



# ADHD and Learning Disabilities

Ellen B. Braaten, PhD

Executive Director, Learning and Emotional  
Assessment Program (LEAP) at MGH

Associate Professor, Harvard Medical School

# Disclosures

I have the following relevant financial relationship with commercial interests to disclose:

- American Psychological Association, Magination Press: Advisory Board
- Guilford Press: Author
- Understood.org: Consultant

# What is Specific Learning Disorder (SLD)?

- Difficulties in learning and using academic skills despite interventions that target those difficulties
- Learning difficulties began during the school years (up to age 17)
- Learning difficulties are not better explained by other impairments (e.g. intellectual, visual, auditory, or other mental or neurological disorders)
- An SLD diagnosis is often specified as having impairment in reading, writing, mathematics, or a combination of two or more areas of difficulty
- Prevalence:
  - 9.7% throughout the U.S. school age population
  - 5.4% of all otherwise typically developing children have an SLD
  - 27.8% of children receiving special mental health care needs have an SLD

# Types of SLD's

## SLD with Impairment in Reading

### Prevalence

- 5-20% in a sample of US school students (Shaywitz et al., 1998)
- Boys are 2-4 times more likely to be diagnosed than girls

### Areas of difficulty

- Word reading accuracy
- Reading rate or fluency
- Reading comprehension

## SLD with Impairment in Writing

### Prevalence

- 7-14% in a sample of US school students (Katusic et al., 2009)
- Boys are 2-3 times more likely to be diagnosed than girls

### Areas of difficulty

- Spelling accuracy
- Grammar and punctuation accuracy
- Clarity or organization of written expression

## SLD with Impairment in Mathematics

### Prevalence

- 6-14% in a sample of US school students (Barbarese et al. 2005)
- Boys are almost 1.5 times more likely to be diagnosed than girls

### Areas of difficulty

- Number sense
- Memorization of arithmetic facts
- Accurate or fluent calculations
- Accurate math reading

# Levels of Severity Within SLD

## Mild

- Difficulties in one or two academic domains, individual may be able to compensate or function well when provided with appropriate accommodations

## Moderate

- Difficulties that make it unlikely the individual will become proficient without some intervals of intensive and specialized teaching during the school years

## Severe

- Difficulties that make it unlikely the individual will become proficient without ongoing intensive individualized and specialized teaching for most of the school years

# Attention Deficit/Hyperactivity Disorder (ADHD) and SLD

ADHD has been shown to be frequently comorbid with SLD

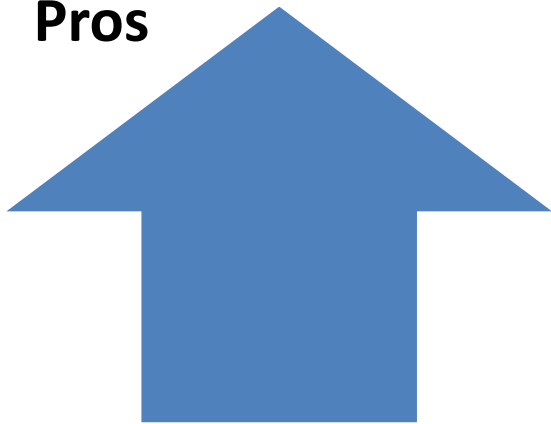
- Any SLD: 31-45% (DuPaul et al., 2013).
- Reading Disorder: 25-40% (Boada et al., 2012)
- Mathematics Disorder: 11-30% (Capano et al., 2008)
- Writing Disorder: 55-64% (Yoshimasu et al., 2011)

# Executive Functioning and SLD

- SLD is a heterogeneous disorder with respect to executive functioning, however:
  - Working memory (and metacognition as a more general domain) has been shown to be impaired in SLD (Giofre et al., 2016; Griblat et al., 2016)
  - Processing speed has similarly been shown to be impaired in SLD (Wilcutt et al., 2005)

# Assessing these conditions: Public Evaluation

## Pros



- Evaluation is free
- The individual completing the testing will often also implement any necessary intervention
- Parents have the right to seek independent evaluation at the school's expense if the evaluation is unsatisfactory

