

Teaching Students with ADHD: A Cognitive Perspective



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R. Tannock: Disclosures

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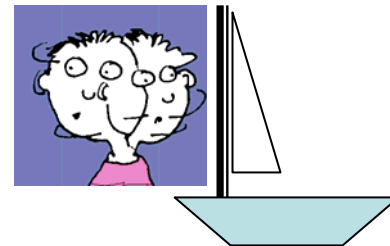
Learning Objectives

- To understand that ADHD, particularly inattention, is a risk factor for academic and occupational under-achievement
- To understand key underlying cognitive difficulties in ADHD and their impact on learning and behavior
- To understand the benefits and limitations of existing treatment approaches
- To be aware of new Canadian resources on ADHD for professionals and parents

ADHD +

Hyperactivity
Impulsivity

Inattention



Behavior symptoms of ADHD are just the tip of the iceberg!

Learning problems

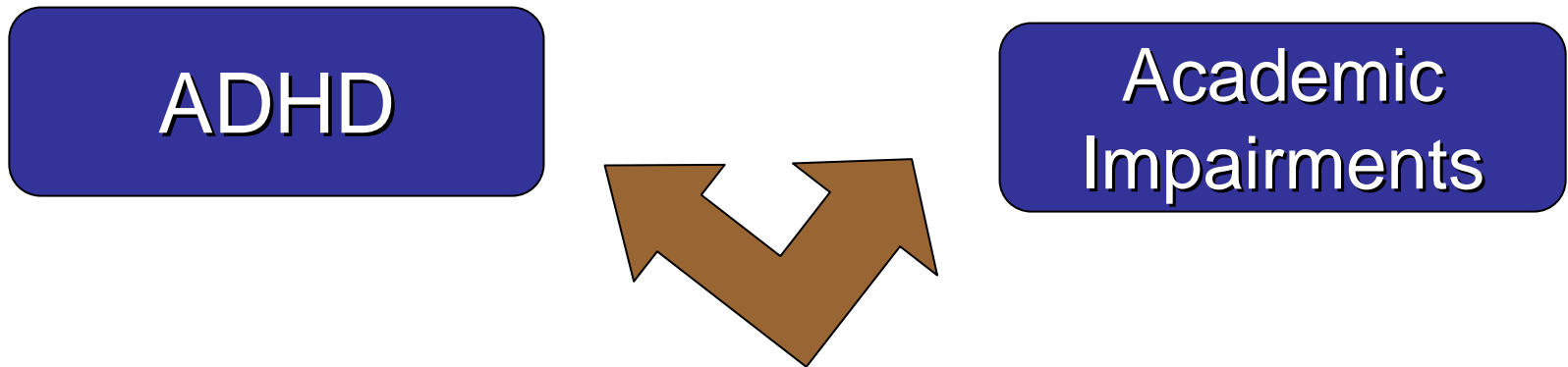
executive function problems



Key Messages

- Pay attention to inattention
- Attend to academic attainment
- Build student engagement

ADHD as a Risk Factor for Academic Impairments



Common school difficulties associated with ADHD

- High rates disruptive behavior
- Low rates of engagement with academic instruction & materials
- Inconsistent completion and accuracy of schoolwork
- Poor performance on homework, tests, long-term assignments
- Low productivity
- Difficulty getting along with peers & teachers

Prevalence of LD in ADHD

(Mayes & Calhoun, 2006)

- Compared various clinical groups on rates of LD (dx via discrepancy score)
- ADHD significantly higher rates of LDs than children with Anxiety/Depression or Behaviour Disorders
- ADHD
 - 33% RD,
 - 26% Math,
 - 63% Written Expression
- Behaviour Disorder (ODD, CD etc.,)
 - 7% RD,
 - 11% Math,
 - 18% Written Expression

ADHD predicts decline in future academic scores (even when exclude youngsters with comorbid LDs)

Educational Outcome	ADHD vs peer group
<p>Low Achievement at School:¹⁻³</p> <p>Grade repetition</p> <p>Low academic grades (C's/D's)</p> <p>Achievement scores (reading, math)</p> <p>Placement in special education</p>	<p>2-fold risk</p> <p>2- to 4- fold risk</p> <p>8% -10% lower</p> <p>2- to 4-fold risk</p>
<p>Early School Leaving:²⁻³</p> <p>Highest level completed</p> <p>High school dropout</p>	<p>1-2 years lower</p> <p>3-fold risk</p>
<p>Tertiary level attainment (college):⁴</p> <p>College GPA</p>	<p>0.7 lower GPA</p>

¹Currie & Stabile (2006): *J Health Economics* (data derived from US NLSY & Canadian NLSCY)

²Todd et al., 2002; ³Manuzza et al 2002; ⁴Heiligenstein et al., 1999

ADHD in College Students

- Academic Issues that increase risk for low grades or course failure
 - Problems estimating multiple demands on one's time (take on too heavy a course load)
 - Poor organization & time management skills
 - Poor reading skills: slow, problems drawing inferences, need for repeated reading
 - Poor note taking skills & writing skills,

ADHD in Adults

- Lower employment rates, lower ranking occupations, lower income than non-ADHD adult with similar education level
- Greater emotional & social problems
- Higher divorce rates
- Less positive self-image
- Higher rates of habitual smoking

Kessler et al., J Occ Environ Med 2005; Riccio et al., Arch Clin Neuropsychiatry, 2005; Wilens & Dodson, J CLin Psychol 2004

Inattention and Academic Risk

Significance of Inattention

“The presence of even a few inattentive behaviors in early childhood should be viewed as a developmental risk factor”

Warner-Rogers et al., *J Learning Disabilities*, 33:2000
Rabiner & Coie, *JAACAP*, 39:2000

WHY?

Pay Attention to Inattention..

