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Making the Reading Connection

Donna Rury Smith, Ed.D.

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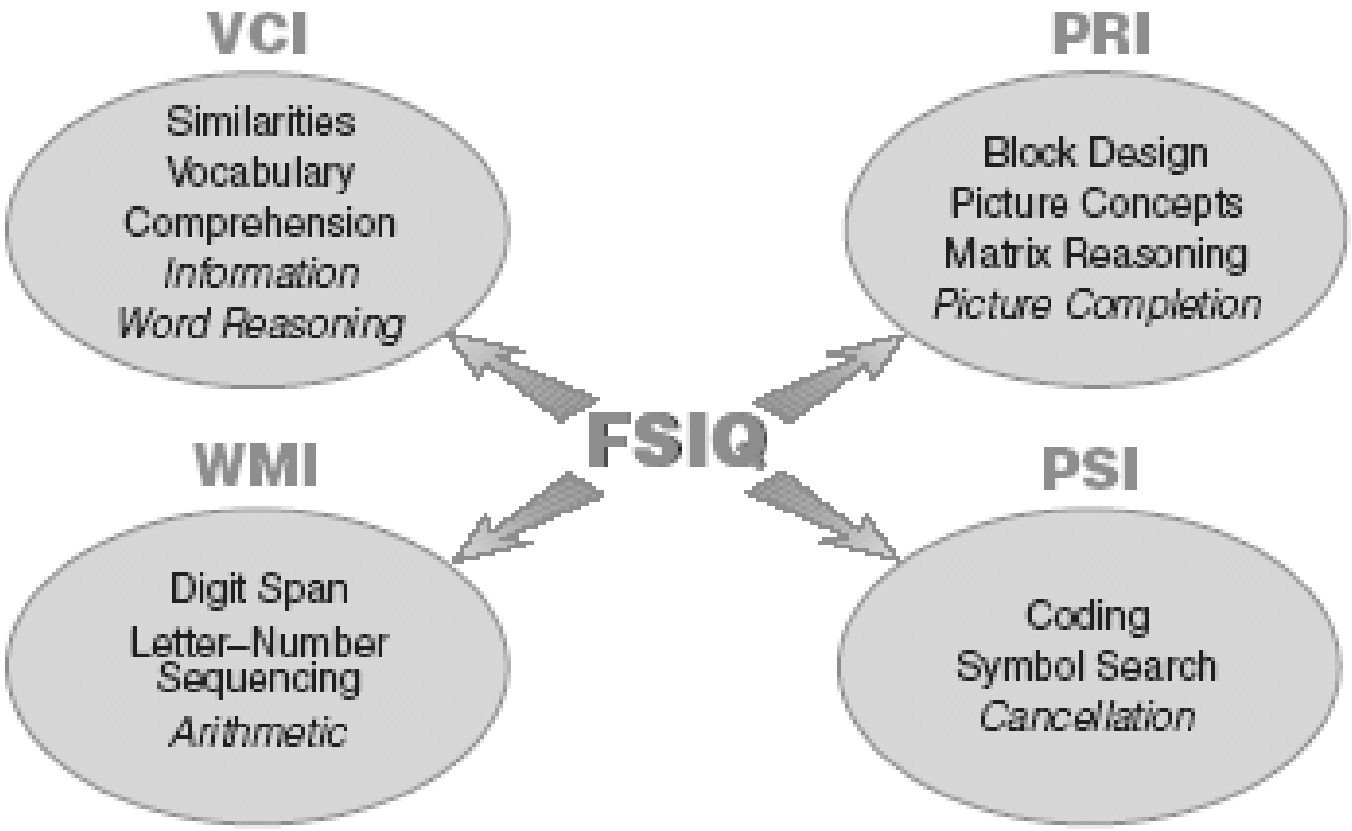
Agenda for Today

- ❑ Review the WISC IV Structure
- ❑ Examine the Reading Literature
- ❑ Focus on Brain Literacy
- ❑ Link Research to Assessment

WISC IV Structure



Note: Supplemental subtests are shown in italics

What can we learn from current reading research?