## Cons

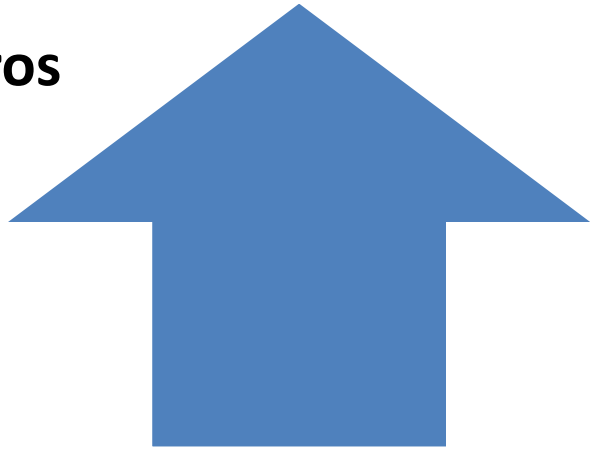


- Cannot request a specific evaluator
- The process can take longer than private evaluation
- The report automatically becomes part of the child's record
- Seeking independent evaluation after school evaluation limits the independent evaluators options in testing



# Assessing these conditions: Private Evaluation

## Pros



- Insurance will often cover some or all of the evaluation
- More confidence that recommendations are being made without regard to cost
- Can request editing of personal information on report
- Individuals being tested control who sees the report
- Individuals can pick the evaluator

## Cons



- Some schools will not accept private testing and will insist on testing of their own
- Usually a long wait to be seen, between 6 months and 1 year
- If insurance will not cover the cost, evaluation can be quite expensive

# Assessing Learning Disorders

## Mathematic

Mathematic fluency

Automaticity of math fact retrieval

Working memory

Visual-motor ability

## Writing

Writing fluency

Spelling

Logical sentence construction

Spontaneous writing

Dictation

Fine motor skills

Visual-motor ability

Executive functions

## Reading

Oral reading fluency

Reading comprehension

Spelling

Phonological awareness

Rapid naming

Rote auditory memory

Vocabulary

## All assessments

Cognitive testing

Clinical interview with parents and child

Screening for common comorbid issues

Processing speed

General language processing

# What is Processing Speed (PS)?

- Colloquially: How quickly one can get things done
  - Reflects automaticity/fluidity with which one can process, evaluate and respond to information
- Assessment varies widely; term often used variably
- Examined extensively in relation to ADHD
  - Overlaps with other constructs (e.g. sluggish cognitive tempo)
- Studies more limited in:
  - Other neuropsychiatric conditions
  - Outpatient child clinical cohorts

# How is processing speed related to ADHD?

- Processing speed is often impaired in children with ADHD
- If executive functions are the car, processing speed is the engine
- ADHD is often comorbid with reading disabilities, and research supports the idea that processing speed is the shared cognitive deficit between these two disorders



# Detrimental Impact of Slow Processing Speed & ADHD

Cook, Braaten, Surman (2017) *Child Neuropsychology*

- Systematic review and meta-analysis of PS in ADHD

Clinical and functional correlates			
Weaker academic skills	More difficulties in adaptive functioning	Increased self-reported anxiety	Overestimates of social competence

Yet, the mechanisms by which PS influences these outcomes are not well understood.

