Reading Disabilities in Childhood and Adolescence:

What research has taught us about the core learning deficits and how to provide effective remediation

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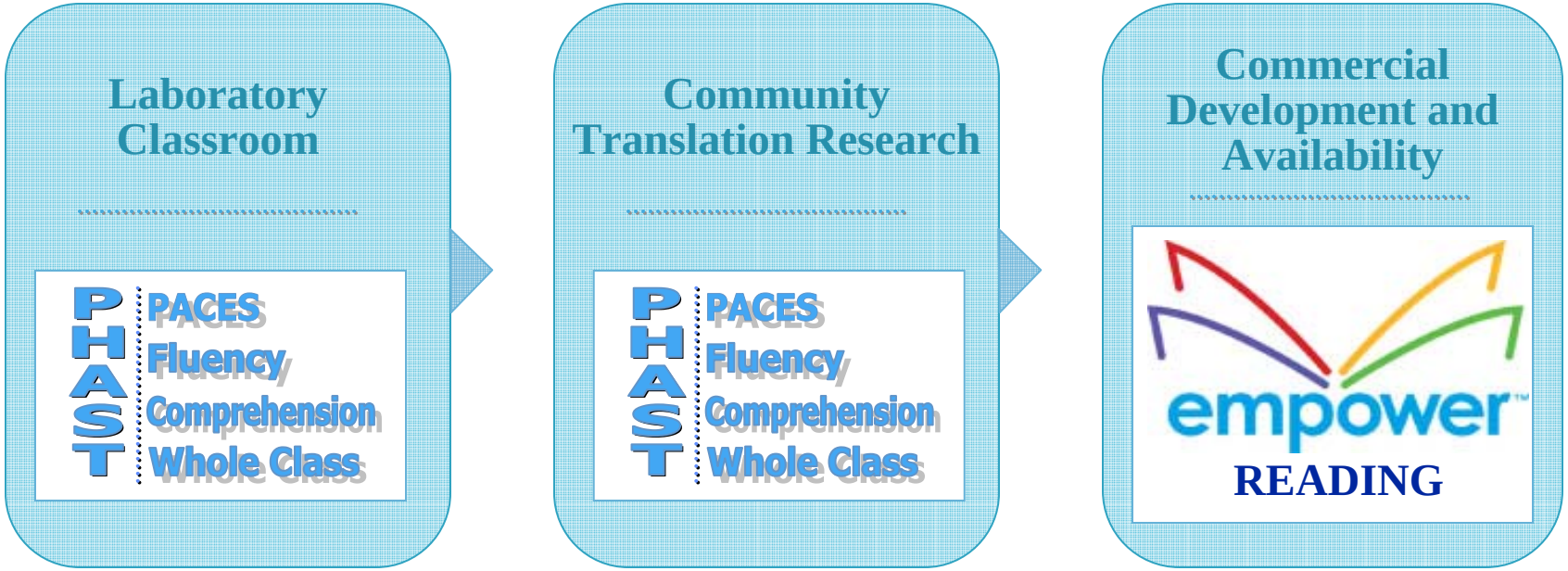
LDRP Reading Programs

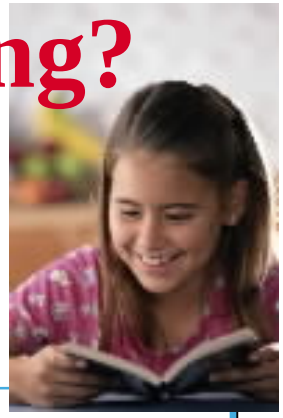
Roll-Out



PHAST Reading Programs are the research versions of Empower™ Reading

Health sciences and literacy learning?

Effective evidence-based treatments for better literacy outcomes and . . .



Improved mental health outcomes.

Reduced maternal and infant mortality rates and healthier families.

Increased occupational and economic opportunities.

Access to post-secondary education.

Participation in information age.

In 2003, 42% of adult Canadians lacked the literacy skills considered necessary to cope in modern society.

More than 3 million adult Canadians are barely literate.

Literacy scores have dropped for young Canadians aged 16-25 whose parents had little education.

Reading disability is the *most common* neurodevelopmental disorder of childhood affecting 10-15% of normally developing children.

