Cognition and Language: The differential diagnosis between cognitive and language disorders

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Neuro-Developmental Disorders

A group of conditions with onset in the developmental period. The disorders typically produce impairments of personal, social, academic, or occupational functioning.

The range of developmental deficits varies from very specific limitations of learning or control of executive functions to global impairments of social skills or intelligence.

The neurodevelopmental disorders frequently co-occur.

For some disorders, the clinical presentation includes symptoms of excess as well as deficits and delays in achieving expected milestones.
Examples of Neuro-Developmental Disorders

- intellectual disability
- sensory impairments
  - visual impairment
  - auditory impairment
- motor disorders
- learning disorders
  - dyslexia (reading disorders)
  - dyscalculia (maths disorders)
  - dysgraphia (written expression and spelling disorders)
- language disorders (expressive and/or receptive)
- attention-deficit hyperactivity disorder
- autism spectrum disorders
- other disorders

.....some children will have difficulties in more than one area

Today’s webinar will focus on assessment and differential diagnosis of....

1. intellectual disability / cognitive impairment
2. learning disorders
   a. Reading, Writing and Spelling disorders (dyslexia/dysgraphia)
3. language disorders (expressive and/or receptive)
4. autism spectrum disorders
What do we mean by “Cognitive”?  

“The capacity of the individual to act purposefully, to think rationally, and to deal effectively with his/her environment.”  
(Wechsler, 1944)

Wechsler utilised subtests designed to measure varied aspects of intelligence:

- Verbal comprehension
- Abstract fluid reasoning
- Perceptual organisation
- Quantitative reasoning
- Memory
- Processing speed

What do we mean by adaptive behaviour?

Personal and social skills needed for everyday living

Independence: the practical skills and behaviours that are needed to take care of oneself

Assessment of these skills can support differential diagnosis
What is Language?

Language /ˈlaɪŋgwɪdʒ/ [noun]
1. the method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way.
2. a system of communication used by a particular country or community.

What is Language vs. Communication?

- Bees: “dances” specify distance, direction, and quality of food
- Vervet monkeys: different signals for different predators
- Parrots
- Animals can communicate.
  - BUT can they use language?
What is Language?

Two conditions must be met:

1. **Semantics** – arbitrary units (words) which must have meaning

2. **Syntax** – words must be organised in a rule-based manner

*Chomsky*: it is syntax that is innately human. Animals can learn words (perhaps) but cannot have a grammar.

Language Developmental Trajectory

Narrative discourse structure

Politeness routines

Turn taking

Word production

Word comprehension

Word combinations

Babbling
Linguistic Environments

- Linguistic-rich environments predict large vocabularies in children and are often associated with
  - Higher socioeconomic status (SES)
  - Being the firstborn / only child
  - The quality of family conversations
  - Quantity and sophistication of mother’s vocabulary
  - Reading and discussing children’s stories

... but this doesn't necessarily mean a child is immune to a specific learning disability

Genetic, Epigenetic and Environmental

- The “nature” vs. “nurture” debate
  - Genetic component to language
  - Environmental factors may influence language development
  - Effect of experience on neurological maturation
    - Responses to input differ as system matures
    - Increasingly complex interaction between them
    - Decreasing flexibility in the system to respond to environmental changes
Learning Foreign Languages

• New language learning becomes more difficult with age

![Percentage correct on grammar test](chart.png)

Language-related difficulties

• Speech, language and communication difficulties may also affect a child’s behaviour, social and emotional functioning
• Left untreated and unsupported children with developmental language disorders can develop significant behavioural and emotional difficulties
• A large proportion of children in the criminal justice system have language difficulties
  • Great article in The Age featuring Professor Pam Snow titled “Victorian prisoners forced to sit numeracy and literacy tests in education shake-up” [http://bit.ly/1XYtSKg](http://bit.ly/1XYtSKg) (SPA FB page)
Child Language Difficulties

May differentially affect:
- Comprehension
- Expression
- Pragmatics of communication
- Reading
- Writing
- Mathematical language
- Music
- Drawing
- Second language learning

ASSESSMENT RESULTS AND DIFFERENTIAL DIAGNOSIS
LANGUAGE DISORDERS VS INTELLECTUAL DISABILITY?