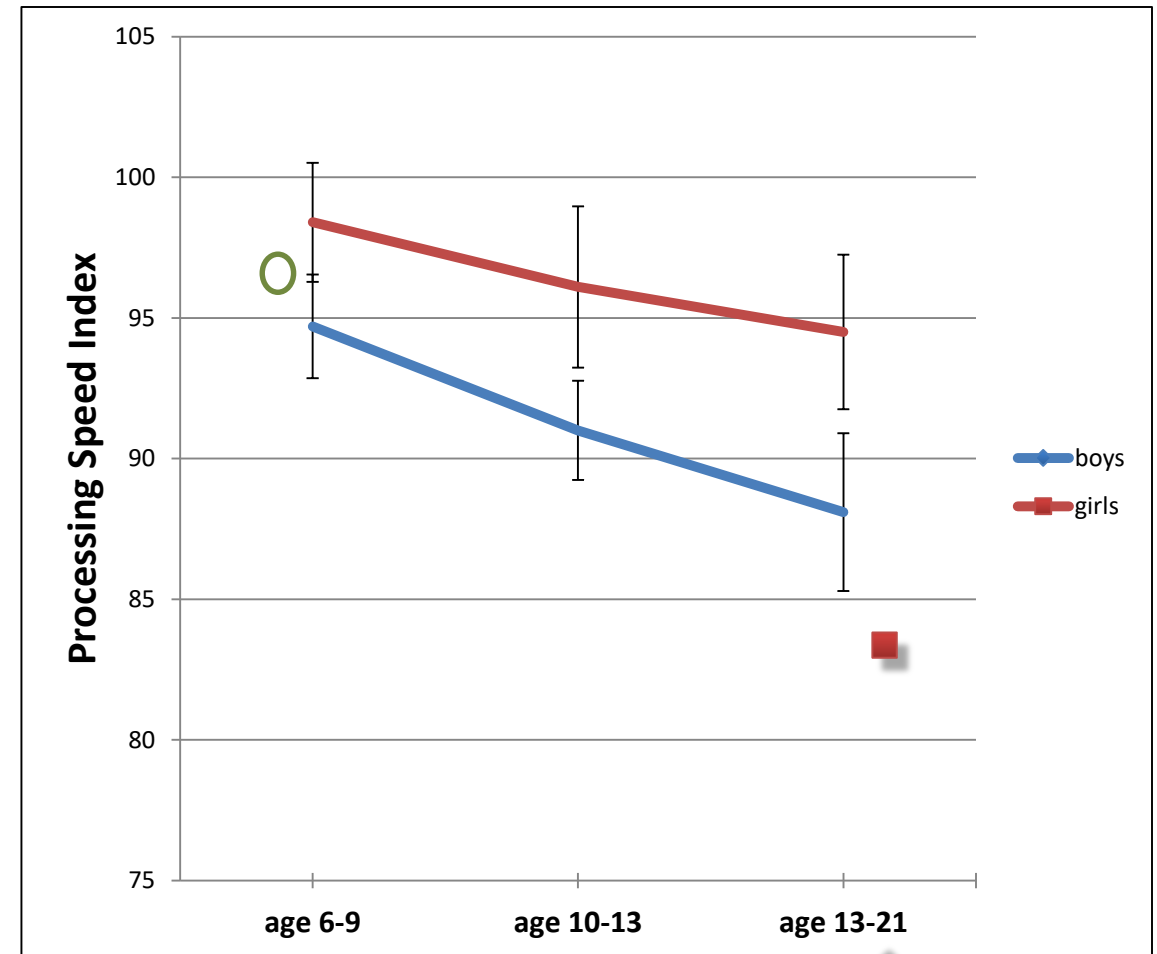
# PS in a Clinical Sample

- LEAP Clinic a MGH sample of 1200 families, children ranging from 2 to 20 years of age (average age of 10.4 years; s.d of 3.79 years):
  - Boys are more affected than girls: 70% were boys
    - Boys slower at fine motor tasks
    - Gender bias in teaching
  - Social Difficulties are common in 1/3 of children
  - Language impairments reported in 40% of children
  - Delayed motor development in 1/3 of children
  - Vast majority (77%) were receiving IEP or 504 services, indicating impact on academic functioning
  - Not the same thing as ADHD: only 61% of kids with ADHD had PS deficits

LOGIC (Longitudinal Study of Genetics Influences on Cognition)

# Comparing PS by Gender at Different Ages

- Not longitudinal data (yet)
- At age 6-9, the boys and girls don't differ significantly.
- In the age 10-13 groups, the boys perform worse than girls on processing speed.
- This difference becomes even more significant in the age group 13-21.



LOGIC (Longitudinal Study of Genetics Influences on Cognition)

# Several diagnoses associated with impaired PS

Odds of having impaired PS for each diagnosis (hierarchical model so odds ratio are over and above what is predicted by age and sex)

Impaired PS was not simply due to comorbid ADHD.

After controlling for all comorbid conditions, the presence of psychosis, ADHD and Anxiety disorders all increased the risk of having slow processing speed.

Total sample age 6-21 (N=775)			
Predictors	Odds ratio	p-value	95% CI
<i>Step 1</i>			
Age	1.05	0.002	(1.02-1.08)
Sex	.47	<0.001	(.38-.59)
Psychotropic med usage	1.35	.009	(1.08-1.68)
<i>Step 2</i>			
Psychosis	3.47	<0.001	(2.16-5.56)
ASD	1.70	<0.001	(1.33-2.18)
Mood disorders	1.23	0.10	(.96-1.58)
ADHD	1.44	<0.001	(1.16-1.79)
Anxiety disorders	1.40	0.002	(1.13-1.73)