(Lyon, 1995)

PART 1:
An Overview of Developmental Reading Disabilities:

What we know about etiology, developmental profiles, and the core deficits

Reading Disabilities:

A Model for the Study of Developmental Disorders

- Unexpected failure to learn a complex system of skills in otherwise normally developing children.
- High prevalence: 10-15% estimated for the school-age population.
- Solid evidence of heritability.
- Known neurobiological substrates.
- Defining deficits in word reading domain.
- Signature neurocognitive deficits.

  Speech/Language: Inability to manipulate individual speech sounds in words ("phonological awareness").

What is *dog* without the *d?*	"ob"
What is *tip* without the *t?*	"it"
What is the first sound in *wish?*	"s"
What does *'b-r-i-ck'* say?	"birk"

Comorbidity is *Very* Common!

Dyslexia

- 15-40% also have ADHD
- About 50% also have language impairments

ADHD

- 25-40% also have dyslexia
- About 50% also have language impairments

Math Disabilities

- 26% also have ADHD
- 17% also have RD

Neurobiological Substrates:
The Genetics of Reading Disability

- **Reading ability and reading disability are both familial and heritable.**

- **Family history is one of the most important risk factors:**
  - Parent with RD → 23-65% risk to the child.
  - Siblings of RD individual → 40% risk.
  - Parents of RD individual → 27%-49% risk.

(Pennington & Gilger, 1996; Scarborough, 1998)

Genetics of Reading Disability

Two strong linkage findings replicated for:

Chromosome 6 (6p just distal to the HLA)

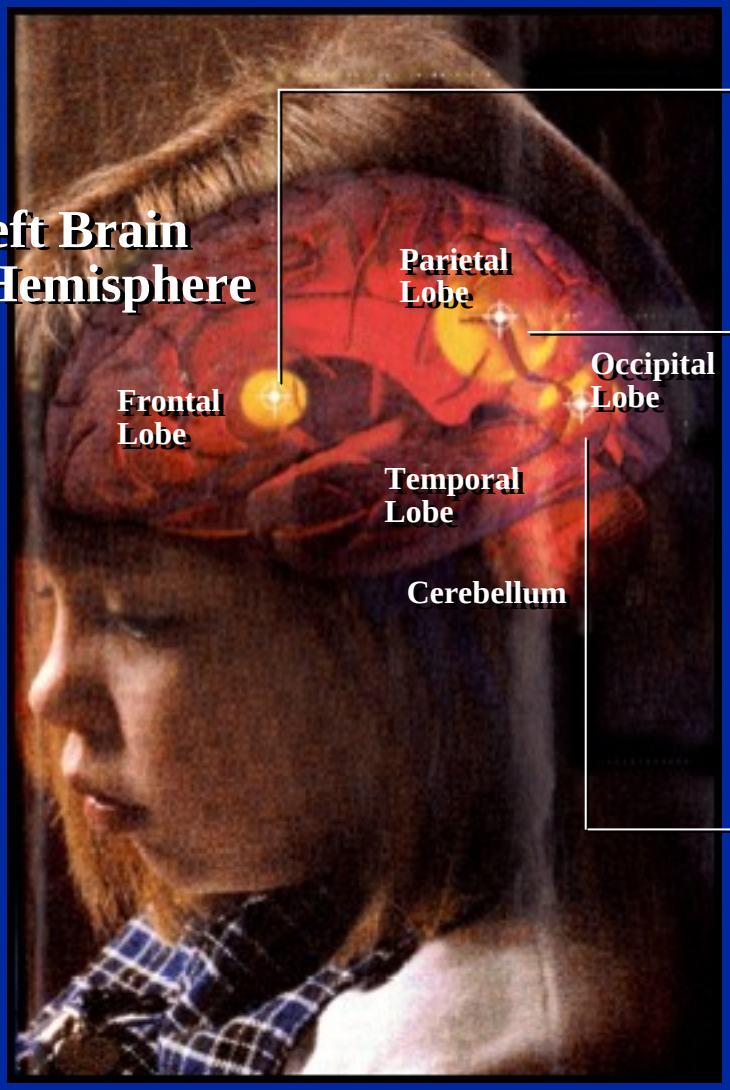
Smith & Kimberling, 1991
Fisher et al., 1999
Cordon et al., 1994
Gayán et al., 1999
Grigorenko et al., 1997
Grigorenko et al., 2000
Petryshen 2001

Chromosome 15

Smith et al., 1983
Schulte-Körne et al., 1999
Grigorenko et al., 1997
Morris et al., 2000
Turic et al., 2003
Nopola-Hemmi et al., 2000

- Evidence for linkage or association also on Chromosomes 1 (Grigorenko 2001), 2 (Fagerheim 1999), 3 (Nopola-Hemmi et al., 2001), and 18 (Fisher 2002).
- Locus heterogeneity exists (different chromosomal regions in different families).

