Neuropsychology of Attention Deficit Disorder

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# Attention

No use to shout at them to pay attention. If the situations, the materials, the problems before the child do not interest him, his attention will slip off to what does interest him, and no amount of exhortation of threats will bring it back. John Holt

If I have ever made any valuable discoveries, it has been owing more to patient attention, than to any other talent. *Isaac Newton* 

The only factor becoming scarce in a world of abundance is human attention. *Kevin Kelly* 

# Typical ADHD event



## Successful Manager

I am horribly disorganized. I have a tremendously difficult time completing the tasks before me, without succumbing to major tangential distractions. I find it nearly impossible to do simple things that I know are necessary, from getting to places on time to completing ordinary daily tasks. My marriage gets strained to near breaking at times due to my inability to stay in a conversation or project reliably. When I do find something that peaks my interest, all else will get pushed aside to make room for it, no matter how trivial it is. Even in print these problems don't appear as dire as they are experienced. " (Patient of Dr. S. Goldstein)

# ADHD

 ADHD is the most common childhood behavioral health problem leading to medical & behavioral interventions. It is a genuine biological and genetic condition.

- 1 in 9 children & adolescents in US have dx (1 boy in 6)
- Medication TX in vast majority

 Significant evidence that: ADHD children suffer academic and community adjustment problems; disproportionate rates of later problems (car accidents, SA, divorce). These problems persist into adulthood.

#### **DSM-V: ADHD: Definition**

- A. ADHD is a <u>neurodevelopment disorder</u>:
  Persistent <u>pattern of inattention</u>
  <u>interferes with functioning or development</u>
  <u>Disorganization</u>
  - And/or <u>hyperactivity-impulsivity</u>

#### DSM-V criteria for ADHD

1- <u>Inattention</u>: <u>6 or more sxs, persist > 6 months</u>, inconsistent with developmental level & <u>negatively impacts social</u>, academic, or occupational activities

Note: Sxs not solely due to oppositional behavior, defiance, hostility, or failure to understand task;

#### **5 sxs required for age 17 or older (Adult ADHD);**

Often:

- A. \* Failure to pay close attention to details or makes careless mistakes
- B. <u>Difficulty sustaining attention</u>
- C. Does not seem to listen when spoken to directly
- D. Does not follow through on instructions and fails to finish tasks
- E. \* Difficulty organizing tasks and activities

# DSM-V 2

- F. <u>Reluctant to engage in tasks that require sustained mental effort</u>
- G. \* Loses things necessary for tasks or activities
- H. \* Easily distracted by extraneous stimuli
- I. Forgetful in daily activities
- 2. <u>Hyperactivity & impulsivity</u>
- A. Fidgets with or taps hands or feet or squirms in seat
- B. Leaves seat in situations when remaining seated is expected
- C. \* R<u>uns about or climbs in situations where it is inappropriate</u> (feeling <u>restless</u> in adults)

#### DSM-V 3

- D. \* Unable to play or engage in leisure activates quietly.
- E. <u>"On the go" acting as if "driven by a motor"</u> (experienced by others as <u>restless</u> or difficult to keep up with)
- F. \* <u>Talks excessively</u>
- G. Blurts out an answer before a question is finished
- H. \* Difficulty waiting his or her turn
- I. Interrupts or intrudes on others

#### **DSM-V** Criteria for ADHD

- B. Several symptoms present prior to age 12 years.
  - Remember: if it's not life-long, it's not ADHD per DSM

- C. Symptoms present in <u>2 or more settings</u> (e.g., home, school, work, with friends or relatives; in other activities).
- D. Symptoms <u>interfere with or reduce quality of social, academic,</u> or occupation functioning.
- E. The symptoms <u>not better accounted for by another mental</u> <u>disorder.</u>

# DSM-V: 3 Types

- 314.00 Predominantly in <u>inattentive</u> presentation
- 314.01 Predominantly <u>hyperactive/impulsive</u> presentation
- 314.01 <u>Combined presentation</u>: 6 months of both inattention and hyperactivity
- Specify if:
  - In partial remission: full criteria previously met, but no longer meets full criteria in 6 last months
- Specify if:
  - Mild: few sxs in excess of full criteria
  - Moderate
  - Severe: more sxs in excess of required

# DSM-V: Not Full Criteria Types

 <u>314.01Other Specified ADHD</u>: causes significant distress or impairment, but <u>not full</u> criteria (must <u>add specific reason for why it</u> <u>does not meet criteria</u>, i.e. insufficient attention sxs)

 <u>314.01 Unspecified ADHD</u>: symptoms characteristic of ADHD but do not meet full criteria (clinician chooses not to specify reason; or situations in which there is insufficient information for diagnosis)



- Get information from other informants about diagnosis;
- Pt. recall is often unreliable.
- Parental recall is more valid measure & better predictor of treatment response.
- i.e. roommate response: "Dah!"

# DSM-V: Symptom Variability

Symptom manifestation is variable depending on context:

- less if reward for appropriate behavior
- under supervision
- in novel setting
- is engaging in interesting activities
- has consistent external stimulation
- in 1 to 1 situation

# **Conditions with Attention Deficits**

- Charlie Vella walking to KP mail room: everyone experiences AD sometimes
- ADHD
- Schizophrenia
- Bipolar Disorder
- Pain Syndromes
- Major Depression
- Anxiety Disorder
- TBI
- Substance Abuse
- Old age
- Note: <u>All but 1<sup>st</sup> above have neuropsychological deficits of their own</u>

# ADHD Cross Culturally

- Appears in nearly all cultures
  - That feature <u>compulsory education</u>
  - It's not just a US thing!
- Polanczyk et al. (2007), *American Journal of Psychiatry*:
  - Diagnostic prevalence strikingly similar across world regions: 5%
  - Disparities linked to dx practices (ICD vs. DSM; informants; etc.)
- Hinshaw et al. (2011), *Psychiatric Services* 
  - Within-country variation high in many nations
  - However, treatments and systems of care vary radically across regions and cultures

## ADHD Facts

- ADHD is a <u>neurodevelopmental disorder</u>
  - High genetic liability
- ADHD incurs <u>huge costs</u>
- ADHD came into being with the advent of compulsory education; its huge increases now may reflect academic and vocational pressure
  - Biology AND culture
- Few with ADHD have excellent outcomes
  - Hallowell: it's a gift that's hard to unwrap

• <u>Medications are poisons</u>, destroying developing brains

OMeds help in 80% of cases, may possibly be neuroprotective

#### Medication alone is a sufficient treatment

ONeed family/school intervention for skill building

OADHD can be assessed/diagnosed in a 10' office visit

•Yet this, far too often, is the <u>national standard</u>

Results in both over diagnosis and under diagnosis

# Adult ADHD Patients: Trouble

- 20 years ago <u>SF NP team</u> saw Driven to Distraction video and dismissed the syndrome ("everyone has those sxs")
- Highly <u>disliked and distrusted</u> by therapists/psychiatrists (almost as much as "borderlines")
- Treated, like most <u>frontally impaired</u> individuals, as if they are <u>personality disordered</u>

## More Trouble 2

- More difficult to work with
- Just drug seeking, or seeking secondary gain
- Always late for appointments
- Don't follow through
- Test limits of therapists skills
- Therapists need: low narcissism, high energy, high tolerance, good diagnosis skills

More trouble a patient is to a therapist, the more neuropsychological deficits

- My neuropsychological bias (based on research and experience):
- The more problematic a patient is, the more likely they have significant neuropsychological deficits
- Includes: Patients with schizophrenia, bipolar disorder, BPD, psychopathy, & ADHD

## History of Disorder

- Morbid Defect of Moral Control: 1902, Dr. George Still, earliest case of ADHD
- Hyperkinetic Reaction of Childhood, 1968
- Mild Organic Brain Damage
- Attention Deficit Disorder, 1980



Inability to properly modulate attention, impulse control, and motor activity.

Three subtypes in DSM-5:

Inattentive (without hyperactivity) Impulsive-hyperactive Combined

#### ADHD: Definition 2

- Age of onset must be prior to age 7.
- Primary symptoms must be observable in at least <u>two</u> <u>different social contexts</u> and have an <u>adverse effect</u> on social, occupational, or academic functioning.
- Also important: WM, EF, Self Control (Marshmallow test), & Motivation Deficit (underarousal), time management

## When ADHD Manifests

- ADHD is not so much a problem of uniformly poor attention or fidgetiness as it is of poorly regulated attention & action; variability; can focus extremely intensely
- Kids use parents as frontal lobes,
- ADHD girls tend to be more inattentive, rather than hyperactive
- ADHD problems may not be noted by teachers or others until JHS or HS or beyond, unless there are politically mandated test requirements

# Reality of ADHD:

Biological, Neurological, and Neuropsychological

Highly genetic: Family and twin studies: higher genetic concordance than has been established for any other psychiatric disorder

Imaging studies reveal <u>differences in brains</u> of ADHD subjects compared to normals

ADHD subjects respond differently to psychostimulants than do controls

Neuropsychological studies show differences in ADHD subjects on a variety of tasks

#### Genetics

- Lead exposure
- Fetal alcohol syndrome
- Maternal smoking fourfold higher risk of ADHD in offspring of smokers
- Metabolic disorders of mother: diabetes, phenylketonuria
- Hypoxia prenatally or during childbirth often affects DA system
- Low birth weight, forceps delivery
- Iron deficiency (rare)

#### ADHD: Heritability

- Heritability and Genes:
  - H<sup>2</sup> of ADHD near .8
  - \*\*What is heritability?
    - 'genetic liability,' but not inevitability
- Too often, assumption is that ADHD is 'fixed' and largely immutable

80% heritability in study by Gjone, Sundet, Stevenson of identical and fraternal twins

Between <u>55% and 92% of identical twins</u> of children with ADHD eventually develop ADHD

Pairwise concordance of hyperactivity <u>51% to 100% (!!) for</u> monozygotic twins, 4% to 33% for dizygotic twins Parents with ADHD: <u>50%+ chance of having a child with ADHD</u>

40% of parents of ADHD kids have same sxs

Children with ADHD: 25% have an ADHD parent

Siblings of ADHD children : 5 to 7 times more likely to develop the syndrome than children from unaffected families

Adoption studies show increased rates of hyperactivity in <u>first degree</u> relatives of hyperactive children (reared apart)

Psychopathology in rearing parents <u>not</u> correlated with development of ADHD (environmental factors contribute little to development of ADHD)

## **Other Risk Factors**

- Low birthweight
  - Predicts ADHD, LD, Tourette's, CP, retardation
- Teratogenic effects
  - Fetal Alcohol Effect: Many are nearly identical to ADHD symptoms
  - Smoking/nicotine: genetic mediation, too
- Increasing evidence related to environmental toxins
- Insecure attachment?

Does NOT predict later ADHD, independent of comorbid aggression

#### Etiology 2

# Hyperbilirubinemia (Jaundice)

 Can result in irreversible damage to basal ganglia, esp. global pallidus, subthalamic nucleus. Even moderate levels of bilirubin in otherwise healthy infants may not be as benign as previously believed.

