

A New Understanding of ADD/ADHD and Executive Functions



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High IQ and Underachievement

Many students with high IQ show academic underachievement
Often blamed on:
laziness
boredom
insufficiently challenged
resistance to authority
substance abuse
depression or anxiety
May be any of the above, but may also be ADHD

Outline

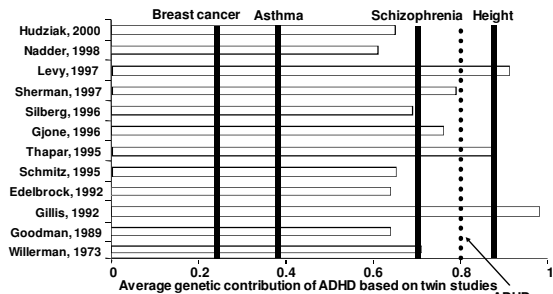
1. A new understanding of ADD/ADHD
2. Executive functions develop gradually
3. Relationship of EF to LD & other disorders

Prevalence and Genetics of ADHD

- 7.5% of children; 4.4% of adults
- Male-female: 6:1, 3:1, 1:1
- All levels of IQ
- All levels of socioeconomic status
- Family genetic transmission: 0.8
- Inheritance not specific to subtype

Barkley RA. *Sci Am.* 1998;279(3):66-71. Gaub M, Carlson CL. *J Am Acad Child Adolesc Psychiatry.* 1997;36(8):1036-1045. Levy F, et al. *J Am Acad Child Adolesc Psychiatry.* 1997;36(6):737-744. Smalley SL, et al. *J Am Acad Child Adolesc Psychiatry.* 2000;39(9):1135-1143.

ADHD Genetics: Heritability Coefficient



Faraone. *J Am Acad Child Adolesc Psychiatry.* 2000;39:1455-1457.
 Hemminki. *Mutat Res.* 2001;25:11-21.
 Palmer. *Eur Resp J.* 2001;17:696-702.

18 year old college dropout Honor student in hs; failed out of college

- “We could hardly wait to get out of hs...and our nose parents”
- “Nobody cared when I went to bed or when I up got up or whether I went to class.”
- “Just their being around...”

Brown, 2005

1.
A New Understanding of
ADD/ADHD

“Focus” and Executive
Function
Impairments of ADHD

- In DSM-IV “inattention”
symptoms of ADHD
 - Do not mean
 - Unable to focus as in holding the
camera still to take a photo of an
unmoving object
 - Do mean
 - Unable to focus as in focusing on
the task of driving a car

Brown TE. 2005.

ADHD Symptoms Overlap
With “Executive Functions”
(EF)

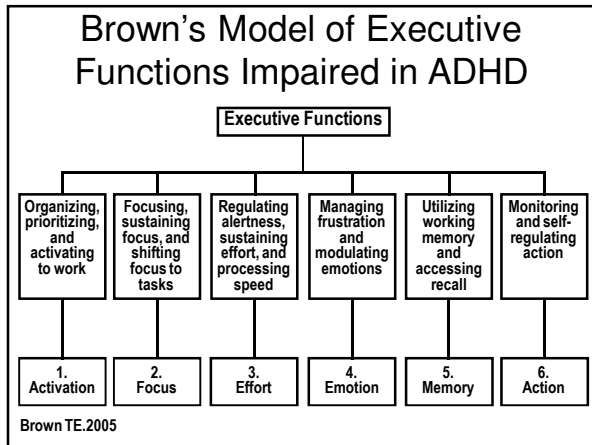
- Wide range of central control
processes of the brain
- Connect, prioritize, and integrate
cognitive functions—moment by
moment
- Like conductor of a symphony
orchestra

Brown's Model of Executive Functions Impaired in ADHD

Symptom Characteristics

- Dimensional, not "all-or-nothing"
 - Everyone sometimes has some impairments in these functions; in ADHD, it is a chronic, severe impairment
- Situational variability: "If I'm interested"
 - Most persons with ADHD have a few activities where ADHD impairments are absent

ADHD looks like a willpower problem, but it isn't!



