# Recent Advances in Understanding Word-Level Reading Problems: Assessment and Highly Effective Intervention

Greater Rochester Association of School Psychologists

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# Today's Objectives

1. Understand "sight vocabulary" development & fluency
2. Understand why some students struggle
3. Learn the "elusive" research based reading interventions

- My real goal is to "whet your appetite" to embark on a course of self-study so you can become a "conduit" of empirical reading research to your schools.

- Dr. Larry Lewandowski's comment

# Key Terms to Understand this Presentation

- Auditory vs. phonological
- Phonological vs. phonemic
- Orthography and orthographic
- Phonological awareness vs. phonics
- Decoding
  - Phonic decoding and word-level reading
- Sight word and sight word vocabulary
  - Also called orthographic lexicon

# Important Note About Dyslexia

- Multiple definitions – organizations and popular
- Researcher Definition:

  Word-level reading difficulty despite adequate opportunity, effort

  (all else is popular lore that's been with us for over 100 years)

  - October 2017 – boost from the chair of the UK Reading Panel
  - Common qualifiers in research studies:

    Not due to blindness, deafness, emotional disturbance, or low IQ

A problem translating research to practice:

*Where do we draw the line?*

# Another Important Note About Dyslexia

- Relationship to SLD in IDEA
- Relationship to IDEA in general
  - Cuts across many disability categories
- Via "operational definitions," researchers reserve the term "dyslexia" for those with normal intelligence
- The three types of reading difficulty
  - Dyslexia
  - Hyperlexia
  - General Poor Reader (or combined or GVPR)
- Poor word-level reading has the same cause regardless of IQ (aside from severe & profound intellectual disabilities)

# The Phonological-Core Deficit of Dyslexia

- From the “most common cause” to the “universal cause”
- Weakness in one or more of the following:
  - Phonemic awareness/analysis
  - Phonemic blending/synthesis
  - Rapid automatized naming
  - Phonological working memory
  - Nonsense word reading, letter-sound knowledge acquisition
- Typically more than one of these, sometimes all
- Very well established with no substantive alternatives

# Diagnosing a Reading Disability

# The School Psychology Landscape as it Relates to Reading

- Behavioral psychology camp
  - Learning theory; task analysis, practice, & reinforcement
  - Reluctant to acknowledge the mound of empirical research on WM, RAN, but will at least acknowledge PA
    - But they demonstrate no clear understanding of where it fits in
- Cognitive/IQ assessment camp
  - Patterns of strengths and weaknesses
  - Cross Battery Assessment
- Neuropsychology camp
  - Cool stuff but not much help for instruction/intervention
  - Some focus on the un-validated subtypes of dyslexia
- Broader reading research field camp
  - Virtually non-existent “camp” in the school psychology field

# The School Psychology Landscape as it Relates to Reading

- Reading research in school psychology is self-generated
  - We are asked to evaluate students with reading problems
  - We are expected to make evidence-based recommendations
  - We apply familiar empirical endeavors to the problem
    - Learning theory, cognitive/intellectual info, neuropsychology
  - Most research in school psychology is unfunded & smaller scale
- However . . .
  - There is little or no awareness or interaction with the broader reading research field (the parallel empirical universe)
  - All recommendations based on these conventional approaches yield 0-5 standard score point gains in reading, often lost at follow up
  - *The broader reading research has generated much better results!*

# FINDINGS FROM READING RESEARCH

## WORD-LEVEL READING SKILL DEVELOPMENT AND WORD-LEVEL READING DIFFICULTIES

# The Problem

- Reading problems
  - NAEP, behavior, self-esteem, graduation, college & career
- The gap between research and practice
  - Documented for general & special education teachers, teacher trainers, and school psychologists

# Bigfoot and the Loch Ness Monster

- Claims about the gap between research and practice seem to stretch credulity
  - Millions of grants dollars are spent each year and nobody in our educational system knows about it!?
- Who's claiming that?
  - American Federation of Teachers
  - Journal of Learning Disabilities
  - U.S. Government
  - Society for the Scientific Study of Reading
- No one is to blame for this gap
  - We all do the best we can with what we know

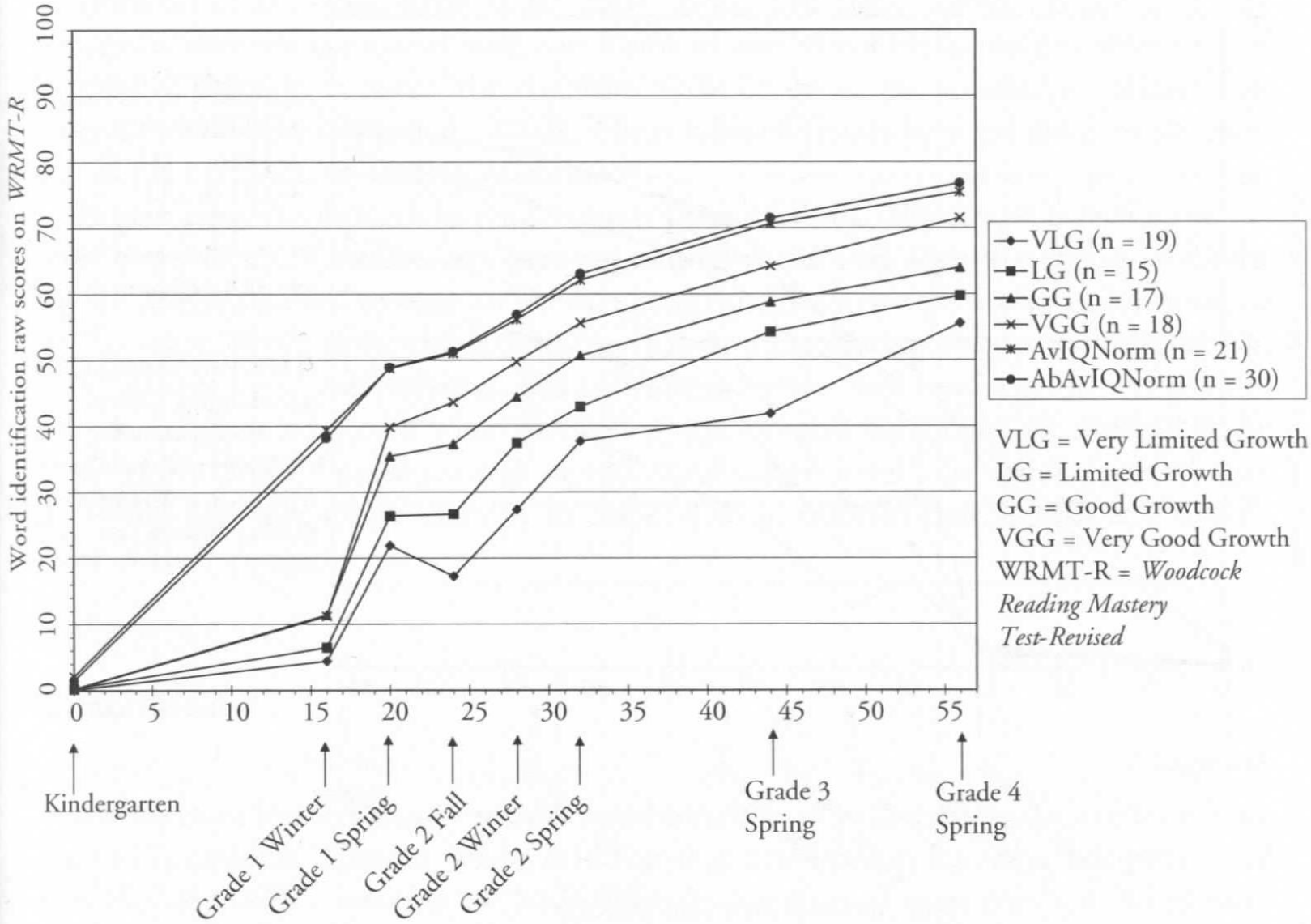
# The Largely "Untapped" Intervention Research