## Etiology 3

#### Problems during early development

- Mesial temporal lobe injury, cysts (connects to dorsolateral prefrontal cortex)
- Traumatic injuries: often frontal lobe damage, shearing of whitematter tracts
- Strokes
- Encephalitis: von Economo's 1910-1920 -- Parkinsonism in adults; ADHD in children ("pseudo-psychopathia")

#### Etiology 4

#### Problems during early development

- Meningitis, Pediatric autoimmune neuropsychiatric disorder with streptococcus (PANDA), Lyme disease
- Early deprivation
- Exposure to toxins -- pesticides, lead (somewhat controversial)

#### **Risk & Prognosis**

- Elevated in 1<sup>st</sup> degree biological relatives
- Rates of <u>minor physical anomalies</u> (hypertelorism (increased body part distance), high arched palate, lowset ears)
- More frequent in males than in females (3:1 in children, 1.6:1 in adults)
Rough estimate of prevalence in population in childhood :

- Wender: 6 to 10%
- DSM-IV: 3 to 5%
- Barkley: 3-7%

Wilens and Dodson: 4-12% in school-aged kids

Israel (2003): <u>8-12%</u> in US, Canada, England, Germany, New Zealand, Puerto Rico, Hong Kong, and India

#### Prevalence 2

#### In clinic populations

- higher prevalence in boys than girls (6:1 to 12:1)
- In epidemiologic studies
  - male to female prevalence ratio much lower, 3:1

Young girls are likely under-identified by school systems, mental health clinics and parents

Adults: gender ratio is 1:1 (Israel: 1.5: 1)

Medications: 3.3 million 19 and under

1.5 million 20 and older

#### **Prevalence: You see more ADHD than you think**

#### NIMH Statistics (% of population, not clinics):

| • | Obsessive Compulsive Personality disorder | 7.9 |
|---|---|-----|
| • | Social Phobia                             | 6.8 |
| • | MDD                                       | 6.7 |
| • | Paranoid Personality Disorder             | 4.4 |
| • |   | 4.1 |
| • | PTSD                                      | 3.5 |
|   | GAD                                       | 3.1 |
|   | Panic                                     | 2.7 |
|   | Bipolar                                   | 2.6 |
|   | Dysthymia                                 | 1.5 |
|   | Schizophrenia                             | 1.1 |
|   | OCD                                       | 1.0 |

#### Prevalence 2

- Adult prevalence: <u>4-5%</u> (8-9 million)
- Less than 1-2 million diagnosed or treated
- Israel, 2005: <u>70% undiagnosed</u>
- <u>12-15% of US military dependents</u> have ADHD (Barkley: military is like parents: more external structure)

## Rates of ADHD Dx and Medication TX

 Although ADHD is a biological condition, rates of ADHD Dx and medication tx vary dramatically across most states related to:

- Family & cultural values
- Health insurance systems
- Media portrayal and direct to consumer advertisements
- And especially, variations in school policies linked to demands for school achievement and performance (high stakes testing); and vocational competition

# Context of ADHD

- Unequivocally, core sxs of ADHD became apparent in societies when children were made to attend school and perform tasks that humans were not evolved to do, like reading.
- Compulsory education was the trigger for revealing childhood variability in attentional and learning styles.
- Current rates of dx and tx are linked to intense pressure for achievement in both education and vocation.
- Biology matters, but context of our pressured world brings ADHD sxs to fore.

# Tidal Wave/ADHD Explosion

National Survey of Children's Health (Visser et al., 2014)

- Parent-reported ADHD 'ever diagnosed'
  - For all 4-17 year olds in U.S.:
    - **2003:** 7.8% **2007:** 9.5% **2012:** 11.0%
    - 41% INCREASE IN 9 YEARS!
    - <u>1 in 20 in 1980s; now 1 in 9; 15% for boys, 1 in 6 (1 in 5 in high school)</u>
  - Low income dx rates now equal to middle class; Black = White; Hispanic lower (but fast growing)
- Medication higher, too:
  - 70% of those 'currently diagnosed 'now receive medication
  - From other sources: Largest medication increases: adolescents, adults

#### Earlier Explosions: 1990s Consider diagnosed prevalence vs. true prevalence

- Policy shifts: <u>41% increase in dx in US</u>
  - 1960s: 1% dx; then loosening of dx; then support groups (CHADHD)
  - 1991: Individuals with Disabilities Education Act (IDEA): ADHD as OHI (other health impairment) – allows accommodations
  - Medicaid: authorizes ADHD
  - SSI: ADHD (with other impairment) can qualify
- Late 1990s: FDA changes regs on Direct To Consumers ads
- 2000: Concerta (first effective long-acting form)
- More and more LBW babies survive

## Huge Regional Variation Now

 1990s: state policies that made funding for schools dependent on district's test scores

- O 2001 No Child Left Behind Laws
- Rise across entire nation, but huge state-by-state variation, too

**O** 2011-12:

- Arkansas now #1, Indiana #2, NC #3; far lower in CA
  - ONC had been #1 in 2007 (16% of kids; 30% of boys)
- Medication trends similar to 2007, but slightly higher overall
- 6% of all children in US are on stimulants; 14% of Medicaid-eligible kids

The ADHD Explosion - S. Hinshaw & R. Scheffler

#### **Diagnostic Prevalence:**



Source: 2011-2012 NSCH, Children Aged 4-17

### Medication Rate Given Current Diagnosis:



# Consequential accountability

1970s-80s: public school reforms "input focused"
Reduce class size, pay teachers more, etc.

Results not consistent; shift in 1990s to "output focused"
I.e., incentivize test score improvements per se

 <u>Consequential accountability</u>—districts get 'noted' or even cut off from funds, unless test scores go up

O30 states implement such laws <2000

 Then, becomes law of the land for all states with No Child Left Behind (takes effect 2002-3)

## Prevalence

 S. Hinshaw: <u>Despite some underdiagnosis (esp. in girls)</u>, <u>ADHD is now as a general rule overdiagnosed</u>, <u>due to</u> <u>cursory diagnostic procedures</u>. <u>Poor medication monitoring</u> <u>contributes to diversion of stimulants to non-ADHD people</u>.

Some experts estimate that <u>15% to 20% of all ADHD</u> medicine in the U.S. is diverted or shared with people who don't have a prescription.

### Prevalence

- National diagnosed prevalence in US has outstripped the true prevalence.
- Currently 11% of US youth aged 4-17 have at some point received an ADHD dx (CDC, 2011-2012); <u>6.4 M</u> children/adolescents; 10 M adults

# **ADHD: Major Reminders**

- A permanent neurological condition; life time, invisible chronic disability
- Genetic
- Developmental (or acquired (TBI))
- More prevalent than many Psychiatric conditions
- Behaviors are <u>not intentional</u>, <u>but due to neurological</u> <u>disorder</u>

## Major Reminders 2

- Produces significant occupational and interpersonal problems, self blame, self esteem issues and comorbidities
- A disorder of inconsistency and variability
- Stimulants are effective in reducing core symptoms in the short run; most gains from combo of meds & skill building, which are rarely done

# Major Reminders 3

 Disorder of routine task management, fails at everyday life maintenance

- Lazy, Crazy, Hazy: Inadequate or variable self application to tasks is interpreted by others as laziness, irresponsibility/moral failure, or uncooperativeness
- All providers need to be able to treat: avoid provider prejudice

## Nature of ADHD: Models

- "Cognitive" models: Attention deficit, EF
- "Inhibitory" models: Barkley (1997)
- "Motivation" models: Reward undersensitivity/underarousal
  - E.g., Volkow et al. (2009): large medication-naïve adult sample, PET scans of transporters and receptors: less D receptors
  - More drawn to immediate reward/less ability to do long term work

## **Posner: Attentional Systems**

- 3 attentional network systems:
  - Alerting: obtain & maintain alertness
    - Norepinephrine
  - Orienting: orienting to sensory event
    - Acetylcholine
  - Executive Control: orientation to own memory and emotional regulation
    - Dopamine

## **3** Attentional Systems



# What's Normal in ADHD

- Attention is thought of as having three fundamental <u>aspects</u>
  - orienting,
  - selecting,
  - and vigilance (watching effectively for something important)
  - <u>Attentional orienting to fast cue/target displays</u>, which activate a posterior/parietal (automatic) brain system for <u>spatial orienting of attention is normal</u>. Automatic spatial orienting of attention is not a reliable marker of ADHD.
- <u>No evidence of abnormality in attentional selection</u>
- Only vigilance/sustained attention appears to be related to ADHD.
- ADHD not an attention deficit per se—but a disorder of *dysregulated* attention
  - Hyperfocus vs. distractibility; question of context and demand

## **Elements of ADHD**

2 core clusters: inattention/disorganization & hyperactivity/impulsivity

Locomotor hyperactivity Vigilance – arousal Motor inhibition **Delay** Aversion Error processing Salience detection Working memory Planning (EF) Variability/inconsistency

#### ADHD is a Disorder of Neuronal Atrophy



Disruption of dorsolateral prefrontal cortex & orbitofrontal-striatal-limbic circuits

ADHD is a disorder of Abnormal Frontal Metabolism

Strong evidence for <u>fronto-striatal network</u> involved in core ADHD symptoms (Kain & Perner)

Generally decreased frontal cortical activity

<u>Abnormal regional and global glucose metabolism</u> during the performance of tasks involving executive function

Decreased dopamine neurotransmission in the left and medial portions of the prefrontal cortex

# EF and Outcomes in ADHD

- EF measures (old school, but this was mid-90s):
  - Global: Rey-Osterrieth Complex Figure (ROCF)
  - Sustained attention: CPT % omissions
  - Response inhibition: CPT % commissions
  - Working memory: Digit Span





Comparison

ADHD

### Poor Childhood EF and Later Outcomes

# Independent of IQ, <u>childhood EF predicts greater impairment</u> in each of these outcomes:

#### Adolescence

Academic achievement

Social functioning (peer acceptance) Global functioning

#### Young Adulthood

Academic achievement

**Occupational functioning** 

**Global functioning** 

Self-injurious behavior/suicide attempts

#### Miller & Hinshaw (2010); Miller, Nevado, & Hinshaw (2012)

## ADHD & EF

Childhood EF predicts adolescent and young adult functional outcomes

Variability in improvement of EF in girls with ADHD over time

EF development may act as mechanism underlying symptom reduction

EF difficulties as risk factors...and potential treatment targets

## Sex Differences/Female Presentation

#### Myth: ADHD affects only boys and men

For decades, ADHD ('hyperactivity') believed to be a male condition

#### A major puzzle: in childhood, it's 3:1 boy: girl

- But in adults, it's a lot closer to 1:1
- Is this because more girls (inattentive) persist?
- Or in adult samples, are females more likely to disclose/self-refer?

#### First decade of life: risk period for boys

- Higher rates of ADHD, autism, conduct disorder, Tourette's
- Why? Lack of protection yielded by Y chromosome; testosterone 'bath' in utero
- In grade school, boys more at risk for behavioral problems, esp. externalizing kind (noncompliance, aggression, impulsivity); more impulse control issues
- For first few years of life, girls more empathic, social, verbal, and compliant; more inattentive dx

## But second decade of life...

Risk period for girls with respect to internalizing disorders...

Depression, anxiety, eating disorders, self-harm

• Why?

Hinshaw (2009): The Triple Bind

 Girls must be empathic, competitive, and effortless/hot at the same time

Greater peer rejection if hyperactive-impulsive

By adulthood, dx is almost even to men; med prescriptions rising faster for women

## Issues in Assessing Females

- Shame and stigma in having a 'male' disorder
  - Especially with achievement and relationships so valued by females

- Are some symptoms either masked, or expressed differently, because of other female attributes?
  - Hyper-verbal vs. hyperactive behaviors?

#### Berkeley Girls with ADHD Longitudinal Study (BGALS)

# In 1990s, Hinshaw fought myth that ADHD effects only males

#### All-female methodology first

- Hinshaw (2002), Journal of Consulting and Clinical Psychology
- Hinshaw et al. (2006), Journal of Consulting and Clinical Psychology
- Hinshaw et al. (2012), *Journal of Consulting and Clinical Psychology*



- Ethnically and socioeconomically diverse
- Group-matched comparison sample
- Three waves to date, 4<sup>th</sup> just completed (94% retention)
  - Largest female sample of childhood ADHD
- Follow-ups: Multi-domain assessments
  - Psychiatric, academic, neuropsychological, family/social, occupational functioning

# Wave: ages 6-12 Hinshaw (2002); Hinshaw et al. (2002)

- Initial publications in 2002
  - Doubled the world literature on preadolescent girls with ADHD
- Significant—and medium to large to very large—diff's between ADHD and comp samples on all observational, rated, peer-nominated, and objective measures
- ADHD in girls is impairing!
  - But without trajectory data, little idea of mechanisms

# Wave 2: 11-17 Hinshaw et al. (2006); Hinshaw et al. (2007)

#### Eleven core domains assessed

- In all eleven, significant impairment in ADHD sample
- Few differences between ADHD-C and ADHD-I, again
- ADHD sample: <u>higher rates of binge eating and other bulimic symptoms</u>
- Lower-than-expected rates of substance abuse and delinquency

 <u>Range of negative outcomes</u> for girls with ADHD <u>including devastatingly</u> <u>high rates of suicide/self-injurious behavior, academic difficulties,</u> <u>relational difficulties, and neuropsych deficit</u>. So, <u>functional impairments in</u> <u>adolescence and young adulthood are common in individuals with ADHD</u>.