National Reading Panel Report

- Critical Areas
  - Alphabetics
  - Fluency
  - Comprehension
- Importance of Early Identification
- Value of Early Intervention
- Role of Assessment
  - Empirically-based decision-making
  - Focus shifted from eligibility
  - Progress monitoring
- Linking Assessment to Instruction

Alphabetics

Phonemic awareness and phonics represent different cognitive skills that are taught at different stages in the process of learning to read. While phonemic awareness represents the understanding that words are comprised of specific sounds, phonics is the ability to relate specific sounds to their corresponding symbols (The National Reading Panel, 2000).

Phonological awareness is one-step in the process of early reading acquisition. It is neither a necessary or sufficient cause of reading disability or reading proficiency. Impaired phonological awareness should be considered a **risk factor** for developing problems in reading decoding and fluency.

Fluency

Automaticity relates to fluency but the concepts are not interchangeable and automaticity of decoding does not ensure fluency. Development of word recognition skills has been associated with better reading comprehension skills and this is likely due to automatization of decoding. The fluent reader is able to decode quickly, effortlessly and accurately with appropriate expression. Fluent readers are multi-tasking, decoding, determining syntax and deriving meaning simultaneously.

Comprehension

Vocabulary knowledge is an important component of translating text into meaning. Oral vocabulary serves as a base for the reader to map their knowledge base onto written text. The ability to apply decoding strategies is facilitated by word knowledge and is useful if correct decoding leads to text understanding.

Cognitive Processes Involved in Word Reading

Ehri (1991, 1994) described 4 means of text translation:

1. *decoding* – reader converts letters into sounds and combines them to form a recognizable word, the ability to convert letter to sound comes from knowledge of the alphabet;

2. *sight* – readers retrieve words they know already by memory from sight (automaticity);

3. *analogy*-reader accesses similarly spelled words or word components in memory to pronounce new word with similar structure; and

4. *prediction*-reader applies context, linguistic and background knowledge and memory to text to anticipate or guess meaning of unknown words (top-down; facilitated by knowledge of word-letter associations).

What can we learn from brain literacy research?

Genetic Factors in Reading Disorder

Genetic studies have implicated the separate and joint contributions of chromosomes 1p and 6p to poor performance on measures of rapid automatic naming and phonological decoding but not phonemic awareness, single word reading or vocabulary (Grigorenko, Wood, Meyer, Pauls, Hart, & Pauls, 2001) and for the 6p chromosme this locus is likely to exist in the 6p22.3-6p21.3 region (Grigorenko, Wood, Meyer, & Pauls, 2000). The heritability of **phonological deficits associated with chromosome 6p appears to be influenced by IQ level with stronger heritability in high IQ versus lower IQ individuals** (Knopik, Smith, Cardon, Pennington, Gayan, Olson & DeFries, 2002).

Epidemiological studies report that the base rate of clinical referral and treatment of learning problems was found to be 5 time higher for boys than girls; however, among families with reading disorder the base rate was only 1.4 times greater (Wolff & Melngalis, 1994). There was a higher incidence of reading problems in families in which at least one parent had a reading disorder. The greatest incidence occurred in families with both parents having a reading disorder while the next highest risk factor was associated with reading disordered fathers (Wolff & Melngalis, 1994).). In families with dyslexia, the base rate for offspring to develop a reading disorder was 34% compared to 6% in low risk families.

Will early intervention eliminate reading disorders?

Genetic studies strongly suggest that **the genetic expression of reading disability occurs over an extended developmental period.** Reading problems may emerge gradually over the course of development, rather than discretely or at a specific age.

Reading Disability and Early Language Development

Children at genetic risk for development of reading disorder display early differences (at a few days and 6 months after birth) in brain response to speech sounds and orienting to speech-sounds (Lyytinen, Ahonen, Eklund, Guttorm, Laakso, Leinonen, Leppanen, Lyytinen, Poikkeus, Puolakanaho, & Richardson, 2001).

Evaluation of children that eventually develop a reading disorder has revealed **expressive language weaknesses** in the form of length of utterances, syntactic complexity and pronunciation accuracy at 2 ½ years of age, at 3 years of age **weaknesses in receptive vocabulary and object naming** and at 5 years of age the reading disordered children had **poorer performance on object-naming, phonemic awareness and letter-sound knowledge** (Scarborough, 1990).