1. Organize, Prioritize, and Activate

- Trouble getting started on work
- Difficulty organizing tasks
- Misunderstands directions

Brown TE. *Brown ADD Scales*; 1996.
Brown TE. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000. Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents*; 2001.

2. Focus, Shift, and Sustain Attention

- Loses focus when trying to listen or plan
- Forgets what was read, needs to re-read
- Easily distracted-internal/external

Brown TE. *Brown ADD Scales*; 1996.
Brown TE. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000. Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents*; 2001.

3. Regulate Alertness, Effort, and Processing Speed

- Difficulty regulating sleep and alertness
- Quickly loses interest in task, especially longer projects; doesn't sustain effort
- Difficulty completing task on time, especially in writing—"slow modem"

Brown TE. *Brown ADD Scales*; 1996.
Brown TE. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000. Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents*; 2001.

4. Manage Frustration, Modulate Emotion (Not included in DSM-IV criteria)

- Emotions impact thoughts, actions too much
- "Can't put it to the back of my mind"
- Overreacts to frustration, hurts, wants, or worries

Brown TE. *Brown ADD Scales*; 1996.
Brown TE. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000. Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents*; 2001.

5. Utilize Working Memory, Access Recall

- Forgets to do planned tasks, where things have been put, what intended to say (difficulty holding info "bits" on-line while attending to other tasks)
- Difficulty recalling learned material ("search engine" of brain has difficulty activating stored memories when needed)

Brown TE. *Brown ADD Scales*; 1996.
Brown TE. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000. Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents*; 2001.

6. Monitor and Self-Regulate Action

- Difficulty in monitoring situation and self at same time
- Impulsive, does tasks too fast, not careful enough
- Difficulty in adjusting actions to setting

Brown TE. *Brown ADD Scales*; 1996.
Brown TE. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000. Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents*; 2001.

The New Paradigm

ADD/ADHD =
developmental impairment of
executive functions

Developmental impairment =
not emerging or developing as expected

2.
Executive functions
develop gradually
& are
challenged gradually

Development of Brain
Structures that Support
Executive Functions

- Structures and functions that support EF are not fully developed at birth
- Shortly before puberty, massive cortical growth and extensive synaptic pruning
- Brain myelination increases 100% during the teenage years
- Development of EF capacities continues into early adulthood

Rothbart MK, Posner MI. Mechanism and variation in the development of attentional networks. In: Nelson CA, Luciana M, eds. *Handbook of Developmental Cognitive Neuroscience*; 2001.

Executive Functions and
Scaffolding

- In early childhood, others perform all executive functions for the child (parents, teachers, sibs and other caretakers)
- Scaffolding is provided by showing, directing, helping, reminding, coaching, critiquing
(Examples: walking, getting dressed, crossing street, riding bike, driving car)
- Scaffolding is gradually withdrawn, as child becomes able to (or is forced to) perform these functions for self
- In adolescence & adulthood scaffolding may be provided by: friends, teachers, coaches, spouses, supervisors

Executive Functions: Development and Demands

- EF capacity develops through childhood, into adolescence, and beyond; it is not fully present in early childhood
- Environmental demands for EF increase with age, from preschool through adulthood
- EF impairments often are not noticeable by age 7!

Brown TE. Emerging understandings of attention deficit disorders and comorbidities. In: Brown TE, ed. *Attention-Deficit Disorders and Comorbidities in Children, Adolescents, and Adults*; 2000:3-55.

When Are ADHD Impairments of EF Noticeable?

- Some are obvious very early and are noticeable in preschool years
- Some are not noticeable until middle elementary or junior high
- Some are not apparent until child leaves home to go to college or later
- Some emerge only later when confronted with increased EF challenges of adulthood

Challenges May Reveal Weaknesses

Cardiac weaknesses may not be noticeable in EKG taken while lying quiet on a table, but may be very noticeable while playing basketball, shoveling snow

EF weaknesses may not be noticeable until one's self-management is challenged by increased demands of adult life

How Can Executive Functions Become Impaired?

