



***Living with S\*L\*O\*W Processing Speed:  
The Impact on Home, School, & Social Life***

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## 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:
  - How it relates to social relationships
  - Overlap with psychiatric disorders

## Detrimental Impact of Slow Processing Speed

- 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.

## Goals of Webinar

- Better understanding of how processing speed can affect social relationships across the lifespan (preschool, elementary age, high school)
- Better understanding of the multi-dimensional effect of a child with slow processing speed on family dynamics
- Better understanding of the emotional challenges (particularly anxiety) that can affect children with slow processing speed
- Better understanding of the most recent research on the effect of slower processing speed in social and home environments and its effect on academic functioning

## Charlie



## Charlie's History

- No problems with pregnancy and delivery
- Baby who liked cuddling and was not fussy
- Met developmental milestones on time:
  - Walked at 11 months
  - Spoke first words at 9 months
  - Was speaking in sentences between 18 and 24 months
  - \*did not crawl

## Charlie at Age 3 years

- Referred for problems with anxiety and attention
- Wechsler Preschool and Primary Scale of Intelligence
  - Verbal IQ of 80 (9<sup>th</sup> percentile)
  - Nonverbal IQ of 71 (3<sup>rd</sup> percentile)

Visual Spatial on VMI: 60 (<1<sup>st</sup> percentile)

No Firm Diagnosis but Speech-Language was pursued

## Charlie at age 5 Years

- Continued to have problems with language and anxiety
- Received speech-language in and out of school for pragmatics, receptive and expressive language
- Very anxious, especially in new situations
- Problems with anxiety and language much more significant at school
- At home, pretty normal child who plays appropriately, loves play dates with others

## Age 5 years: Evaluation

- Verbal Intellect: 81 (10<sup>th</sup> percentile)
- Nonverbal Intellect: 80 (9<sup>th</sup> percentile)
- Processing Speed: 75 (5<sup>th</sup> percentile)
- Significant problems with attention
- Significant problems with anxiety
- Social skills deficits

## Processing Speed Measures



## Age 5: Diagnoses & Treatment

- Considered Autism Spectrum by multiple professionals, including ADOS (Autism Diagnostic Observation Schedule)
- Diagnosed with ADHD and Generalized Anxiety (GAD)
- Treatment:
  - Speech/Language
  - CBT
  - Medication?
  - IEP

## Biology of Processing Speed

- No single brain region has been, or is likely to be, identified as the cause of Slower Processing Speed
- Rather, multiple regions of the brain are probably involved
- Neural (Brain Cell) Efficiency Model:
  - A faster nervous system allows for more rapid processing of information and is related to more efficient cognitive information processing and higher intelligence

## Sample

- Children and adolescents consecutively referred for neuropsychiatric evaluation who agreed to participate in research
- Clinic: MGH Learning and Emotional Assessment Program LEAP
  - Both neuropsychological and psychopathology assessment
- Source study: Longitudinal Study of Genetic Influences on Cognition (LOGIC)
  - Permission measures clinical measures, supplementation of clinical data, collection of DNA

## 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

CLINICAL SAMPLE: 868 Probands with WISC PSI <85  
*No control for co-morbidity*

| Diagnosis                | Percentage of children who had SPS |
|--------------------------|------------------------------------|
| ADHD                     | 30%                                |
| --ADHD inattentive type* | 39%                                |
| --ADHD hyperactive*      | 19%                                |
| --ADHD combined*         | 33%                                |
| Generalized Anxiety      | 32%                                |
| Autism Spectrum          | 46%                                |
| Depression               | 40%                                |
| Bipolar disorder         | 46%                                |
| Language disorder        | 30%                                |
| Reading disorder         | 27%                                |
| Writing disorder         | 42%                                |
| Math disorder            | 44%                                |
| Learning disability NOS  | 36%                                |

## Processing Speed in the Home

- The slower the PS, the more problems are reported with chore completion and daily life.
- Children with SPS tend to report more negative relationships with their parents
- Problems include:
  - Has trouble with changes in routine at home such as trying new foods
  - Has trouble getting used to new situations, ranging from new sneakers to a family vacation
  - Forgets to bring materials home to complete homework
  - Underestimates time to complete tasks
  - Doesn't stay seated during mealtimes

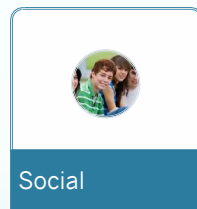
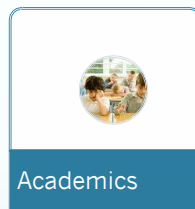
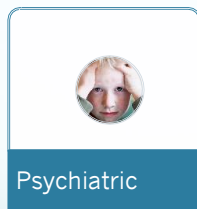
## Difficulties at Home

| Problem Area                | Percentage who were reported to exhibit significant problems |
|-----------------------------|--|
| Staying Organized/planning  | 83%  |
| Self-Monitoring             | 76%  |
| Getting Started on Tasks    | 72%  |
| Keeping Track of Belongings | 66%  |
| Inhibiting Impulses         | 65%  |
| Shifting/transitioning      | 63%  |

## Charlie at age 11

- Still anxious but less because of CBT
- Can be negative about himself, overreacts
- Receives IEP services in school – language-based classroom and outperforms most kids in the class
  - Problems in reading comprehension and math (especially math with a language component)
- Few friends because he doesn't have many choices in small classroom

## Diagnostic Considerations



## School Evaluation

- Verbal: 45<sup>th</sup> percentile
- Visual Spatial: 5<sup>th</sup> percentile
- Fluid Reasoning: 7<sup>th</sup> percentile
- Working Memory: 50<sup>th</sup> percentile
- Processing Speed: 3<sup>rd</sup> percentile
- School “diagnosed” with ASD profile
  - Teacher but NOT parent reports consistent with ASD
  - High levels of anxiety at school