At age 5, the best predictor of reading disability was letter-name knowledge (Pennington & Lefly, 2001).

Rapid naming and general literacy skills predicted later reading achievement for youth with reading disorder (Scarborough, 1998).

Studies suggest that children with reading disorder may evidence early language delays.

McArthur, Hogben, Edwards, Heath & Menger, (2000) studied a large sample of children diagnosed as having a specific reading disorder or a specific language impairment. Evaluation of reading and oral language abilities indicated that **55% of reading disordered children displayed impaired oral language skills and 51% of language disordered youth exhibited reading deficiency** suggesting a high degree of overlap between these groups. Research has also revealed that a subgroup of children with reading disorder display global deficits in language functioning (Morris, Stuebing, Fletcher, Shaywitz, Lyon, Shankweiler, Katz, Francis & Shaywitz, 1998).

Not all children with reading disorder necessarily display impairment in phonological processing.

Reading and Processing Speed

A subset of children with reading disorder display marked difficulties with **verbal and visual processing speed** and that may indicate a subtype of reading disorder (Morris, Stuebing, Fletcher, Shaywitz, Lyon, Shankweiler, Katz, Francis & Shaywitz, 1998).

Individuals with impairments in both **RAN and phonemic awareness** had the most severe reading problems when matched on phonological skills individuals with worse RAN scores had poorer performance on timed word recognition and comprehension tests (Compton, DeFries & Olson, 2000).

The ability to rapidly access semantic information based on visual inputs is significantly diminished in some reading disordered youth. The difficulties observed in reading disorder children in rapidly access semantic information in a non-reading context suggests that **poor automatization of decoding may actually reflect a broader impairment in efficient visual-semantic retrieval systems.**

Reading and Executive Functions

In a large community sample of twins, Reading Disability was associated with increased rates of all internalizing and externalizing behavior disorders with girls at high risk for internalizing and boys at higher risk for externalizing disorders (Wilcutt, & Pennington, 2000). The increased risk of internalizing and externalizing behavioral disturbance associated with Reading Disorders is likely due to the **dysfunction in the neurocognitive networks** associated with problems learning to read and problems managing behavior (Grigorenko, 2001).

Deficits in executive functioning are primarily associated with ADHD and not reading disability; however, children with Reading Disorder and Co-morbid ADHD display executive function impairments. Willcutt, Pennington, Boada, Ogline, Tunick, Chhabildas & Olson, 2001 & Klorman, Hazel-Feernandez, Shaywitz, Fletcher, Marchione, Holohan, Stuebing, & Shaywitz, 1999).

Children with RD display high rates of rule violations on the tower of Hanoi suggesting some **difficulties with self-monitoring during problem solving** (Klorman et al, 1999).

Children with reading disabilities that tend to read quickly but have high error rates compared to reading disorder children that read slowly but accurately display significant **problems with inhibiting pre-potent responses on measures of executive functioning** (van der Sloot, Licht, Horsley, & Sergeant, 2000).

Behavior Associated with Deficits in Executive Functions

1. Disinhibition-lacks behavioral control, impulsive
2. Perseveration-repeats non-functional behavior, inability to change behavior despite corrective feedback, difficulties learning from experience
3. Forgetfulness-off-task behaviors, mental errors, loses track of what they were doing

4. Inefficiency-takes more steps to complete task than necessary
5. Difficulty understanding consequences and cause-effect relationships
6. Frequently violate rules despite apparent knowledge of the rules
7. Apathetic-lacks motivation, does not set goals, engages in behavior only when prodded

8. Difficulties accessing knowledge
9. Concrete thinking
10. Emotional lability
11. Poor frustration tolerance
12. Disorganized
13. Inconsistent performance on tasks within ability range
14. Difficulties coping with change
15. Poor judgment

The presence of both disorders (ADD and Reading Disorder) has been associated with **significant deficits in executive functioning** (Seidman, Biederman, Monteaux, Doyle, Alysa & Faraone, 1001), while children with Reading disorder alone were more likely to have **phonological processing deficits and poor working memory** rather than difficulties with inhibitory control (Purvis & Tannock, 2000; Willcutt, Pennington, Boada, ogline, Tunick, Chhabildas, Nomita & Olson, 2001) or cognitive rigidity (Klorman, Hazel-Fernandez, Shaywitz, Fletcher, Marchione, Holohan, Stuebing, Shaywitz & Bennet, 1999).