## *The little known origins of RTI* (Part 2)

- **TIER 1**: Prevention research in 1980s-1990s
  - 50%-75% reduction in reading problems
    - (reviewed by the *National Reading Panel*, 2000)
- **TIER 2**: Vellutino, et al. (1996) *Journal of Educational Psychology*
  - Reduced RD kids down to 3% under 30th %ile & 1.5% under 16th %ile!
  - Results maintained 3 years later
- **TIER 3**: Torgesen et al., (2001) *Journal of Learning Disabilities*
  - Severely RD 3rd to 5th graders (average score = bottom 2%)
  - Average improvement was 14 SS points; then 18 points 2 years later
  - 40% discontinued from special educational reading support
  - Replicated with older students and adults
    - There is no 'statute of limitations' on reading improvement

# Vellutino et al. (1996) Long Term Results





# *The Little Known Origins of RTI*

- Doesn't this all sound too good to be true?
  - RTI was designed to "capture" these amazing results
- However, the implementation focus has been on the
  - Universal screenings for RTI (finding at-risk students)
  - Structure of RTI (tiers, group sizes, session frequency/length)
  - Progress monitoring for RTI (determining degree of success)
  - Process of RTI (criteria for moving through the tiers)
  - Determining SLD via RTI (encouraged by IDEA 2004)
- The instructional approaches that produced these highly successful outcomes were lost in transition
  - Those highly successful intervention approaches will be covered later
  - **Quick quiz question about your Tier 1 . . .**

# The Simple View of Reading

A Empirically Well Validated Framework for Assessment and Intervention

# The Simple View

Reading Comprehension is the Product of:

Decoding

and

Linguistic Comprehension

RC = D x LC

# The Simple View

Reading Comprehension is the Product of:

Word-Level Reading
and
Language Comprehension

RC = WLR x LC

# Case Studies

- Steve - Grade 6 (LD)
  - Decoding is at the late first grade level
  - Language Comprehension average (IQ = 106)
- Kevin - Grade 7 (TBI?)
  - Decoding is at the beginning first grade level
  - Listening Comprehension is age appropriate

D = 0; LC = 1;  Therefore 0 x 1 = 0

# More Case Studies

- Andrea - Grade 6 (SLI)
  - Decoding is at the 6th grade level
  - Language Comprehension is 1st grade level
- Erin - Grade 5 (ID; Down's syndrome)
  - Decoding is on grade level
  - Listening comprehension is kindergarten level

D = 1; LC = 0;  Therefore 1 x 0 = 0

# The Simple View Challenge

- Find a skilled decoder with good language comprehension who struggles with reading comprehension
- Find a student with very weak decoding or weak language comprehension (or both) who is doing well in reading.
- What then, is Reading Comprehension?

# Should We Teach Reading Comprehension Strategies?

- Yes, because
  - Research has shown the effectiveness of teaching reading comprehension strategies
  - Language development involves oral and printed language - reading comprehension strategies apply to listening comprehension and vice versa
- But,
  - While reading comprehension strategies help all students, they have less impact on students with decoding problems
  - With these students, it won't close the "gap"

# Reading Comprehension = D x LC

Decoding (Word-Level Reading)
is based on:

1. Cipher Knowledge
   - Code vs. Cipher
     - 007
     - Kbnft Cpoe
2. Word Specific Knowledge
   - Regular and irregular words
   - Based to a large degree on cipher knowledge

# Reading Comprehension = D x LC

Language Comprehension is based on:

1. Verbal IQ/Receptive Language
2. Background Knowledge
3. Executive Functioning Skills
4. Inferencing
5. Visual-Spatial/Imagery skills
6. Working Memory

# Language Comprehension (LC)

- Less commonly the source of reading comprehension difficulties than decoding
- Research on LC related to reading comprehension is far behind research on decoding
  - The nature and relationship of the LC components are less clear than with decoding

# "Exceptions" to the Rule

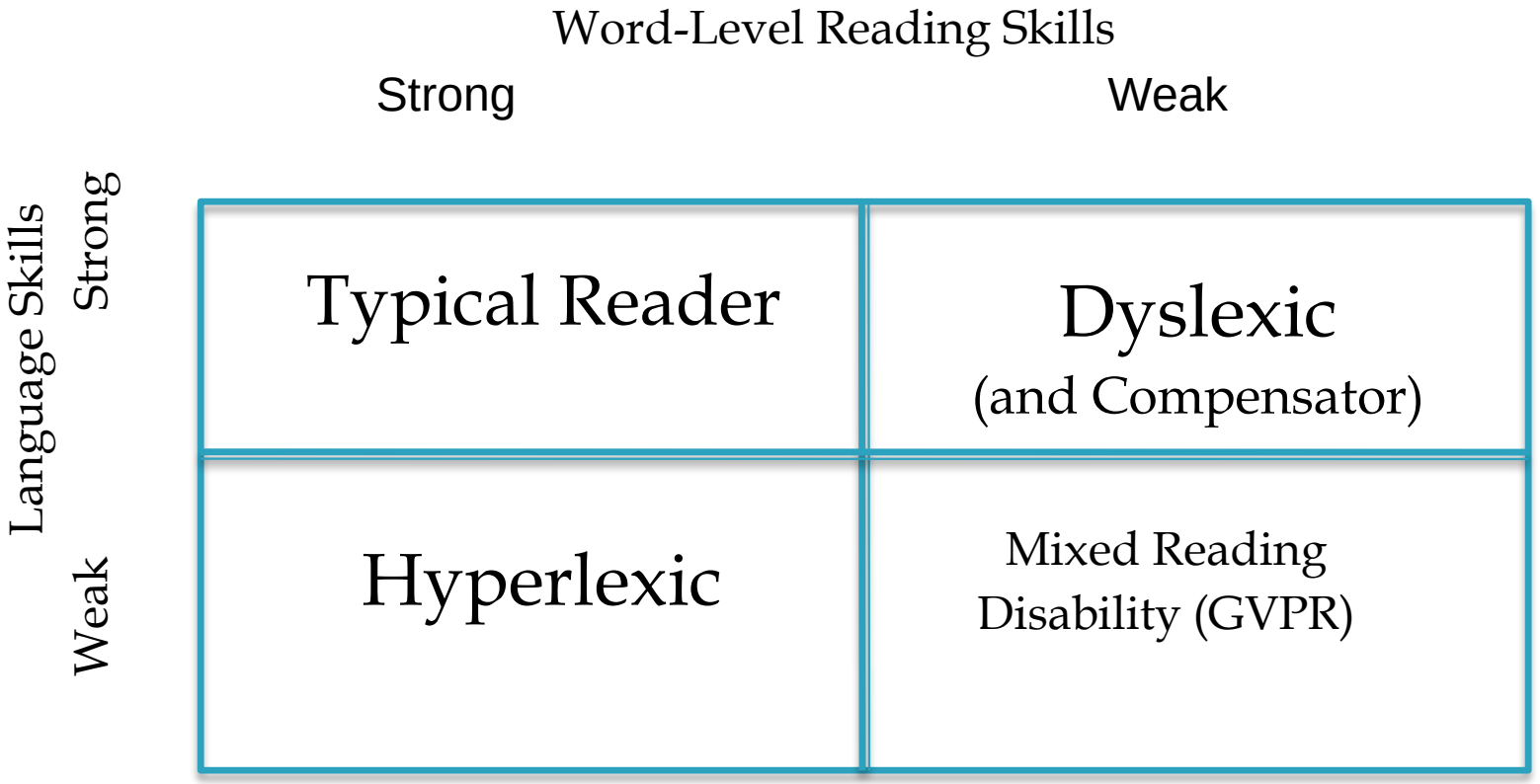
- I've tested students with this pattern:
  - Good LC and "fluent" word reading
  - Yet poor reading comprehension!
- Does this contradict the Simple View?
- Yes - but no . . .
  - These students had 1) good phonics, 2) poor phonemic awareness, and 3) poor working memory
- "Fluent" reading was very effortful for them
  - Little working memory capacity left for comprehension
- These students are "compensators"

# Simple View of Reading (SVR)

- Explains the three well established RD subtypes
  - DYSLEXIA—Good language comprehension, poor word reading
    - Most LD struggling readers and many ED kids fit this pattern
  - HYPERLEXIA—Good word reading, poor language comprehension
    - Some kids with SLI, ID, and Autism fit this pattern
    - Often not detected until late elementary school
  - MIXED or COMBINED TYPE—Poor language comprehension, poor word reading
    - Most kids with SLI & ID, some LD, ED, Autism fit this pattern
  - (Compensator—Strong language skills, poor word reading)
    - Not as well studied as the other three
    - Typically high IQ with mildly dyslexic pattern
    - Reading skills average, far below potential, reading is a chore and they avoid it

