

# Heterogeneity in ADHD:

Is it just measurement error?

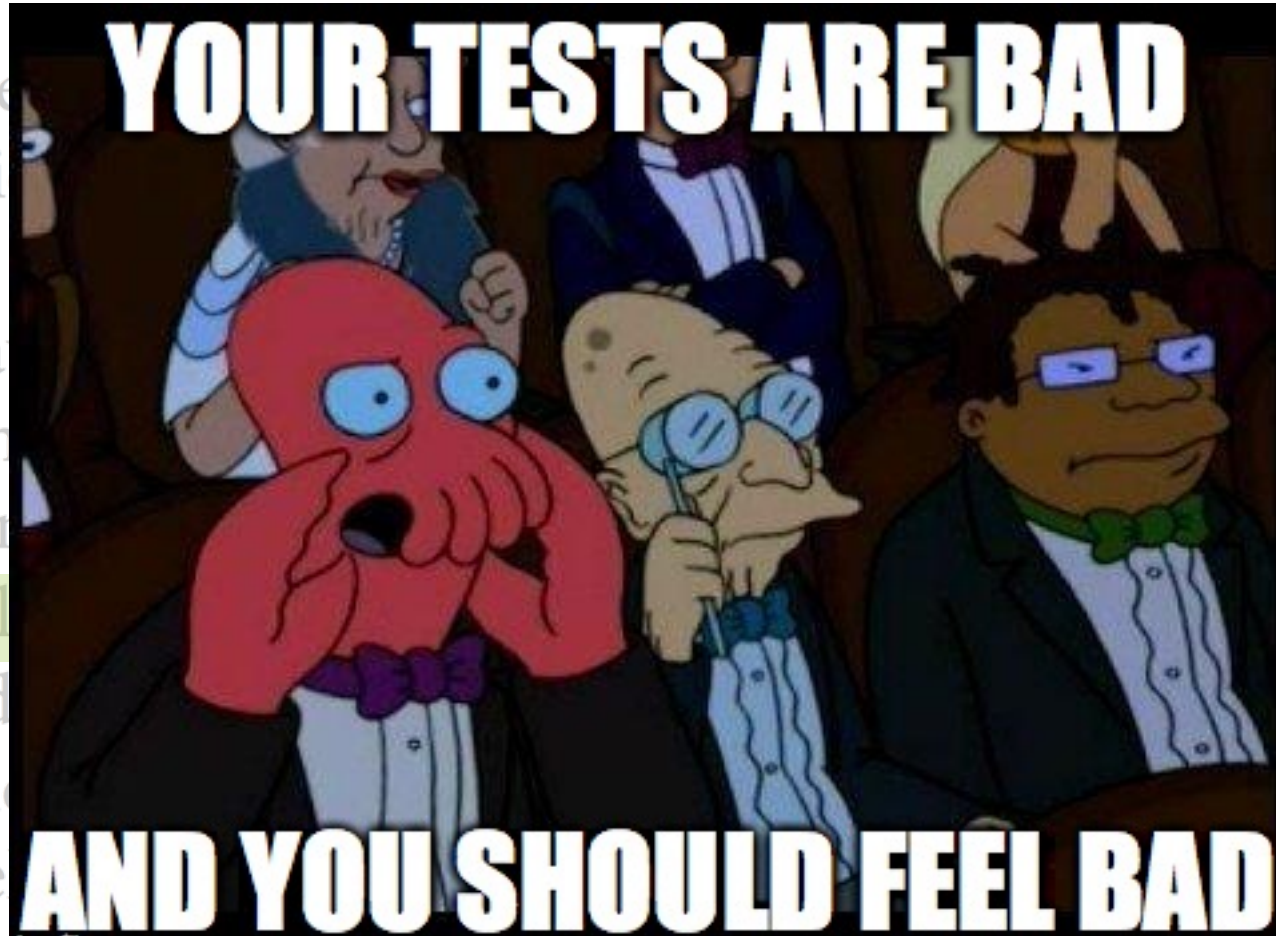
# Executive functioning in ADHD

- ▶ 30% to 50% of children with ADHD have EF deficits
- ▶ EF ratings correlate better with functional outcomes than lab EF tasks
- ▶ “relatively **heterogeneous** findings ... have suggested the **[neurocognitive] deficits** are **not central** to the disorder” -- Reviewer 1

# Snyder, Miyake, & Hankin (2015)

However, despite the proliferation of research on EF in clinical populations, the history of cognitive approaches in psychopathology has followed a curious path, best illustrated as mostly parallel play, between two predominantly independent scientific traditions: clinical psychology/psychiatry and cognitive psychology/cognitive neuroscience. With notable exceptions, this theme of parallel play between clinical and cognitive science is largely reflected up to the present, and sometimes leads to failures to apply theoretical and methodological advances in one field to the other field, hindering progress.