- Inattentive symptoms, NOT hyperactivity-impulsivity symptoms, are related to poor academic achievement (Dally, 2006; Todd et al., 2002; Rabiner & Coie, 2000)
- Inattention not as “noticeable” as disruptive behaviour in the classroom,
 - but it is the behavioural risk factor for academic problems.

What do ADHD symptoms, particularly inattention, look like at school?

DVD Program 2: Video Clip

A multi-media Professional Development Program for Teachers, developed by researchers at the Hospital for Sick Children¹ in collaboration with TV-Ontario & University of Saskatchewan *(video footage)*

with funds from NIMH, CIHR, TV-Ontario, Hospital for Sick Children & an unrestricted educational grant from Shire Biochem Inc.

¹ R. Tannock, B. Ferguson, P. Chaban, R. Martinussen, A. McLInnes

Inattention in Grade 1 affects school functioning

(Warner-Rogers et al., *J Learning Disabilities*,33:2000)

Inattention in Grade 1-2: associated with

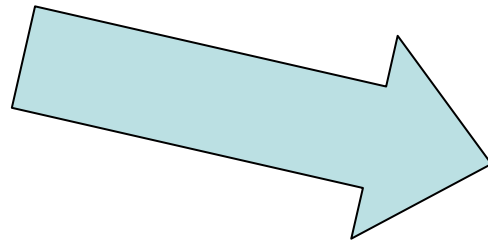
- “below average” academic skills
 - oral language, reading, written language, number concepts and computation
- poor classroom adjustment
 - low confidence
 - need for repeated instructions

Significance of Inattention in early childhood for reading

387 children followed from Kindergarten - Grade 5



Inattention in kindergarten
as reported by teachers



even after controlling for IQ, hyperactivity &
emotional problems, reading ability in Grade 1
(Rabiner & Coie, 2000; JAACAP 39(7) p.859-867)

Poor reading in Grade 5



Again...Inattention as Risk Factor for Poor Reading Achievement

- Dally (*J Educational Psychology*, 2006)
 - Inattentive behaviour in kindergarten students is an **independent predictor** of reading ability in Grade 1 (controlling for K –reading-related skills)
 - Inattention also has an **INDIRECT effect** on later reading outcomes via its detrimental effect on phonological analysis skills in grade 2
 - *No effects of hyperactivity-impulsivity on reading*
 - *No increases in behaviour problems as a result of early reading difficulties*

Inattention, Orthographic Abilities, and Literacy Outcomes (Thomson et al., 2005)

- Sample of children with dyslexia
- Inattention symptoms associated with:
 - later reading and writing outcomes via **orthographic skills** (visual word form) and **rapid serial naming**
 - but not via phonological skills

Orthographic weaknesses also identified in children with ADHD (Willcutt et al., 2005)

Inattention and Mathematics

(Fuchs et al., 2005; 2006)

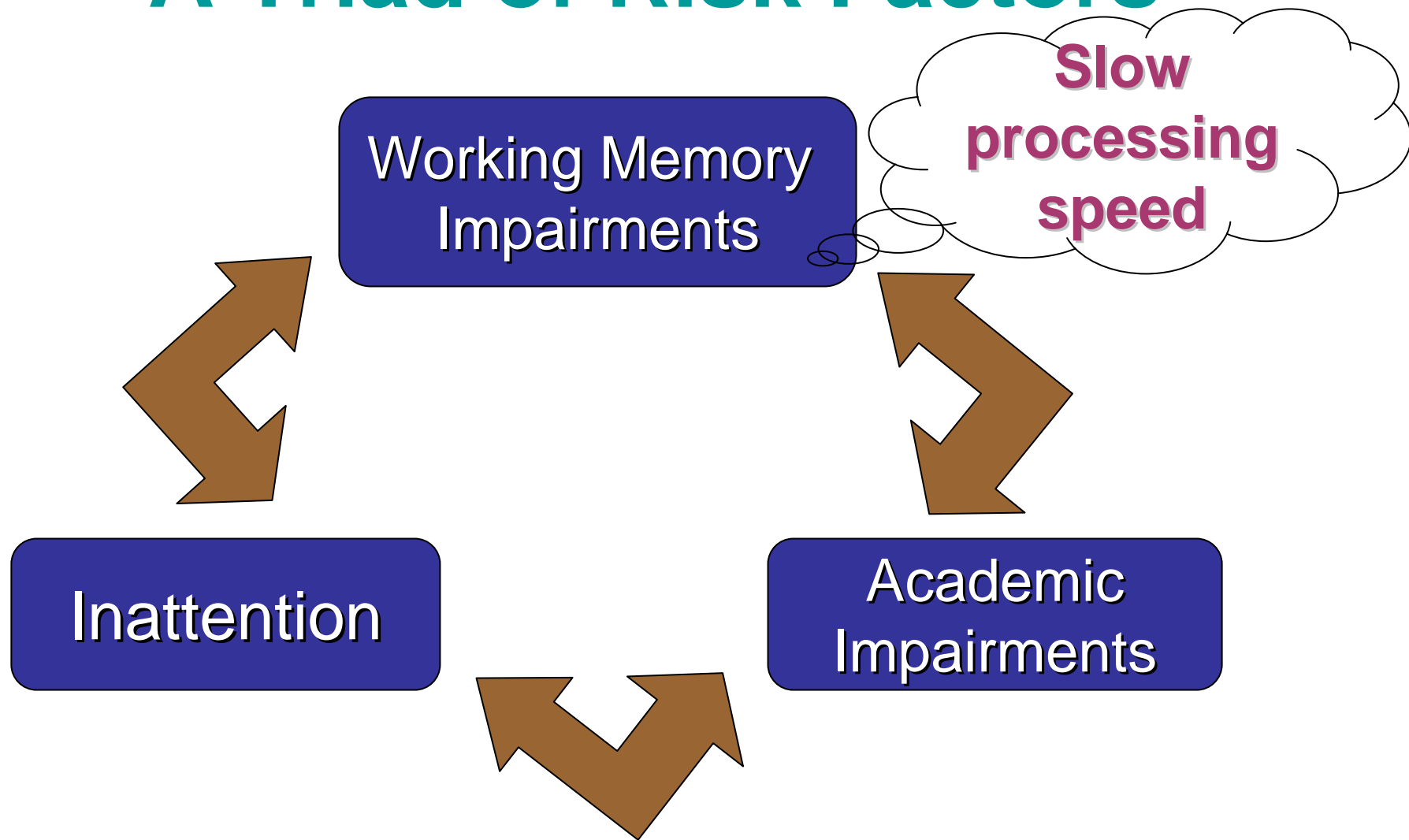
- *Inattentive behaviour*, as rated by classroom teachers, is a significant independent predictor of Gr. 1 & Gr. 3 children's math skills in three key areas
 - Fact fluency
 - Computation
 - Story problems