Identifying Language Disorders

• The definitions require that a language disorder be identified only when the child’s language development is below the level expected based on their cognitive skills (IQ)
• For children with language disorders, the best measure of cognitive skills are often measured in a non-verbal way.
• So, a discrepancy analysis could be conducted using scores from expressive and receptive language tests and non-verbal cognitive measures

Let's take a closer look at various definitions
Language Disorder: DSM-IV Diagnostic Criteria

**Expressive type**
- Substantially lower scores on measures of expressive language development than scores on measures of NONVERBAL intelligence and receptive language development.

**Mixed Receptive-Expressive type**
- Substantially lower scores on measures of receptive and expressive language development than scores on NONVERBAL measures of intelligence.

Language Disorder: DSM-5 Diagnostic Criteria

A. Persistent difficulties in the acquisition and use of language across modalities (i.e., spoken, written, sign language, or other) due to deficits in comprehension or production that include the following:

   a. Reduced vocabulary (word knowledge and use).
   b. Limited sentence structure (ability to put words and word endings together to form sentences based on the rules of grammar and morphology).
   c. Impairments in discourse (ability to use vocabulary and connect sentences to explain or describe a topic or series of events or have a conversation).

B. Language abilities are substantially and quantifiably below those expected for age, resulting in functional limitations in effective communication, social participation, academic achievement, or occupational performance, individually or in any combination.

C. Onset of symptoms is in the early developmental period.

D. The difficulties are not attributable to hearing or other sensory impairment, motor dysfunction, or another medical or neurological condition and are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay.
Intellectual Disability
(Intellectual Developmental Disorder): DSM-5 Diagnostic Criteria

Criteria 1: Deficits in intellectual functions, such as reasoning, problem solving, planning, abstract thinking, judgment, academic learning, and learning from experience, confirmed by both clinical assessment and individualised, standardised intelligence testing.

This means: IDD requires a current intellectual deficit of approximately 2 or more standard deviations in Intelligence Quotient (IQ) below the population mean for a person’s age and cultural group, which is typically an IQ score of approximately 70 or below, measured on an individualised, standardised, culturally appropriate, psychometrically sound test.

Criteria 2: Deficits in adaptive functioning that result in failure to meet developmental and sociocultural standards for personal independence and social responsibility. Without ongoing support, the adaptive deficits limit functioning in one or more activities of daily life, such as communication, social participation, and independent living, across multiple environments, such as home, school, work, and community.

Criteria 3: Onset of intellectual and adaptive deficits during the developmental period.
Adaptive Behaviour: General Adaptive Composite (GAC) is made up of 10 specific skills and 3 Domains

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<th>Conceptual</th>
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<td></td>
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<td>Motor Skills/Work</td>
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WISC IV Clinical Group Studies with children who have language disorders

- Expressive type:
  - Verbal Comprehension Index (VCI) and auditory Working Memory Index (WMI) were the lowest scores for this group, relative weaknesses in the cognitive profile, and are the two scores that are the most different to a matched control group (large effect size)
  - Perceptual Reasoning Index (PRI) is the highest index score for this group compared to control (made up of non verbal tasks - like building with blocks, matrix reasoning, etc)
  - The PRI may be the best score from the WISC IV for conducting a discrepancy analysis with measures of language
  - Adaptive behaviour should be within the broad average range, with probable relative weaknesses in the communication domain
AWMA clinical study: Specific Language Disorder

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<td>60</td>
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**WISC IV Clinical Group Studies with children who have language disorders**

- **Mixed Receptive-Expressive type:**
  - This group tends to have more global deficits in cognitive functioning, however, with relatively better performance on nonverbal than verbal tasks.
  - Perceptual Reasoning Index (PRI) highest index score compared to control
  - The PRI may be the best score from the WISC IV for conducting a discrepancy analysis with measures of language
  - Adaptive behaviour should be within the broad average range, with probable relative weaknesses in the communication domain.
How is this different than Intellectual Disability?