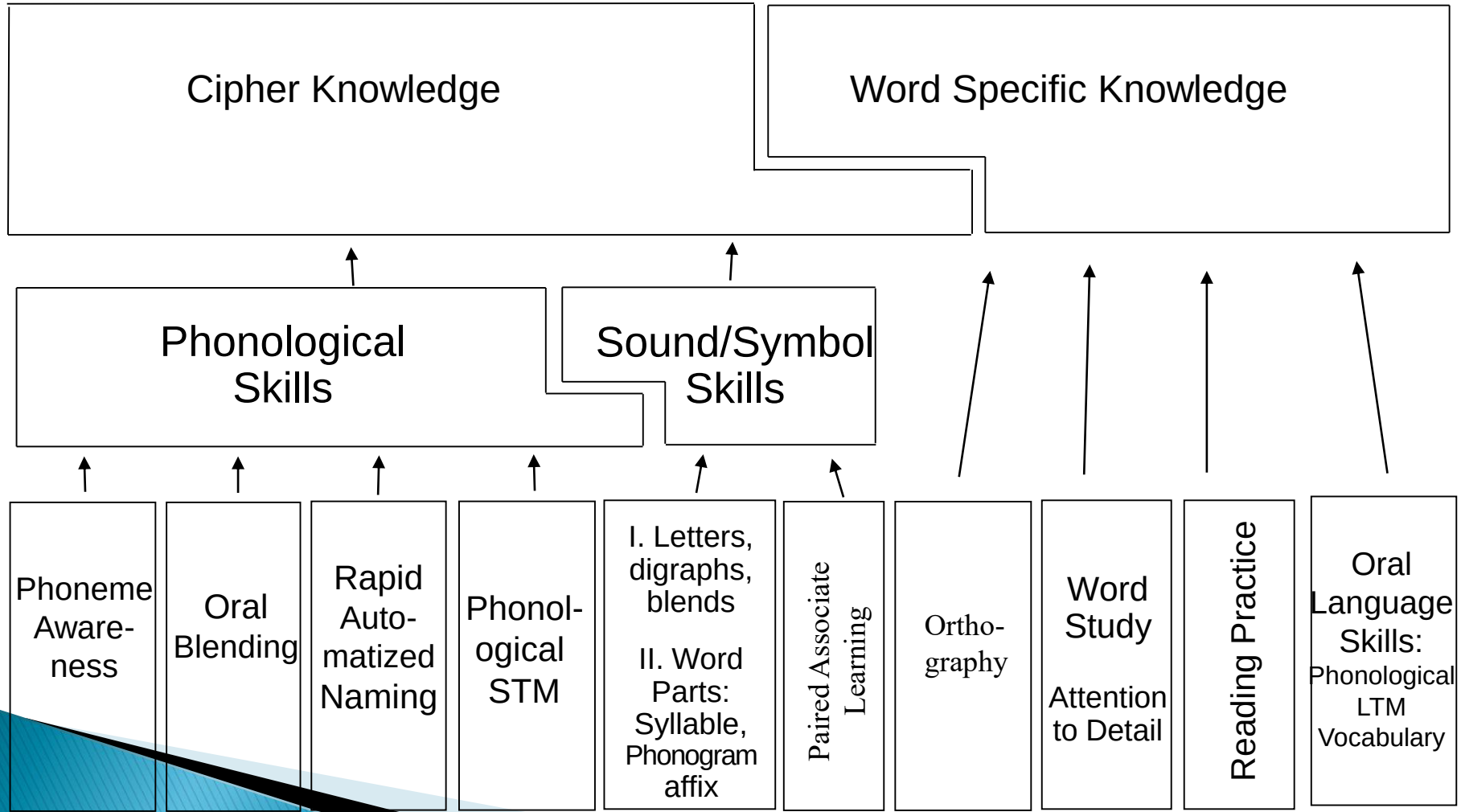
# Empirically Established Subtypes of Reading Difficulties

## Consistent with the Simple View




Note that each of these subtypes (except compensator) has extensive research support

# Decoding (Word-Level Reading)



# Implications of this information

- These factors account for over 90% of the (practical) statistical variation among good and poor readers
- This suggests there are no mysterious factors affecting reading growth, including LD!
- These components provide direct and systematic guidance for our prevention and intervention efforts

# The Simple View of Reading (SVR) and the Psychoeducational Assessment of Reading

# First Step

Reading Comprehension is the product of:

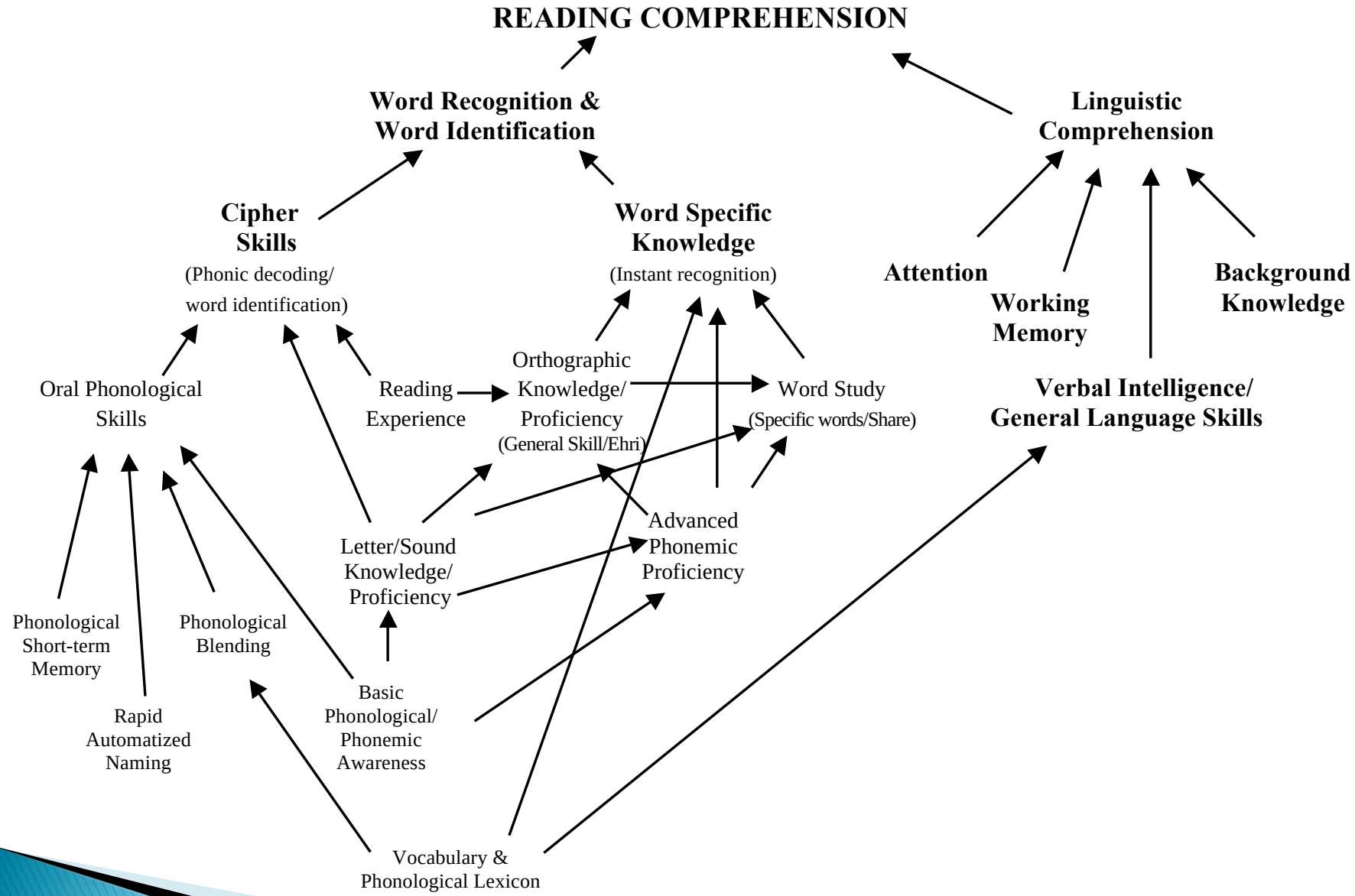
LANGUAGE COMPREHENSION and

WORD-LEVEL READING

- The first diagnostic question of any student struggling in reading comprehension is:
- *What if you read it to him or her?*