# Wave 3: 17-24 Hinshaw et al. (2012); Miller et al. (2012)

#### Note on retention rate (95%):

 Great program, respectful staff, regular b-day and holiday cards, relentless tracking, social media

#### Impairments persist

- Even stronger in math
- Exception: no longer significant difference in eating pathology
- Exception: some differences in substance abuse, not huge

## **ADHD: Differences from Males**

• Lower rates of delinquency and substance abuse

 Girls did graduate from high school (barely) but have major post-secondary issues

• <u>Around half no longer met formal criteria for ADHD</u>

O Yet high impairment even for those who had 'remitted'

O Self -harm: Predicted by early impulsivity, mediated by adolescent response inhibition, and either externalizing (NSSI) or internalizing (suicide) problems
#### BGALS Follow-up: Self-harm

10-year follow-up (M age = 20)

Hinshaw et al. (2012), Journal of Consulting and Clinical Psychology



Higher rates for combined type; impulsivity is major component; 25% have made SA; 50% moderate to severe levels of cutting

### Trauma and peer relationships

- Physical abuse, sexual abuse, and/or neglect higher in ADHD than comparison girls
- Within ADHD group, maltreated subgroup more likely to show depression and suicide attempts
  - But not externalizing behavior)

AND, girls with ADHD likely to be victims of intimate partner violence by early adulthood

Guendelman et al. (2015a, *Development and Psychopathology*) Guendelman et al. (2015b, *Journal of Abnormal Child Psychology*)

### Summary: Female ADHD

- Females more likely than males to have inattentive form
  - But plenty of really impulsive females exist

#### Risk of self-harm extraordinarily high

History of impulsivity crucial here

#### Look for particular <u>patterns of peer difficulties</u>.

And with, for girls motivated to do well, anxiety and perfectionism

#### Inattentive types: more academic issues & higher driving accidents

ADHD is a Disorder of Reduced Neurotransmitter Function

Dopamine (DA): pleasure & reward, motor control & behavior regulation; regulation of learning, maintaining trained or conditioned responses, motivation (goal-directed behaviors), inhibition, working memory, prefrontal-subcortical systems, drives, emotions

Norepinephrine (NE): maintaining alertness, attention, "readiness." NE neurons triggered by novel, important stimuli.

Psychostimulants increase what is a lower than normal amount of central DA, NE

# ADHD is a Disorder of Reduced Neurotransmitter Function 2

- <u>NIDA study by Nora Volkow</u>: never medicated adults with ADHD have substantially fewer D receptors in 2 brain regions related to reward & motor & behavior regulation:
  - People with the disorder can't generate the same degree of enthusiasm as other people for activities they don't automatically find appealing.
- Gene variation (DRD4-7), common in ADHD dx'ed pts, contributes to lower rate of brain receptors for dopamine; presence correlates with propensity to seek excitement & novelty, risk taking
- Stimulants prevent reuptake of D in synapses, therefore increasing amount of D available

### **Evolution of DRD4-7R allele**

 ADHD stem from hunter-gatherers, when it made sense for survival of group that <u>a percentage of people would be</u> prone to more risk taking and impulsivity. ADHD types may have been more vigilant hunters

About 15 kya, when Bering strait had land bridge, <u>hunters</u> <u>carrying the DRD4-7R allele were most likely to migrate to</u> <u>Americas.</u>

The farther one travels down west coast of N and S America, the higher the concentrations of DRD4-74 allele (associated with risk taking) found in population.

# Stimulant Side effects

- Excess D causes alertness & wakefulness
- Suppress appetite (used as diet pills)
- Mildly affects PNS
  - Increases heart rate
  - Increases blood pressure
- Reduces ultimate height by 1 each or so (slows down release of growth hormone)
- Schedule II drugs (illegal unless medical supervision): Can produce euphoria (risk of SA in non-ADHD; 13% of casual users)
- Rare possibility of psychosis

#### ADHD involves Neuropsychological Deficits

#### Cognitive Deficits in:

sustained attention (CPT) auditory-verbal list learning (esp. 1 x info; conversations) planning and organization (WM, EF) behavioral inhibition/impulsivity cognitive flexibility speed of information processing verbal fluency But no correlation with IQ

Real-Life Consequences of Neuropsychological Problems

Immediate Reinforcement contingencies: now not later

**Poor Response Inhibition** 

High Response variability

**Poor Time estimation** 

**Impaired Sustained Inattention** 

**Executive Dysfunction (Planning, Organizing)** 

**Phonemic Processing** 

# Comorbidity: Rule not Exception

• 67 % of children with ADHD have comorbid dx



# **Relationship difficulties**

- Children with ADHD are more often rejected by peers than for any other disorder
- Peer rejection during grade school is single strongest predictor of delinquency, failure to finish high school, & long lasting MH problems
- Having even one high-quality friendship can at least partly outweigh the negative impact of multiple rejections from peers.
- Children with ADHD are slower to make friends, more likely to have conflicts with such peers, and have more trouble repairing damaged relationships

### ADHD in adolescence

- Less hyperactivity in adolescence
- Problems with school become more serious, when demands for organizational skills increase; tracking homework is difficult
- By age 18, 3 x more teens with ADHD will have failed a grade or been suspended or expelled
- 30% will quit high school before 12<sup>th</sup> grade

### ADHD in adolescence 2

- Higher rates of teen pregnancies, earlier sex, STDs, more car accidents, more injuries, juvenile delinquency, hospital stays, & ER visits; Car accidents are leading cause of death for 15-19
- In girls, more physical abuse by partners; more depression, eating disorders, esp. bulimia, suicide attempts, cutting

#### **Untreated ADHD: Negative Consequences**

#### <u>Girls</u>:

- higher chronic low self-esteem
- Under-achievement
- teen pregnancy
- smoking
- single parenting

#### Adolescents:

4 x more serious injuries
4 x more MVA
3 x more speeding tickets
license suspension
unplanned pregnancies
loss of custody of children
4 x more STDs

Adults: 2x more health service use

## Course from Childhood to Adulthood

- Prospective studies: <u>adults diagnosed with ADHD as children retain at</u> <u>least one ADHD symptom into adulthood</u>
- Hyperactivity tends to decrease with age
- Replaced with inner restlessness or impulsivity
- Sustained attention deficit persist
- 50% fail one grade

### Adults with ADHD

- Three decades ago, they "didn't exist"
  - Consequence of focus on overactivity per se as the signal

- But now, fastest growing segment re: diagnosis and treatment
- 50% of children with ADHD continue to meet criteria for dx as adults; two thirds, when more informants
- Assessment challenging for kids, more so for adults
  - How to distinguish general amotivation, or personality disorders, or substance abuse, from adult ADHD?
  - Real need for retrospective and informant data

# **Adult-related Impairments**

Educational and vocational

Relationship quality

Accidental injury (autos, power tools)

Substance abuse

75% of adults with ADHD have at least 1 co-morbid condition

- Major depression 63%
- Generalized anxiety 21% to 53%
- Cyclothymia, bipolar 17% to 25%
- Interpersonal problems 75%
- Nicotine use 40 to 70%
- 50% of untreated ADHD adults have substance abuse disorder
  - but ADHD TX decreases substance abuse

### Symptoms of Inattention

- Easily distracted by extraneous stimuli
- Attention <u>deficit in low interest, repetitive situations</u>
- Seen as spacey or lethargic
- Normal attention in new, interesting, highly motivated tasks: look normal some of the time
- Children with inattention are often ignored, not rejected as are the impulsive types
  - Adults with inattentive type have more EF deficits

#### **Executive Dysfunction: Disorganization**

- \*\*Start and don't complete tasks
- Difficulty coordinating multiple demands, prioritizing, sequencing
- Messiness: home and workplace
- Task switching
- Disorganization: finances, time management, problem solving

# Executive Dysfunction: Inhibition deficit, Impulsivity

- Blurts out answers before questions have been completed
- Difficulty awaiting turn, impatient (child blows out other child's birthday candles)
- Interrupts or intrudes on others
- Act quickly without considering consequences (buying, quits job)
- Poor frustration tolerance

- <u>Conversational listening impaired:</u> <u>1 x presentation of verb material</u> (CVLT Trial 1 impaired = 5 or less)
- Impulsivity: interrupt, blurt out (viewed as insensitive)
- Conflicts due to lateness
- Anger management
- <u>Poorer affect recognition</u>: more intense emotion experienced, poorer recognition of other's affect (Rappaport, 2002)
- Tend to miss cues, surprised at negative reaction (less aware of receptive deficits; told about expressive deficits)

#### Altered Emotionality

- Affective lability
- Mood variability for hours
- Easily bored

 Hot temper: strong emotional reactions, <u>short-lived</u> <u>outbursts</u>, transient, explosive, loss of control, easily provoked, irritable, cool off quickly, decreases with age

#### Most Commonly Endorsed Symptoms in ADHD Adults

- Difficulty following directions (98%)
- Poor sustained attention (92%)
- Shifting activities (92%)
- Easily distractible (88%)
- Losing things (80%)
- Not listening (70%)
- Fidgeting (70%)
- Interrupting (70%)
- Speaking out of turn (70%)



- History of childhood ADHD predicts...
  - 10-15% reduction in likelihood of employment
  - Average earnings reduction of 33%
  - 15% increase in likelihood of receiving social assistance

#### Legal Consequences

ADHD adolescents have increased: school suspensions (14% vs. 2) law enforcement contacts (19: 3) Juvenile Hall admissions (5: 1) substance abuse (10-20 %) MVA, bodily injuries speeding citations driving without a license (3x) and license suspensions



# ADHD adults:

develop more ASP or Substance Abuse (7x)
higher arrest rates (20%)
crime convictions (11)
incarceration (1)

ADHD in Adults: What the Science Says

R. Barkley, K. Murphy, M. Fischer 2008

- Longitudinal: Milwaukee study of 158 hyperactive (ADHD, combined) children followed to adulthood (aver. age 27) vs. control group <u>1977-2003</u>
- <u>Clinical Differentiation: UMASS Sample: 146 ADHD adults (99 males) at ADHD Clinic of U of MA Medical School Psych. Dept., 97 clinic control, 109 community control (mean age 32, educ 14, IQ 106, 94% white)</u>

# Mythology

- Myth: ADHD adults as more intelligent, creative, "lateral" in thinking, optimistic, entrepreneurial, better able to handle crises
- That there is a positive benefit to ADHD
- Most of these assertions have no scientific basis
- This book refutes most of these beliefs

## Longitudinal and clinic referred ADHD

- Establishes legitimacy of diagnosis of ADHD in adults
- No support for view that ADHD produces positive results in adults
- Positive attributes of those with ADHD have nothing to do with their disorder

### Age of Onset

- Diagnostic criteria of <u>age 7 years</u> has <u>no scientific or</u> <u>clinical merit</u>
- Misses 50% of all adults who meet all other DSM criteria
- Recommendation: abandon age of onset or <u>use prior to16</u> (captures 98%) (DSM = age 12)

### **Diagnostic Criteria**

- DSM IV inappropriate for adults; underestimates ADHD
- Before age 7 age of onset unempirical; age 14-16 better
- From combined/hyperactive to inattentive by adolescence and adulthood
- If sxs fit affective disorder, be careful of dx ADHD

#### Negative Consequences of ADHD

- Decreased educational achievement
- Poorer occupational achievement
- Greater propensity for antisocial activities and drug abuse
- Greater divorce rates
- Poorer personal health choices
- Earlier parenthood
- Increased driving risks

#### Adult Niche Picking:

Adopt lifestyle that minimizes self reported dysfunction

- An adult with occupational impairment, lives alone, no longer attends school, stays with part-time work, fewer friends or those with CD issues, have minimal insight into their dysfunction
- Therefore does not self identify as ADHD

# Defining ADHD in Adults

- <u>86%</u> of hyperactive sample manifested ADHD sxs in adulthood
- Agreement between self and other reports increases with age, esp. by early 30s
- Greater awareness of symptoms with age:
  - Others more aware of sxs than self when younger
# DSM 18 Symptoms Utility

Adults with ADHD display most of DSM sxs; uncommon in controls

<u>4 sxs on either DSM list effectively rule out 100%</u> of controls and capture 100% of ADHDs

#### **Correct Interview Questions to Ask**

- <u>1 symptom</u> in UMASS ruled out the normal adult sample with >97% accuracy:
  - "often being easily distracted by extraneous stimuli"
  - This item determines whether someone is <u>attentionally normal</u> <u>or not</u>

## Barkley: Correct Interview Questions to Ask

<u>4 attention and 4 hyperactive items of 18 DSM ?s</u>

differentiate ADHD from clinical samples:

- Is easily distracted
- Fails to give close attention to details
- Has difficulty organizing tasks
- Loses things necessary for tasks
- Feels restless
- Has difficulty engaging in leisure quietly
- Talks excessively
- Has difficulty awaiting turn

# Impairment in major life activities

- UMASS: 70% report impairment:
  - Education\*\* (90%)
  - Daily chores and responsibilities (75%)
  - Work
  - Money management
  - Dating/marriage
- ADHD is not a benign condition; associated with <u>high risk of</u> impairment and adverse impact on ability to function in majority of life activities important to adult adjustment.
- It conveys no special gifts, benefits or positive attributes.