Implications of Inattention for Intervention

- Need to think of inattention symptoms as RISK indicator for academic problems
- Suggests that we need to think about how to facilitate on-task, engaged behaviour in students with ADHD (& others with marked inattention) during literacy and numeracy instruction
- Need to intervene early to support early acquisition of foundation skills

Cognition and ADHD: Implications for Instruction

A Triad of Risk Factors



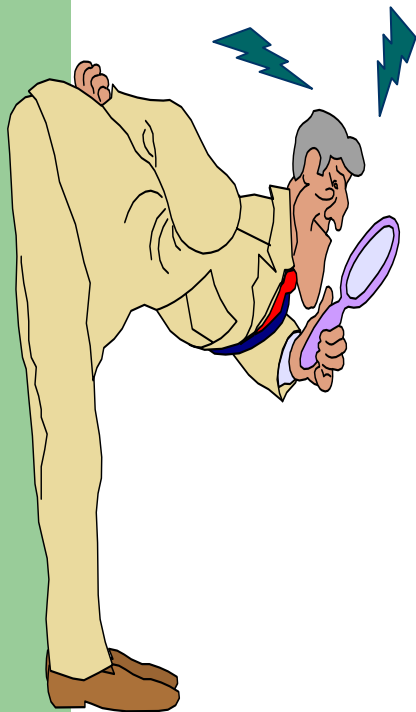
ADHD: Slow Processing Speed

Children with ADHD may *move* fast...

But research shows that children, adolescents, adults with ADHD are slow & inconsistent in processing information:

- Slower and more variable in responding
- Slow and inaccurate (not fast & inaccurate!)
- ADHD & Dyslexia share problems in processing speed (*Shanahan et al. J Abnorm Child Psychol 2006*)

What is Working Memory?



A limited-capacity cognitive system that allows us to actively *keep critical information in mind*, despite ongoing distraction

– for 1 or 2 seconds!

current focus of the mind

How do I get to the X-building from here?

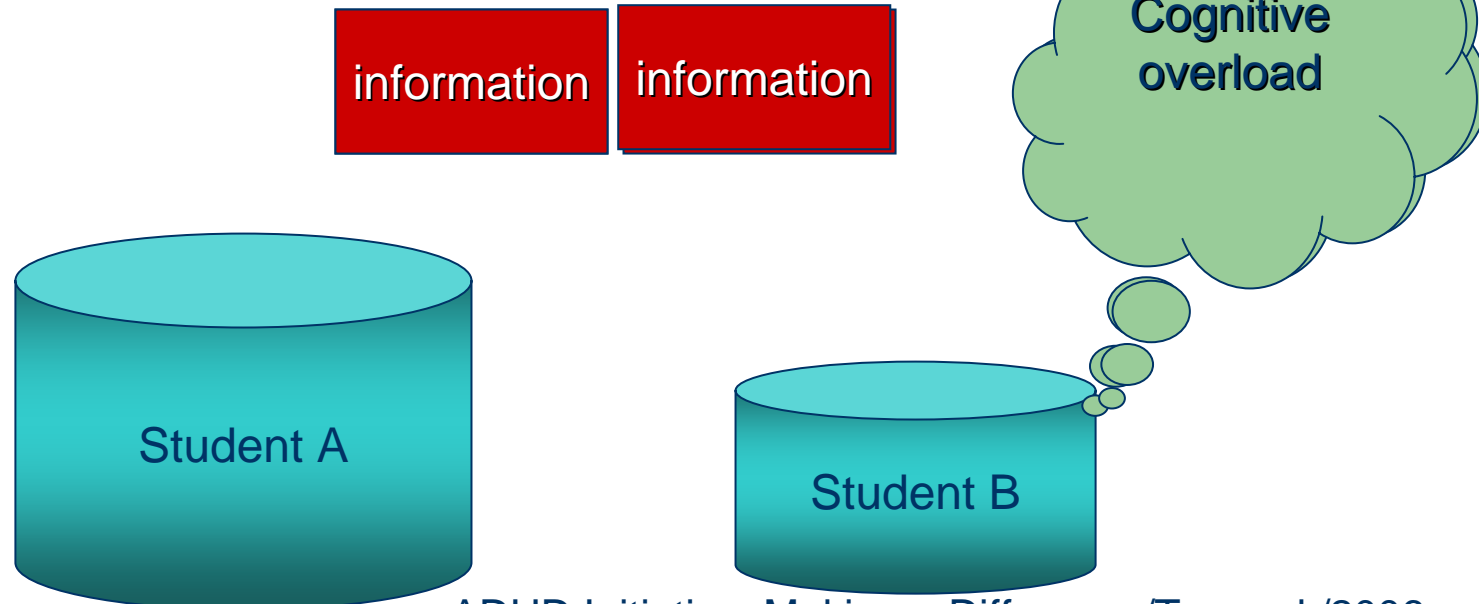
Significance of processing speed & working memory

