The Literacy and Numeracy Secretariat
Le Secrétariat de la littératie et de la numératie

Ontario

What Works? Research into Practice

A research-into-practice series produced by a partnership between The Literacy and Numeracy Secretariat and the Ontario Association of Deans of Education

Research Monograph # 3

How can teachers improve the academic performance of children with ADHD?

The Educational Implications of Attention Deficit Hyperactivity Disorder

By Dr. Rosemary Tannock
OISE/University of Toronto

Research Tells Us

Beyond difficult-to-manage behaviour, ADHD also includes impairment in regions of the brain related to processes that are key for learning.

Executive function **allows us to develop and carry out plans, organize ourselves and activities, inhibit actions, regulate emotions, and self-monitor. It also directs academic performance and behaviour.**

Working memory **refers to our "mental workspace". It enables us to momentarily hold and manipulate information in the face of ongoing processing and/or distraction. It is a strong predictor of literacy.**

DR. ROSEMARY TANNOCK holds a Canada Research Chair in Special Education and Adaptive Technology (Tier 1) at OISE. She is also a senior scientist at the Hospital for Sick Children in Toronto and a professor of psychiatry and of special education at the University of Toronto. Dr. Tannock and colleagues Dr. Rhonda Martinussen (OISE), Dr. Alison McInnes (University of Windsor), and Peter Chaban (Hospital for Sick Children) are conducting a study of a professional development program for teaching children with ADHD for the Bluewater District School Board. They are also working with the Ontario Provincial Demonstration Schools to develop a systematic curriculum for Teacher Professional Development, which will be taught by core Provincial School faculty in a three-day summer institute this year.

Teachers should be aware that although there are many different perspectives on ADHD, there is ample scientific evidence affirming its existence and its detrimental impact on individuals. Classroom practices can make a difference for children with ADHD.

Attention Deficit Hyperactivity Disorder (ADHD) is the medical term used to describe a neurobiological condition that affects between 5 and 12 per cent of children worldwide with impairing levels of inattentive or hyperactive/impulsive behaviour, as well as those with a formal diagnosis of ADHD. A diagnosis is based on developmentally inappropriate behavioural symptoms that begin in pre-school years and tend to persist through childhood, adolescence, and adulthood.[3] These symptoms include inattention, hyperactivity, and/or impulsivity.

Medical, educational, and legal organizations view ADHD as a behavioural disorder but they also recognize that many children with ADHD (as many as one in four) also have Learning Disabilities (LDs).[3-4] Many children with ADHD – not just those with a Learning Disability (LD) – are at high risk for academic underachievement or failure despite having average or above average intellectual abilities.[1, 5-6]

Longitudinal epidemiological surveys in Canada and the United States show that childhood ADHD (and particularly childhood inattention) predict subsequent lower achievement scores in reading and mathematics (8 to 10 per cent lower). These surveys also indicate an increased risk for grade repetition and high school incompletion as well as underemployment and poor workplace performance in adulthood.[1, 5-10]

ADHD is associated with subtle but important structural and functional differences in the brain, specifically those regions that support critical psychological processes. These processes include executive function, memory, learning, and speed of information processing.[11-13] Cognitive research shows that individuals with ADHD process information more slowly than their peers and have difficulty with executive functions, particularly working memory.[14-21]

April 2007

The Literacy and Numeracy Secretariat is committed to providing teachers with current research on instruction and learning. The opinions and conclusions contained in these monographs are, however, those of the authors and do not necessarily reflect the policies, views, or directions of the Ontario Ministry of Education or The Literacy and Numeracy Secretariat.

Research into treatment outcomes shows that medical and psychological interventions are generally effective in reducing disruptive and off-task behaviour in students with ADHD.[24] These include:

- medication,
- parental training in behaviour management,
- classroom-based behaviour training,
- social skills training and multimodal approaches.