Reading and Memory

Fletcher (1985) reported that children with reading-spelling disorders **performed more poorly than controls on a verbal list-learning task but not on a visual memory task.** On the *California Verbal Learning Test-Children's Edition*, Kramer, Knee & Delis (2000) reported that children with dyslexia recalled fewer words compared to controls, they learned the word list at a slower rate and they recalled fewer items on the last learning trial and on delayed recall trials.

Delayed memory impairment is associated with reading disorder but not ADD (Kaplan, Dewey, Crawford, Fisher & Geoffrey, 1998). Children with reading disorder appear to have **less efficient rehearsal and encoding skills for processing verbal information** (Kramer et al, 2000).

Verbal short-term memory impairment is present in some children with reading disability (Morris, Stuebing, Fletcher, Shaywitz, Lyon, Shankweiler, Katz, Francis & Shaywitz, 1998).

Immediate memory performance has been found to predict the development of reading decoding skills (Meyler & Breznitz, 1998).

Visual-verbal paired associate learning independent of phonological processing predicts development of word decoding skills in children (Windfuhr & Snowling, 2001).

Visual and verbal short-term memory skills (in non-paired learning paradigms) also predict the development of decoding skills in children (Meyler & Zvia, 1998).

Short-term memory functioning relates to level of reading performance among children with reading disabilities (Kirk & Rattan, 1991).

Reading and Working Memory

Wilcutt et al (2000) found **verbal working memory deficits** were associated with Reading Disorder and not ADHD. de Jong (1998) found reading disorder youth deficient on all language and numbers based auditory working memory tasks. Deficits in working memory performance occur in both visual and verbal domains and are related to difficulties in cognitive resource allocation associated with the “central executive” storage system.

Performance on working memory tasks has been found to predict reading comprehension performance in non-disabled readers above the effects of decoding and vocabulary abilities (Seigneuric, Ehrlich, Marie-France, Oakhill & Yuill, 2000). Increasingly, working memory is becoming an important construct in the understanding of cognitive difficulties experienced in a variety of clinical conditions.

Comprehension and Verbal Intellectual Ability

The presence of fast decoding skills alone does not necessarily result in good comprehension (Faulkner, Barnes & Dennis, 2002). Additional processes such as listening comprehension (Faulkner et al, 2002), working memory (Palladino, Cornoldi, De Beni & Pazzaglia, 2001) language/semantic abilities (Nation, Adams, Bowyer-Crane, Claudine & Snowling, 2000) and **verbal intellectual ability (Hatcher & Hulme, 1999) have also been found to relate to reading comprehension abilities.**

In Summary

1. Children identified as poor readers (decoding and comprehension) display deficits in **auditory working memory and phonological short-term memory.**

2. Children with poor reading comprehension but not impaired decoding exhibited deficits in **auditory working memory but average phonological short-term memory**.

3. Auditory working memory predicts reading comprehension in both skilled and disabled readers and predicts components of writing ability.

4. Auditory working memory tasks that contain an element of storage and active manipulation of the information are good predictors of language comprehension, in general.

5. Verbal intelligence has been found to predict reading decoding and comprehension abilities in children.

6. Verbal intelligence accounts for a large amount of the variance in a variety of language based skills.

7. Rates of response to intervention for reading comprehension relate to verbal ability. Among low SES children, verbal ability differentiated the children that would attain average reading versus those that would develop below average reading.