- "Make a right at the first red light. Go three blocks until you see a stop sign and make a left turn onto Willow Street. Then look for a large green sign about two and a half blocks down Willow, and you'll see the parking lot."
- **Where should you make a left turn?**
- **How far down Willow Street is the X-Building?**

Two important aspects of working memory

(Conway et al., *Psychon Bull Rev*, 12:769-786, 2005)

- How much it can hold
- How efficiently it can be used



Working memory is impaired in ADHD

(Meta-analysis: Martinussen et al., JAACAP 2005)

- A substantial proportion of students with ADHD exhibit working memory problems
- Particularly for visual-spatial information
- Impairments evident in preschoolers, children, teens, adults
- Problems evident on standardized tests of working memory (e.g., WISC-IV, CANTAB)

Another perspective on working memory

- VIDEO CLIPS OF WORKING MEMORY
 - A. working memory & long term memory
 - B. Boy getting distracted - why?
 - C. Working memory in typically developing student & in student with ADHD

Importance of working memory in Education

- Working memory predict performance on national curriculum achievement tests:
 - Auditory/Verbal:
 - literacy, reading comprehension, written expression, vocabulary,
 - Visual/spatial:
 - math, science

(Gathercole & Pickering, 2000; Jarvis & Gathercole, 2003)

How Working Memory Deficits Affect Language Functioning

In listening and talking, students will have difficulty with

- remembering what one was going to say
- understanding complex instructions and explanations
- taking turns and following topic shifts in a discussion
(i.e., following the gist of what is being said)
- expressing complex ideas sequentially and coherently
(e.g., retelling a story)

How Working Memory Deficits Affect Reading & Writing

- keeping the meaning of a sentence in mind while decoding an unfamiliar word
- making inferences when reading long, new, and/or complex information
- organizing sub-skills needed for writing while formulating a sentence
(e.g. keeping word and sentence in mind while printing or writing)
- Writing a paragraph puts heavy demand on working memory and all aspects of executive function

Example: reading comprehension

- Athens is one of the great **classical architectural** cities of the world. Modern cities in North America have modelled their buildings after Athens. These structures are often called neoclassical architecture.
1. Name a great architectural city? (recall)
 2. What does neoclassical mean? (inference)

Working Memory Deficits in the Classroom

Students will have difficulty with....

- maintaining relevant information in mind during problem-solving (e.g., word problems in math)
- Planning for the final product of a project (e.g., project report, display)
- accuracy during multiple steps in sequential procedures (e.g., long division)

Example: Word Problems

- John has \$25. He has to buy three books as well as ten pencils. One book costs \$5 and the other two each cost \$7. How much money will John have left to buy pencils?
- $X = \$25 - \$5 - \$7$ $X = \$13$
- $X = \$25 - \$5 - (\$7 \times 2)$ $X = \$11$

Outside the classroom, working memory & processing speed problems may interfere with the ability to....

- Keep track of a conversation

- Who said what..to whom
- who asked what...



- Keep track of a game

- Whose turn is next...
- What cards have already gone...
- What stage the game is at...



Working memory problems are not unique to ADHD:

Impairments may also occur in students with specific LD, language impairments, autism, and other types of behavior problems

Problems with anxiety/depression may also affect working memory

Educational implications of slow processing speed

- Child may need extra time to complete tasks and to process/digest new information
- Child may take longer than peers to respond to question, so needs longer ‘wait-time’ during Q&A
 - (e.g., more than half-a-second)
- Assignments may need to be adjusted to accommodate child’s processing speed
 - Shorter, but build up speed of completion
- Use of Assistive Supports (taperecorder)

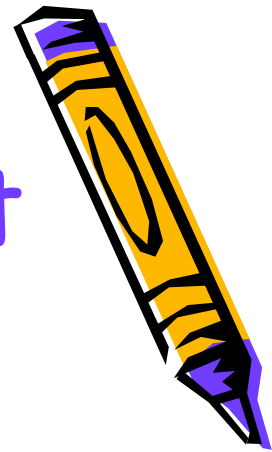
I am a physician...so what does this mean for my practice?



Implications for clinical
practice

Implications for assessment

- Obtain information about school function directly from the teacher
- Pay attention to symptoms of inattention
- Routinely screen for academic problems and LDs
- Consider screen for cognitive problems (e.g., BRIEF)



TEACHER'S SUMMARY FORM

Dear Teacher:

The parents of this student have given their permission for you to give me information about his/her performance at school, as part of the clinical assessment. It would be most helpful if you would take a few minutes to respond to the following questions:

Student's First Name & Initial: _____ Date of Birth (DD/MM/YY): _____ Grade: _____

1. In what capacity do you teach this student: (e.g., regular classroom teacher, Math teacher, Resource Teacher)?

2. Does this student receive any Special Education? NO: _____ YES: _____

If YES: what type of help does he/she receive? _____

3. Do you have concerns about this student's functioning at school? NO _____ YES _____

If YES, please indicate your primary concerns below"

a) _____

b) _____

c) _____

4. Does this student have a modified curriculum or any other accommodations or adaptations: NO _____ YES _____

If Yes: Please describe

5. Do you have concerns about this student's functioning at school? NO _____ YES _____

If YES, please indicate your primary concerns below"

a) _____

b) _____

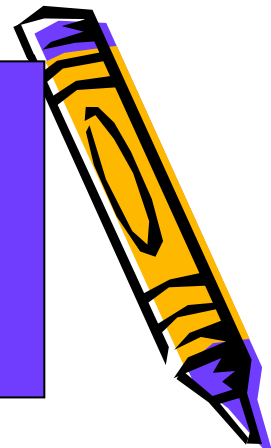
c) _____

3. Academically, how well does this student perform relative to others student at this grade level?

	Well Below Avg	Below Avg	At Grade level	Above Avg	Well Above Avg
Reading: Word recognition Accuracy Fluency					
Reading Comprehension					
Spelling:					
Oral communication					
Handwriting					
Written Expression					
Math Computation					
Math Reasoning					
General knowledge					