#### New Symptoms of ADHD in Adulthood

- 6 of 9 best symptoms accurately classify 99% of Community, 92% of ADHD, and 53% of clinical pts
- Impulse control and attention-executive control are superior to DSM criteria
- Items that emphasize distractibility, impulsiveness, poor concentration or persistence, and problems with working memory and organization are best identifiers for adults with ADHD.

#### New Symptoms of ADHD in Adulthood 2

- Adults with ADHD are more likely to complain of difficulties with Executive Function than of hyperactivity.
- Difficulties with impulsive decision making, stopping, starting and organizing activities, persistence toward goals, and planning for future events are most significant complaints in identifying these adults with ADHD.

## **Comorbid Psychiatric Disorders**

- Convincing evidence that <u>ADHD increases the liability for other</u> <u>psychiatric disorders</u>.
- 80% had at least 1 other disorder; 50% had 2 other disorders; 30% had 3; markedly higher than controls
- <u>Dysthymia or depressive personality disorder</u> appears to be most convincingly elevated in ADHD.
- 30% have a significant anxiety disorder; 1 in 4 have learning disability
- Internalizing disorders (MDD, dysthymia, anxiety) more common in ADHD cases referred to clinics

#### **Comorbid Psychiatric Disorders 3**

- ADHD is a more severe psychological disorder than many outpatient disorders seen in same clinic
- Greater levels of maladjustment (SCL-90) in ADHD relative to community and clinical controls:
- ADHD in adults likely to require multiple treatments (stimulants, antidepressants, and CBT)
- Treat ADHD <u>aggressively in SA</u> population

## **Educational Functioning**

 <u>Clinic ADHD adults</u> (relative to grown up hyperactive children) have higher intellectual levels, higher HS graduation rates, attend college more, and have less achievement difficulties

 But <u>UMASS adults</u> (grown up hyperactives) rate themselves as <u>more</u> impaired educationally and have less years of education, lower grades, lower gpa, more days absent from school, but not worse SATs Impaired Occupational Functioning: Need for longer acting stimulants

Clinic referred adults: <u>lower level occupational functioning</u>

Problems: <u>behavior</u>, <u>being fired</u>, <u>quitting from boredom</u>, <u>being</u> <u>disciplined by supervisors</u>

 Milwaukee group: more work difficulties, more firings and disciplinary actions

 Supervisor reports: more inattention, impaired assigned work, being punctual, time management, daily responsibilities

Need to use longer acting stimulants

## Drug Use: Higher risk, reduced with TX

- Greater risk for alcohol use disorders
- Clinic referred adults have greater Cannabis use risk
- Elevated risk for:
  - substance abuse,
  - antisocial behavior,
  - legal consequences (arrests, jail)
  - <u>Stimulants</u> in childhood unrelated to increased drug use in adulthood; in fact, <u>decreased</u> use of speed and prescription drug <u>addiction</u>

## **Antisocial Behavior**

- UMASS Most common: <u>shoplifting (53%)</u>, <u>assault (35%)</u>, <u>selling</u> <u>drugs (21%)</u>
- Lifetime <u>criminal diversity and arrest frequency predicted by</u> <u>childhood hyperactivity or ADHD</u>; teen drug use increased these results
- Severity of ADHD is less significant than hx of CD

TX of ADHD is likely to help with rehabilitation of these behaviors

#### Health and Lifestyle: Lower Life Expectancy

- Diminished regard for future consequences of one's behavior leads to reduced concern for health behavior: less healthy life style
- Problems relative to clinical controls: sleep, social relationships, family interactions, tobacco use, drug use, medical/dental care, motor vehicle safety, emotional health
- Later risks for cancer, CV disease, accidents, shorter life expectancy
- Milwaukee: <u>higher injury, hospitalizations, poisonings, higher lipids, risk for</u> <u>coronary heart disease, less exercise</u>
- Taking stimulants in childhood had no significant impact on physical parameters in adulthood (hgt, wgt)

#### Lifestyle: Money Problems

- <u>Money problems</u>: greater problems with money management, saving money, impulse buying, nonpayment of utilities, missing loan payments, exceeding credit limits, poor credit ratings, no retirement savings
- Not saving, impulse buying, meeting financial deadlines most notable

## **Driving: More Dangerous**

- Substantially elevated driving risks
- Licenses suspended, driving without a license, car crashes, <u>speeding</u>, reckless driving
- Improved with stimulant use

#### More Problems in Sex, Dating, Marriage

- Milwaukee: riskier sexual behavior, earlier sex, earlier pregnancy, become parents, STDs
- Greater marital dissatisfaction, poorer dating relationships; spouses less satisfied in marriage (but similar to clinical controls)
- No major sex differences between men and women in ADHD characteristics

11-year longitudinal study of psychiatrically and pediatrically referred girls with and without ADHD followed into young adulthood.

- By a mean age of 22 years, <u>62% of girls with ADHD continued</u> to have impairing ADHD symptoms
- They also had significantly greater lifetime and 1-year <u>risks for</u> <u>antisocial, mood, and anxiety disorders</u>



## Maternal environment

- Mothers of children with ADHD were significantly more likely to be younger, be single, have smoked in pregnancy, have labor induced, and experience threatened preterm labor, preeclampsia, urinary tract infection in pregnancy, or early term delivery irrespective of the gender of the child, compared with the control group.
- **CONCLUSIONS:** <u>Smoking in pregnancy, maternal urinary tract infection, being</u> <u>induced, and experiencing threatened preterm labor increase the risk of ADHD</u>, with little gender difference, although oxytocin augmentation of labor appears protective for girls. Early term deliveries marginally increased the risk of ADHD.</u>

<u>Tylenol</u> use during pregnancy is correlated with increased ADHD and hyperkinetic activity in child

Desiree Silva, et al., Pediatrics, 2013

## Parenting: high genetic predisposition

- Parents with ADHD:
- Elevated <u>risk for ADHD</u> in children (22-43%)
- <u>Greater psychopathology in children</u>: ADHD, OCD, CD, Depression, somatization
- OCD in 48% of children; most common comorbidity
- More parenting stress in ADHD adults, strongly related to child's ODD and ADHD symptoms
  - \*\*\* Treat parent ADHD before doing child behavioral programs

## Family Conflict

- <u>Stress load on parents of ADHD kids</u>, esp. mothers, greatly increases with entry into grade school & first encounters with problems with teachers and peers.
- Mothers are often target of judgments of teachers and other parents, report they have lower levels of self-esteem and markedly more depression, self blame & social isolation
- Parenting-related stress levels are actually higher for parents of ADHD kids than for parents of ASD kids

### Family conflict 2

- Rates of separation & divorce in such cases are twice national average.
- Parents of inattentive types: nightly battles over homework are difficult; After years of this, many parents enter "learned helplessness", which leads to withdrawal from children, providing little supervision during teen years

#### **Best Parenting**

- Best parenting: <u>"authoritative"</u> blend warmth with clear limits and strong guidance toward independence
- Not "authoritarian" too many limits; too little warmth
- Not "permissive" warmth without clear limits

- Study of low birth wgt kids: direct correlation between M's affection toward baby & later ADHD; greater warmth = lower sxs (remember Michael Meany & maternal rat licking & stress hormones)
- S. Campbell: parents who respond negatively & harshly to kid's behavior tend to exacerbate these sxs

# Parenting 2

- <u>Hinshaw</u>: boys with ADHD whose primary caregivers deployed greater levels of authoritative parenting showed highest levels of social competence in summer camps
- Posner: cold, dictatorial, authoritarian parents increased odds that DRD4-7 kids develop difficult temperament & EF problems; some genes expressed only in some environments
- Kids influence parents & vice-versa.; kids with ADHD who took meds, Mothers got less nagging; nagging was not a cause, but a reaction to sxs

#### **Role of Parenting**

Parent management: Essential part of intervention

- Parents tend to fight fire with fire
- Coercive discipline (too lax, too harsh) increase sxs
- Cycles of dysregulated emotion
  - Parents likely to have ADHD symptoms themselves

Important New Findings Harold et al. (2013a, 2013b)

- Adoption study in UK
  - Takes biological relatedness out of the equation

That is, even in adoptive families, kids' levels of ADHD elicit overcontrolling parenting from parents

 AND, levels of parental harshness predict further ADHD symptoms, over time

It's not all in the genes!

#### Peer Rejection: How Quick? Erhardt & Hinshaw (1994)

- Summer program for boys with ADHD and comp's
  - None knew one another prior to program
  - Behavior observations began Morning 1
    - Peer sociometric interviews afternoon of Day 1, Day 3, then each Friday
- By afternoon of Day 1 and 3, boys with ADHD >4 times more to be disliked than comparisons
- <u>Days 1-3 noncompliance/aggression predict Week 1 negative nominations: explain 50% of variance</u>

- Correlation of Week 1 norms with end of summer: r = .7
  - Moral re: treatments in place at beginning of school year

#### Teen Brain: age 5 to 21



Lose 50% of all synaptic connections.

#### The Great Pruning: A leaner brain is better



Fig. 2. A depiction of the time course of brain development in human prefrontal cortex, sensorimotor cortex, and parietal and temporal association cortex. Modified from Thompson and Nelson (2001).

<u>Growth curves</u> show that ADHD patients' brain development trajectories, although <u>lower in volume</u>, parallel those of normal volunteers (NV).



Solid lines compare the total brain volume in milliliters (vertical axis) of normal and ADHD males (top) and females (bottom) at different ages (horizontal axis) through childhood and adolescence

#### Developmental delay in cortical thickness

Estimated cortical thickness at >40,000 cerebral points from 824 magnetic resonance scans acquired prospectively on 223 children with ADHD and 223 typically developing controls.

- Delineating a phase of childhood increase followed by adolescent decrease in cortical thickness.

However, there was a marked delay in ADHD in attaining peak thickness throughout most of the cerebrum: the median age by which 50% of the cortical points attained peak thickness for this group was 10.5 years (SE 0.01), which was significantly later than the median age of 7.5 years (SE 0.02) for typically developing controls

The delay was most prominent in prefrontal regions important for control of cognitive processes including attention and motor planning.

### Cortical Thickness less in ADHD

# **ADHD: A Dimensional View**

FIGURE 1. Cortical Thickness in Typically Developing Youths With Symptoms of Hyperactivity/Impulsivity Relative to Those With ADHD<sup>a</sup>



#### Imaging Studies

Total <u>cerebral volume 4%-5% smaller</u> in children with ADHD compared to controls: right prefrontal gray matter & left occipital gray and white matter reduced in ADHD children (and, to a lesser extent, their siblings)

Frontal lobes reduced in ADHD: inferior dorsal prefrontal cortex & anterior temporal cortex, bilaterally

Reduced basal ganglia, especially caudate

# Imaging 2

- Vermis region of <u>cerebellum smaller</u> in ADHD children (connections to prefrontal cortex, executive control)
- Right hemisphere structures more affected than left hemisphere, but not a consistent finding.
- <u>Default mode</u>: reliable differences when S's daydreaming; more 'intrusions' into task performance in ADHD

## Neurophysiology

<u>ADHD</u>: disorder of disinhibition and deregulation of the frontal cortex, esp. premotor and superior prefrontal cortex, esp. right frontal.

