

**Attention or different types of attention?**
(e.g. Posner & Petersen, 1990)
- **Selective attention**: Filtering goal-relevant from irrelevant information (often under time pressure) — (anterior cingulate)
- **Sustained attention**: Remaining focused on your goal, particularly during long, repetitive activity (right prefrontal cortex)
- **Spatial attention**: Moving attention between locations (parietal lobes)
- **Switching attention**: Switching between cognitive sets as required, not getting ‘stuck’ (frontal)

**Contemporary neuroscience of Attention**
(from Duncan and Desimone 1996)

**Ventral Stream**

**Competition...**
So – objects and locations “compete” for representation.
If one begins to dominate by chance it will squash out the representation of others.
But not just chance...

Factors that influence competition
Salience
Intensity
Movement
Abrupt onset
Biological significance

Desimone and Duncan’s (1995) crucial observation was that this cannot occur after visual processing has taken place because our target may already have been extinguished by salient rivals.
Rather, our intentions is one of the factors influencing competition at all levels (integrated competition model)

The processes must be influenced by our plans
Is there anything special about lateral frontal neurons? Many neurons have quite specific tuning – wavelength, angle, frequency, face, words… Cells in lateral prefrontal cortex appear to tune to whatever is relevant to the task at hand (Roa et al., 1992; Everling et al. 2002).

E.g. “Look out for red and blue squares, green objects and circles are not relevant” “Look out for the last location in which the object was hidden” These cells may form a quick ‘model’ of the task that influences other regions.

“Multiple demand” areas
Duncan and Owen (2000)
Meta-analysis of fMRI studies of a range of attentionally demanding tasks.
The same regions were active across a range of tasks…

I am doing a task…
My task is to find Wally…
Wally looks like this…

Goal achieved?
Check

I am thinking about chocolate
Mmm, chocolate.

What goal?
Who’s Wally?

Different types of attention?
“Selective attention task” – Is Wally present?
“Sustained attention task.”
Count Wally...

What can go wrong?
Not form the intention (motivation? comprehension?)

What can go wrong?
Form and maintain the intention but the demands of
the task exceed resources

What can go wrong?
Intention not well maintained or outcompeted by a
rival

Development of attention
1-6 months
Subcortical areas relatively similar to adult state
Cortical areas different and change at different rates.
Visual areas peak synapse formation 3-4 months (Colombo & Cheatham, 2006; Ruff, 1986)
Orienting to objects (e.g. faces) present (Johnson & Tucker, 1996)
Goal-directed attention?
Sustained attention?

6-8 months
Frontal changes (increased fibres, fewer neurons; Kanaumura et al., 2003; Tsekhmistrenko et al., 2004)

12 months
Frontal lobe synapse formation peak reached (Colombo & Cheatham, 2006; Ruff, 1986)
Onset of sustained attention… possibly in relation to an internal goal (Colombo & Cheatham, 2006; Ruff, 1986)

12 months +

Attention problems in developmental conditions
Preterm (Weijer-Bergema, Wijesko, Jongmans, 2008)
Fragile X (Serf et al., 2004)
Williams Syndrome (Serf et al., 2004)
Autism (Burack et al., 1997).
Asperger’s syndrome (Kim, Sparrow, Volkmar, Cicchetti, & Rourke, 1999).
Tourette’s syndrome (Georgiou, Bradshaw, Phillips, & Chiu, 1996).
Leukemia (Browers, Ricardi, Fazio, & Poplak, 1985).
Turner’s Syndrome (Browers et al., 1997).
Dyslexia, Conduct Disorder, Depression, Anxiety...

Discussion
Why are attention problems so common across developmental conditions?
Why is attention so important?
ADHD
Melchior Adam Weikard (1775)
“The inattentive person is to be separated from the noise or any other objects; he is to be kept solitary, in the dark, when he is too active.”
Sir Alexander Crichton (1798)
“there are many to whom the dryness and difficulties of the Latin and Greek grammars are so disgusting that neither the terrors of the rod, nor the indulgence of kind entreaty can cause them to give their attention to them.”
Sir George Frederick Still (1902)
Children with “moral defect without general impairment of intellect”

ADHD
APA DSM 1968
Hyperkinetic
APA DSM III 1980
Attention Deficit Disorder
APA DSM III 1987
Attention Deficit Hyperactivity Disorder
APA DSM IV 2000
combined type ADHD
predominantly inattentive type ADHD
predominantly hyperactive-impulsive type ADHD

attention deficit hyperactivity disorder (ADHD)
A. Either (1) or (2)
Six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:
Inattention
(a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
(b) often has difficulty sustaining attention in tasks or play activities
(c) often does not seem to listen when spoken to directly
(d) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behaviour or failure to understand instructions)
(e) often has difficulty organising tasks and activities
(f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework).

attention deficit hyperactivity disorder (ADHD)
(g) often loses things necessary for tasks or activities (e.g. toys, school assignments, pencils, books, or tools)
(h) is often easily distracted by extraneous stimuli
(i) is often forgetful in daily activities

The Onion
“Youthful Tendency Disorder (YTD), a poorly understood neurological condition that afflicts an estimated 20 million U.S. children...”