According to laboratory tests, medication may improve processing speed and some aspects of executive function in children with ADHD.[25] Unfortunately, no robust evidence exists to date that suggests these approaches (alone or in combination) benefit educational outcomes.[24, 26-27] However, school-based interventions, where teachers have modified their instructional practices and used behavioural management techniques, have been found to improve both behavioural and literacy outcomes in students with ADHD.[24, 28-29] As well, intense and systematic computer-based training with working memory has shown promise for both cognitive and behavioural improvement in children with ADHD.[30]

Implications for Educational Practice

Support and Improve Executive Function

Classroom teachers should try to reduce the amount of information students with ADHD have to retain and juggle in their heads:

- **Emphasize direct instruction in specific academic skills**
- **Chunk, pause, and repeat critical instructions**
- **Use advance organizers, structured note-taking sheets, manipulatives, and visual representations**
- **Use teaching/learning strategies such as mnemonics**
- **Introduce class-wide peer tutoring**

We need to reconceptualize ADHD

Beyond difficult-to-manage behaviour, ADHD also includes impairment in "one or more processes related to perceiving, thinking, remembering, or learning."[4] Therefore, it may be more useful to view ADHD as a learning disorder, though one that differs from currently recognized reading or non-verbal LDs.

Under current Canadian educational policies and employment laws, recognizing ADHD as a type of LD would confer the right to accommodations in schools, colleges, and workplaces. While this would significantly increase the cost of assessment and education, the current socio-economic costs of ADHD are exceedingly high.[31-33] It would be a case of short-term financial pain for long-term national gain in human and social capital.[1, 34]

We need to change teaching practices

Students with ADHD benefit from an inclusive educational model where teachers use the latest teaching strategies for students with a LD. Indeed, these same instructional practices could be considered best practices for all students in mainstream classrooms.[35]

Currently, classroom interventions for students with ADHD focus on reducing problematic behaviour and increasing task engagement. While these are important goals, reducing disruptive behaviour alone does not ensure learning and academic progress. To achieve this, academic interventions are required that will address academic deficits directly, while accommodating and improving cognitive difficulties in executive function and processing speed. There are two critical principles behind academic intervention:

- Reduce the cognitive load of academic tasks and avoid overloading working memory and
- Support and improve executive function through modified instruction.

All teacher-preparation programs should ensure that the latest ADHD scientific evidence and the most recent advances in educational intervention are core components of their curricula.[35]

References

1. Currie J, Stabile M. (2006). Child mental health and human capital accumulation; The case of ADHD. *Journal of Health Economics*, 25(6):1094–1118.

2. Faraone S.V., Sergeant J., Gillberg C., Biederman J (2003). The worldwide prevalence of ADHD: Is it an American condition? *World Psychiatry*, 2, 104–113.

3. American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition, text revision (DSM-IV-TR). Washington, DC: American Psychiatric Association.

4. Learning Disability Association of Canada [http://www.ldac-taac.ca/Defined/defined_new-e.asp]

5. Spira E.G., Fischel J.E. (2005). The impact of preschool inattention, hyperactivity, and impulsivity on social and academic development: A review. *Journal of Child Psychology and Psychiatry*, 46(7), 755–773.

6. Carroll, J.M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: evidence for comorbidity. *Journal of Child Psychology and Psychiatry*, 46, 524–532.

7. Rabiner, D., & Coie, J.D. (2000). Early attention problems and children's reading achievement: a longitudinal investigation. The Conduct Problems Prevention Research Group. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 859-867.

8. Barkley, R.A., Fischer, M., Smallish, L., Fletcher, K. (2006). Young adult outcome of hyperactive children: Adaptive functioning in major life activities. *Journal of the American Academy of Child and Adolescent Psychiatry*, 45(2), 192–202.

9. Biederman, J., Faraone, S.V., Spencer, T.J. et al. (2006). Functional impairments in adults with self-reports of diagnosed ADHD: A controlled study of 1001 adults in the community. *Journal of Clinical Psychiatry*, 67(4), 524–540.