<u>Meta-analytic study</u> (Nigg, et. Al., 2004):

**Right prefrontal cortex** 

Caudate

Cerebellum (vermis smaller; prefrontal connection)

Corpus callosum (anterior)

Spect study (Hinshaw): stimulants increase perfusion in prefrontal cortex and caudate

#### Recent Structural Imaging Studies: Reduced Volume

Overmeyer et al, 2001: hyperkinetic children compared to normal controls

- grey matter deficits
- right superior frontal gyrus
- right posterior cingulate gyrus
- basal ganglia bilaterally (especially R globus pallidus and putamen)
- central white matter deficits:
- Ieft hemisphere anterior to the pyramidal tracts & superior to the basal ganglia
- possibly due to lack of myelinization

#### Baumeister & Hawkins, 2001: reduced brain volume in pts (male) with ADHD

- right prefrontal cortex
- anterior corpus callosum
- caudate nucleus
- globus pallidus
- sub-region of cerebellar vermis

#### Castellanos study: 50 ADHD girls, 50 controls:

- reduced volumes only found in left caudate and posterior-inferior vermis after controlling for vocabulary
- open questions how much structural abnormalities in ADHD influenced by gender, intellectual differences

Strong evidence for <u>fronto-striatal network</u> involved in core ADHD symptoms (Kain & Perner)

Generally decreased frontal cortical activity

Abnormal regional and global glucose metabolism during the performance of tasks involving executive function

Decreased dopamine neurotransmission in the left and medial portions of the prefrontal cortex
ADHD: <u>Reduced regional brain size</u> in inferior portions of <u>dorsal prefrontal and anterior temporal</u> cortices bilaterally; large <u>increases in grey matter</u> in large portions of the posterior temporal and inferior parietal cortices



Sowell, NIMH

# Neuronal Reduction



# More Left PFC Pruning in ADHD 1

# **ADHD: A Dimensional View**



# More Cerebellar Pruning in ADHD 2

# **Developmental Trajectory: ADHD**

FIGURE 3. Developmental Trajectory of Whole Cerebellum in ADHD Patients With Better and Worse Outcomes and Healthy Comparison Subjects<sup>a</sup>



<sup>a</sup> Difference between better outcome group and worse outcome group, p=0.01; between worse outcome group and healthy comparison group, p=0.01; between better outcome group and healthy comparison group, n.s.

### College Student use of Stimulants

| Medication Effect<br>(n = 326)* | Nonmedical Users<br>(n = 31), % | Nonusers With Nonmedical Use<br>Among Peers (n = 207), % | Nonusers Without Nonmedical Use<br>Among Peers (n = 88), % | Spearman p | P Value |
|---------------------------------|---------------------------------|--|--|------------|---------|
| Study longer                    | 96.8                            | 78.8   | 54.5   | .29        | <.001   |
| Study better                    | 83.9                            | 64.7   | 40.9   | .26        | <.001   |
| Relax                           | 10.0                            | 27.5   | 46.6   | 23         | <.001   |
| Remember more                   | 27.6                            | 28.5   | 28.4   | 003        | .96     |
| Perform better in sports        | 10.3                            | 6.8  | 10.2   | 03         | .60     |
| Good mood                       | 22.6                            | 12.6   | 23.0   | 06         | .24     |
| Stay awake                      | 96.8                            | 73.4   | 44.3   | .34        | <.001   |
| Maintain better complexion      | 0.0                             | 4.4  | 5.7  | 06         | .27     |
| Lose weight                     | 51.7                            | 24.9   | 12.5   | .22        | <.001   |
| Build muscle                    | 0.0                             | 2.5  | 3.4  | 05         | .36     |

\*Ten students did not complete this section of the survey.

| Table 4. Stepwise Logistic Regression for Nonmedical Use (Yes/No)* |                               |         |            |            |  |  |
|--|-------------------------------|---------|------------|------------|--|--|
| Predictor Variable   | <b>Regression Coefficient</b> | P Value | Odds Ratio | 95% Cl     |  |  |
| Study better   | 1.15                          | .04     | 3.17       | 1.05-9.60  |  |  |
| Stay awake   | 2.20                          | .03     | 9.04       | 1.17-69.60 |  |  |
| Lose weight  | 0.90                          | .03     | 2.45       | 1.08-5.56  |  |  |

## Variability & Inconsistency: all NP↓ sometimes

- ADHD is a disorder of inconsistency:
  - Castellanos & Tannock, 2002: "the most striking clinical characteristics of ADHD include the transient but frequent lapses of intention and attention, and the moment-to-moment variability and inconsistency in performance.
  - Response variability is the one ubiquitous finding...across a variety of speeded-reaction-time tasks, laboratories & cultures."

#### Third Neuroscience Summary: (Castellanos & Tannock, 2002)

#### Deficits:

- Delay reward aversion
  - Choose small, immediate reward over larger, delayed one
  - Decline in effectiveness of reinforcement as delay between behavior, reward increases
  - Problems with response inhibition
- Deficits in temporal processing
  - High response variability, inconsistency in performance
  - Deficits in perception, reproduction of time intervals
- Impairment in working memory
  - Inattention
  - Executive dysfunction
  - Phonemic awareness deficits

# Neurobiological substrates:

- Abnormalities in reward-related circuitry
  - Dopaminergic dysfunction in humans
  - Psychostimulants effective in treating ADHD, probably by raising catecholamine levels at synapses
- Anatomical findings:
  - Striatal abnormalities, alterations in DA transporter expression, reduced volume of cerebellar vermis, cerebellar dysfunction, changes in catechol-O-methyltransferase (COMT) in prefrontal cortex, changes in EEG

Neuropsychological Testing in ADHD

# Meta-Analysis of Neuropsychological Measures in Adults with ADHD

# Hervey, Epstein & Curry, 2004: Neuropsychology 18(3), 485-503

# <u>16 of 25 studies show differences on WCST</u> (Barkley, 1997)

Executive function deficits on Tower of Hanoi, Matching Familiar Figures errors, motor inhibition, Trails B time (Pennington & Ozonoff 1996)

Children with combined type ADHD had significantly fewer solutions and more rule violations; results mixed in a number of studies (Klorman et al 1999)

Response inhibition less efficient, slower in ADHD kids compared with anxiety or conduct disorder kids (Oosterlaan et al 1998, Stop Signal task

Literature clearly shows <u>deficits in executive inhibition of behaviors</u> (deliberate suppression to achieve a later goal, e.g. Stop Task) (Nigg, 2001)

## **ADHD** Adults: Frontal findings

Adults with a history of childhood ADHD had <u>reduced scores on PASAT</u>, <u>CVLT Delayed Free Recall</u>, verbal fluency (COWAT) (Jenkins 1998)

Adults with ADHD <u>impaired on measures of vigilance (CPT omissions,</u> <u>late responses), CVLT recall and semantic clustering;</u> NOT impaired on Stroop, WCST, Rey figure after controlling statistically for age, gender, psychiatric comorbid, LD. (Seidman et al 1998)

ADHD lower than healthy normals but not significantly lower than individuals with mild psychiatric disorders including attentional complaints (Walker et al, 2000)

#### Hervey et. al. Conclusions

# ADHD:

- Greater difficulty with Verbal presentation > Visual
- Distracters worsen performance
- Increasing task demand decreases performance
- Reach maximum cognitive capacity sooner
- Deficits in multiple cognitive domains: global impairment probably subcortical, frontal
- Effortful attention was crucial in majority of NP tests

#### Adult ADHD Meta-analysis: Woods et al. 2002

#### Adult ADHD have NP deficits:

divided and sustained attention (CPT) verbal fluency auditory-verbal list learning planning and organization behavioral inhibition/impulsivity cognitive flexibility speed of information processing Disruption of dorsolateral prefrontal cortex and orbitofrontal-striatal-limbic circuits NP measures differentiate ADHD from controls, but limited predictive validity in differentiating ADHD from psychiatric and neurological conditions

- ADHD is associated with *lowered* dopamine production
- Ritalin works by increasing the brain's production of dopamine (as do nicotine, cocaine and methamphetamine)
- A variant in the <u>dopamine D4 receptor gene (DRD4) was associated</u> <u>with ADHD</u>. This form of the gene is <u>linked with thinner tissue</u> in areas of the brain that control attention.
- About <u>one-quarter to one-fifth of children with ADHD has this gene</u> <u>variant</u>
- Among the children with ADHD seen over six years, those who had this gene variant had better outcomes and had regained healthy tissue thickness in the affected brain region. This may explain ADHD's natural history of improvement with age

#### Real-Life Consequences of Neuropsychological Problems

#### Reinforcement contingencies

- Jumping at the first thing which looks good affects career choice
- Immediately gratifying relationships maybe be chosen disregarding "danger signals"
- Taking on too many projects
- Susceptibility to substance abuse

# **Response Inhibition**

Blurting things out in interpersonal situations

# Speeding tickets

#### Real-Life Consequences of Neuropsychological Problems 2

# **Response variability**

"If you can do it sometimes, if you're not doing it now, you're just not trying hard enough"

- Low self-esteem
- Feeling of not living up to potential

# **Time estimation**

- Problems meeting deadlines
- Interpersonal conflict due to lateness

# Inattention

- Making errors in work, not correcting them before turning them in
- Problems following directions
- Interpersonal conflict due to "not listening"

# Executive Dysfunction (Planning, Organizing)

- Difficulty coordinating multiple demands, prioritizing, sequencing
- Difficulty following through, completing projects with attendant job, interpersonal problems

### Phonemic Processing

Difficulty hearing, processing conversations

Being "one step behind" in listening leads to inattention

Age of Onset

Symptoms generally apparent by 7 years old

Median age of onset of first symptom: 1 year

Median age of impairment: 3.5 years

Hyperactive/impulsive and combined types diagnosed earlier than inattentive type

- Hyperactive & combined types mean age of onset/diagnosis: 4 years
- Inattentive mean age of onset: 6 years

Infants with D4 polymorphism (associated with ADHD) have disorganized attachment behavior

#### **Comorbidities in Childhood**

#### Learning disorder (20% to 50%)

- reading/writing disorder
- nonverbal LD

#### **Disruptive problems**

- oppositional defiant, 40%
- conduct disorder 25% 40%
- juvenile court involvement 25% 50%
- substance abuse 20% 30%

#### Non-disruptive problems

- major depressive episode 18% 25%
- anxiety related disorder 25%
- developmental coordination disorder
- Tourette's (50% of Tourette's have ADHD), tics, OCD
- Mood disorders; bipolar disorder (10%)

#### Course from Childhood to Adulthood

- 30% to 80% (most recent estimate: <u>57%</u>) of children with ADHD continue to have symptoms in adulthood
- 10% of ADHD group <u>attempted suicide</u> (Weiss & Hechtman)
- <u>5% of ADHD group dead from suicide or accidental injury</u> (possibly ADHD-related)
- Prospective studies: <u>adults diagnosed with ADHD as children retain at least one ADHD symptom into adulthood</u>
- Hyperactivity tends to decrease with age (replaced with inner restlessness), while problems with sustained attention persist
- After matching for comparative education & IQ, ADHD adults tend to have lower occupational attainment

# 75% of adults with ADHD have at least 1 co-morbid condition

- Major depression 63%
- Generalized anxiety 21% to 53%
- Cyclothymia, bipolar 17% to 25%
- Interpersonal problems 75%
- <u>Half of untreated ADHD adults have substance abuse disorder</u> (ADHD TX decreases SA)
- Alcoholism and/or drug abuse 30 45%
- Nicotine use 40 to 70%
- Compared with controls, adults with ADHD have a <u>3 to 4-fold higher rate of marijuana and cocaine use, a 3-fold higher rate of alcohol abuse, and utilize tobacco 40% more</u>

# Lewy Body Dementia & ADHD

 360 patients with degenerative dementia and 149 healthy controls, matched by age, sex and education. The dementia patients comprised 109 people with dementia with Lewy bodies (DLB) and 251 with Alzheimer's.

•Adults who suffer from attention-deficit and hyperactivity disorder (ADHD) are three times more likely to develop LBD

• <u>48 per cent of patients with DLB had adult ADHD.</u>

 $\bullet$ 

• More than three times the 15 per cent rate found in both the control group and the group with Alzheimer's.