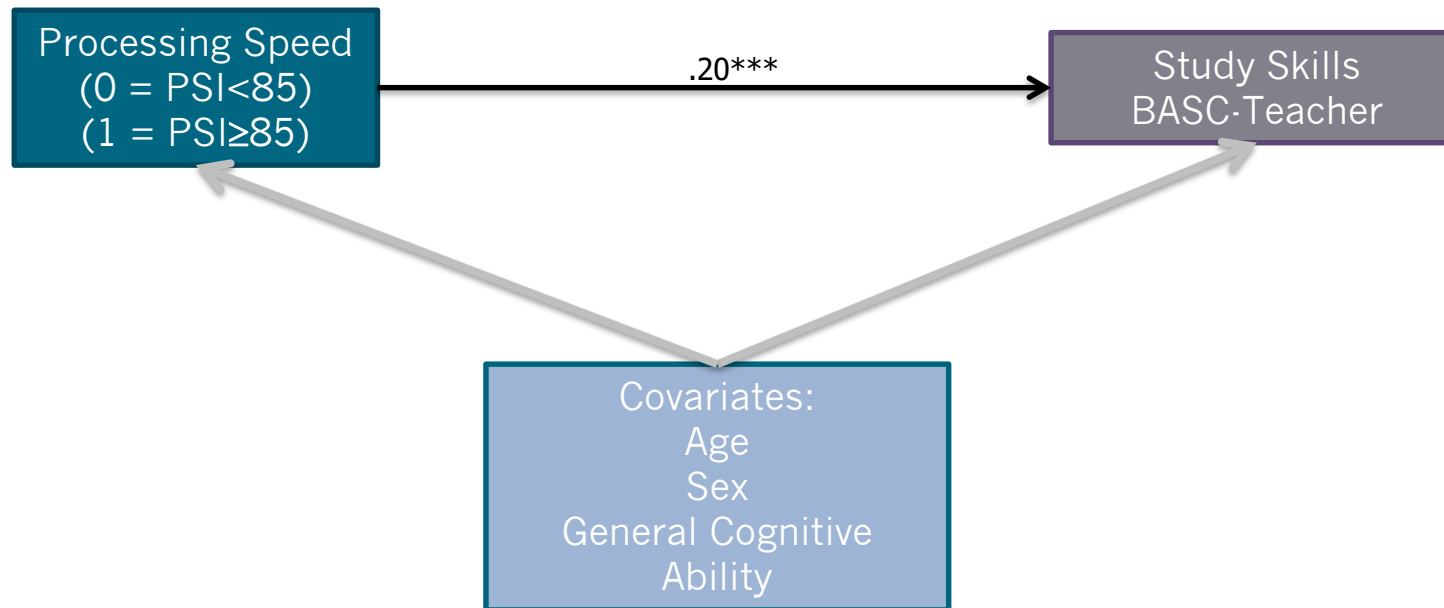
# Symptoms associated with impaired PS

Yet, when we studied symptoms, only inattention predicted slow processing speed across diagnoses

Raises the question: could treating inattention improve PS? Complicated because stimulants do not seem to treat slow PS...

Youth aged 6-21 (N = 464)			
Predictors	Odds Ratio	p-value	95% CI
Age	1.04	0.36	.96-1.13
Sex	0.50	0.006	.31-.82
Psychotropic medication	1.83	0.014	1.13-2.96
Aggression (CBCL)	1.03	0.86	.76-1.39
Depression (CSI)	1.08	0.54	.84-1.40
Inattention (CSI)	1.49	0.003	1.14-1.96
Hyperactivity (CSI)	1.03	0.87	.72-1.47
Inhibition (BRIEF)	0.87	0.46	.60-1.26
Anxiety problems (CBCL)	1.05	0.70	.81-1.36
Social responsiveness (SRS)	0.84	0.26	.63-1.13
Mania symptoms(CMRS)	1.08	0.64	.78-1.50