## WISC Coding

|   |   |    |   |   |
|---|---|----|---|---|
| 1 | 2 | 3  | 4 | 5 |
| 1 | 1 | 00 | ^ | = |

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 4 | 4 | 3 | 4 | 2 | 2 | 2 | 5 | 5 | 5 | 3 | 1 | 5 | 5 |
| 1 | 1 | 2 | 1 | 5 | 4 | 4 | 4 | 2 | 1 | 3 | 5 | 5 | 1 | 5 |
| 4 | 3 | 1 | 3 | 1 | 3 | 4 | 3 | 1 | 3 | 2 | 5 | 4 | 3 | 4 |

## Neuropsychological Evaluation

|                         | Verbal           | Nonverbal Reasoning | Spatial         | GCA              |
|-------------------------|------------------|---------------------|-----------------|------------------|
| Standard Score          | 110              | 85                  | 74              | 88*              |
| Percentile              | 75 <sup>th</sup> | 16 <sup>th</sup>    | 4 <sup>th</sup> | 21 <sup>st</sup> |
| Qualitative Description | Above Average    | Below Average       | Low             | Below Average    |

## Executive Functioning

| Cluster          | Standard Score | Percentile       | Qualitative Description |
|------------------|----------------|------------------|-------------------------|
| Working Memory   | 100            | 50 <sup>th</sup> | Average                 |
| Processing Speed | 79             | 8 <sup>th</sup>  | Low                     |

## Academic Functioning

Reading Comprehension

Academic Fluency

Written Expression



## Question of Autism

- Inconsistent Symptoms
  - Spontaneous Speech
  - Shared enjoyment, good eye contact, facial expressions
  - Age-appropriate insight into social relationships/friendships
  - Shared information appropriately
  - No stereotyped or repetitive behaviors
- Atypical Behaviors
  - Mild symptoms of anxiety
  - Formal speech, slow halting speech

## Why all the Confusion?



### A range of diagnoses associated with impaired PS

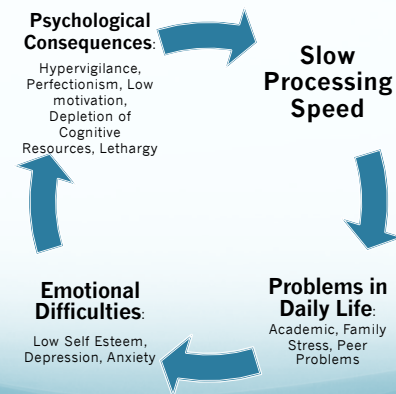
Total sample age 6-21 (N=775)

| 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) |

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.

## Emotional Consequences of SPS



## So Back to Charlie.....

- Strengths in verbal and weaknesses in nonverbal reasoning, visual-motor skills, PS, and EF
- Focus on specific details at expense of “big picture”
- Seemed almost precocious and insightful, but underlying PS deficits contribute to social challenges, especially in less structured, less predictable situation

## NLD versus ASD

- ASD
  - Scores on ADOS not suggestive
  - PS
  - Anxiety
  - Difficulty managing changes in routines
  - Difficulty picking up on social cues
- NLD
  - Difficulty identifying and integrating salient details in environment
  - Can't see forest for trees
  - Poor spatial and nonverbal reasoning
  - Strong vocabulary
  - Strong rote learning
  - Difficulty with academic fluency and complex problem solving

## Recommendations

- New School Placement
  - More appropriate peers
- Accommodations
  - Extra time
  - Capitalizing on verbal system
  - Organizing verbal system
  - Executive function coaching
- Therapy
  - Coping skills
  - Stress management





A word cloud visualization centered around the word "accept". The word "accept" is the largest and most prominent. Other large words include "responsibility", "life", "complete", "others", "open", "receive", "mind", "universe", "gates", "actions", "change", "without", "reality", "run", "desire", "want", "possibilities", "beliefs", "total", "things", "unconditionally", "good", "abundance", "easily", "right", "highest", "peace", "words", "experience", "everything", "way", "now", "totally", "appreciate", "and", "nearly", "happy", "just", "acceptance", "and", "actions".

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A word cloud visualization of terms related to differentiated instruction. The words are arranged in a circular pattern, with 'differentiate' and 'differentiation' being the largest and most central. Other prominent words include 'instruction', 'student', 'classroom', 'environment', 'content', 'teacher', 'teaching', 'learning', 'needs', 'products', 'processes', 'assessment', 'engage', 'tailored', 'readiness', 'variance', 'group', 'master', 'whether', 'successful', 'motivated', 'possible', 'various', 'order', 'apply', 'concrete', 'differentiating', 'work', 'planning', 'rehearse'.

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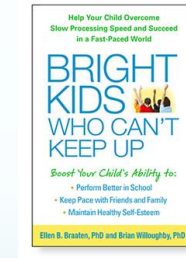
person,  
champion, up  
**advocate.** noun  
supporter, b  
promoter, r  
keeper

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- Provide ample opportunities to assume responsibilities that make a contribution to their home, school, or community environments
  - Provide concrete proof to kids at risk that they can be successful, are capable and can earn respect
- Provide opportunities to learn the skills necessary for making sound choices and decisions for solving problems
  - Essential ingredient of high self-esteem is the belief that one has some control over what is occurring in one's life

## And Charlie?

- 14-year-old in an appropriate high school environment
- Issues related to dating and social relationships became more complicated, but ready for the challenges
- Much less anxiety due to treatment and better school environment



*The Clay Center for Young Healthy Minds is devoted to promoting the emotional well-being of young people by providing innovative education about mental health.*

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