How the Brain Reads Words



In a normal response . . .

1

The Phoneme Producer

Left inferior frontal gyrus

This section of the brain helps a person vocalize words—silently or out loud. It also starts to analyze phonemes, the smallest sounds that make up words. Cat, for example, contains three phonemes: /k/, /a/ and /t/. This section is especially active in the brains of beginning readers.

2

The Word Analyzer

Left parieto-temporal area

This section of the brain does a more complete analysis of written words. Here they are pulled apart into their constituent syllables and phonemes, and letters are linked to the appropriate sounds.

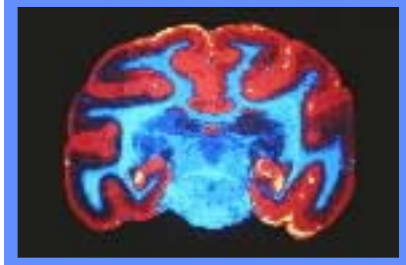
3

The Automatic Detector

Left occipito-temporal area

This section of the brain is to automate the process of recognizing words. The more the automatic detector is activated, the better it functions. Skilled readers can breeze through print with assembly-line-like speed.

—Source: *Overcoming Dyslexia*, by Sally Shaywitz M.D.; TIME Graphic by Lon Tweeten.



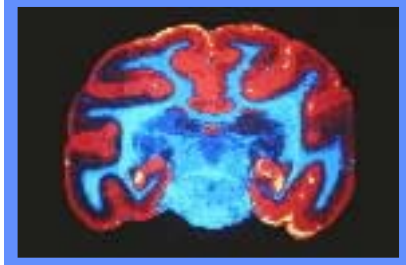
With normal readers . . .

As reading skill increases, brain activation increases in neural subsystems that subserve reading (B.A. Shaywitz et al., *Biological Psychiatry*, 2002).

With disabled readers…

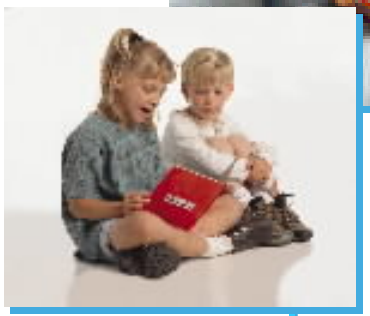
Effective use of an evidence-based reading intervention (Blachman et al., 2005) leads to normalization of brain activation profiles and development of neural subsystems both in anterior and posterior brain regions (B.A. Shaywitz et al., *Biological Psychiatry*, 2004).

Effective Remediation Impacts Brain *and* Behaviour



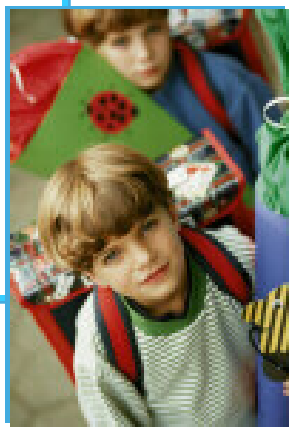
Effective phonologically-based remediation facilitates the development of those neural systems which underlie skilled reading.

(S.E. Shaywitz et al., *Biological Psychiatry*, 2005)



Preschool Signs:

- Cannot rhyme,
- No language play . . .

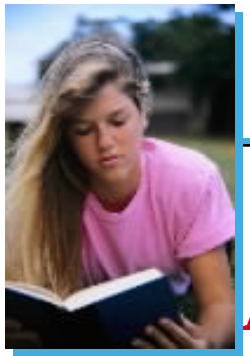


School-Age Problems:

Learning letter-sounds, sight words, spelling, written expression, slow reading rate, separating sounds in words . . .