- Developmentally, eg, ADHD
- Trauma, eg, traumatic brain injury
- Disease, eg, Alzheimer's disease
- In trauma and disease, the patient usually has had adequate EF, then loses it
- In ADHD, EF has not developed adequately

3.

How are ADD/ADHD related to LD & other psychiatric problems?

ADHD vs LD Separate entities?

Some think:

ADHD = chemical problem in brain

LD = "hard-wiring" problem in brain

Current research suggests that ADHD and LD may not be so separate

Evidence suggests shared genetic etiology in Reading Disorder and ADHD
(Willcutt, Pennington & DeFries, 2000)

Working Memory

plays crucial role in:

- **Reading**
 - learning to read-integrating fragments
 - recalling & comprehending
- **Math**
 - recall of facts and procedures
 - computation & problem-solving
- **Written Expression**
 - organizing & elaborating

Reading Comprehension

(3 Items on Brown ADD Scales)

- Distracted frequently when doing required reading; keeps thinking of things that have nothing to do with what is being read.
- Loses track in required reading of what has just been read and needs to read it again; understands the words, but what was read "just doesn't stick."
- Remembers some of the details in required reading but has difficulty grasping the main idea.

Reading & ADHD

- Reading is often impaired in children, adolescents and adults with ADHD
- 25% of persons with ADHD are dyslexic (vs. 5% of general population)
- ADHD impairments of working memory, processing speed, attention, etc. often impair reading, even if there is no dyslexia

Psychiatric Comorbidities in adults with ADHD

	12 mo.		Lifetime	
	%	OR	%	OR
Any mood	25.5	3.5	45.4	3.0
Any anxiety	47.0	3.4	59.0	3.2
Any substance	14.7	2.8	35.8	2.8
Any impulse ¹	35.0	5.6	69.8	5.9
Any psychiatric	66.9	4.2	88.6	6.3

¹impulse = antisocial pd, ODD, CD, Intermittent explosive disorder, bulimia, gambling
(from Ntnl Comorbidity Survey-Replication data presented by R.Kessler at APA, 5/1/04)

←

Other problems don't eliminate possibility of ADHD or vice-versa

- Specific Learning Disorders
- Substance abuse
- Depression
- Anxiety
- OCD
- Asperger's Disorder (autistic spectrum)

**ADD/ADHD is a foundational disorder
that increases vulnerability to LD
& other disorders**

How Is ADHD Related to Comorbid Disorders?

- **ADHD**: developmental impairment of executive functions that organize and regulate many specific functions of mind cf: impaired orchestra conductor
- **Comorbidity**: ADHD with 1 or more specific mental functions also impaired cf: orchestra player(s) + conductor impaired
eg: reading comprehension vs dyslexia

Impairment?

- Is student's functioning significantly Impaired relative to apparent ability?
- Has impairment been fairly consistent over time and/or exacerbated with increasing challenges?
- Functioning OK on tasks with strong personal interest or "gun to head"?

8 Measures of EF Impairment

- **Working Memory** Index +/-or **Processing Speed** Index ≥ 1 SD below VCI or POI
- **Story Memory** Test Score (CMS/WMS) ≥ 1 SD below Verbal Comp Index
- T-score on any of the 5 **cluster scores** on Brown ADD Scale ≥ 65
- Overall impairment of EF = ≥ 4 of **844 or more of 8**

Brown, Patterson, Quinlan, 2003

WISC-IV & WAIS-III Index Scores Discrepancies to Assess ADHD

- Index Scores [VCI, POI] less sensitive to problems in attention, memory, processing speed
vs
 - Index Scores [WMI, PSI] more sensitive to these problems