• Running, jumping and skipping
• Sudden episodes of shouting or singing
• Preferring playtime to schoolwork
• Running around the neighbourhood claiming to be Superman

ADHD
Hyperactivity/Impulsivity
(a) often fidgets with hands or feet or squirms in seat
(b) often leaves seat in classroom or in other situations in which remaining seated is expected
(c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
(d) often has difficulty playing or engaging in leisure activities quietly
(e) is often “on the go” or often acts as if “driven by a motor”
(f) often talks excessively
(g) often blurts out answers before questions have been completed
(h) often has difficulty awaiting turn
(i) often interrupts or intrudes on others (e.g. butts into conversations or games)–a.
ADHD

USA
9-11% of school age children
France
< 0.5% (Wedge, 2012)
Very high comorbidity with dyslexia, oppositional behaviour, anxiety, depression etc.

Very high ‘co-morbidity’ rates with other psychiatric disorders. DSM influences (e.g. if ASD then not ADHD).

ASSESSMENT OF CHILDREN’S ATTENTION

Good news
We have access to a device that is exquisitely tuned to the direction and intensity of human attention.

Getting at attention:
Parent/teacher questionnaires
Strengths and Difficulties (free, many languages - google)
On-line version of DSM-V ADHD
Brown Attention Deficit Disorder Scales - Adolescent Version
Connors’ Rating Scales – Revised (3-17 years)
Behaviour Rating Inventory of Executive Function (BRIEF)
Questionnaire measures are great… but what are some of their limitations?

Limitations
What, exactly, are they measuring (specificity?)
Bias and preconceptions (e.g. boys vs. girls)
Responders ‘baseline’ – what level of attention is normal?
(are teachers better assessors than parents)
Awareness in self-report
Are some attention problems hidden?

Performance measures of attention
More objective than questionnaires… but there is one major problem.
(Almost) everything that we do when we assess a child requires attention.
How can we separate out the effect of attention on these other functions?
How can we measure attention independently of other functions?
Is this even possible?

The IQ problem
Performance on almost all cognitively demanding tasks positively (if modestly) correlate; people who do well at task X will also tend to do well at task Y. People who do poorly at task X will also tend to do poorly on Y.
- The shared component between tasks has been called g or "general intelligence"
- You can ask, what sort of task best correlates with this general factor?
  - Fluid IQ measures… (Raven’s, Cattell, Matrix Reasoning)

The IQ problem
- It’s not just that our measures of IQ are ‘contaminated’ by differences in attention.
- Good IQ measures are therefore quite likely to be indicative of attention function
- If you control for IQ, you may be taking out something that is important
  - but IQ measures lack specificity (to what extent is poor performance attributable to attention?).
The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

The solution to the specificity problem?

Task requiring a lot of attention

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory

Knowledge

Strategy

What are some problems with controlling for other processes?

Problem 1

Does this task require attention?

Attention

Task comprehension

Speed of response

Knowledge

Strategy

Memory
Problem 2. Reliability of difference scores

Problem 3. Interpretation difficulty

Jane does an attention-switching task and a baseline task which only requires one rule (e.g. >><5).
She is very, very fast at the baseline task.
She is quite fast and accurate on the switching task but the amount of slowing attributable to switching is unusually large.
Jill does the same tasks.
She is very slow on the baseline task.
She is also very slow on the switching task but the difference between the two tasks is not unusual.
Jane has the greater switching ‘cost’ but who has the better attention?

Aims in developing the Test of Everyday Attention for Children

Simple tasks with practice and demonstration (reduce demands on memory and comprehension)
Minimal demands on memory and language
Attempt to separate out selective attention, sustained attention and attention switching
Try to make it ‘fun’ without the tasks themselves being too engaging
Make it practical within a clinical setting

(Aside – why did we develop the TEA-Ch at all?: The power of attention)
• Unilateral Spatial Neglect
• Surprisingly common
• Debilitating

• Important features:
  • Unilateral neglect is not absolute.