WISC IV: **Mild Intellectual Disability Clinical Study**
- Mean FSIQ 60 in study
- Less variation between index scores
- Adaptive Behaviour on par with FSIQ generally

WISC IV: **Moderate Intellectual Disability Clinical Study**
- Mean FSIQ 46 in study
- Lowest subtests: Comprehension, Vocabulary, and Information: all verbal subtests. Relative strength in PSI
- Adaptive Behaviour on par with FSIQ generally

**Clinical Presentation and Adaptive Behaviour**

Mild Intellectual Disability
- Mean GAC Score ages 0-5: 68 parent
- Mean GAC Score ages 5-21: 58 parent
- Mean GAC Score ages 5-21: 61 teacher

Language Disorder
- Mean GAC Score: 84, with variability between skills areas and greatest deficits in Communication and Functional Academics

Hearing Impairment
- Mean GAC Score: 99
Quick Guidelines for WISC IV users

- If both the VCI and WMI from the WISC IV are below the average range (<90), and PRI is significantly larger than VCI, consider a language disorder. Compare PRI to a score from a language measure.
- If the WMI is the only relative weakness in the profile, and VCI is similar to PRI, a language disorder is unlikely. However, other disorders, such as those in reading, may still be a hypothesis.
- If FSIQ is in the extremely low range with little variation between indices, an intellectual disability may be a more appropriate hypothesis.

Same IQ score, different clinical presentation

- FSIQ 70
- VCI 61
- PRI 92
- PSI 85
- WMI 62
- Adaptive Behaviour in the broad average range with scatter between S & W

- FSIQ 70
- VCI 69
- PRI 71
- PSI 73
- WMI 74
- Adaptive Behaviour in the Extremely Low range
Language Disorder: Terminology

- Children with language disorders have been variously referred to as
  - language disordered
  - language impaired
  - language delayed, or
  - as having a specific language impairment.

- Clinicians tend to use the first three terms
- Specific language impairment is the preferred term in research publications

Developmental Delay vs. Receptive/Expressive Language Disorder?

- It is sometimes difficult, if not impossible, to distinguish at an early age a late bloomer from a child with a language disorder
- The late bloomer will eventually develop grammatically correct speech and language
- The child with a language disorder will not do so without intervention
Clinical Profile: Receptive/Expressive Language Disorder

- Normal cognitive ability
- Normal hearing
- Good socio-emotional relationships
- Normal articulation skills
- Appears not to listen when they are spoken to
- Appears to lack interest when storybooks are read to them
- Inability to understand complicated sentences and to follow instructions
- Frequently struggles to find the correct word
- Often makes grammatical mistakes
- Relies on short, simple sentence construction
- Relies on standard phrases for responses
- Inability to "get to the point"
- Struggles to retell a story or relay information
- Inability to start or hold a conversation.

Case Study: 8 year old girl

Overview of CELF-4 Core language and Index Scores (Age 8 Years 0 Months)

<table>
<thead>
<tr>
<th>CELF-4 Index scores</th>
<th>Standard score</th>
<th>Confidence interval (90%)</th>
<th>Percentile rank</th>
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### WPPSI-IV Intellectual Disability-Mild

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n = 39; ages 2:6-7:6

### WPPSI-IV Non-Verbal Index (NVI)

- The NVI offers an estimate of overall ability for children who have expressive issues (e.g. language disorder, ASD, English Language Learners, etc).
- The NVI has important applications for children with language disorders:
  - The NVI is noticeably higher than the Full Scale IQ
  - The NVI is less language loaded than the Full Scale IQ
  - The NVI removes expressive requirements from the measurement of intellectual ability
### Expressive Language Disorder

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### Mixed Receptive-Expressive Language Disorder