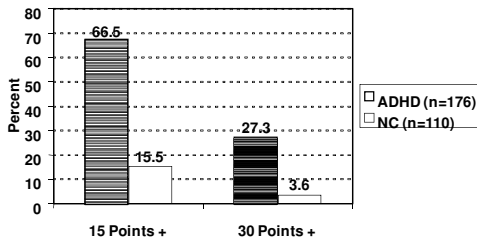
(Brown, Manual for Brown ADD Scales for Children & Adolescents 2001)

Verbal Working Memory assessment

- Digit Span test (esp. backward) picks up some impairments of working memory
- another important aspect can be tested with story memory test of WMS-III (Logical Memory Subtest)
- compare individual score to verbal IQ
- many with ADHD 1 SD or more below VIQ

VIQ vs. Prose Memory Index:

% Adults Showing 15- and 30-point Discrepancies



Prose Memory Index= Logical Memory Score on Wechsler Memory Scale-R (transformed into IQ-type score) (Quinlan & Brown, 2003)

126 High IQ Patients with ADHD 4 age groups

- Charts of 126 consecutive children, adolescents and adults
- Seen in specialty clinic for ADHD
- Ages 6-40 yrs
- Fully met DSM-IV criteria for ADHD
- VIQ and/or PIQ \geq 120 (top 9% of pop.)
- Predom Inattentive 63%; Combined 37%

Brown, Patterson & Quinlan, 2003

126 High IQ Patients with ADHD

Cognitive Strengths & Impairments

<u>Age (yrs)</u>	<u>n (%)</u>	<u>male%</u>	<u>VCI</u>	<u>POI</u>
6-12	19 (15)	84	127	116
13-17	50 (40)	83	131	115
18-25	40 (32)	65	125	121
26-40	17 (13)	60	126	124

Brown, Patterson & Quinlan, 2003

**126 High IQ Patients 6-40 yrs
2003**

% significantly impaired:

- 62% on Working Memory (31%)
- 77% on Processing Speed (43%)
- 85% on auditory story memory (50%)
- 75% on 3 of 5 clusters on Brown Scale
- Across age groups 66% of individuals showed significant impairment in 4 or more of 8 markers of EF impairment, despite their superior IQ

Brown, Patterson, Quinlan, 2003

115 High IQ Adults (2007)

% significantly impaired:

- 68% on Working Memory
- 81% on Processing Speed
- 85% on auditory story memory
- 81% on 3 of 5 clusters on Brown Scale
- 91% of individuals 18 to 59 yrs showed significant impairment in 4 or more of 8 markers of EF impairment, despite their superior IQ

Brown, Reichel, Quinlan, 2007

Yale Study of High IQ Adults with ADHD

- 103 treatment seeking adults (not representative of all high IQ)
- Ages:
 - 29% 18 to 29 yrs
 - 32% 30 to 39
 - 39% 39 to 63
- 72% male
- fully met DSM-IV criteria for ADHD
- Verbal +/-or Performance IQ \geq 120 (9%)

Brown & Quinlan, 1999

Educational & Vocational Achievement

- 98% completed high school
- 56% completed at least 4 yr college degree
- 22% completed advanced degree (M.S., J.D., M.D., Ph.D.)
- 42% dropped out of post-secondary school at least once (some later returned)
- 41% currently in low-skilled, unskilled jobs

Brown & Quinlan, 1999

38 yo woman

- reading sentences in kindergarten
- "almost a genius"
- gifted classes until high school
- Dropped from TAG classes- hw
- Outstanding in theatre & sports
- Admitted to excellent university
- Kicked out middle of 2nd year

26 yo man

- “I’ve always had a hard time making choices”
- “Keep trying things out and then I get bored”
- Dropped out of college after switching major x5
- 7 jobs in past 4 years
- “always have to keep changing channels.”

Brown, 2005

Key Points

- EF develop gradually infancy to 20+ yrs
- ADHD = developmental impairment of EF
- Impairment in emotion regulation is aspect of ADD syndrome
- ADHD meds often alleviate EF impairments
- EF impairments underlie comorbid dx

My Website

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www.DrThomasEBrown.com