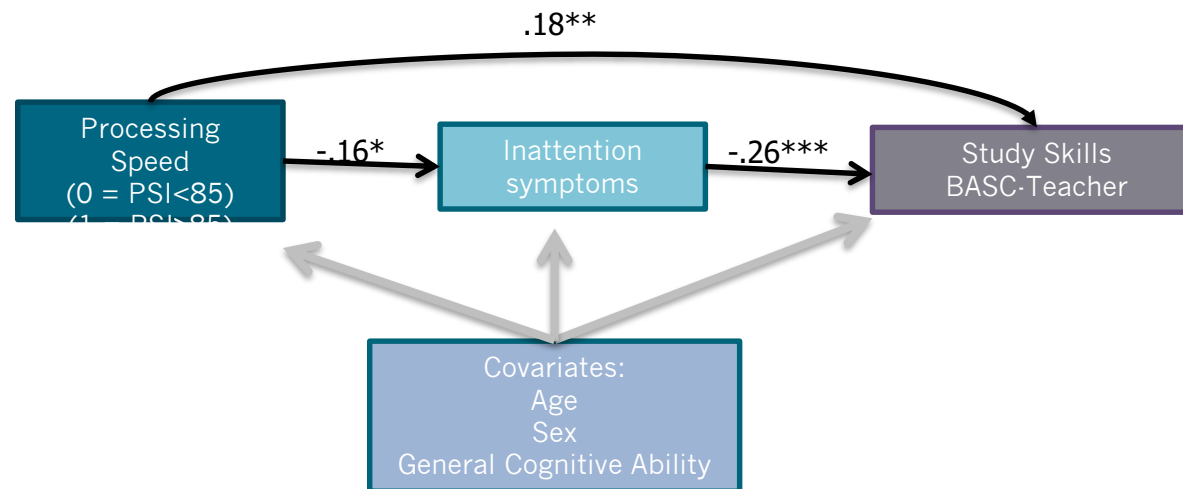
# Processing Speed explains variation in study skills after controlling for age, sex and GAI.



Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ ;  
dashed arrow = no statistical significance reached.

# Inattention symptoms are only a partial mediator of the relationship between PS and Study Skills

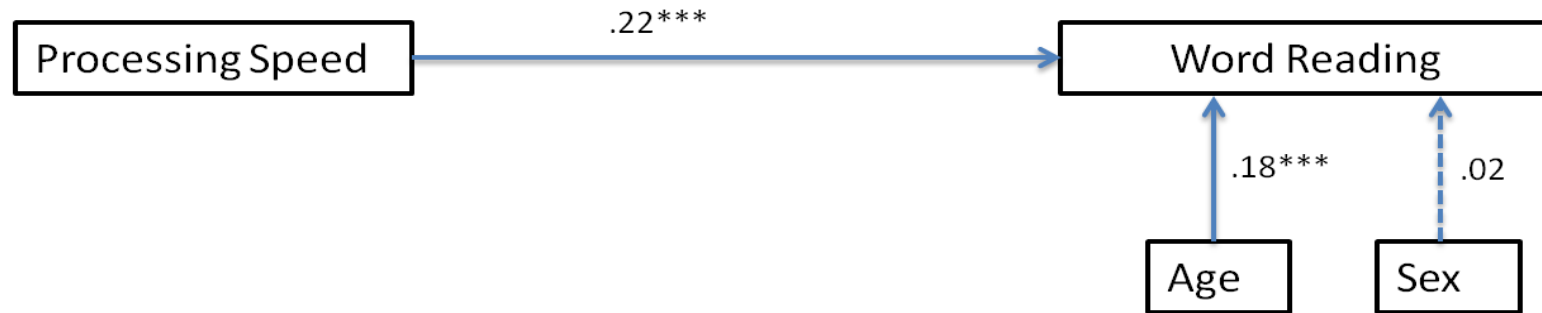
PS also has a direct effect on study skills, as well as an indirect impact through inattention. This could explain why treating attention doesn't fully resolve the burden that slow PS represents on academic difficulties.



Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ ;  
dashed arrow = no statistical significance reached.