10. Kessler, R.C., Adler, L., Ames, M. et al. (2005). The prevalence and effects of Adult Attention Deficit/Hyperactivity Disorder on work performance in a nationally representative sample of workers. *Journal of Occupational and Environmental Medicine*, 47(6), 565–572.

11. Castellanos, F.X., Tannock R. (2002). Neuroscience of Attention-Deficit/Hyperactivity Disorder: The search for endophenotypes. *Nat Rev Neurosci*, 3, 617–628.

12. Makris, N., Biederman, J., Valera, E.M. et al. (2006). Cortical thinning of the attention and executive function networks in adults with Attention-Deficit/Hyperactivity Disorder. *Cereb Cortex*, Aug 18; [Epub ahead of print]

13. Shaw, P., Lerch, J., Greenstein, D. et al. (2006). Longitudinal mapping of cortical thickness and clinical outcome in children and adolescents with Attention-Deficit/Hyperactivity Disorder. *Arch Gen Psychiatry*, 63(5), 540–549

14. Shanahan, M.A., Pennington, B.F., Yerys, B.E. et al. (2006). Processing speed deficits in Attention Deficit/Hyperactivity Disorder and Reading Disorder. *Journal of Abnormal Child Psychology* [Epub ahead of print, accessed July 19 2006]

15. Tannock, R. (2005). Language and mental health disorders: The case of ADHD. synergies: Interdisciplinary communications 2004/2005. W. Ostreng (Ed). Center for Advanced Study, Oslo [http://www.cas.uio.no/Publications/Seminar/Convergence_Tannock.pdf]

16. Mathers, M. (2005). Some evidence for distinctive language use by children with Attention Deficit Hyperactivity Disorder. *Clin Linguist Phon*, 19(3), 215–226(4); 466–485.

17. McInnes, A., Humphries, T., Hogg-Johnson, S., Tannock, R. (2003). Listening comprehension and working memory are impaired in Attention-Deficit Hyperactivity Disorder irrespective of language impairment. *J Abnorm Child Psychol*, 31(4), 427–443.

Special Education in Ontario

In May 2005, the Ministry of Education allocated $25 million to the Council of Ontario Directors of Education (CODE) to develop a plan to support the recommendations in the ministry's special education expert panel report *Education for All*. The report's recommendations focus on strategies to improve teacher professional practice and to raise the achievement of students with special education needs.

The CODE Project involved 75 supervisory officers, 21,000 school board employees, and almost two million students. Evidence-based strategies such as differentiated instruction, assistive technology, and professional learning communities were introduced and monitored for their impact on student achievement. Overall, evaluations show that the outcomes have been positive. The work is ongoing as board practice shifts to include students with special needs in regular classrooms and to zero-in on effective teaching strategies for *all* students.

Twelve categories of exceptionality have been developed in Ontario to assist in the identification and placement of exceptional students. Although ADHD is not named as a specific category of exceptionality, students with ADHD may present characteristics that can be identified in the various categories such as Learning Disability or Behaviour.

Professional Learning

The Literacy and Numeracy Secretariat creates training, resources, and institutes to support ongoing professional learning:

- Coaching, Facilitating, and Co-Teaching: Professional Learning for Numeracy and Literacy Leaders

  http://www.curriculum.org/LNS/coaching/

- Differentiated Instruction Webcast featuring Jeffrey Wilhelm, Lyn Sharratt, Elizabeth Coelho, and Camille Williams-Taylor

  This webcast discusses strategies proven to be successful with struggling students. Includes demonstration of a think-aloud as a high-yield strategy, the power of accountable talk, and how to connect assessment to instruction.

  http://www.curriculum.org/secretariat/march29.html

For more information: info@ontario.ca

Go to www.teachadhd.ca for additional resources and in-depth coverage of the issues raised in this monograph. This evidence-based website is approved by The Hospital for Sick Children.

18. Biederman, J., Monuteaux M.C., Doyle, A.E. et al. (2004). Impact of executive function deficits and Attention-Deficit/Hyperactivity Disorder (ADHD) on academic outcomes in children. *Journal of Consulting and Clinical Psychology*, 72(5), 757–766.