Linking Research to Assessment

Multiple Meanings of Assessment

- Assessment of component reading skills, processes related to reading, and components of curriculum
- Process Assessment: Test results + clinical observations + clinical hypothesis testing
- Assessment of response to instruction

Nature-Nurture Interaction

- Learner's skills result of (a) individual's processing abilities at a specific time in development, AND (b) instructional environment (curriculum, instructional materials, and teaching approach and practices)
- Assess both the student and the instructional environment

WISC IV and CMS

WISC IV Composite	CMS General Memory	CMS Attention/ Concentration	CMS Learning
Verbal Comprehension	.54	.58	.42
Perceptual Reasoning	.46	.55*	.33
Working Memory	.52	.74	.49
Processing Speed	.29	.37	.18

*** Correlation between WISC III PIQ and CMS A/C was .45 (Cohen, 1997)**

WISC IV VCI and WIAT II

VCI and Reading Composite	.74
VCI and Math Composite	.68
VCI and WL Composite	.67
VCI and OL Composite	.75
VCI and Total Achievement	.80

WISC IV WMI and WIAT II

WMI and Reading Composite	.66
WMI and Math Composite	.64
WMI and WL Composite	.64
WMI and OL Composite	.57
WMI and Total Achievement	.71

WISC IV PSI and WIAT II

PSI and Reading Composite	.50
PSI and Math Composite	.53
PSI and WL Composite	.55
PSI and OL Composite	.49
PSI and Total Achievement	.58

WISC IV LD - Reading

	RD	Match	Diff	Effect
VCI	91.9	100.9	9.0	.89
PRI	94.4	99.3	4.9	.48
WMI	87	99.8	12.8	1.10
PSI	92.5	98.6	6.16	.53

N=56 children aged 7—13 who met DSM IV-TR diagnostic criteria for Reading Disorder.
Largest effect sizes were noted for Vocabulary, Letter-Number Sequencing, Information, and Arithmetic.

WISC IV LD – Reading & Writing

	RWD	Match	Diff	Effect
VCI	94.8	101.3	6.5	.49
PRI	98.0	101	3.1	.25
WMI	90.2	100	9.8	.77
PSI	90.6	102	11.4	.87

N=35 children aged 8—13 who met DSM IV TR diagnostic criteria for both Reading Disorder and Writing Disorder. LD-R is distinguished from the LD-RW group by the PSI which seems to play a larger role in LD-RW.

WISC IV
LD – ADHD

	LD/AD	Match	Diff	Effect
VCI	92.7	103.1	10.4	.72
PRI	92.7	101.9	9.2	.64
WMI	88.7	100.9	12.2	.88
PSI	88.2	100.5	12.3	.94

N=45 children aged 8—13 who met DSM IV TR diagnostic criteria for both Learning Disorder and ADHD. About 65% of the ADHD children were on medication.

WISC IV
ADHD

	ADHD	Match	Diff	Effect
VCI	99.0	102.5	3.4	.26
PRI	100.1	102.3	2.2	.16
WMI	96.1	101.7	5.6	.38
PSI	93.4	100.7	7.3	.59

N=89 children aged 8—13 who met DSM IV TR diagnostic criteria for ADHD. About 64%of the ADHD children were on medication. The largest effect sizes occurred on the Coding and Arithmetic subtests.

Tables and Graphs Report for WISC-IV and WIAT-II

Ability-Achievement Discrepancy Analysis
Date of Ability Testing: 6/6/2003
Ability Score Type: FSIQ
Ability Score: 101

Simple-Difference Method

	FSIQ Score	WIAT-II Score	Diff.	Critical Value	Sig. Diff. Y/N	Base Rate
WIAT-II SUBTEST						
Word Reading	101	72	29*	7.74	Y	<1%
Reading Comprehension	101	83	18*	9.48	Y	5%
Pseudoword Decoding	101	75	26*	8.65	Y	2-3%
Numerical Operations	101	103	-2	16.42	N	
Math Reasoning	101	91	10*	12.24	N	15-20%
Spelling	101	88	13*	11.61	Y	10-15%
Written Expression	101	78	23*	15.48	Y	2-3%
Listening Comprehension	101	84	17*	17.31	N	5%
Oral Expression	101	83	18*	14.48	Y	10-15%
COMPOSITES						
Reading	101	75	26*	7.74	Y	<1%
Mathematics	101	96	5*	12.24	N	>25%
Written Language	101	82	19*	11.61	Y	4%
Oral Language	101	81	20*	13.41	Y	3%
Total	101	80	21*	8.65	Y	<1%

Statistical Significance (Critical Values) at the .01 level
*Greater than or equal to critical difference of 0 points
Base Rates are not reported when the achievement score equals or exceeds the ability score.