# THE SIMPLE VIEW OF READING

(Originated by Philip Gough and colleagues and expanded by others. This expanded version by David Kilpatrick)



# The Two Levels of Skilled Word Reading

# Two Levels of Word-level Reading

1) The ability to sound out unfamiliar words
   - Researchers call this *phonological recoding, decoding*, or applying *grapho-phonemic correspondences* (GPCs)
   - Based primarily on letter-sound skills & phonemic blending
     - Also aided by knowledge of phonically regular patterns
2) The ability to remember words
   - Instant, *effortless* recognition
   - Unrelated to visual memory
   - Words are remembered via orthographic learning
   - Based on phonemic analysis skills and letter-sound skills

# Word Reading Level 1: Accurately Sounding Out Unfamiliar Words

- All skilled readers of alphabetic writing systems *learn* this skill, whether we *teach* them or not
- Most weak readers do not naturally develop this skill
- Phonics instruction can reliably develop this skill if a student has sufficient basic phonological skills
- Promotes word memory in typical readers (Share's theory of orthographic learning) but not weak readers
- The term "phonics" is a lightening rod for controversy, yet is required for skilled reading

# Word Reading Level 2: The Ability to *Efficiently* Remember Words

- Requires Level 1: Skill at sounding out new words
  - David Share's self-teaching hypothesis
- Letter-sound skills and phonemic skills also central
- Not addressed by any current reading approaches
  - Exposure only produces word memory for those already possessing word memory skills (i.e., good orthographic memory)
- Weak readers may become competent at Level 1 (sounding out words), but virtually *never* at Level 2 (efficiently remembering words)

# Three Types of Learning Required for Word-Level Reading

1) Paired-Associate Learning (PAL)
2) Statistical Learning
3) Orthographic Mapping

- These are typically not distinguished from one another by teachers or researchers
- Each plays a different role in word-level reading acquisition
- Not acknowledging these different learning processes can negatively affect assessment and instruction

# Paired-Associate Learning (PAL)

- Involves associating two things so that the presence of one activates the other
  - Language/labeling involves verbal PAL
- Foundational for learning letter names and sounds
  - Letter learning involves visual-phonological PAL
  - The visual half of that equation is not the problem
- *Not* the basis for written word learning
  - Yet many teaching methods seem to presume this
- Learning is explicit (i.e., conscious learning)
- Dozens to hundreds of exposures needed for accuracy-based *mastery*, hundreds to thousands for *automaticity*

# Statistical Learning

- Involves deriving patterns from multiple incidences
- Statistical learning is generally implicit learning
- Skilled readers never taught the "six syllable types" learn them anyway via statistical learning
  - (e.g., *dack* vs. *dake* vs. *dar*)
  - Many other orthographic patterns learned this way
  - Source for build up of general orthographic knowledge
- Unclear how many learning "trials" are needed
  - It may vary depending on specific types of patterns
- Poor readers do not display efficient statistical learning when it comes to reading
- Statistical learning is currently a "hot" area of study

**Objective 3:**
The four classic approaches to teaching reading

# The Four Classic Approaches to Teaching Reading

## And why they do not help weak readers

# The Four Classic Reading Approaches

- Clear delineation between them based on the instruction's unit of focus
  - Teachers may sample strategies from multiple approaches
- They fall along a continuum of unit size
  1. **Letters/graphemes** – phonics approach
  2. **Word parts/rime units** – linguistic/word family approach
  3. **Words** – whole word approach
  4. **Sentences/paragraphs** – whole language/balanced literacy

# The Four Classic Reading Approaches

- In every study I've seen, one has the best results
- In every study I've seen, one has the weakest results
- What they share in common
  - -None adequately addresses both levels of word-level reading

To understand highly effective prevention and intervention, we need a

# CRASH COURSE ON HOW WORDS ARE LEARNED

# The Alphabetic Principle

- Chinese writing vs. alphabetic writing
- We do not write words!
  - We write sequences of characters designed to represent sequences of phonemes in spoken words
- Poor access to the phonemes makes reading alphabetic languages very difficult
- Phoneme skills are needed for BOTH sounding out new words AND remembering the words we read

# National Reading Panel (2000) on the role of Phonemic Skills in Word Reading

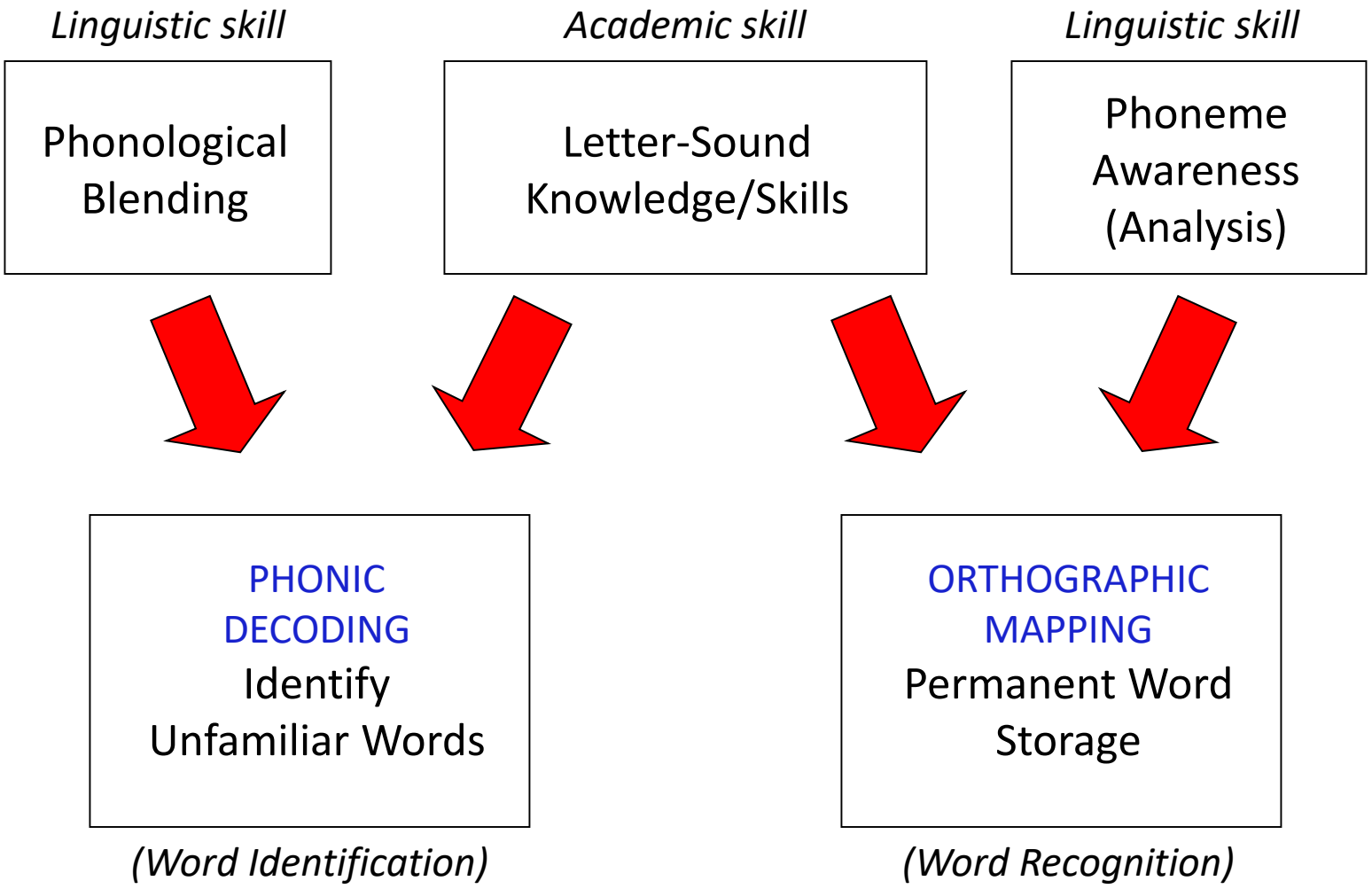
(From Section 2 page 32)

## Blending:

"The skill of blending is needed to decode unfamiliar words."