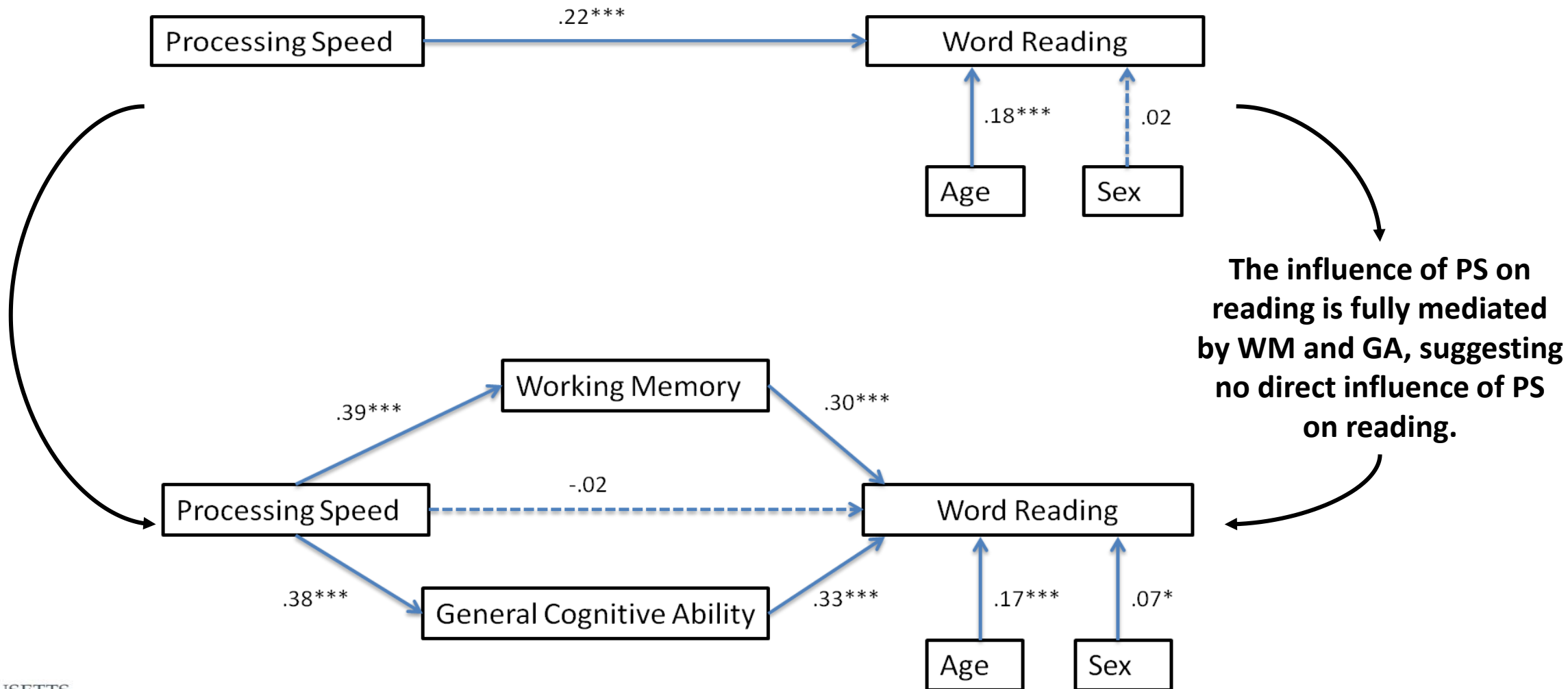
Partial mediation with indirect effect = .04,  $z = 2.03$ ,  $p = .04$

# Impact of PS on Reading



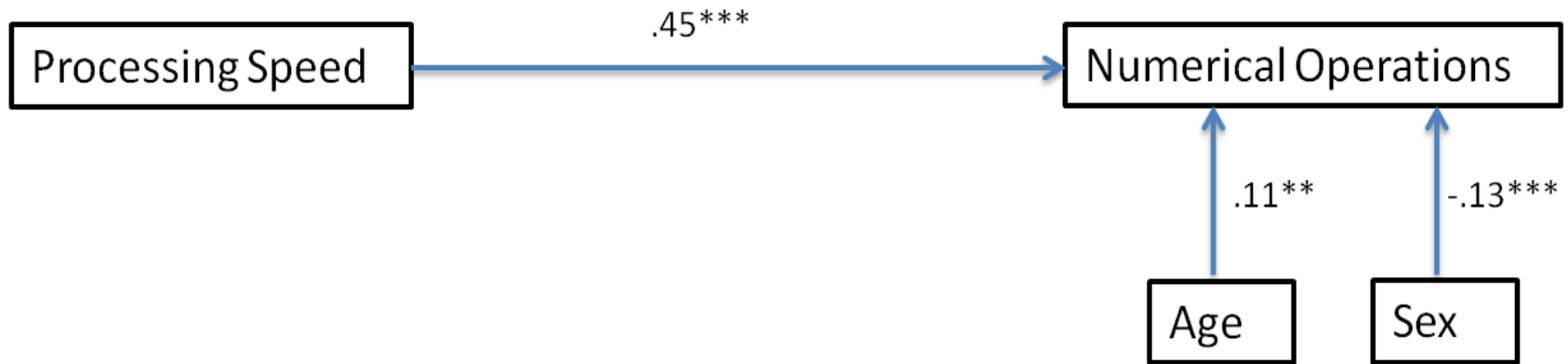
**PS shows a small but significant impact on reading achievement in our data**