Speech/Language Problems of Disabled Readers

- Poor discrimination of speech sounds. *("Did you see the Seven Wharfs?")*
- Difficulty attending to or remembering language spoken rapidly.
- Trouble finding the right word. *("Eskimo cabin"* for *igloo; "an imagination horse"* for *unicorn)*
- Problems learning correct grammatical forms. *("A apple and a peach—you both eat them.")*



Adolescence: Generalized Effects

- Poor academic performance in several areas
- Problems reading for information, taking notes, report writing
- Low self-esteem; social consequences
- Misguided beliefs about effort and achievement

A profile of less specificity over time?

Specific reading disabilities become associated with:

- Global deficits in reading comprehension.
- Poor strategy use in content area learning.
- Widespread academic underachievement in higher grades. *(Moats, 1994)*

Long-Term Outcomes

- **Reading ability improves with age and intervention for most RD children.**
- **RD symptoms persist into adulthood, particularly in severe cases.**
  - Phonological deficits persist, even in cases with good outcomes.
  - Problems with spelling, word recognition speed, and reading rate. *(Bruck, 1992, 1997; Scarborough, 1984)*
- **A deficit rather than a developmental lag model of reading disorder.** *(Francis et al., 1996)*

Argentine woman, at 110, takes up reading lessons

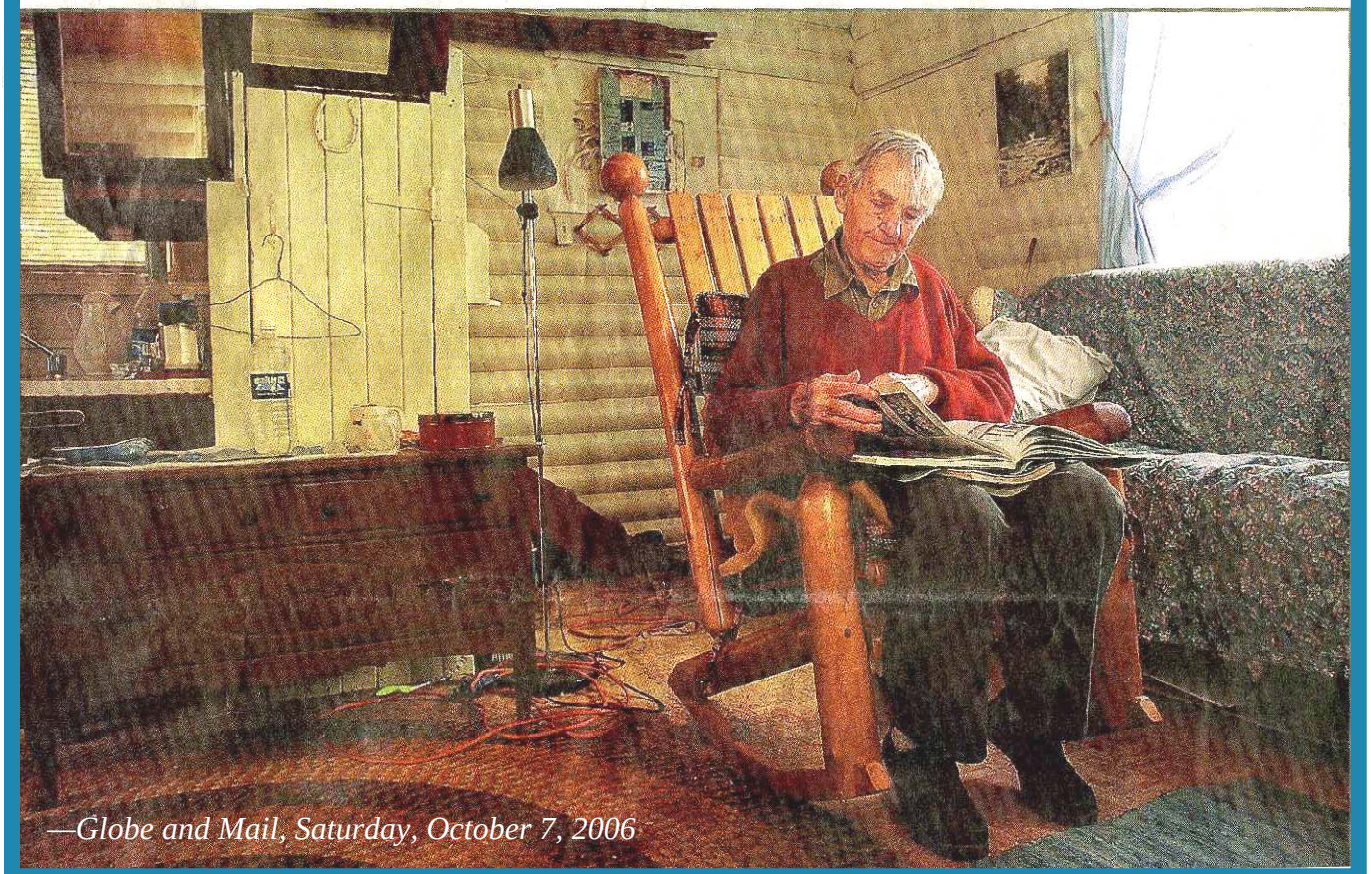
BUENOS AIRES, Argentina—