• Important features:
  • Unilateral neglect is not absolute.
  • Unilateral neglect is not stable.
What causes variability?

- Poor performance on boring sustained attention tasks predicts persistent neglect (Robertson, Manly et al. 1997)
- Neglect can be reduced by...
  - Loud alerting tones (Robertson et al. 1998)
  - Stimulant medication (Malhotra, Parton et al. 2006)
  - Stimulating thoughts (George et al.,
  - Made worse be sedatives

If low alertness/sustained attention is relevant to spatial neglect, do other groups have problems?

- Not detected by services, schools or parents
• DA “Now you see it, now you don’t” left neglect.

• DA Star Cancellation

• Latest methods (Corinne Bareham, Tristan Bekinschtein)

• Dobler et al. Sustained attention problems best predictor of left-errors with time-on-task.
• Same pattern in adults?
TEA-Ch² why was it changed and how was it changed?
• Importance of up-to-date norms
• Too long
• Did not include 5-year-olds
• 6-16 years ‘computer game’ format worked well but some tasks were difficult to get across to youngest children
• Larger normative sample would be nice
• Computers now ubiquitous…
• Including cleverer ways of scoring…
• Chance to get rid of Neuropsychology’s scariest logo

Can you use performance-based tests of attention in 5-year-olds?

Pilot and empirical evaluation
• Separable Sustained and Selective Attention Factors Are Apparent in 5-Year-Old Children. (Underbjerg et al., PLoS ONE)
• 172 5 yr olds from the general population
• 98% completed all measures
• As with older children and adults, separable sustained and selective attention factors were found
• Built in validity checks were passed (see later)

TEA-Ch² Early design decisions.
A psychologist goes to do a ‘quick assessment’

TEA-Ch² Shorter
Shorter, simplified version for 5-8 years (TEA-Ch² J)
Reduce influence of non-attention factors such as strategy
Increase reliability
Use on-line assessment to streamline admin and scoring
TEA-Ch² Early design decisions.

- Manual (once familiar with test)
- Stimulus book
- Scoresheet

Stimulus presentation
Response capture
Audio player
Stop-watch
Scoring aid

EXAMPLE FOR PRESENTATIONS

CERTIFICATE OF MERIT
AWARDED TO

FOR COMPLETING THE FOLLOWING TASKS EXCELLENTLY AND WELL

CERTIFICATE AWARDED TO

SIGNATURE
Selective attention

- TEA-Ch Sky Search
  - Open ended
  - Relies on child to indicate completion (or examiner discretion)
  - To what extent is a cautious criterion being assessed?
  - “One shot”
  - Destroy evidence of the assessment by washing
  - Destroy your favorite shirt (ditto)

- TEA-Ch J Balloons
  - 15-sec trials x 4 (reliability)
  - Children stopped in ‘full flight’
  - Standard countdown start-stop timing intervals on computer (although stopwatch can be used)

Can you help me with some games and puzzles? You get a sticker for each one that you try..

On our first game we need to help the dog who has lost his balloons.

The balloons look like this. When you find one I want you to cross it out with your pen.

Demonstrate

“There are lots of other things on the page. Don’t cross them out – just the balloons.

Go as quickly as you can.

Watch me first.

Now you have a go.”

Check comprehension.

Give additional prompts as necessary.

Only when you are certain, begin the task...
Hello. I need some help with some games and puzzles. In the first one, with your pen, I'd like you to find and mark shapes that look like this.

We need to be careful because there are other shapes that look like it... but I don't want you to mark them.

Demonstration, practice, correction if necessary and then 6 10-second trials.
Visual selection without motor response?

- TEA-Ch Sky Search and Map Mission both required manual responses.
- Is poor performance due to inattention or slow motor speed?
- Is it possible to get around this?
- ...to a degree

Hide-and-Seek (visual)
Oh no! The dog has lost its favorite red ball. It looks like this.
Could you look in each box and say "yes" if you see the ball and "no" if you don't. Try to do it as quickly as you can.

There is a red ball in only some of the boxes, so don't be surprised if there isn't a red ball there.
Can you see a red ball there? Can you point to it for me?
Check comprehension and correct if needed.
Look at each picture and say "Yes" if a red ball is there and "No" if it isn't, as quickly as you can. We only have 20 seconds to do as many as we can. Are you ready?
Spatial (laterised attention)
- Spatial attention was not measured in the original TEA-Ch.
- Since then its potential importance in children has become clearer.
- Most healthy adults start cancellations on the left.
- 90% of patients with left neglect started on the right (Manly et al.)
- Note down location of first cancellation (L, R or middle if you need to).
- Characterize the pattern of cancellations (all left, mostly left, balanced, mostly right, all right).