Thank you very much for your time and help

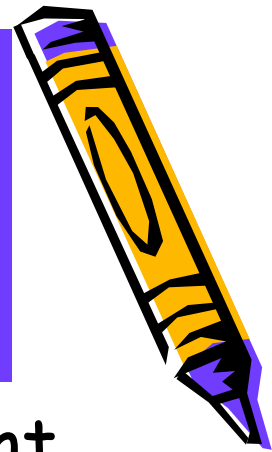
Behavior Rating Inventory of Executive Function (BRIEF: Goia et al. PAR)



- Behavioral Regulation Index (inhibit, shift, emotional control)
 - Has trouble putting the brakes on his/her actions
 - Overreacts to small problems
- Metacognition Index (initiate, working memory, organize, monitor)
 - When given three things to do, remembers only the first or last
 - When sent to get something, forgets what s/he is supposed to get
 - Does not plan ahead for school assignments



Can I use the BRIEF instead of conducting psychological tests? NO!

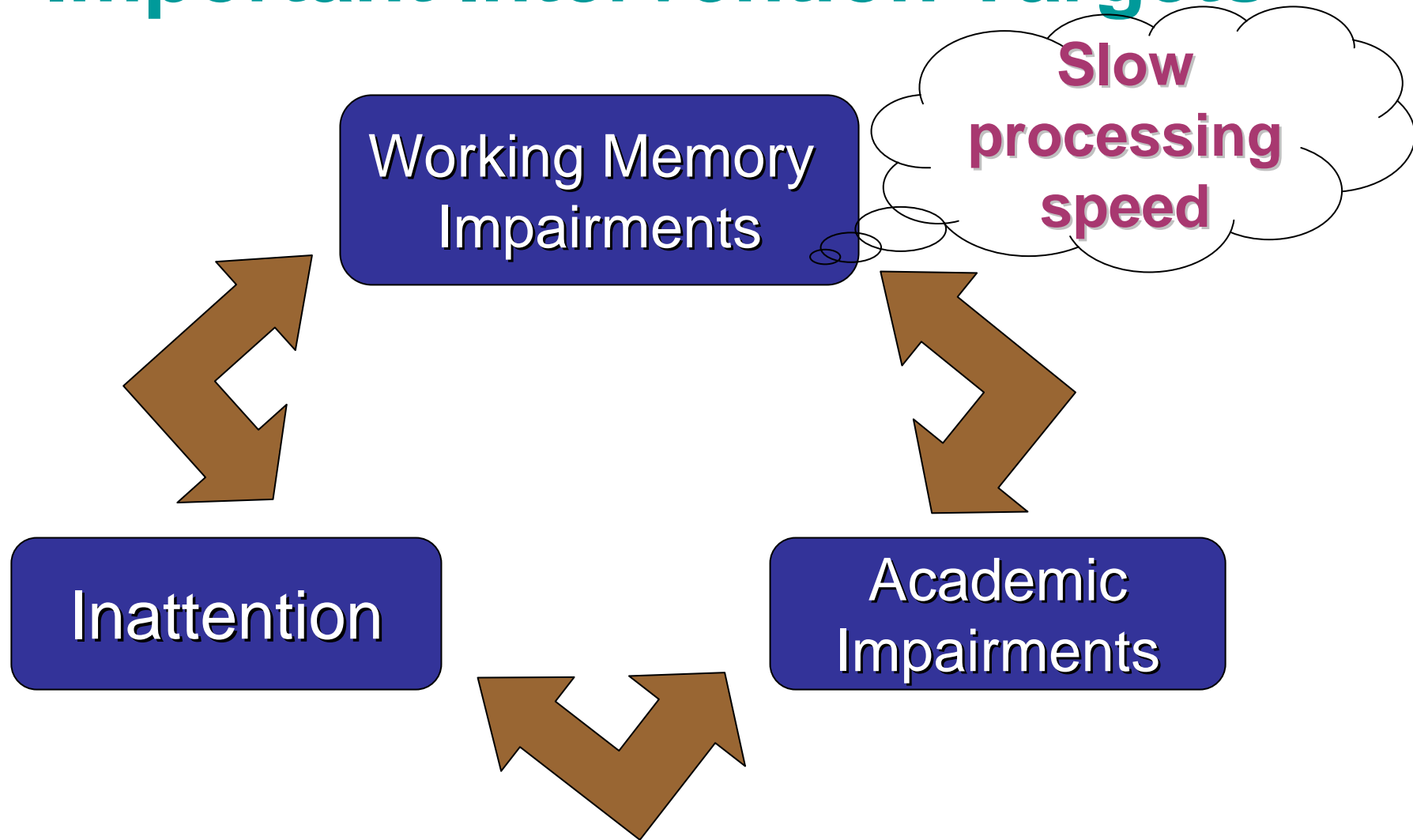


- In a clinical sample of adolescents, parent and teacher ratings on the BRIEF showed high sensitivity and specificity with ADHD diagnosis.
- BRIEF ratings correlate modestly with standardized measures of executive function, but BRIEF ratings lack adequate sensitivity and specificity to serve as a proxy measure of executive function



(Toplak, Bucciarelli, Jain, Tannock; manuscript submitted for publication)