•Impulsivity and hyperactivity were significantly higher in the DLB group than the Alzheimer's group and the control group (measuring 14.7, 5.9 and 6.4 respectively on the Wender Utah Rating Scale). Angel Golimstok, 2010

Adults with ADHD usually present with multiple co-morbid diagnoses

14

- ADHD alone
- ADHD plus one other disorder
   20
- ADHD plus two other disorders 29
- ADHD plus three other disorders 11
- ADHD plus four other disorders 33

- Over diagnosed in children <u>AND</u> underdiagnosed in adults
- Usually present with psychiatric co-morbidities
- Virtually any of the co-morbidities can generate ADHD-like symptoms
- Diagnosis of exclusion
- Difficulty of reliability of informants
- Difficult to obtain accurate history from adults
- "Masking" of symptoms in some patients
- Categorical versus dimensional

#### Symptoms of Inattention

Attention deficit in low interest, repetitive situations; normal attention in new, interesting, highly motivated tasks.

- Fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
- Difficulty sustaining attention in tasks or play activities
- Does not seem to listen when spoken to directly (interpersonal conflict source)
- Does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)

### Symptoms of Inattention 2

- Difficulty organizing tasks and activities
- Avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
- Loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)
- Easily distracted by extraneous stimuli
- Forgetful in daily activities

# Hyperactivity

- Fidgets with hands or feet or squirms in seat
- Leaves seat in classroom or in other situations in which remaining seated is expected
- Runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness, fidgets)
- Difficulty playing or engaging in leisure activities quietly
- "On the go" or often acts as if "driven by a motor": finger drumming, hair twist, tapping feet
- Talks excessively
- Feels dysphoric when inactive
- Poor motor coordination, handwriting

### Impulsivity

- Blurts out answers before questions have been completed
- Difficulty awaiting turn, impatient
- Interrupts or intrudes on others (e.g. butts into conversations or games)
- Act quickly without considering consequences (buying, quits job)
- Poor frustration tolerance

#### Disorganization

- Messiness: home and workplace
- Uncompleted tasks
- Task switching
- Disorganization: finances, time management, problem solving
- Difficulty coordinating multiple demands, prioritizing, sequencing

### Other Common Symptoms and Signs in Adults

- Difficulties sustaining attention, especially in tedious or low-interest tasks
- Disorganization, problems prioritizing
- Procrastination
- Problems with follow-through
- Impulsivity
- Hyperactivity
- Altered response to social reinforcement
- Altered interpersonal relations
- Altered emotions

### Other conditions which can present with ADHD-type symptoms

#### **Psychological**

- Anxiety, depression, psychosis, eating disorders
- Bipolar disorder
- Substance abuse
- Learning disabilities

#### **Medical**

- Acquired neurological insults
- Thyroid disorders & other metabolic disorders
- Systemic lupus erythematosus
- Some seizure disorders
- Hypoglycemia
- HIV
- Medication side effects
- Remember: if it's not life-long, it's not ADHD per DSM

#### Childhood vs. Adult Presentation

| Symptom   | DSM-IV Characteristic in Children:  | Typical Symptoms Seen in Adults:  |
|---|---|---|
| Hyperactivity<br>An aimless restlessness, which often<br>shifts to a purposeful restlessness  | <ul> <li>Talks excessively</li> <li>Squirms and fidgets</li> <li>Runs/climbs excessively</li> <li>Can't play/work quietly</li> <li>"On the go"</li> </ul> | <ul> <li>Talks excessively</li> <li>Inner restlessness</li> <li>Feelings of being overwhelmed</li> <li>Chooses active jobs</li> <li>Inability to enjoy quiet leisure</li> <li>Subjective sensation of being "driven"</li> </ul>   |
| <b>Inattention</b><br>Continued experience with attention<br>problems may lead to coping strategies<br>that may be problematic in their<br>own right; attention problems may be<br>evident in deficits in self care, financial<br>management, driving, housework, paperwork<br>or other workplace demands | <ul> <li>Difficulty with homework</li> <li>Doesn't listen</li> <li>Forgetful</li> <li>Loses things</li> <li>Easily distracted</li> </ul>                  | <ul> <li>Complaints that they read, 'but it<br/>doesn't register'</li> <li>Frustrated over inability to organize</li> <li>Poor time management</li> <li>Problems prioritizing</li> <li>Misplaces belongings</li> <li>Easily distracted</li> <li>Prefers multi-tasking</li> <li>Inefficient</li> </ul> |
| Impulsivity<br>Impulsivity in adulthood may decrease<br>successful function in the workplace and<br>in the home   | <ul> <li>Blurts out answers</li> <li>Can't wait turn</li> <li>Interrupts others</li> </ul>  | <ul> <li>Irritability &amp; quick to anger</li> <li>Blurts out rude/insulting thoughts</li> <li>Impulsively changes jobs</li> <li>Reckless driving</li> <li>Impulsive sexuality</li> <li>Quits new projects</li> </ul>  |

Adapted from Miller M. Attention-deficit hyperactivity disorder: Pharmaceutical treatment updates. Optima Educational Solutions, Inc., 2002

#### **Reward-Delay Gradient**

Behavioral Reinforcement depends on how soon you are rewarded

### ADHD: rapid reward-delay gradient, must have immediate, frequent rewards, immediate gratification

<u>Jumping at immediate reward</u>: affects career and relationship choices, disregard later danger signals, don't learn from mistakes, increased substance abuse

Greater risk taking: more accidents, MVA

As adults, it has been estimated that <u>33 percent will not complete high</u> school, with only 5 percent completing a college degree

Often seek jobs (non-clerical) without high attentional demands to reduce stress

More uncorrected errors

Problems following directions

Interpersonal conflicts due to "not listening"

Army: ADHD no longer disqualification, but...

Law Enforcement: "mental disorder" question

ADHD adults: view themselves as less socially competent but more sensitive to violations of social norms

After watching emotional interactions:

use more words to describe the scenes,

rated the emotions as more intense

used fewer emotion-related words

Overall, ADHD adults appear more aware of their problems in social versus emotional skills

Report being less able to engage others in conversation, less tactful, less able to adjust their behavior to current situation
# Kaiser San Francisco: 300 Pts. referred for ADHD Assessment

- 30%: Impaired Sustained Attention and EF
- 30%: Only Impaired Sustained Attention
- 30%: Only Impaired Executive Function
- 10%: Normal Attention & EF

ADHD: primary impairment in <u>behavioral inhibition</u> (response inhibition, ability to inhibit prepotent responses), which leads to deficits in:

- Working memory (nonverbal)
- Self-regulation of affect, motivation, arousal
- Internalization of speech (verbal WM)
- Reconstitution (behavioral analysis/synthesis)

### Barkley's Ideas

- ADHD Creates a "<u>Time Blindness</u>" or "<u>Temporal Neglect Syndrome</u>" (Myopia to the Future)
- Those with ADHD Live in the Moment
- It's a Disorder of:
- Performance, not skill
- Doing what you know, not knowing what to do
- The when and where, not the how or what
- Not using your past at the "point of performance"
- The point of performance is the place and time in your natural settings where you should have used what you know but did not
- Its Not an Attention Deficit but an <u>Intention</u> Deficit Disorder (Inattention to mental events & the future)

### Three fold Treatment

Most effective TX = <u>education</u>, <u>drug treatment</u>, <u>psychotherapy</u>

Medication:

- <u>66% of ADHD adults</u> given medications for ADHD show significant improvement in ADHD symptoms AND in related maladaptive behaviors
- Patients who receive pharmacological treatment have an <u>85%</u> reduction in risk for substance abuse

Stimulant Medication effects: Significant Improvement

Can Concentrate

Decreased distractibility

Decreased impulsivity, conversational interruptions, anger, mood lability

Improved inhibition, RT variability on CPT

82% of ADHD children show therapeutic response to stimulant medication (NIMH, 1999)

### Recommendations

- Every clinic needs:
  - Adult ADHD group
  - Metacognitive (EF) group
  - Training of therapists in ADHD and EF dysfunction

A.D.D. for All = Adderall "A.D.H.D. – It's Everywhere You Want to Be."

- FDA has cited every major ADHD drug for <u>false and</u> <u>misleading advertising</u> since 2000, some multiple times.
- Half of ADHD children are not impaired as adults, and that little is known about the risks or efficacy of long-term medication use.
- <u>C.H.A.D.D.</u> receives 30% of income from ADHD drug companies

### Methods of Diagnosis

- Clinical <u>interview</u>: best specificity is history
- Behavior <u>rating scales</u> (ADHD-specific): high sensitivity, poor specificity
- Multiple <u>informants</u> (parents, teachers, patient, spouse) very important, high specificity
- Use formal <u>neuropsychological assessment</u> for the most questionable cases

### **Differential Diagnosis Problem**

You <u>cannot immediately diagnose ADHD</u> If patients have:

- Significant depression (PHQ9 score = 10-27)
- High anxiety symptoms
- High substance use
- Many providers don't know how to say "No you don't have ADHD" to a
  patient or "We can't tell at this time" because you are too depressed,
  too anxious, or have significant substance abuse.
- Have to be able to say to patients "<u>We have to wait about ADHD dx</u>" until your other issues are under better control

### But ADHD needs to be identified

- Adult ADHD patients may look different than children with ADHD
- Women with ADHD are <u>often inattentive</u>, not hyperactive, and are <u>underdiagnosed</u>
- How are their <u>executive functions</u>?
- Do they have an <u>ADHD developmental history</u>?
- Is there evidence of chronic <u>real world functional impairments in</u> <u>multiple domains</u>?

### **Diagnostic Dilemmas**

- Virtually any <u>psychiatric co-morbidity can generate ADHD-like</u> <u>symptoms</u>
- Difficulty in obtaining accurate history from adults
- Vagueness of DSM criteria
  - e.g., <u>"often</u>" has "difficulty" "organizing tasks"
- Categorical (DSM) versus dimensional reality

### **Assessment Practices**

- Use of <u>rating scales</u> (as with kids)
  - Go beyond self-report, whenever possible
  - Get info from parents, even if adult hasn't lived there
  - Partners/employers
    - Ethical issues, but as with bipolar disorder, these data are invaluable
  - Estimates of 'faking ADHD symptoms': 20% or higher
- Get thorough history
  - Many differential dx's—medical, substance-related, mood, anxiety
  - Self-referral vs. pressure from job/relationships/family

## Cautions

- Demonstration of ADHD vs. normal is of little value; <u>the phone</u> <u>call to clinic is diagnostic tool</u>
- Differential from clinical conditions more important
- More important diagnostic procedures:
  - establish child or adolescent onset
  - evidence of chronic real world functional impairments
  - rule out alternatives

### Newer methods

- In 2013, FDS approved <u>EEG as measure of ADHD</u>: pervasive evidence that a dominant patter of slow-frequency theta and beta waves may serve as partial marker for ADHD
- FDA also approved a <u>computerized test of sustained attention and</u> <u>impulse control that features an infrared tracking device</u> to detect subtle head and body movements (Dr. Martin Teicher)

Neither method is a substitute for thorough evaluation

### Kaiser NP Service: Adult ADHD Diagnostic Guide

- For Clinician Use Only <u>NOT To Be Filled Out By Patients!</u>
- Note: Everyone is distractible and inattentive at times, particularly when under stress.
- To warrant an ADHD diagnosis, <u>symptoms must be</u> <u>developmentally inappropriate</u> and at a frequency and intensity that causes clear evidence of <u>significant impairment</u> in <u>functioning in at least 2 life domains</u>.