## Segmenting:

"Phonemic segmentation helps children *remember* how to read and spell words . . ." (emphasis added)


*Linguistic skill*
*Academic skill*
*Linguistic skill*
Phonological Blending
Letter-Sound Knowledge/Skills
Phoneme Awareness (Analysis)
PHONIC DECODING
Identify Unfamiliar Words
ORTHOGRAPHIC MAPPING
Permanent Word Storage
*(Word Identification)*
*(Word Recognition)*

# Theories of Word-Level Reading

**Fundamental assumption:**

*We all do the best we can with what we know*

- My first 9 years as a school psychologist & first 4 years teaching courses in learning disabilities and educational psychology

# A Common Misconception About Reading: "Children Learn to Read in Different Ways"

- This confuses *teaching* and *learning*
  - We teach things they don't learn; they learn things we don't teach!
- We TEACH reading in different ways; they LEARN to read ***proficiently*** in only one way
- Teaching is what we do—learning is what their brains do
- It's amazing there's even one way our brains read so efficiently
  - Perceive words in 1/20$^{th}$ of a second
  - Read 150-250 words a minute
  - Have 30,000 to 70,000 words in our instant, orthographic lexicon
  - Add new words to that lexicon after 1 to 4 exposures
- There are not 2, 3 or 4 ways our brain is set up to do that!
- All skilled readers have the same basic skills
  - All skilled readers can read nonsense words, even if not taught phonics
  - All skilled readers have large and continuously expanding sight vocabularies

# Theories of Word-Level Reading

## 1) Three-cueing systems approach

- Actually a theory about getting meaning from print
  - But has a lot to say about identifying words
- No real change since the 1960s despite over 45 years of research
- Central to whole language, balanced instruction, MSV, literacy-based approach; the foundation for LLI & Reading Recovery

## 2) Visual Memory Hypothesis

- Classic whole word approach, flash card approach, repeated readings; even incorporated into the phonic approach
  - It's the phonic approach to irregular words and word memory

## 3) Phonics

- Also called a *code-based approach* and *structured literacy*
- Focuses on word identification, not word memory

# The Three-Cueing Systems Approach

- This has been the dominant approach to reading for the last three decades
- This theory of reading was developed in the 1960s
- It has resisted any modifications based upon the thousands of scientific studies conducted since then
- It is continuously affirmed as valid despite extensive evidence to the contrary
- There is no evidence that it helps weaker readers catch up and and stay caught up
  - There is plenty of evidence that it does not
  - It is the most common “control group” instruction!

# Poor Readers, not skilled readers read based on the "Three-Cueing Systems" Approach

## Contextual

- Skilled readers recognize most of the words they read
  - Context is required for meaning, but not for recognizing familiar words
- Poor readers know fewer words so they *must* rely on context

## Syntactic/Grammatical

- These skills are required for meaning, but are virtually uncorrelated with word-level reading

## Grapho-phonic

- Refers to sampling letters, not sounding out words phonically
- Skilled readers effectively sound out unfamiliar words with help from context and set for variability (80%-90% accuracy rate)
  - In contrast to phonic decoding, guessing is ineffective (≤25% accuracy)

# Sight Word Vocabulary is NOT Based on Visual Memory/Visual Skills

- Our intuitions fail us here
- Input and storage are not the same thing
  - Input is visual, storage is orthographic (via phonological)
- Cattell's findings in 1886
- Findings from the 1970s
  - Correlation between word reading & visual memory: zero to weak
- 1960s to 1980s miXeD cAsE sTuDiEs
  - Adams' comment about debating with students
  - Kevin reading Calvin & Hobbes
  - If a first grader learns "bear" he can instantly identify "BEAR"
  - Our "abstract representation" of every letter
  - Consider all the fonts and personal handwriting we read

# Sight Word Vocabulary is NOT Based on Visual Memory/Visual Skills

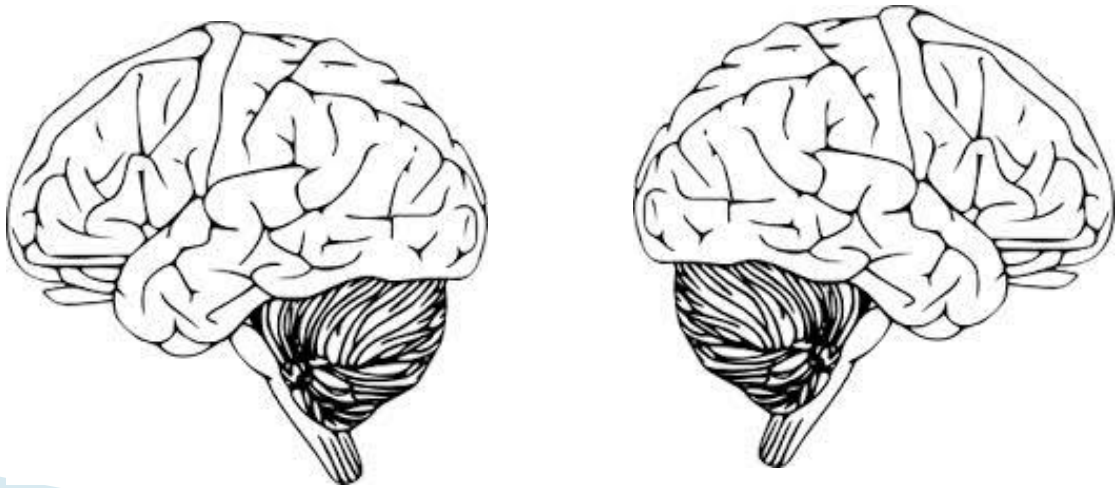
- Word reading correlates strongly with phonological skills
  - *Phonological awareness & Word Reading: r* = .30 to .85;
    - Usually .5 to .7 depending on which PA test (more later)
  - *Visual Memory & Word Reading: r* = .1 to .2
- Note how we sometimes "block" on names of people and things (visual memory), but never written words
- Most students who are deaf struggle tremendously with word level reading
  - This should not be such a problem if word reading was based on visual memory

# Sight Word Vocabulary is NOT Based on Visual Memory/Visual Skills

- Neuroimaging studies since the late 1990s show that
  - 1) phonic decoding;
  - 2) instant word recognition;
  - 3) memory for faces; and
  - 4) object naming

  *are all processed in different areas/sub-systems of the brain!*

  (Cattell's findings from 1886 now make sense)

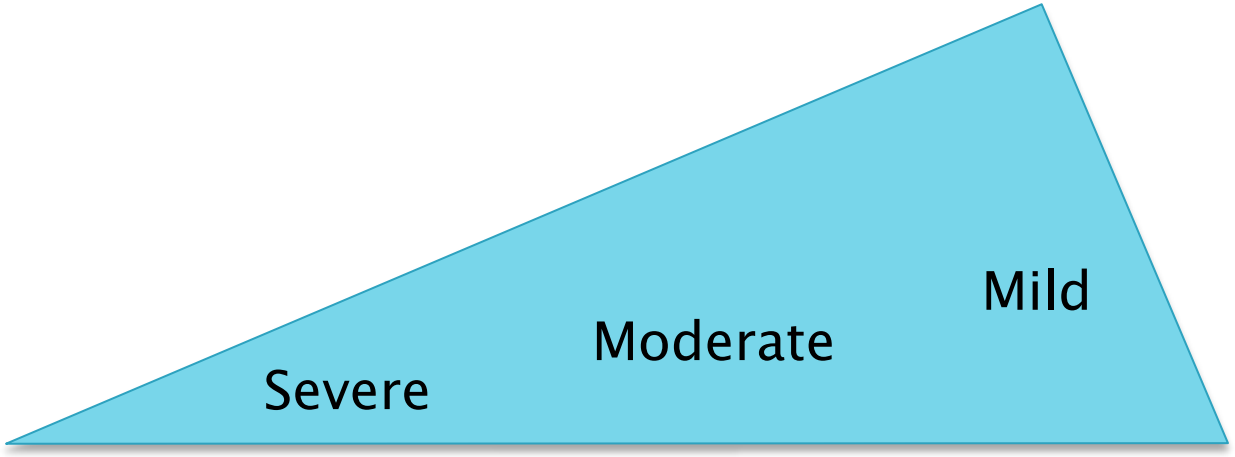


# Concerns About the Efficacy of Phonics

- Explicit and systematic phonics instruction displays superior results than whole word or whole language (three cueing, guided reading, balanced instruction)
  - This is true for all children but results "wash out" in the top half to two thirds of students by 3rd to 4th grade
  - Bottom third show ongoing benefit over time
- Too many, however, never "catch up"
- A small percentage cannot seem to learn via phonics
- No built-in mechanism or theory about fluency and building a sight vocabulary

# Concerns About the Efficacy of Phonics

- Three levels of response to phonics based upon the severity of the phonological-core deficit
  - (And you know all these students!)