TEA-Ch2J and TEA-Ch2A also include a cancellation test with no time-limit to check for unusual levels of omissions on left and right.

Auditory selection
- In the TEA-Ch there was no measure of selection outside of the visual modality.
- Auditory selective attention is difficult to measure outside of the laboratory and has potential confounds of hearing problems.
- TEA-Ch2J Hide-and-Seek Auditory, TEA-Ch2A Cerberus (more, more difficult items)
- First, introduction to the computer subtests.
Here we need to listen out for the dog's bark. It is quite difficult because there will be lots of other animal sounds too.

Each go will begin with this sound … … and end with this sound.

This is the bark that we are listening out. As soon as you hear that bark sound, I want you to press the spacebar as quickly as possible.

In some goes there will be a bark, and in some goes there won’t. A bark could come at any time so keep listening until you hear the end sound.
Auditory selection

- Attention lapse or hearing problem?
- Repeated items validity check
- If missed target on both – could be hearing
- If missed target on one but not the other more likely to be attention lapse
- Almost all cases in normative sample were suggestive of inattention

Sustained attention

TEA-Ch Score! required children to keep mental count of a series of tones separated by long, unpredictable (and very, very boring!) intervals.

Very hard to keep attention on it – inattention shows up in incorrect total

Equivalent of Score! is called Barking in TEA-ChJ and Vigil in TEA-ChA

Ceiling effects expected but clinically useful test

Validity check – we used fast and slow paced items. If fast correct, then poor performance is not due to counting per se

Validity check (5 year olds)

- 97.79% correct on fast-paced items
- Errors on slow-paced items 80% within 1 of actual target
Once you have entered a value for practice 1, this screen will appear.

This means repeat what has just happened (here, practice 1)

This means go on to the next thing (here, practice 2)

This returns you to the select practice/test menu

This returns you to the main TEA-Ch2 menu

---

Simple reaction time (SRT)

Children watch a box at the center of the screen and respond as quickly as possible to the onset of a blob at the left, right or central location.

![Simple Reaction Time](image)

Computer measures RT

If a premature response is detected it presents ? as a warning not to anticipate onsets

If no response is detected within 6 seconds ? is presented to see whether anyone is still there...

Spatial L-R index possible

---

Sustained Attention to Response Test (SART)

Replaces Walk Don’t Walk in TEA-Ch

Respond to all regularly presented shapes except triangles

Difficult to maintain attentive control over responding

Computer measures RT and errors of commission

---

Tests that appear only in TEACH²A

Troy (dual task)

Reds and Blues, Bags and Shoes (attention switching)

---

Not to be administered unless the Hector Cancellation and Vigil subtests have already been administered (it is not necessary to have administered the Hector-B cancellation).

First set up the computer part of the task.
Do you remember finding these shapes?
Do you remember the sounds that we have just counted?
Now we are going to try doing both at the same time!

In a moment, I am going to ask you to cross out the shapes as fast as you can, like you did before.
At the same time, I'd like you to listen and count how many sounds you hear.
Don't start crossing out until I say, 'Go!' When I say, 'Stop', you must stop crossing out, and tell me how many sounds you heard. Sounds tricky, so let's have a practice first.
On each go you are going to see one of 4 objects appear in the centre of the screen here (indicate red shoe):
It might be a red shoe, or a blue boot, or a red toolbox or a blue bag.
At the bottom of the screen you will see a hand and a foot.
If the object is something that you hold in your hand - the handbag or the toolbox, you need to press the 'M' key as quickly as possible (indicate) because the picture of the hand is on that side of the screen.

OK, now I see a red tool box. That is carried in the hands so I press the 'M' key over here under the hand. [Press 'M' key]

Now there is a blue boot. What does that go with, the hand or the feet? What button should I press?
Continue asking until examinee gets 4 correct responses in a row or it is clear that the task cannot be understood.
Possible to ‘do’ the task by pressing at random (50% correct and very fast!)

See what happens if I get it wrong…

You see, it has put up that question mark. When that happens, we just need to wait for a second or two and it will give us the next object.

When you are doing the task, I want you to press as quickly as you can but try not to make a mistake, as waiting for the question mark to go will slow us down. If you do make a mistake, don’t worry, just wait for the next object to appear.