Saying she still hopes to live many more years, an illiterate 110-year-old Argentine woman has started learning to read and write to prepare herself for the challenges of the next century.

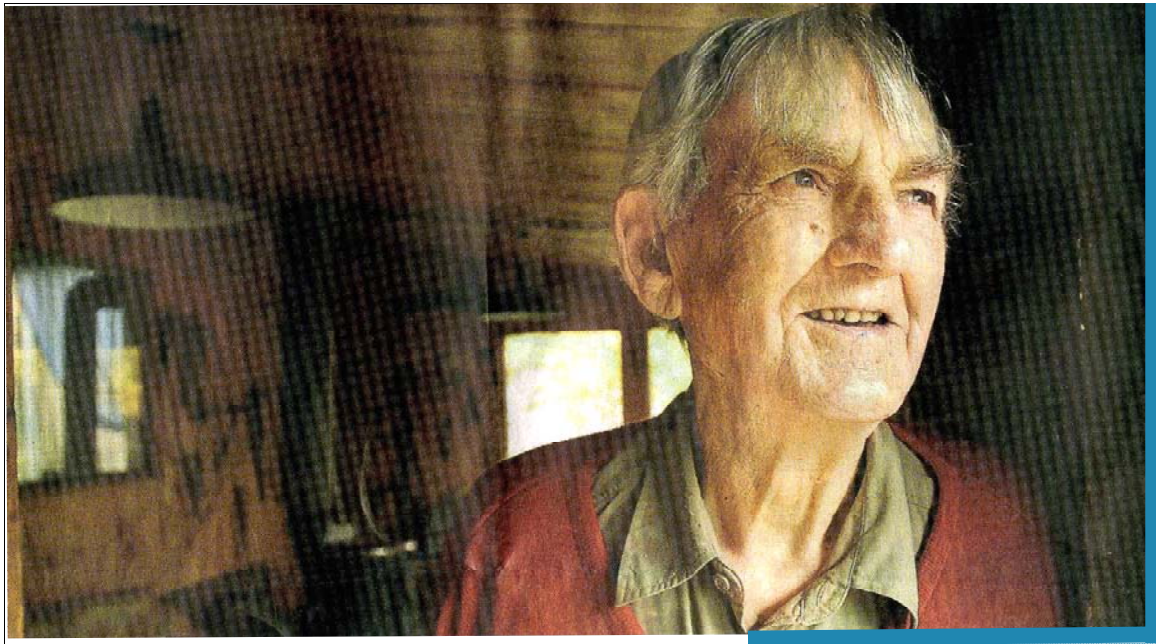
"I want to learn reading and writing as one has to be prepared for the future," said Concepción Fernández, who lives in the northern province of Chaco. . .

—Reuters News Release, 1999

Learning to read at 93



—Globe and Mail, Saturday, October 7, 2006



Learning to read…

…at 93

“It all started with junk mail.”

Clarence Brazier is about to spend the better part of a day telling one of the most remarkable stories this country holds.

It is the tale of a boy who took over the family farm by age 7, a youngster who survived the Spanish flu, became a logger and miner who survived various close brushes with death, a wood supplier who finally gave up his chainsaw at age 99 and who, at 100, has perfect vision, a full head of hair and can get out of his easy chair so quickly he sometimes looks like a gymnast executing a kip-up.

But none of this is remarkable.

Not compared with what Clarence Brazier decided to do at age 93 and accomplished by the time he was 95.

He learned to read.

—Globe and Mail, Saturday, October 7, 2006

The Hospital for Sick Children's
LEARNING DISABILITIES RESEARCH PROGRAM

Developing and evaluating methods of remediating language learning problems in children

(>3000 children and adolescents seen in our laboratory classrooms…..)