# Impact of PS on Reading



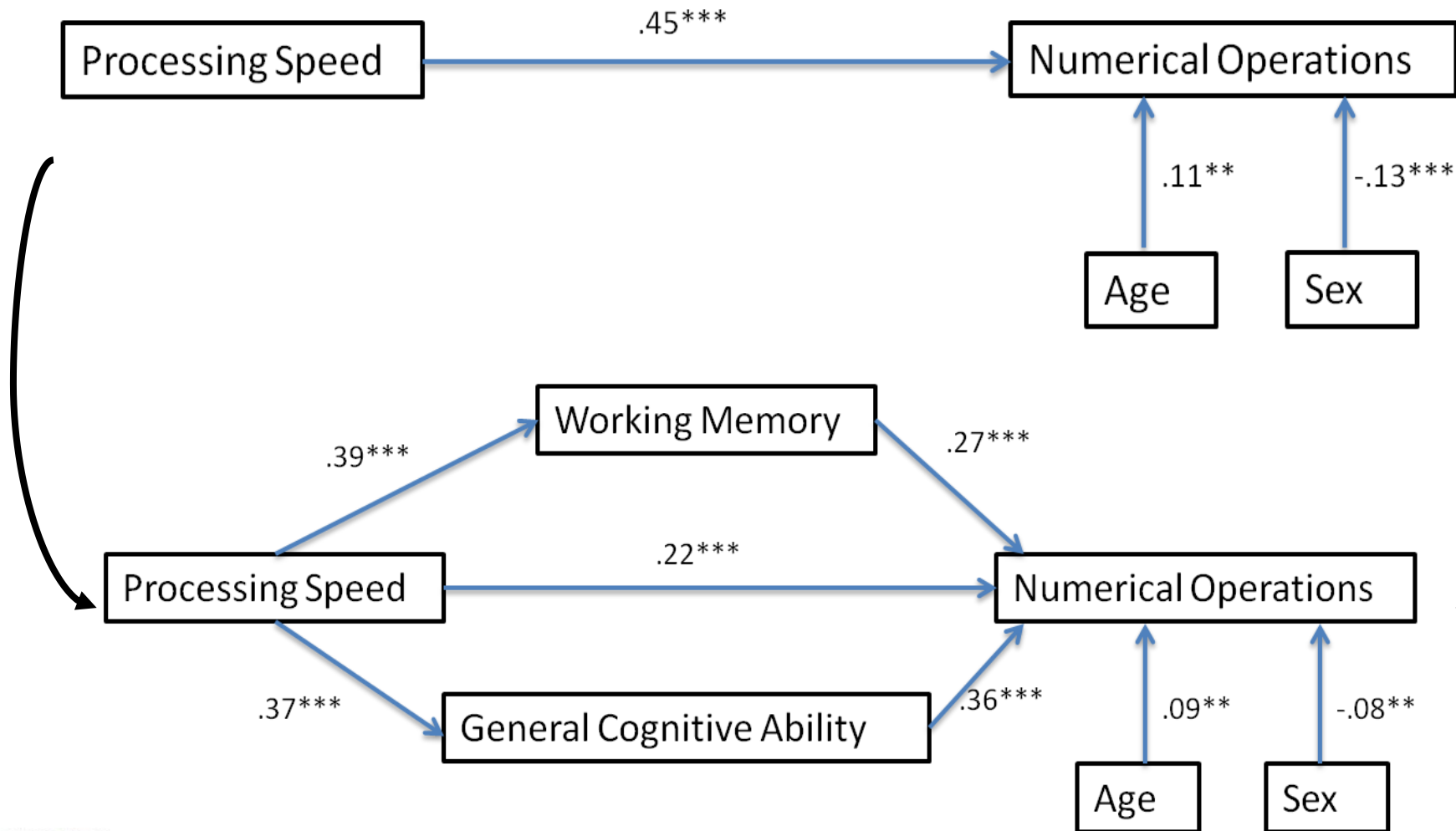
The influence of PS on reading is fully mediated by WM and GA, suggesting no direct influence of PS on reading.