19. Seidman LJ (2006). Neuropsychological functioning in people with ADHD across the lifespan. *Clinical Psychology Review*, 26(4), 466–485.

20. Willcutt, E.G., Pennington, B.F., Olson, R.K., Chhabildas, N., & Hulslander, J. (2005). Neuropsychological analyses of comorbidity between Reading disability and Attention Deficit Hyperactivity Disorder: In search of the common deficit. *Developmental Neuropsychology*, 27, 35–78.

21. Martinussen, R., Hayden, J., Hogg-Johnson, S., Tannock, R. (2005). Meta-analysis of working memory impairments in children with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 44(4), 377–384.

22. Zelazo, P.D. (2005). http://www.aboutkidshealth.ca/news/SREFarchive.asp

23. Gathercole, S.E., Pickering, S.J., Knight, C., Stegman, Z. (2004). Working memory skills and educational attainment: Evidence from National Curriculum assessments at 7 and 14 years of age. *Appl Cognitive Psych*, 18, 1–16.

24. DuPaul, G.J., Weyandt, L.L. (2006). School-based intervention for children with attention-deficit/hyperactivity disorder: Effects on academic, social, and behavioral functioning. *Int J Disability, Development and Education*, 53(2), 161–176.

25. Connors CK (2002). Forty years of methylphenidate treatment in attention-deficit/hyperactivity disorder. *J Attention Disorders*, 6(1 Suppl), S17–S30.

26. Purdie, N, Hattie, J., Carroll, A. (2002). A review of the research on interventions for attention deficit hyperactivity disorder: What works best? *Review of Educational Research*, 72(1), 61–69.

27. Jensen PS, Hinshaw Sp, Swanson JM et al., (2001). Findings from the NIMH Multimodal Treatment Study of ADHD (MTA): implications and applications for primary care providers. J *Dev Behav Pediat* 22(1):60-73.

28. Rowe, K., Pollard, J., & Rowe, K. (2005). Literacy, behavior, and auditory processing: Does teacher professional development make a difference? Australian Council for Educational Research. [http://www.acer.edu.au/news/latestnews.html]

29. Miranda, A., Presentacion, M.J., & Soriano, M. (2002). Effectiveness of a school-based multicomponent program for the treatment of ADHD. *Journal of Learning Disabilities*, 35, 546 – 562.

30. Klingberg T, Fernell E, Olesen PJ et al (2005). Computerized training of working memory in children with ADHD – A randomized, controlled trial. *J Am Acad Child Adolesc Psychiatry*, 44(2), 177–186.

31. Harpin, V.A. (2005). The effect of ADHD on the life of an individual, their family, and community from preschool to adult life. *Archives of Disease in Childhood* 90(1 Suppl), i2–i7.

32. Leibson, C.L., Long, K.H. (2003). Economic implications of attention-deficit hyperactivity disorder for health-care systems. *Pharmacoeconomi*, 21(17), 1239–1262.

33. Matza LS, Paramore C, Prasad M (2005). A review of the economic burden of ADHD. Cost Effectiveness and Resource Allocation [http://www.resource-allocation.com/content/pdf/1478-7547-3-5.pdf; June]

34. Coulombe, S., Tremblay, J.F., Marchand, S. (2004). International Adult Literacy Survey: Literacy scores, human capital, and growth across fourteen OECD countries. (www.stats.can.ca)

35. Martinussen R, Tannock R, with McInnes A, Chaban P (2006). TeachADHD: Teacher's Resource Manual (DVD enclosed; Website: www.teachADHD.ca). TVOntario, Toronto, Canada [www.tvontario.org/sales/teachadhd]

What Works? is updated monthly and posted at: www.inspirelearning.ca/english/research/researchRoom.htm
ISSN 1913-1097 What Works? Research Into Practice (Print)
ISSN 1913-1100 What Works? Research Into Practice (Online)