Level of Severity of the Phonological-Core Deficit

# How Sight Vocabulary is Developed

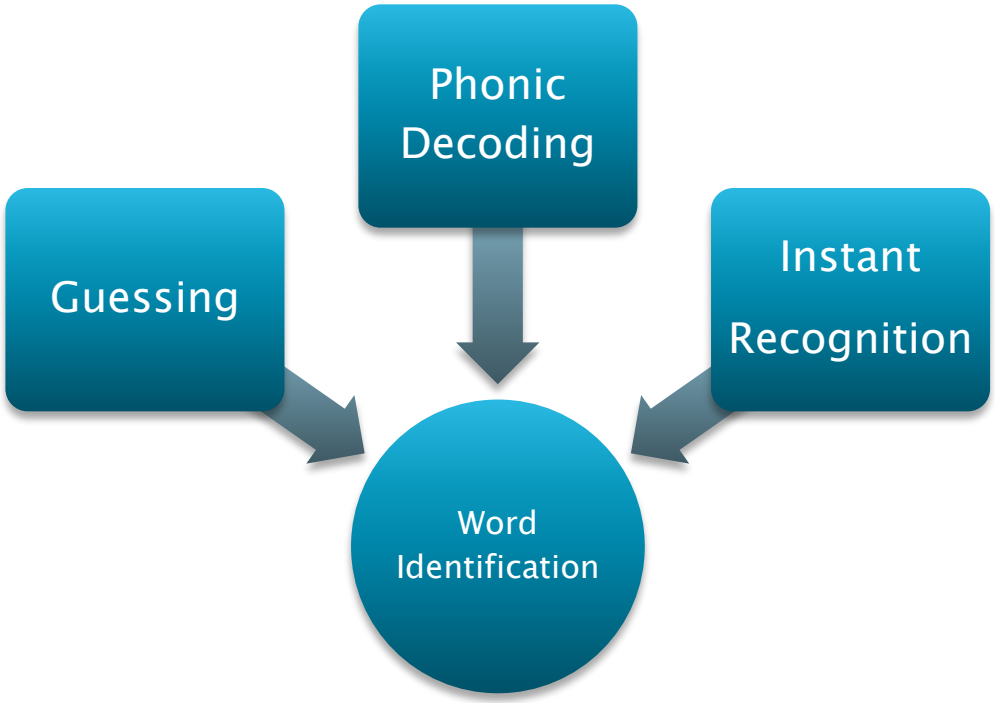
An Introduction to Orthographic Mapping

# The Science of Remembering Written Words

- Orthographic learning
  - How we remember the words we read
  - Instant effortless access to words
  - Building the orthographic lexicon
- Orthographic learning research
  - Computational/computer models
    - Multiple competing versions
  - Cognitive/behavioral models
    - Ehri's theory of sight word learning (orthographic mapping)
    - Share's theory of word learning (self-teaching hypothesis)

# Orthographic Memory

- To understand orthographic memory, we must distinguish two aspects of word-level reading:
  **Word Identification vs Word Recognition**



# David Share's Self-Teaching Hypothesis

- We teach ourselves most of the words we know
- Orthographic learning occurs one word at a time
- As students sound out new words, orthographic connections are formed
  - When newly encountered words are not sounded out, they are poorly remembered
  - Self teaching does not refer to "the code," but presumes you know the code and can use it reliably
- Orthographic learning is implicit – it typically does not involve conscious thought or effort
- From 2nd grade on, typically developing readers remember words after only 1 to 4 exposures

# Research on the Self-Teaching Hypothesis

- For typically developing readers, newly encountered words are permanently learned after only 1-4 exposures
  - Fits with the growth curves we normally see
- Common way to study Share's theory: the "Yait" paradigm
  - Grades 2+ engage in silent reading
  - New words are reading 1, 2, 4, 6, or 8 times
  - Tested after, 1-3 days, or a week
  - One study tested after a month
  - A recent poster presentation at SSSR tested a year later!

# Word Identification vs. Word Recognition

- Unfamiliar words vs. familiar words
- Effort vs. effortless (irrepressible, pre-cognitive)
- Poor fluency vs. good fluency
- Phonic decoding vs. instant sight word recognition/orthographic memory
- ***Word identification tests typically confound these***
- Classic phonic and whole language approaches focus on unfamiliar words & do not address recognition
  - Classic whole word focuses on recognition, but did not accurately represent how recognition occurs (visual memory hypothesis)

# Linnea Ehri's Orthographic Mapping Theory

- *Orthographic mapping* is the mental process we use to store words for immediate, effortless retrieval.

- In other words, orthographic mapping is what we do to make an unfamiliar written word into an automatic "sight word."

# Linnea Ehri's Orthographic Mapping Theory

- Sight words are highly familiar spellings (i.e., letter sequences), regardless of the visual look of the word
  - e.g., bear, BEAR, **Bear,** bear, **bear**, *BEAR* , bear, *bear*, BEAR
- Sight words are anchored in long-term memory (LTM) via a connection between something well established in LTM (the word's pronunciation) and the stimulus that needs to be learned (the letter sequence in the word's spelling)
- Phonemic segmentation ***skill**** and letter-sound knowledge are central to this connection-forming process

*Segmentation *skill* is not the same as segmentation *task* performance (more later)

# How Words are Learned for Instant, Effortless Retrieval

- Orthographic mapping requires:
  - Letter-sound proficiency
  - Phonemic proficiency (this goes well beyond what is tested on our universal screeners)
  - The ability to establish a relationship between sounds and letters unconsciously while reading

# Combining Ehri's & Share's Theories

- Both are independently well-established via multiple empirical approaches and designs
- Both help make sense of literally thousands of existing studies on reading development and reading difficulties
- Both theories indicate that
  - Letter-sound skills and phonemic skills are central for written word memory (i.e., sight word acquisition)
  - Visual memory plays no discernable role in word-level reading beyond letter recognition and the input of letter strings
- First apparent attempt to integrate these theories was 2015
  - Integrated version more powerful in explaining reading research findings than either alone

# Common Misunderstandings About the Role of Phoneme Skills in Reading

- Thought to only relate do early learning of CVC words
- Not thought to be involved in sight word acquisition
- Not thought to be worth training after first grade
- Some still think it is not causal in reading – only a byproduct of learning to read
  - (This is actually true! — but only for the top 2/3rds of readers)

# How We “Map” Words

Words that are “Opaque”

(i.e. words without a one-to-one correspondence)