### ADHD Guide: Symptoms

# ADULT ADHD DX GUIDE

Date: \_\_\_\_\_

Completed by:

Name:

<u>Note</u>: Everyone is distractible and inattentive at times, particularly when under stress. The box below lists the official DSM-5 dx criteria; please see the DSM-5 for the elaborated symptom list, which may increase sensitivity to adult sxs (\*=Dr. Barkley dx criteria). To warrant an ADHD dx, sxs must be developmentally inappropriate and at a frequency and intensity that causes clear evidence of **significant impairment** in functioning in **at least 2 life domains**.

| IN | ATTENTIVE SYMPTOMS             | Need ≥ 5 🗹 for<br>Inattentive Type | <u>HY</u> | PERACTIVE/IMPULSIVE<br>SYMPTOMS | <i>Need</i> ≥5 ☑ for<br>Hyperactive- Impulsive Type |
|----|--------------------------------|------------------------------------|-----------|---------------------------------|---|
| *  | Fails to give close attention  | to details                         |           | Often fidgets                   |   |
|    | Difficulty sustaining attentio | on                                 |           | Leaves seat                     |   |
|    | Does not seem to listen        |                                    | *         | Feeling restless (Irritable?    | ?)  |
|    | Does not follow through eas    | sily sidetracked                   | *         | Unable to engage in leisur      | re activities quietly                               |
| *  | Difficulty organizing          |                                    |           | "On the Go" or "Driven by       | / a motor"  |
|    | Decreased/avoids mental e      | ffort                              | *         | Talks excessively               |   |
| *  | Loses things                   |                                    |           | Blurts out                      |   |
| *  | Easily distracted              |                                    | *         | Difficulty waiting              |   |
|    | Forgetful                      |                                    |           | Interrupts or intrudes on a     | others  |
|    |                                |                                    |           |                                 |   |

DEVELOPMENTAL HX OF SXS (age of onset? why seeking tx now?):

#### C. Root, C. Vella, E. Miccio, 2017



| DEVELOPMENTAL HX OF SXS (age of onset? why seeking tx now?):                                      |  |
|---|--|
|   |  |
| Ŷ   |  |
| WHAT IS THE IMPACT ON FX?   |  |
|   |  |
|   |  |
| Any concerns for secondary gains such as accommodations, seeking performance-enhancing meds, etc? |  |
| Life Domain #1  |  |
|   |  |
|   |  |
| Life Domain #2  |  |
|   |  |
|   |  |
| What other diagnoses are you considering?   |  |
|   |  |
| Resiliency/Strengths/Protective factors/Compensatory strategies?                                  |  |
|   |  |

#### Life Domains Affected by ADHD Symptoms

While the following problems are not always indicative of ADHD, these are typical impairments seen in adults with the disorder.

<u>Assessment of Adult ADHD</u>: strict adherence to DSM-5 can result in a missed diagnosis. For example, the individual might not meet full criterion, lack evidence in childhood due to being a poor historian, but presents with the overall sx pattern of ADHD. Dx rule-outs can include medical conditions such as diabetes or sleep apnea, and <u>comorbidity is common</u>, such as substance abuse, mood disturbances (dep/anx), and Personality Disorders.

#### HOME SCHOOL WORK RELATIONSHIPS LEGAL HEALTH Often LATE or Diff w/monev Asthma? chronic time management? Allergies? Failure to turn in management Frequently accused of Speeding Environmental/Animal difficulties, tasks on time not listening tickets Savings? Appts create undue Debt? Food Sensitivities? distress Forget to eat? Several short-lived Diff organizing or Healthy eating habits? Diff paying bills Difficulty meeting relationships of at-fault planning academic on time? deadlines accidents # of close BMI? path friendships Caffeine use? Impulsive sexual Frequent job Often buy items Dx (or suspected) encounters/ changes/multiple Shoplifting Daily Amount: learning disability on impulse "Risky sexual behx" careers Ounces Substance use: Left/right handed? Alcohol/MJ/ State of home Hx of Challenges with Rx meds for Quality of environment? Hx of IPV: Restraining/Protective/ handwriting? authority/command recreational use Chaotic, serene, Perpetrator/Victim/Both Personal Conduct/Stayorganized, Athletic? Smoking hx structure Away/Move-Out Order disarray Age began :\_\_\_\_ Clumsy?

#### Circle all that apply:

## Life Domains Affected by ADHD Symptoms

| Diff maintaining<br>household<br>chores?<br>Dishes,<br>groceries,<br>laundry, trash,<br>paperwork | GPA lower than<br>likely ability level                    | Fired from job(s)/<br>Quit due to boredom  | Unplanned/unintended<br>Pregnancies<br># of children= | Hx of arrests<br>Age of arrests:                                   | Sleep Hygiene:<br>Diff. falling asleep?<br>Night waking?<br>Slow to wake up? |
|---|---|--|---|--|--|
| "Packrat"   | Failure to complete<br>degree, despite<br>desire to do so | Inappropriate emails<br>sent without<br>recognition of<br>potential<br>consequence | Hx of STDs  | Hx of violent behaviors  | Exercise habits:<br>Minutes per week:  |
| Tax payment hx?<br>Ever filed late?   | Years of<br>education:<br>Years to complete<br>degree:    | Interpersonal<br>challenges with<br>colleagues                                     | Challenges managing<br>conflict                       | Subjective driving<br>experience:<br>Enjoy driving<br>or avoid it? | Last dental visit?<br><br>Recommended every<br>6-12 months                   |

For <u>items circled above-please explain</u> in attached notes how this is unique to a formal dx of ADHD (e.g. longevity, degree and impact on fx) versus a medical, mood, personality or substance related disorder. **Substance Use 4 times/wk or more**: Please let patient know they may have to refrain from substance use and may be asked to undergo a urine drug screen.

### AACAP

- American Academy of Child and Adolescent Psychiatry and American Academy of Pediatrics: both maintain detailed guidelines for diagnosing ADHD, based on goldstandard, evidence-based practices
- Unfortunately <u>not followed</u>
- Most ADHD diagnosis done by pediatricians

### TREATMENT: OVERVIEW

- Two evidence-based treatments for youth & adults:
  - Medications
  - Behavioral treatment

- Questionable to promising:
  - Neurofeedback (definitive trials ongoing)
  - Diet (small effects)
  - 1:1 therapy (vanishingly small effects for youth)
  - Specific cognitive training in WM (little generalization)

## Treatment

- Effective treatments are at the "point-of-performance"
- Medications may be essential for most (not all) cases
- While it creates a diminished capacity: Does this excuse accountability?

- (No)

- Behavioral treatment is essential for restructuring natural settings and externally assisting EF
  - but it does not generalize or endure after removal
- The compassion and willingness of others to make accommodations are vital to success
- A chronic disability perspective is most useful

### Medication

### SDRIs or SDNRIs

- SNRIs or other noradrenergic agents
- See in light of underarousal: Volkow et al.
- Paradoxical response? No. Stimulants normalize Dopamine levels
- Average response rate: > 80%
  - vs. < 15% for placebo; largest 'gap' in field</p>
- Monitor:
  - Sleep, appetite, cardiovascular, growth
- For adults, alternatives to stimulants may be needed

#### Treatment

### <u>Most effective TX = education , drug treatment, psychotherapy</u>

### **Medication**

- <u>Two thirds of ADHD adults given medications for ADHD show</u> <u>significant improvement</u> in ADHD symptoms AND in related maladaptive behaviors
- Patients who receive pharmacological treatment have an 85% reduction in risk for substance abuse
- Meta-analysis shows robust effect sizes for methylphenidate (0.9 1.3, dose-dependent) (Faraone et. al., 2004)

### **Behavioral Intervention**

- Home, school, child components
- Small steps, regular rewards, clear consequences
- Take negative emotion out of parenting
- Parent-teacher collaboration (DRC)
- Generalization and maintenance?

### CBT/Adults

Active approach to intervention

- Challenge beliefs
  - Patient works via 'homework' on trying out different belief/emotion patterns
- Additional modules for skill building:
  - Time management

### Planning

## Effectiveness?

Randomized trials: important changes in symptoms and impairments

As with youth, will effects multiply when combined with medications?

Practitioner needs to be experienced

#### Interventions

- Research shows that no intervention matches strength of ADHD medication or benefits of behavioral therapies
- Feingold diet: no food additives; no control groups; only 5% response rate;
- Good British studies: additives (artificial colors, sodium benzoate) increased hyperactivity
- Harvard Metaanalysis: removing additives from diets was half as effective as medications
  - Problem: only a subset of ADHD are sensitive to these; difficult dietary project to manage
  - Sugar has no effect on ADHD

## CogSmart Treatment

- Externalize important information
  - lists, posters, signs, other cues of critical reminders and post at the point of performance
- Externalize time periods related to tasks
  - use timers, clocks, counters, that signal time's passing
- Break up future tasks into many small steps
  - do 1 step each day
- Externalize sources of motivation
  - Quick praise, token/point systems, tangible rewards
- Permit more external manipulation of task components

#### Psychostimulants and other Medications

### Stimulants

- Methylphenidate (Ritalin, Concerta)
- Mixed salts of amphetamine (Adderall)
- Dextroamphetamine sulfate (Dexedrine)
- Methamphetamine (Desoxyn) and Pemoline (Cylert: no longer)
- Dexmethylphenidate (Focalin)

### Antidepressants

- Venlafaxine (Effexor) SNSRI
- Bupropion (Wellbutrin)
  - SSRI's do not work (Israel, 2005)

#### Strattera: "Nonstimulant stimulant"

- Atomoxetine HCL (Strattera)
  - Highly selective <u>norepinephrine reuptake inhibitor</u>
  - Mechanism of action different than the stimulant drugs
  - Minimal affinity for 5-HT or dopamine transporters and neuronal receptors.
  - Dose ranges: 1.2 to 1.8 mg/kg/day in children; 60 to 120 mg/day for adults
  - Half-life of 5 hours
  - Similar to methylphenidate in ameliorating ADHD symptoms
  - Side effects: upset stomach, decreased appetite (15 to 20% of pts), nausea and vomiting, dizziness, tiredness, mood swings.
  - "Atomoxetine does not induce subjective effects similar to methylphenidate and suggest that it is unlikely that atomoxetine will have abuse liability."
  - Takes 3-4 weeks to work

| Medication                | Frequency            | Peak Effect | Duration of Action |
|---------------------------|----------------------|-------------|--------------------|
| Dexedrine (d-amphetamine) | 2 or 3 times per day | 1-3 hours   | 5 hours            |
| Adderall                  | 2 or 3 times per day | 1-3 hours   | 5 hours            |
| Dexedrine Spansules       | Once in am           | 1-4 hours   | 6-9 hours          |
| Adderall XR               | Once in am           | 1-4 hours   | 9 hours            |
| Ritalin                   | 3 times per day      | 1-3 hours   | 2-4 hours          |
| Focalin                   | 2 times per day      | 1-4 hours   | 2-5 hours          |
| Ritalin SR                | 1 or 2 times a day   | 3 hours     | 5 hours            |
| Metadate CD               | Once in am           | 5 hours     | 8 hours            |
| Concerta                  | Once in am           | 8 hours     | 12 hours           |

Table adapted from Greenhill, Laurence, "Are New Stimulants Really Better?" AACAP Oct. 2001 Annual Meeting

Normals: 1-2 months effective, tolerance Speed Addicts: not as effective, neurotoxicity Not effective for: LD, executive deficits TBI associated ADHD: effective

Other stimulants: cocaine, caffeine, nicotine

Treatment 2

### Education, Compensation, Coaching

- "not lazy, crazy or stupid"
- using external aids
- changing environment: minimize distractions, emphasize regularity, OHIO
- community resources
- legal issues

### Treatment 3

### Psychotherapy

- Adjunct psychiatric conditions common
- TX often raised by ADHD parents
- Unhappy childhood, quasi-abused
- History of occupational, educational, relationship failures
- Group therapy often helpful

#### Other Treatments

- Exercise always helpful: arousal, brain-derived neurotrophic factor
- Meditation often difficult but helpful when tolerated

# MTA Study – Best Study ever done

- 579 youth with ADHD-Combined, 7-10 yrs
- 4 randomly assigned groups: 14 months of tx

Medication management (MedMgt) Intensive behavioral treatment (Beh) Both treatments in combination (Comb) Community care (tx as usual; CC)

- Assessed at baseline, 3, 9, and 14 months
- Diverse sample, 7 sites in US/Canada


- Medication only (Meds)
  - Sophisticated protocol, ongoing titration of dose
  - Careful coordination with teachers, family, counselors
  - Generally higher dosage levels than standard care
  - Very few side effects: 86% had no or mild SEs,
    - Most common SEs: decreased appetite, upset stomach, tearfulness, trouble sleeping, headache, dullness or listlessness
    - 3% reported severe SEs (depression, irritability, worrying) unclear if due to meds
    - In general SEs decreased with increasing dose
- Medication + behavioral treatment (M+BT)
- Behavioral treatment only (BT)
  - Very intensive
    - Parent training, family meetings
    - child-focused TX: 8-wk summer program in group recreational settings, 9 hr/ day, 5 days/wk
    - school-based intervention: 10-16 sessions biweekly teacher consultation + 12 wks of PT interventions conducted by paraprofessionals also involved in the child-focused program
- "Community Care" (CC)
  - Generally medication was not monitored or titrated carefully
  - "hit or miss" therapies, psychoeducation

# MTA Study – Initial Findings

- For symptoms of ADHD:
  - MedMgt, Combined > Beh, CC
- For impairments:
  - Comb > CC, consistently
- For getting youth close to "normal range":
  - Comb superior

    - ▣ 55% MEDMGT
    - 34% BEH
    - 25% CC



Multimodal Treatment Study

## Results

- Meds and Medic+BehavTx much superior to BehavTx, Community Care
- BehavTx added only a slight, often NS amount to the effects of meds in original study

## Beyond 14 months

 By 24 months, Beh and CC hold their own, but MedMgt and Comb worsen some

 By 3 years and now 6-8-10-12-14-16 years post-random assignment, the 4 treatment groups are equal

Treatment needs to be sustained in order to continue benefits

GROWTH: Those on moderate-high doses, continuously, grow less rapidly (about 1 inch), but this effect may be subject to slight rebound in other trials

### Does medication reveal 'late tolerance'?

- Long-developing tolerance (& less effectiveness):
  - Literature underdeveloped here
  - Stimulant use DOES decrease DA receptors, transporters
  - So, does that mean that, clinically, we reach a point where the meds don't work any more?