Important Intervention Targets



Treatment Strategy

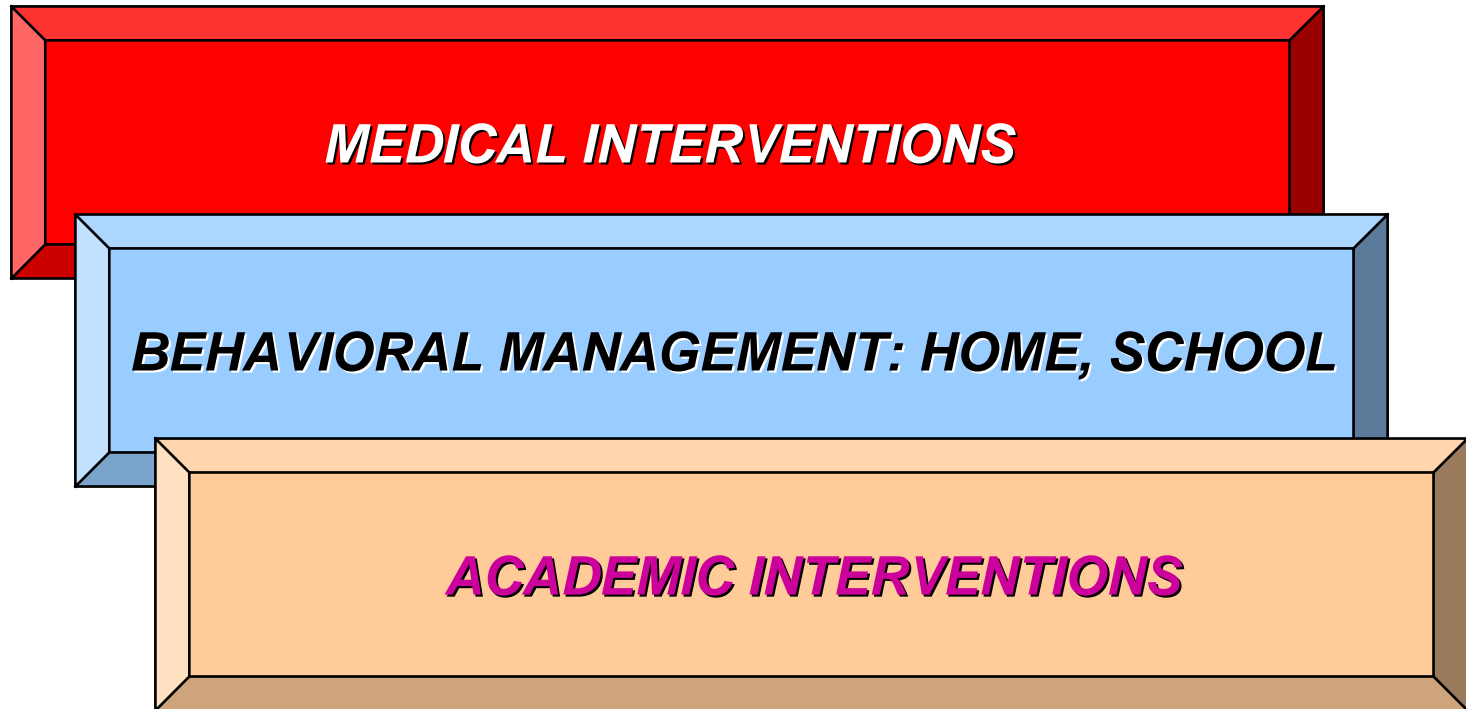


Target not only behavioral symptoms
but also
academic/cognitive problems
of ADHD



So, what interventions are effective for academic problems associated with ADHD?

Intervention approaches for ADHD



Beneficial Effects of Medical Treatment with Psychoactive Drugs



Suppress behavioral symptoms of ADHD ***

Improves:
Academic productivity
Classroom behaviour
Lab measures

(inhibitory control, attention)



But.....



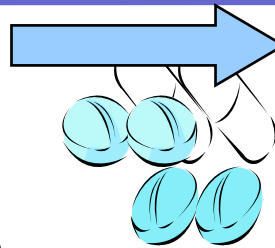
Grade 1

Report Card

Unsatisfactory

Math	✓	
English		✓
Art	✓	
Science		✓

needs improvement



Grade 3

Report Card

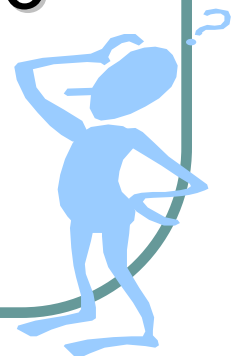
Unsatisfactory

Math	✓	
English		✓
Art	✓	
Science		✓

needs improvement

Treatment related improvements in core behavioral features of ADHD & daily academic work have not translated into robust gains in long-term academic achievement (e.g., MTA Study, 1999)

WHY NOT?



Medical Treatment: issues for education

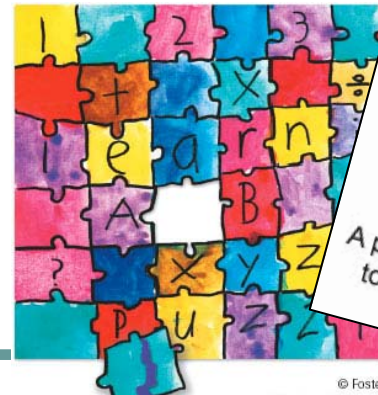
- Only effective when the medication is active...
- Effects do not generally last for 24 hours
 - Except for perhaps non-stimulant medication
- Compliance is an issue
- **No robust evidence of impact on learning**
- **Cannot fix missed skills & learning**

Stimulants have selective effects on Working Memory

- In children with ADHD, stimulant medication has
 - modest beneficial effects on impairments in *spatial working memory* (CANTAB; Mehta et al., 2000a, 2000b; Bedard et al., 2005; Bedard et al., in press)
 - modest beneficial effects on *verbal working memory* (Bedard et al., in press)
 - *but no effects on verbal span* (Bedard et al., in press)

Implications for physicians

- Need to monitor effects of medication on academics
 - Daily/weekly home-school reports
 - School reports
 - School grades & standardized tests of academic achievement
- Advise, co-ordinate, & monitor,
 - comprehensive multi-component intervention approach
 - Wrap-Around-Kids model from Australia



Wrap Around Kids™
brings the pieces of
the puzzle together.