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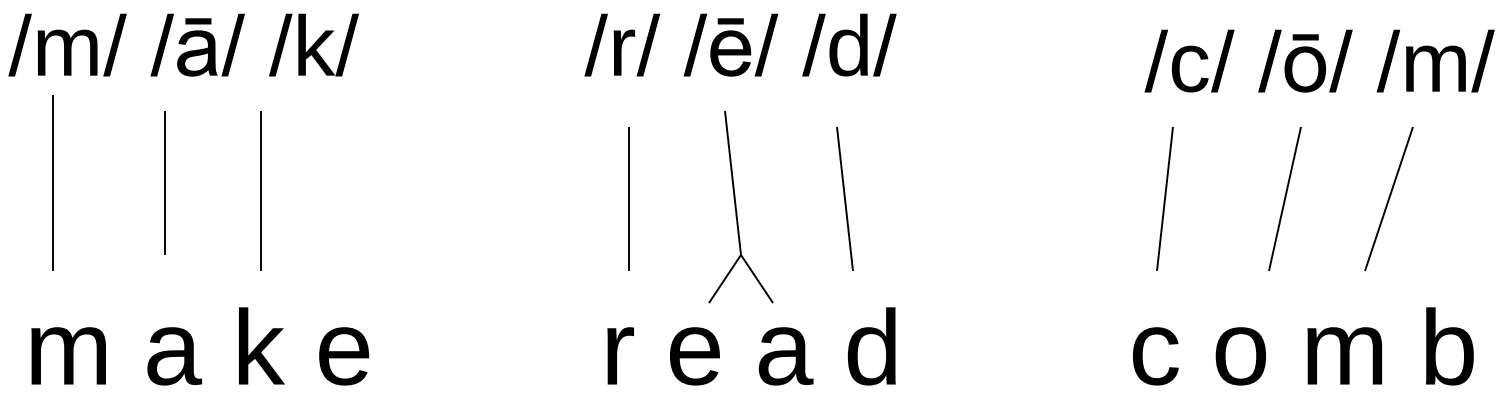
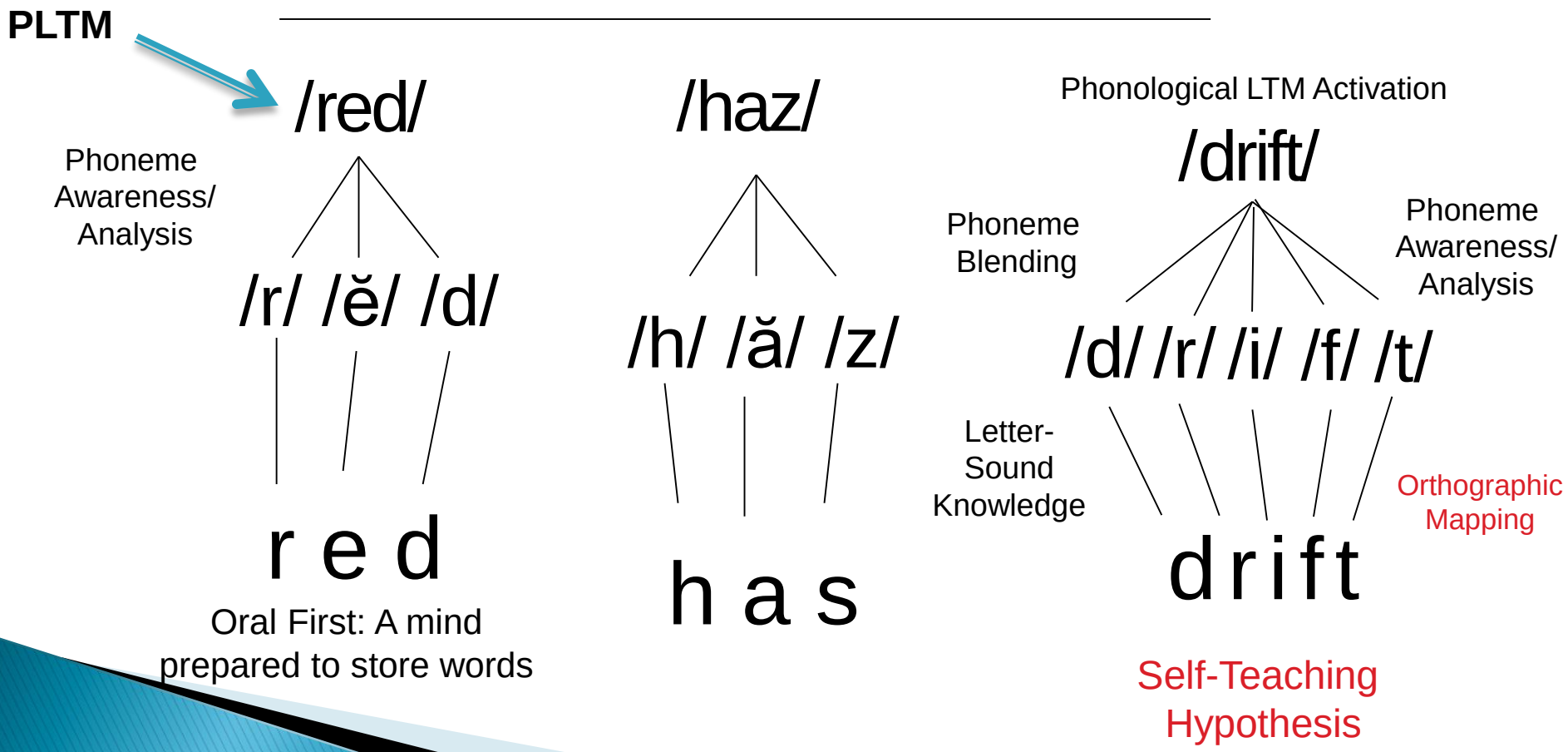


# How We "Map" Words

## "Transparent" Words

(i.e. words with one-to-one correspondence)



# What about irregular words?

- Irregular and opaque words take longer to learn
  - Only 1-2 extra exposures for typical readers; many more for RD
- Most irregular words are off by only one element
  - (*said, put, comb, island*; multiple violations are rare: *one, iron*)
- Irregular words not a challenge for orthographic mapping
  - "Exception words are only exceptional when someone tries to read them by applying a [phonic] decoding strategy. When they are learned as sight words, they are secured in memory by the same connections as regularly spelled words . . ." (Ehri, 2005 p. 171-172)

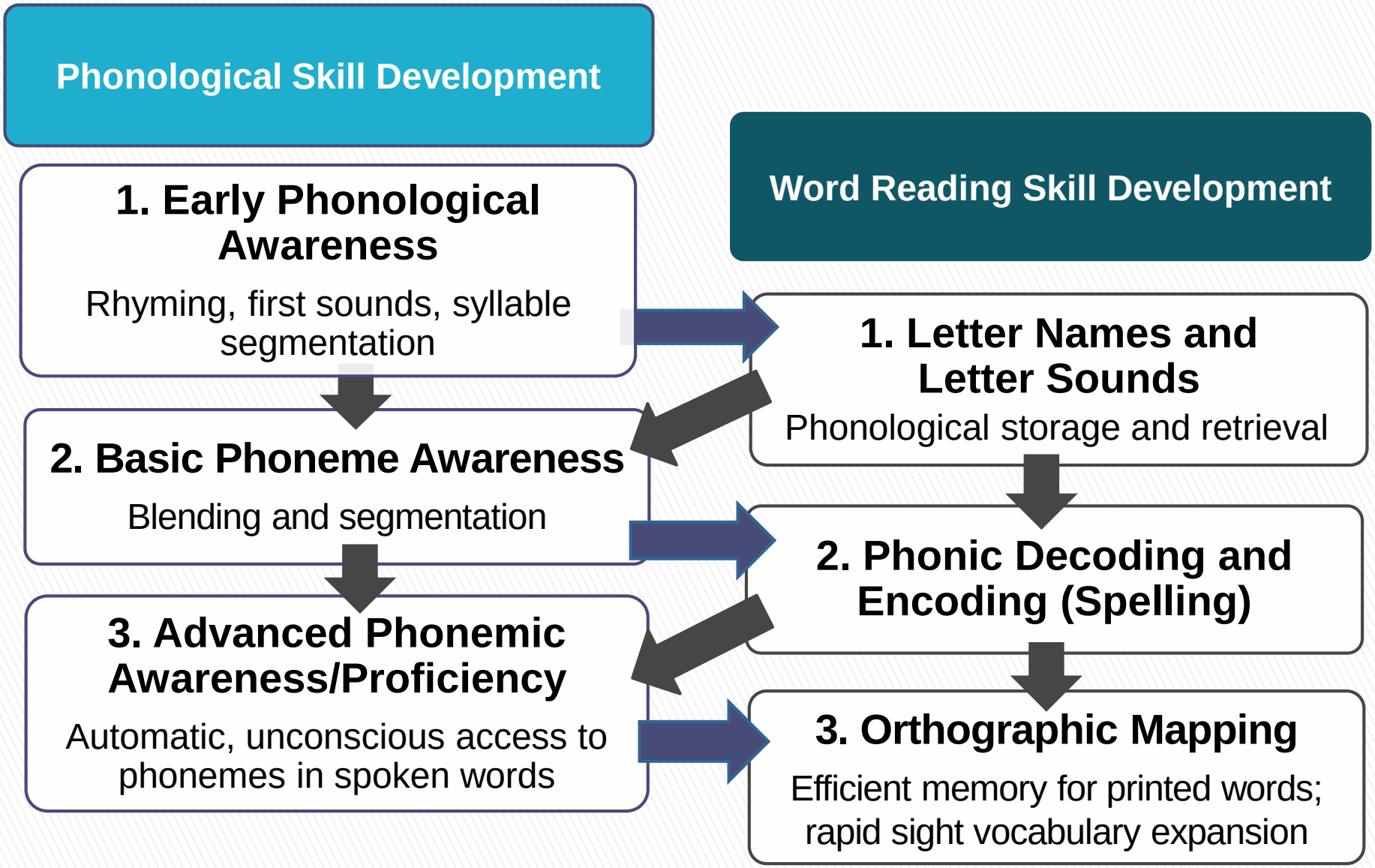
# What about irregular words?