# Conclusions

• Symptom relief from medications

• Skill building with multimodal tx

• Normalization when parenting becomes far more authoritative

• CBT for adults

Additional interventions for comorbidities/associated conditions
 Depression, trauma, learning disorders, anxiety, conduct problems

## **Grades & Medication**

- Little evidence that the drugs actually improve academic outcomes.
- Achievement scores, grade-point averages or the likelihood of repeating a grade generally aren't any different in kids with ADHD who take medication compared with those who don't
- 4,000 students in Quebec over an average of 11 years
- No clear evidence that stimulants can enhance cognition in non-ADHD individuals
  - The medicine may help with focus, but it doesn't help with deciding what to focus on. Rather, it needs to be coupled with skills training, such as learning how to organize or prioritize. Fahar, 2013

### **Psychotherapy Issues**

<u>Undiagnosed ADHD</u>: difficult childhood, adolescence; failure experiences; underachievers, blamed, poor self esteem, depression

ADHD parents: inconsistent, anger, often abusive, substance abuse, ACA pattern, more difficult children

ADHD Adults: interpersonal difficulties, impulsive relationships

Target consequences of core ADHD symptoms

Not insight oriented therapy; CBT+ medications, group therapy better

- Appropriate medication
- Create "accessory frontal lobes"
  - Organization systems
  - Auxiliary helpers ranging from computers to coaches
- Intensive, prolonged involvement with parents (family members), teachers (employers)
- Evaluate and treat learning disorders separately
- Evaluate and treat co-morbidities as necessary

## **Treatment Principles**

- Regularize schedules for eating, sleeping, exercising
- Educate to encourage understanding, self-awareness, autonomy
  - Avoid "just try harder"
  - Avoid "can't do it because I have ADHD"
  - Avoid resentment/codependency issues with helpers
- Compliance with routines should be monitored and facilitated with frequent, pleasant reminders and consequences

### Neuropsychological Assessment Issues

- Never use NP testing alone; clinical history is mandatory (historical dx)
- Need to differentiate ADHD from Depression, Anxiety, Substance Abuse
- Possibility of False negatives: test room as frontal lobes
- Helpful in assessing sustained attention, executive deficits
- Use of effort testing

ADHD Self Report Measures

KP ADHD Guide

**Connors** Adult ADHD Rating Scale (CAARS)

Achenbach Adult ADHD Rating Scale

**Brown ADHD Rating Scale** 

Murphy-Barkley Symptom Scale

Wender-Utah

Attention Deficit Scales for Adults (ADSA)

### ADHD and the Law

- Section 504 of the Rehabilitation Act of 1973 (RA):
- Prevents discrimination against individuals in <u>employment by the federal government</u> and in access to programs conducted by the federal government with federal funds.
- <u>Colleges</u> must <u>provide accommodations</u> to students with disabilities at no additional charge. However, the institution is not required to provide remedial services to improve the skill level of the student.

#### Modifications to academic requirements may include:

- Counseling to assist student in choosing a major and the appropriate courses
- Priority registration, reduced course load, priority seating, course modifications
- Clarification of assignments with specific feedback from course instructor
- Time and a half or double time for tests (in j.h.s. or h.s., untimed or oral tests)
- Distraction-free environment for taking tests
- Course substitution for foreign language or math requirement
- Use of tape recorders or note takers to record lectures
- Auxiliary aids such as computers, taped texts, or readers
- Extra time for completing written assignments with an arrangement to have rough drafts evaluated
- Alteration of examination schedule so that the student has more time between examinations or does not have several examinations within a short interval

### ADHD and the Law 3

- Americans with Disabilities Act of 1990 (ADA)
- ADA protection does not depend on the receipt of federal funds. It was designed to prevent discrimination against individuals with disabilities in the private sector in areas of <u>employment and public accommodations.</u> It also covers children with disabilities.

### ADHD and the Law 4

When completing job application, if it asks for any psychiatric conditions and they don't feel comfortable writing "none", can write "learning disability", which is less stigmatizing than ADHD.

Modifications to the Workplace may include:

- Part-time or modified work schedules
- Job restructuring or reassignment
- Modifying equipment
- Adjusting or modifying examinations, training, materials or policies
- Providing readers or interpreters
- Making the workplace readily accessible for people with disabilities

### ADHD services in the KP Department of Psychiatry

- The ADHD and EF classes for adults
- New Medication class for individuals suffering from ADHD,
- "Cogsmart Group"
- www.CHADD.org
- Literature
- Psychotherapy techniques (e.g. structured, CBT approach most effective)

### **ADHD/ADHD Health Education Class at Kaiser**

 This 6 week class series introduces a basic understanding of Attention Deficit/Hyperactivity Disorder (ADHD/ADHD) in adults coping with "real life" situations and activities, and treatment options for managing through each cycle of adulthood.

Class Objectives:

- Understand and define ADHD/ADHD.
- Identify symptoms and behaviors associated with ADHD/ADHD.
- Understand how ADHD/ADHD impacts self-esteem and relationships.
- Learn effective skills to manage negative behaviors such as impulsivity, angry outbursts and poor communication styles.
- Gain skills in time management, planning, and organization for "every day life."
- Learn about various self-care and treatment options available.
- Gain skills to plan for your future including goal setting & accessing ADHD/ADHD resources.
- Establish a support system with people who relate to your experience.
- \*Appropriate referrals\*
- Individuals who are not actively abusing substances, psychotic, severely depressed or anxious, or suicidal or homicidal.

### OUTLINE OF THE SIX WEEK ADHD GROUP

#### Session #1: Overview of ADHD/ADHD

Sxs, Etiology, Prevalence, Co-morbidity, Brief review of tx.

#### Session #2: Treatment Options

- Identification, Diagnosis, Self-Care, Education, Psychotherapy, Medications, School accommodations, Coaching, Alternative Treatments
- Session #3: Managing Impulsivity
  - Positive & negative aspects, ways to decrease negative aspects, anger, substance use, & sexual promiscuity as forms of impulsivity.
- Session #4: Relationships, Communication & Self-Esteem
  - Identification of communication difficulties at home, work & school. Ways to improve.
- Session #5: Time Management, Planning & Organization
  - Optimizing space.
- Session #6: Planning for the Future
  - Hope, encouragement & direction. Accessing resources, establishing support network, on-going coping, managing w/ADHD.

### Current Assessment Used at KP San Francisco

- Initial Clinical Assessment + Adult ADHD Guide
- NP Clinical evaluation
- Brief NP Assessment (if above inconclusive):
  - WASI
  - TMT/Design Fluency
  - WCST
  - IVA

### Feedback

- ADHD: permanent neurological condition, life time invisible disability
- ADHD: behaviors are not intentional
- Stimulant medication is important part of treatment, but need skills learning and CBT
- Untreated ADHD: adult depression, poor self esteem (due to multiple unexplained failures), substance abuse, vocational impairment, interpersonal difficulties

### **CPTs and IQ**

Deficits on CPTs not specific to ADHD: be careful

IQ/CPT correlation:

if very high IQ, and low average or impaired: ADHD if very high IQ, and average: not clear, check hx

### IVA

- A test of <u>sustained attention</u>
- 500 intermixed visual & auditory stimuli, 1.5 seconds apart: 13 minutes of boredom
- Click the mouse if you see or hear a <u>"1" (target)</u>
- Do nothing if you see or hear a <u>"2" (foil)</u>
- Correct response: 1 click to target
- Errors of omission (miss 1) = inattention
- Errors of commission (hit 2) = impulsivity

## **IVA Norms**

- N= 781, ages 5 to 90
- Standard scores with Mean 100, SD 15; (exceptional = 130; superior = 120; above average = 110; average 90; moderately impaired = 80; severe=70; extremely (3 SD)= 60)
- Ages 5 up, but unreliable until 7 (if ok IVA, pre 7 then no ADHD)
- Most CPT tests have 50 % false negative rate; IVA had 7.7%

### **IVA Variables**

- Visual and Auditory modalities
- Response Control: Impulsivity (hit the 2)
  - Prudence errors of commission
  - Consistency variability of typical performance: quartile 1 ranked RT / quartile 3 ranked RT
  - Stamina mean RT in first 200 trials versus last 200 trials
  - Attention Quotient: Sustained Attention (hit the 1)
    - Vigilance errors of omission Focus standard deviation of RT (includes outliers, "atypical performance")
    - Speed average RT for correct trials

## Cautions:

- Recent Alcohol and MJ use affects IVA
- Lack of Effort affects IVA
- Anxiety is not a major issue: too simple a task, boring
- If there is gain to be had (school accommodations, access to stimulants, etc.), IVA can be faked (need effort test)





IVA+Plus CPT Test (c) Copyright 1994-2004 BrainTrain, Inc. Distributed by BrainTrain, 727 Twin Ridge Lane, Richmond VA 23235 Phone (804) 320-0105 http://www.braintrain.com FAX (804) 320-0242

IVA - 2

|    |  |        |           |                         |                  |     | •        |                |             |           |                |       |
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# IVA 3

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|------|---|-----------|
|      | IVA+Plus SUSTAINED ATTENTION SCALES   |           |
|      | These two additional scales are provided for use with the IVA+Plus Interpretive Flowchart for ADHD. |           |
|      | Sustained Auditory Attention Quotient 0<br>Sustained Visual Attention Quotient 23                   |           |
| ient | scores which are between zero and 59 reflect extreme  | deficits. |

## IVA Histogram



## IVA Histogram - ?





### Feedback 1

- ADHD Dx: IQ vs IVA (1-2 S.D. difference)
- TMT B: set shifting impaired
- WCST: (executive functioning) nonverbal problem solving, organizational ability, ability to do it alone
- IVA:
  - Response Control (impulsivity, distractibility)
  - Attention (sustained, not WM)

## When to refer for full NP Testing

- Very low IQ
- Significant Difference between VIQ & PIQ
- Language issues
- Thought Disorder
- Complex conditions (Fragile X, etc.)

CHADD (Children and Adults with Attention Deficit Disorder) Northern California Chapter (415) 442-1944 National (800) 233-4050 www.CHADHD.org

ADHDA (The National Attention Deficit Disorder Association)P. O. Box 543, Pottstown PA 19464(484) 945-2101
## ADHD Recommended Readings

- Childhood ADHD
  - Driven to Distraction by Edward Hallowell, 1995
  - Parenting Children with ADHD by Vincent Monastra, 2005
  - Understanding Girls with AD/HD by K. Nadeau, E. Littman, & P. Quinn
  - The ADHD Explosion by Stephen Hinshaw & Richard Scheffler, 2014
- Adult ADHD
  - *Succeeding with Adult ADHD* by Abigail Levrini and Frances Prevatt, 2012
  - More Attention, Less Deficit by Ari Tuckman, 2009
  - *Taking Charge of Adult ADHD* by Russell Barkley, 2010

## Organizations and Helpful Websites

- Children and Adults With Attention-Deficit-Hyperactivity Disorder (<u>www.chadd.org</u>)
- National Resource Center for ADHD <u>www.help4adhd.org</u>
- www.ADHDWarehouse.com

## Books

- ADHD: What Everyone Needs to Know by Stephen Hinshaw & Katherine Ellison, 2016
- Taking Charge of ADHD by Russell Barkley, 2013
- Executive Skills in Children and Adolescents by Peg Dawson and Richard Guare
- Evelyn Miccio's ADHD book page:

http://www.permanente.net/homepage/kaiser/pages/c6367-45333.html

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