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</tr>
</tbody>
</table>

n = 42; ages 4:0-7:6
Wechsler Non Verbal (WNV)

- An alternative to the WISC IV may be the WNV
- A test of general ability measured by using nonverbal tests that
  - do not contain verbal content (e.g., Vocabulary)
  - do not require the examinee to speak
  - use pictorial directions
  - Measure fluid reasoning, processing speed, and memory
- The WNV score may be an appropriate score for conducting a discrepancy analysis with measures of language

WNV uses Pictorial Instructions
Example

Child A
- CELF 4 = 80
- WNV = 81

Child B
- CELF 4 = 80
- WNV = 110

The difference between these two scores is only 1 point and would not indicate a language disorder because the child’s language development is at the level expected for their cognitive skills.

The discrepancy between the two scores is 30 points, which would be statistically significant and clinically meaningful.

Although both children have the same score on the CELF 4 only Child B would be considered for a language disorder.

The Bilingual Child

- A bilingual home environment may cause an apparent temporary delay in the onset of both languages.
- A “silent period” is a common second-language acquisition phenomenon.
- The younger the child, the longer the silent period tends to last when a second language is introduced.
- The bilingual child’s comprehension of the two languages is normal for a child of the same age.
- Usually shows spoken proficiency in both languages before the age of five years if they are supported by the community and the child is motivated to use both.
WNV and English Language Learners

- The WNV was administered to 55 children who met the criteria for classification as English Language Learners:
  - Child’s native language was not English
  - Child’s primary language spoken was not English
  - Language other than English spoken at home
  - Parents had resided in an English speaking country less than 6 years

### English Language Learners

<table>
<thead>
<tr>
<th>Subtest/Full Scale Score</th>
<th>English Language Learners Mean</th>
<th>SD</th>
<th>Matched Control Group Mean</th>
<th>SD</th>
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<tbody>
<tr>
<td>Matrices</td>
<td>50.2</td>
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<td>Object Assembly</td>
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<td>9.9</td>
<td>51.1</td>
<td>9.9</td>
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<tr>
<td>Recognition</td>
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<td>7.6</td>
<td>50.0</td>
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### WPSSI IV and young English Language Learners

<table>
<thead>
<tr>
<th>Composite</th>
<th>Clinical Mean</th>
<th>Control Mean</th>
<th>Mean Diff.</th>
<th>p value</th>
<th>Std. Diff.</th>
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<tbody>
<tr>
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<td>100.9</td>
<td>-1.48</td>
<td>.55</td>
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</table>

n = 33; ages 2:7-7:6

**Language Disorder or Reading Problem?**
Language seems ok, but still not reading!?

- Is it a reading disorder, dyslexia?
  - Characterised by unexpected difficulty in reading accuracy, rate of decoding, word reading, text reading & spelling (Lyon et al. 2003)

- Difficulties attributed to a phonological core deficit. Is not due to poor hearing or vision.

- Is neurobiological in origin & is unexpected on basis of other cognitive skills & instructional history

WISC IV: Specific Learning Disability for Reading (aka dyslexia):

- Auditory WMI: Lowest index score for this group, and the score most different that a matched control group

- Verbal Comprehension Index (VCI) was not a significant relative weakness, (i.e., child can express answers verbally in an age appropriate way).

- May have slightly lower scores on Information and Vocabulary due to lack of information acquired through reading

- Adaptive Behaviour generally in the broad average range.
AWMA Reading Disorder (Dyslexia)

<table>
<thead>
<tr>
<th></th>
<th>Verbal STM</th>
<th>Visual-Spatial STM</th>
<th>Verbal WM</th>
<th>Visual-Spatial WM</th>
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</tr>
<tr>
<td>60</td>
<td></td>
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</tr>
</tbody>
</table>

Dr. Ben Foss’s brain is on the right – the scan shows low activity in the language area: the temporal parietal lobes that sit on both the left and right sides of the brain. Book: *The Dyslexia Empowerment Plan*
Reminder: Quick Guidelines for WISC IV users

- If both the VCI and WMI from the WISC IV are below the average range (<90), and PRI is significantly larger than VCI, consider a language disorder. Compare PRI to score from a language measure.
- If the WMI is the only relative weakness in the profile, and VCI is similar to PRI, a language disorder is unlikely. However, other disorders, such as those in reading, may still be a hypothesis.
- Although a full language assessment is not warranted, a comprehensive reading assessment is.