A program providing collaborative support
to Wrap Around students with medical
conditions that impact at school.

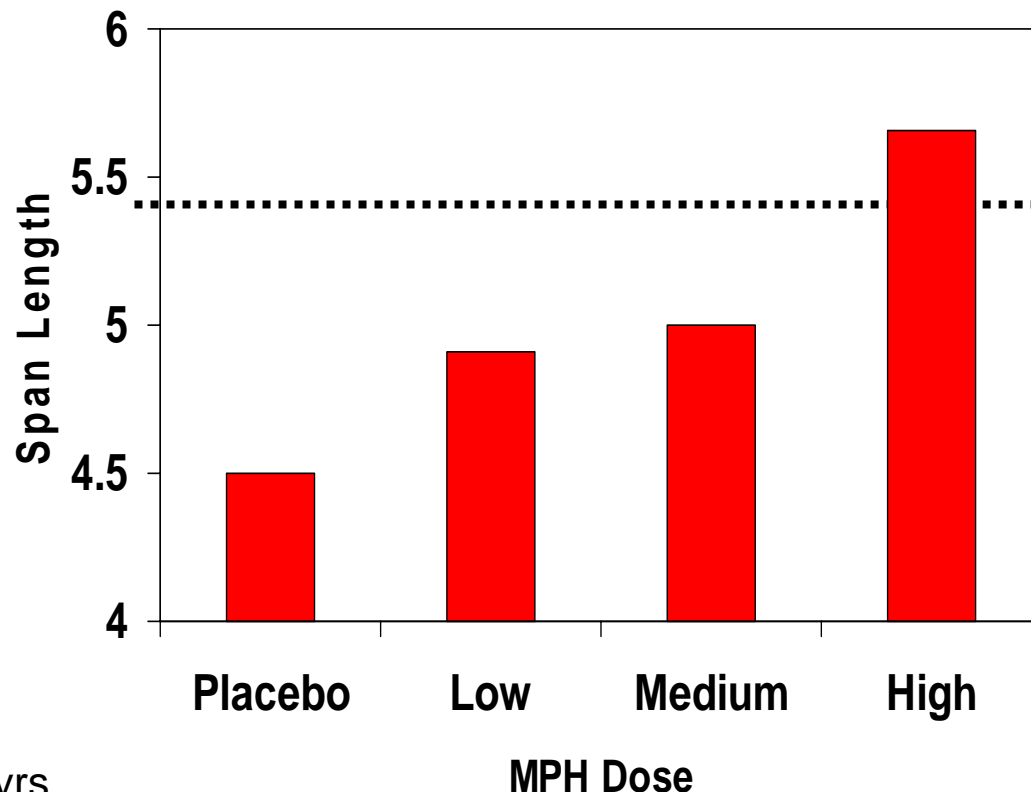
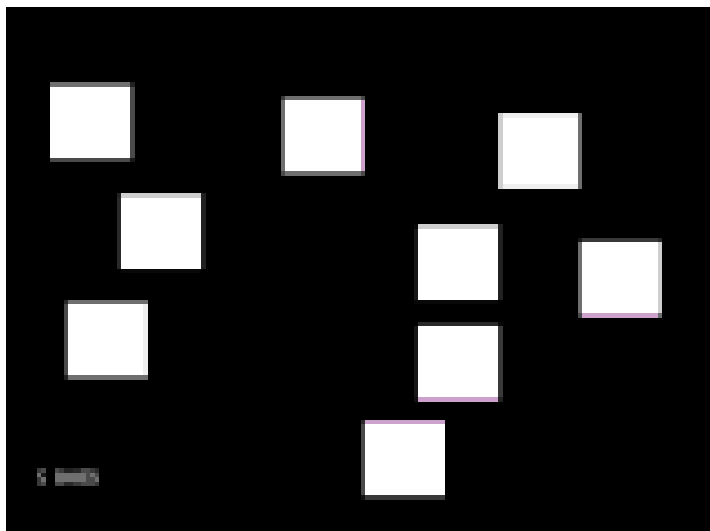
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I am a teacher, CYW, school psychologist...so what does this mean for me?

Can working memory be improved?