Practice 1 (hand or foot rule)
Practice 2 (red or blue rule)
Test 2 (red or blue rule)
Test 3 (switching block)
Test 4 (switching block)

TEA-Ch² Normative sample

- Emma Lycet, Christine Carvalho
- Age, Sex, Parents Educational Level stratified according to 2011 Census
- UK regions North East, North West, Yorkshire & Humberside, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland, and Northern Ireland: Mixture of urban and rural
- TEA-Ch² J n = 393
- TEA-Ch² A n = 621

TEA-Ch² Scoring: Two ways

1. Conventional age/sex lookup
2. Demographically adjusted continuous norms obtained via regression

Advantages – efficient use of all standardisation data
Compares a score to that expected based on age, sex and parental educational level
Avoids step changes at boundaries of age-bands
Only practical with online scoring

30/06/17
TEA-Ch² Factor structure

- Confirmatory factor analysis
- Null model – no relationships, poor fit
- Model 1 – single attention factor, better but still poor
- Model 2 – sustained and selective attention uncorrelated, not bad
- Model 3 – sustained and selective attention superimposed on general inter-correlation “good fit” in both J and A
- Replicates 5 year old pilot and TEACH

TEA-Ch² J

Had expected this to load on selective factor but the requirement to maintain attention over time for the dog may have led to a greater ‘sustained’ component.

TEA-Ch² A

TEA-Ch² Factor structure

- Justifies formation of selective and sustained attention factors calculated across the tests.

Reliability – a paradox?

- Poor attention can be seen as a disorder in reliability (sometimes you get it right…sometimes you get exactly the same thing wrong)
- We used lack of reliability (different responses to the same item) as a validity check in Hide-and-Seek Auditory
- At the same time we want to give sufficient numbers of trials to get a relatively stable estimate of a child’s abilities (or lack of reliability!)
- This has to be balanced against the practicalities of testing

Reliability

- Internal consistency: How well does performance on half of the items in a test predict performance on the other.
- TEA-Ch²A, Hector Cancellation, Hecuba Visual Search, Troy Dual Task, SART, SRT subtests and Attention Indexes - reliability is excellent (> .9)
- RBBS (> .7)
- TEA-Ch² J Balloons (> .9), SART (> .8) Hide & Seek Visual (> .7), Simple RT (> .7), Selective attention index (> .8), Sustained Attention index (> .7)
- Vigil/Barking and Cerberus/Hide-and-Seek auditory limited number of items.
Reliability

- Test re-test reliability: How well does performance on half of the items in a test predict performance on the other.
- TEA-Ch2A: Hector Cancellation (>0.7), Hecuba Visual (>0.7), Simple RT (>0.7), Troy Dual Task (>0.6), RBBS (>0.6), Vigil (>0.5), SART (>0.5), SART (>0.5), Cerberus (>0.5)
- TEA-Ch2J Balloon Hunt (>0.7), Hide & Seek Visual (>0.6), SART (>0.6), SRT (>0.6), Barking* and Hide & Seek Auditory (>0.6)
- * 89% scored within 2 of previous score

Clinical Samples

- MRC Cognition and Brain Sciences Unit
- Center for Attention, Learning and Memory

  - Sue Gathercole
  - Joni Homles
  - Duncan Astle
  - Ayla Humphrey
  - Francesca Woolgar
  - Sarah Bishop
  - Sara Gharooni
  - Salty Butterfield
  - Andrew Gade
  - Agnieszka Jarosliwka
  - Gemma Crickmore
  - Joe Batheil
  - Amy Johnson
  - Laura Forde

  - Practitioner (e.g. SENCO) referred school age sample
  - Ecologically valid referral sample
  - N = 139 (now 500)
  - TEA-Ch2 J 40, TEA-Ch2 A 99

CALM sample

- NOTE: MORE UP TO DATE INFORMATION ON THE CALM DATASET WILL BE PRESENTED. ANALYSIS ON FULL SAMPLE INCOMPLETE AT TIME OF HANDOUT GOING TO PRESS

Stroke

- TEA-Ch1 TBI sample poor selective attention
- Mardee Greenham, Vicki Anderson et al. Murdoch Children’s Research Institute
  - J (n = 18): Lower cancellation and visual search scores (p< 0.006-0.003)
  - A (n = 11): Lower visual search scores (p<0.003)
  - More to follow…
  - Publication updates
  - Spatial index

Summary

- What is attention?
- Development of attention
- Cognitive neuroscience of attention
- Assessment of Attention
- Test of Everyday Attention for Children2 (TEA-Ch2)