Case Study: Harry, age 8:2

**Strengths**
- Hearing: Within Normal Limits
- Vision: Within Normal Limits
- Receptive Language (CELF 4): 75%ile
- Expressive Language (CELF 4): 91%ile
- Visual Memory (WNV): 76%ile
- Maths Operations (WIAT II): 88%ile
- Fine Motor Skills (NEPSY II): 75%ile
- Visuo-Perceptual (NEPSY II): 91%ile
- Gross Motor Skills: Excellent
- Verbal Comprehension Index (WISC IV): 108, 70%ile
- Perceptual Reasoning Index (WISC IV): 110, 75%ile
- Processing Speed Index (WISC IV): 106, 66%ile
- Social-Emotional: Generally happy with many friends and interests

**Challenges**
- Auditory Working Memory Index (WISC IV): 76, 6%ile
  - Comment: longest auditory working memory span: 2
- Spelling (WIAT II): 34%ile
- Phonological Awareness (WRMT 3): 14%ile
- Phonological Fluency (NEPSY II): 16%ile
- Word Identification (WRMT 3): 19%ile
- Word Attack/Decoding (WRMT 3): 23%ile
- Word Comprehension (WRMT 3): 21%ile
- Passage Comprehension (WRMT 3): 18%ile
- Oral Reading Fluency (WRMT 3): unable to complete
Questions about Harry’s results?

1. Which scores would indicate, or rule out, the hypotheses of a language disorder?

2. Have vision and hearing difficulties been ruled out?

3. Which scores would indicate, or rule out, an intellectual disability?

4. Can the difficulties in reading be explained by low IQ, or are they unexpected based on cognitive skills?

5. Does research show that deficits in auditory working memory impacts on reading skills?

6. Is the best diagnostic hypothesis for Harry a Language Disorder or a specific learning disability in reading (aka dyslexia)?
Children with Autism

- Difficulty with the understanding of what others know (Theory of Mind) and how social aspects of meaning affect communication.
- Often have problems with narrative meaning and inferring the significance of messages.
- Their difficulties involve the emotional, social and pragmatic aspects of interactions that go beyond their often relatively good ability to process the lexical and grammatical content of language.

ASD and Adaptive Behaviour

- Deficits in social-emotional reciprocity, failure of normal back-and-forth conversation
- Deficits in nonverbal communicative behaviours used for social interaction, abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
- Deficits in developing, maintaining, and understand relationships, ranging, for example, from difficulties adjusting behaviour to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.
Autism and Adaptive Behaviour

Vineland II profile characteristics of those with autism:

- Low score in Socialisation Domain, relative to other domains
- Significant score discrepancies across various subdomains (lots of scatter)
- Low score in Expressive Language, Interpersonal relationships, Play and Leisure Time, and Coping Skills Subdomains, relative to other subdomains.

High Functioning Autism vs Asperger’s Syndrome

- Lower Communication domain scores for Autism
- Similar Daily Living Skills domain scores
- Similar Socialisation domain scores
- Higher Motor Skill domain scores for Autism

Autistic Disorder

<table>
<thead>
<tr>
<th>Composite</th>
<th>Clinical Mean</th>
<th>Control Mean</th>
<th>Mean Diff.</th>
<th>p value</th>
<th>Std. Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCI</td>
<td>75.2</td>
<td>102.7</td>
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<td>&lt;.01</td>
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<tr>
<td>VSI</td>
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<td>FRI</td>
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<td>WMI</td>
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<tr>
<td>VAI</td>
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<td>101.6</td>
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<td>NVI</td>
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<td>CPI</td>
<td>75.9</td>
<td>99.2</td>
<td>23.30</td>
<td>&lt;.01</td>
<td>1.81</td>
</tr>
</tbody>
</table>

n = 38; ages 2:10-7:6
WISC IV Autism Spectrum Disorders

**Autism**
- Lower scores on all indices and FSIQ compared to control group
- **Best performance** on Block Design relative to other subtests
- Second best performance on Arithmetic