# Impact of PS on Math



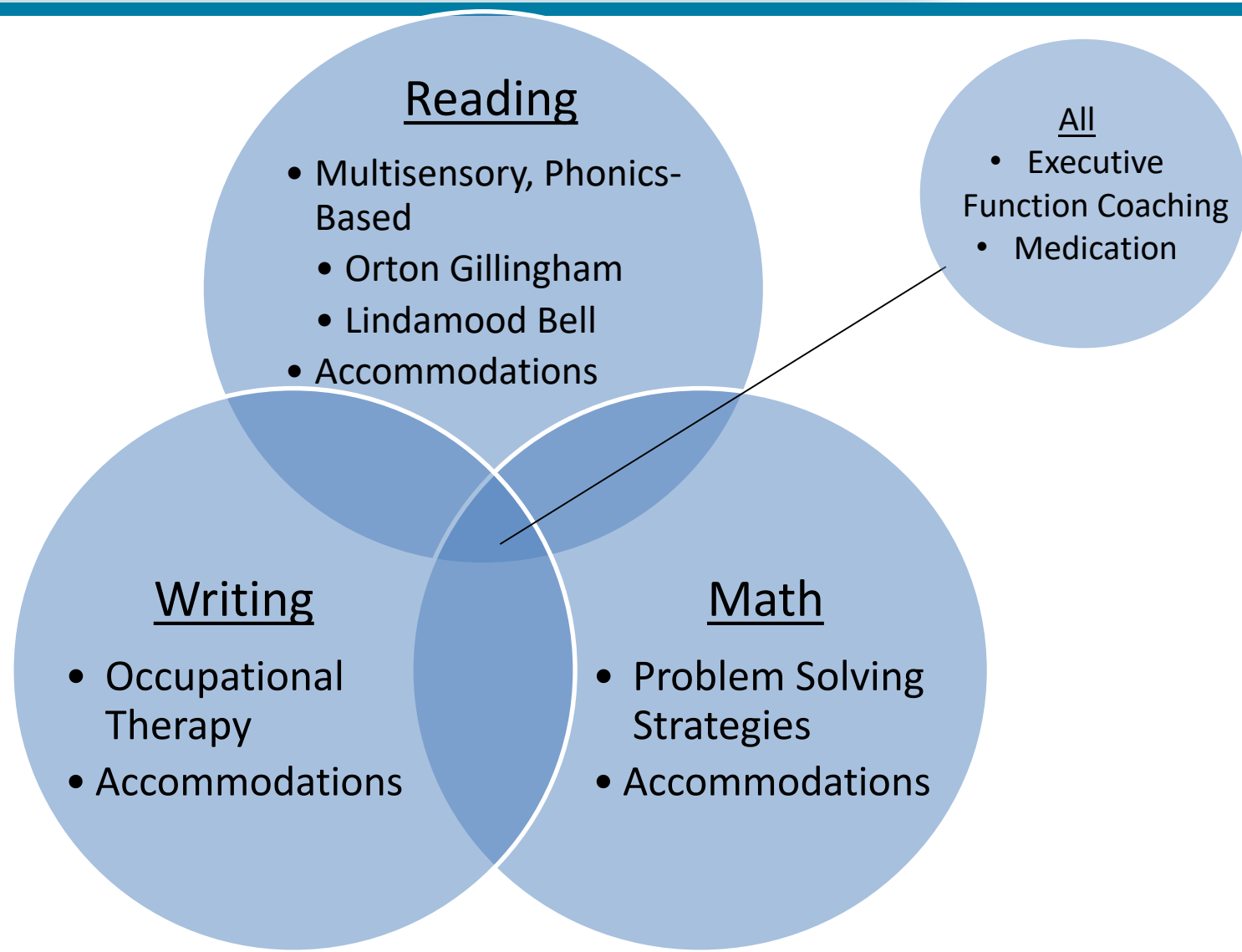
**PS shows a significant relationship with math achievement in our data**

# Impact of PS on Math



The influence of PS on math is only partially mediated by WM and GA, suggesting there is some direct influence of PS on math.

# Remediation for SLD in the Context of ADHD





# Summary

- High Comorbidity of ADHD and SLD
- Need to assess for SLD in ADHD when treatments do not lead to better school performance
- Processing Speed and Working Memory tend to be the areas most affected across all diagnoses

# Thank You!

---