Stimulant medication improves the ability to hold spatial information

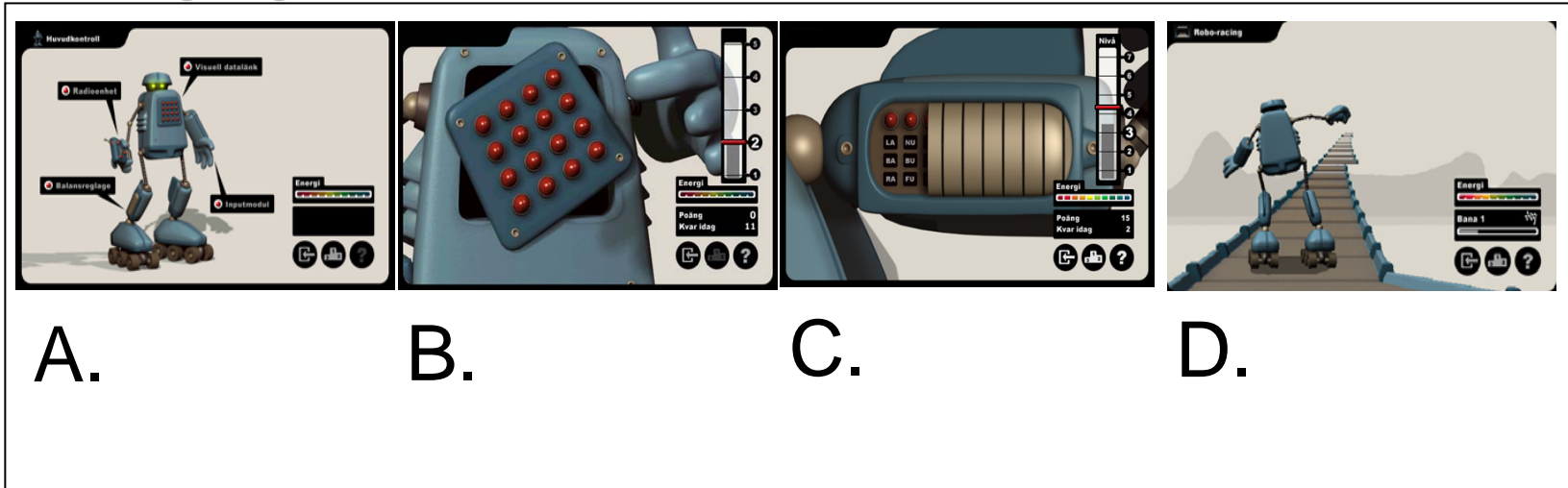
CANTAB Spatial Span



..... Mean span score for age 8-9yrs
(Luciana & Nelson, 2002)

Computerized Cognitive Training of Working Memory in Children with ADHD

Klingberg, T (MD, PhD), et al. Karolinska Institute, Stockholm, Sweden



Software used for intervention. **A.** Main menu, from which different WM tasks are chosen. **B.** Example of one visuo-spatial WM task. **C.** A verbal WM task. **D.** After training, the children use the collected points in a reward-game.

– a **Controlled, Randomized, Double-blind Trial**

Computerized Cognitive Training of Working Memory in Children with ADHD

Klingberg, T (MD, PhD), et al. Karolinska Institute, Stockholm, Sweden

– a Controlled, Randomized, Double-blind Trial

Computer program (RoboMemo®, from Cogmed Cognitive Medical Systems AB, Stockholm, Sweden

(www.cogmed.com). Practice: 25 sessions, each 45 mins

(Comparison condition identical to the treatment - but difficulty of the WM trials remained on the initial low level)

RESULTS:

- Working memory improved
- Inattention & hyp/imp improved after training (parent rating)
- Improvements lasted at least 6-months

Strategies for improving working memory

- BrainCog Strategies (www.fablevision.com)
- Organize / chunk information
- Crazy Phrases
 - Make up whacky sentence to help remember names, places, items, events in specific order
- Acronyms
 - Make up real or nonsense word in which each letter is the first letter of something you are trying to remember
- Cartoons
 - Draw picture to help remember key information
- Visualize
 - Develop picture in your head; link names/objects/events to rooms in your house etc and “walk yourself around your house” several times

Tips on giving directions to individuals with attention & working memory problems

- Give one direction at a time
- Make directions clear, specific, & brief
- Demonstrate what is to be done
 - Model what you do at each step
- Provide visual support
 - (e.g., checklist of items to do)
- Always check for understanding
 - ask the individual to paraphrase instructions
- Monitor progress often to check understanding

Implications for teaching

- Intervention for students with ADHD needs to focus on promoting their learning & academic success
- Intervention to improve academic progress must focus on *instruction*
- *Adaptations to instruction* for students with ADHD will benefit *all students*, including those with other types of learning and mental health problems

School-based intervention for ADHD

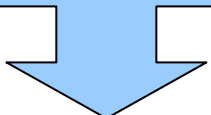
- Manipulating consequences (reactive)
 - Token reinforcement
 - Verbal reprimands
 - Response costs
 - Time out from positive reinforcement
 - Self-management
- Manipulating antecedents (proactive)
 - Post rules
 - Adjust workload
 - Modify instruction
 - Providing choices
 - Peer tutoring

**Minimal effects on
Academic function**

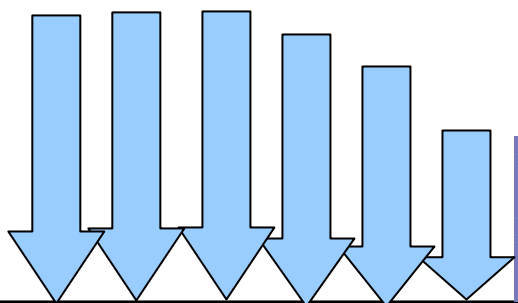
Why aren't behavioral contingency approaches very effective for ADHD?

Poor executive control of attention, poor working memory & slow processing speed pose problems for consequential approaches

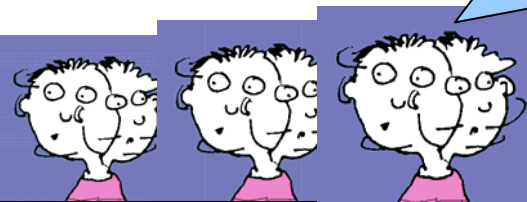
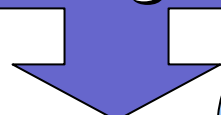
Intended Target



Concentrating



Actual Target

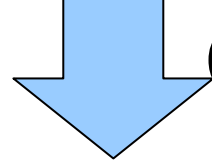


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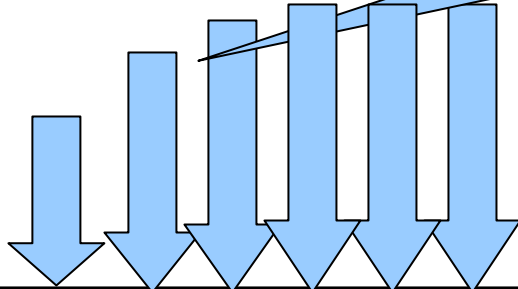
Time (seconds)

Consequential approaches may be limited by poor working memory capacity!

Prompt for Target Behavior



Concentrating



Praise approximations

Ignore



20 40 60 80 100 120

Time (seconds)

Antecedent /at-point-of-performance approaches will be more effective

Impact of school-based tutoring on reading in children with & without inattention *(Rabiner et al., 2004)*