Snyder, Miyake, & Hankin (2015)



Parallel Play

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# “Bad” Tasks

Shifting	Inhibition	Working memory	Planning
WCST	Stroop Color-Word	Digits backward	Tower of London/Hanoi
Trails B	Go/no-go	Self-ordered pointing	Rey-O Complex Figure
		N-back	

	WM Reordering	WM Complex Span
WM Reordering	--	
WM Complex Span	<b>.74</b>	--
WISC-IV Backward Digits	.08	.28

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- ▶ 30% to 50% of children with ADHD have EF deficits
- ▶ EF ratings correlate better with functional outcomes than lab EF tasks
- ▶ Based on:
  - ▶ Rey Complex Figure, CPT, WCST, WRAML/CVLT, Stroop, Digits Forward/Backward
  - ▶ CPT, Stroop, WCST, Digit Span Forward/Backward, Design Fluency task

# Executive functioning in ADHD

- ▶ 30% to 50% of children with ADHD have EF deficits
- ▶ EF ratings correlate better with functional outcomes than lab EF tasks
- ▶ Meta-analysis: ~80% of kids with ADHD have WM deficits (based on “better” measures of WM)
  - ▶ Defined as scores outside TD range (Zakzanis, 2001); Cohen’s  $d > 2.0$



# Executive functioning in ADHD

- ▶ 30% to 50% of children with ADHD have EF deficits
- ▶ 80% of children with ADHD have WM deficits
- ▶ Question: How do we interpret the ADHD EF literature given the cognitive critiques?

# “Good” Tasks

Shifting	Inhibition	WM Updating	WM Manipulation
Category switch	Experimental Stoop Color-Word <sup>1</sup>	Verbal n-back <sup>3</sup>	Reading span
Number-letter switch	Stop signal <sup>2</sup>	Spatial n-back <sup>3</sup>	Operation span
Color-shape switch	Antisaccade	Letter memory (“Last 3”)	Serial reordering (not reversal)
CANTAB ID/ED		Keep Track	Complex span

<sup>1</sup> Infrequently occurring incongruent trials

<sup>2</sup> SSD metric (not SSRT) for dynamic versions of stop task

<sup>3</sup> Recall version (not recognition)

# Problems with ...

- ▶ N-back
  - ▶ Redick & Lindsey (2013) meta-analysis
  - ▶ Kane et al., 2007
- ▶ Stroop color-word
  - ▶ Unsworth & Engle (2007) review
  - ▶ Kane & Engle (2003)
- ▶ Digits backward
  - ▶ Engle et al. (1999)
  - ▶ Conway et al. (2005) review
  - ▶ Wells et al. (2015) ABCT poster ☺

ADHD N = 33	WM Reordering	WM Complex Span
WM Reordering	--	
WM Complex Span	<b>.74</b>	--
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# Hyperactivity in ADHD

- ▶ DSM-5 shift from subtypes to current presentations
  - ▶ Continue to differentiate based on perceived differences in hyperactivity/impulsivity
    - ▶ e.g., Inattentive vs. Combined/HI presentation
- ▶ 4 of 6 hyperactivity items explicitly refer to gross motor behavior

# Hyperactivity in ADHD

- ▶ Objective measurement of gross motor activity
  - ▶ Consistently find no significant difference between Inattentive vs. Hyperactive/Combined subtypes/presentations
  - ▶ Meta-analysis of 63 studies (under review): Subtype does not moderate between-study effect sizes as expected
    - ▶ i.e., studies including more Inattentive participants show just as large effects as studies including all/mostly Combined/Hyperactive participants

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  - ▶ Longitudinal studies: ADHD persists and remitters don't differ in activity level
    - ▶ Meta-analysis: No difference between child and adult studies re: magnitude of hyperactivity deficit (based on objective, mechanical measurement)

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    - ▶ i.e., studies including more Inattentive participants show just as large effects as studies including all/mostly Combined/Hyperactive participants
  - ▶ Longitudinal studies: ADHD persisters and remitters don't differ in activity level
    - ▶ Meta-analysis: No difference between child and adult studies re: magnitude of hyperactivity deficit (based on objective, mechanical measurement)
- ▶ **Inattentive presentation isn't actually less hyperactive than Combined/Hyperactive type ???**

# So ...

- ▶ ADHD groups rated as more and less hyperactive don't actually differ on gross motor activity
  - ▶ Inattentive and Combined presentations/subtypes show highly similar activity level, both in excess of TD control groups
- ▶ Adult studies don't show smaller magnitude effects than child studies
- ▶ ADHD remitters don't show lower activity level than persisters (and both show higher activity than controls)
- ▶ The proportion of Inattentive to Combined/Hyperactive participants doesn't moderate effect sizes
- ▶ Informants/raters are identifying differences, but objective measures aren't ... if the difference isn't 'hyperactivity', what is it ???



# Hyperactive/impulsive, or hyperactive/verbally intrusive?

## Excess Gross Motor Activity

- Fidgets/squirms
- Leaves seat
- Runs/climbs
- On the go/driven by a motor

## Verbally Intrusive Behaviors

- Can't play quietly
- Talks excessively
- Blurts out
- Interrupts/intrudes

## Other?

- Difficulty waiting turn

# Thank you!

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