**Aspergers**
- Better verbal ability and higher adaptive behaviour than Autistic children
- **PSI** showed the largest effect size, and was the lowest index score
- PSI mean 86 versus VCI mean 105
- **Coding weakness** (mean 6.7) versus **Information strength** (mean 12)

---

**Quick thinking – diagnostic hypothesis building #1**

<table>
<thead>
<tr>
<th>WISC IV</th>
<th>VCI: 110</th>
<th>PRI: 88</th>
<th>WMI: 98</th>
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<tbody>
<tr>
<td>PSI: 75</td>
<td>S: Information 14</td>
<td>W: Coding 6</td>
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</tr>
</tbody>
</table>

### Conceptual: 80
- Communication: 7
- Funct Academics: 10
- Self-direction: 3

### Social: 60
- Leisure: 7
- Social: 2

### Practical: 69
- Community Use: 3
- School living: 6
- Self-care: 3
- Health and Safety: 7
- Motor Skills: 3

**GAC: 69**
Quick Thinking – diagnostic hypothesis building #2

WPPSI IV VCI: 62 VSI: 103 FRI: 91
WMI: 89 PSI: 94 VAI: 79 NVI: 93

Conceptual: 60 | Social: 86 | Practical: 91
- Communication: 4  
- Funct Academics: 4  
- Self-direction: 7
- Leisure: 9  
- Social: 7
- Community Use: 9  
- School living: 7  
- Self-care: 9  
- Health and Safety: 8  
- Motor Skills: 12

Quick Thinking – diagnostic hypothesis building #3

WISC IV VCI: 67 PRI: 73
PSI: 78 WMI: 66 FSIQ: 70

Conceptual: 61 | Social: 60 | Practical: 76
- Communication: 4  
- Funct Academics: 3  
- Self-direction: 5
- Leisure: 4  
- Social: 4
- Community Use: 7  
- School living: 6  
- Self-care: 5  
- Health and Safety: 4  
- Motor Skills: 6

GAC: 63
Summary

• There are many potential causes of language disorders because language is a complex behaviour influenced by genetic, biological, perceptual, cognitive, linguistic, and environmental factors.
• Deficits in each of these areas have been linked to difficulties learning language (Leonard, 1998).
• The primary risk for young children with language disorders is subsequent reading and academic learning difficulties.

Conclusion: The bigger picture

• More than 40 years of research has found that children with language disorders, may have cognitive weaknesses that may explain at least some of the language learning difficulties these children experience (Clark & Kamhi, 2010).
• Therefore, it’s really important to work closely with the School Counsellor / Educational Psychologist to fully understand the child’s language and learning needs for effective intervention programs to ensure the best possible outcome for the child and his/her family and the School.
Clinical picture

Half a brain
Johannes Burgstein, Caroline Grootendorst

This 7-year-old girl had a hemispherectomy at the age of 3 for Rasmussen syndrome (chronic focal encephalitis). Intractable epilepsy had already led to right-sided hemiplegia and severe regression of language skills. Though the dominant hemisphere was removed, with its language centres and the motor cortex for the left side of her body, the child is fully bilingual in Turkish and Dutch, while even her hemiplegia has partially recovered and is only noticeable by a slight spasticity of her left arm and leg. She leads an otherwise normal life.

University Hospital Rotterdam, 2015 JJB Rottendam, Netherlands (J Burgstein una, C Grootendorst una)

Baby boy born with no brain speaks and says 'mum'

We’re here to help

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References

• The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5; American Psychiatric Association, 2013)