- Many regular words require mapping "adjustments" like irregular words
  - Silent e words, vowel digraphs, consonant digraphs are all opaque
  - Multisyllabic "regular" words with vowel reduction require mapping adjustment, much like irregular words (e.g., *holiday, market*)
- Irregular words are not the *cause* of reading problems in English
  - Even very regular orthographies (e.g., Italian, Spanish) have RD, and their RD is based upon poor orthographic mapping
  - It makes English phonic decoding harder to learn, but these irregularities are not the cause of poor sight word reading
  - Even regular words are poorly represented in the orthographic lexicons of poor readers

# Effective Use of Flash Cards
## From the Perspective of Orthographic Mapping

- Introduce the word orally first
- Segment into phonemes verbally (no letters)
- Emphasize each phoneme
- Ask for letters associated with phonemes
- Build a "phonological framework"
  - Focus first on regular letter-sound connections
- Elaborate if possible
- Then work that word into a stack of flash cards

# The Developmental Relationship Between Phonological Skills and Word-Level Reading



# What about "orthographic skills"?

- Current discussion of "orthographic processing" in school psychology is 10 years behind the research
  - Classic case of "correlation does not determine causation"
- Orthographic "skills" result from orthographic mapping
  - Orthographic mapping maps words and *word parts and patterns!* (e.g., *–ing, –tion, –ight*)
  - Studies with consistent-irregular patterns (e.g., *nalk*)
  - My study using pseudo-rime units
    - (e.g., *mant, mank, menk*)

# What about “orthographic skills”?

- Orthographic knowledge appears to be a byproduct of learning to read, not a causal skill like PA & LS skills
- Current ideas floating around about orthographic processing implicitly posit word learning based upon visual memory
- Intervention recommendations coming from such a notion have been shown to be ineffective

# Are There Subtypes of Dyslexia?

- Acquired vs. Developmental Dyslexia
- Some acquired dyslexics showed one of three patterns
- Most showed mixture or alexia
- Helped prompt the *dual-route theory* of reading

# The Dual Route Theory of Reading

- We read using one of two routes:
  - *Direct route:* Instant recognition of familiar words
  - *Phonological route:* sounding out unfamiliar words
- Ultimately, the direct route proposes that some words we know and some words we do not know
  - It is a description of skilled reading
  - It does not tell us how the direct route skill develops nor how the phonological route develops
  - Thus, it is not useful for instruction
- Useful for looking at the “finished product” from a neurological point of view

# Are There Subtypes of Dyslexia?

- The subtyping model superimposes adult, neuropathology findings onto children with no history of neuropathology
  - Reminiscent of the MBD inferencing fallacy
  - Adults had become skilled readers, the children had not
- A 40 year search to establish such subtypes in the reading research literature has not yielded support
  - Primarily in the neuropsychology literature
  - This enterprise within neuropsychology does not seem abreast of the vast dyslexia literature outside neuropsychology, nor the intervention literature or orthographic learning literature
  - Heavy reliance on case studies, reading-age controls, and discrepancies between nonsense words and irregular words

# Problems with the Methods of Study

- Case studies have many natural confounds
  - Example of an 85 year old "phonological dyslexic"
  - Parallel to the 11th grader I assessed & stories of magicians
- Reading-age matched control research method seems to create the phonological subtype
- Discrepancies between nonsense word reading and irregular word reading may represent a pattern, but it is a non sequitur to suggest it establishes neurologically-based subtypes
  - Other, better explanations exist

# Problems with Dyslexia Subtyping Based on the Dual-Route Theory

- Both subtypes show phoneme awareness problems
- Assumes "orthographic skills" are largely independent of phonological skills
  - Seems to assume a visual memory aspect to reading via the direct route
- Phenomena being described better accounted for by more recent theoretical developments
  - The phonological-core deficit hypothesis covers all the "symptoms" of dyslexia, when developmental considerations are accounted for

# Problems with the Phonological vs. Surface Subtyping Scenario

- Subtypes are presented in the school psychology field as if they are well-established by research
- Instructional implications inconsistent with actual instructional/intervention research
  - Consider the article in Journal of Neuroscience (2015)

# Are There Any Other Subtypes of Dyslexia?

- There are 3-4 subtypes of RD but not of dyslexia
  - Dyslexia, hyperlexia, combined, compensators (more below)
- A potential dyslexia subtyping scenario involves differential abilities in RAN vs. PA
- Three example subtypes
  - Problems in PA only
  - Problems in RAN only
  - Problems in PA and RAN (the "double deficit")
- Seemed more promising in the 1990s and early 2000s than it does today
- Verdict is still out
- Should we even test for RAN? How about WM?

# Why We Should Assess for Rapid Automatized Naming & Working Memory

Neither is well understood in terms of its role in reading development, *however . . .*

- Both moderately correlate with reading
  - Poor RAN and/or WM typically means poor word reading
  - But strong RAN & WM do not mean skilled word reading
- Both predict reading outcomes (good for screening)
- Both predict response to intervention
  - This has implications for assigning to Tier 2 or Tier 3
- Both appear to help explain reading difficulties
  - Especially if PA is okay
- Affects the interpretation of broader reading profile
- Provides evidence for SLD in reading
  - Both are symptoms of the phonological-core deficit of dyslexia
- Has implications for small group instruction

# The Special Case of Compensators

- Commonly overlooked
- I "discovered" them either via a writing evaluation or a behavioral issue or a parent complaint about homework
  - Sometimes perceived as whiny parents
- Common pattern (from a study I did; n = 22)
  - **113.0** – Verbal skills
  - **98.4** – Reading comprehension
  - **92.3, 92.2** – Word identification (timed and untimed)
  - **91.6** – Spelling
  - **93.7** – Nonsense word reading (untimed)
  - **84.4** – Nonsense word reading (timed)
  - **93.1** – Phonemic awareness (untimed)
  - **81.4** – Phonemic awareness (timed)

# The Special Case of Compensators

- It appears that they are being dragged down by limited
  - Letter-sound proficiency
  - Phonemic proficiency
- Detectable via the TOWRE-2 and the PAST
- Very correctable
- Best prevented via early detection and intervention

**Objective 6:**
Understand the difference between phonemic tasks and phonemic skills

# Phonemic *Tasks* vs. Phonemic *Skills*

# Phonemic TASKS vs. Phoneme SKILLS

- We need to move from a *task* mentality to a *skill* mentality
- Two types of phoneme tasks: *synthesis* and *analysis*
  - *Synthesis* goes from part to whole (e.g., blending)
  - *Analysis* goes from whole to part (e.g., segmenting)
- There are many phoneme *tasks* but only two *skills* are needed for reading
- Synthesis and analysis play different roles in reading:
  - Phoneme blending is needed for phonic decoding
  - Phoneme analysis is needed for remembering words

# National Reading Panel (2000) on the role of Phonemic Skills in Word Reading

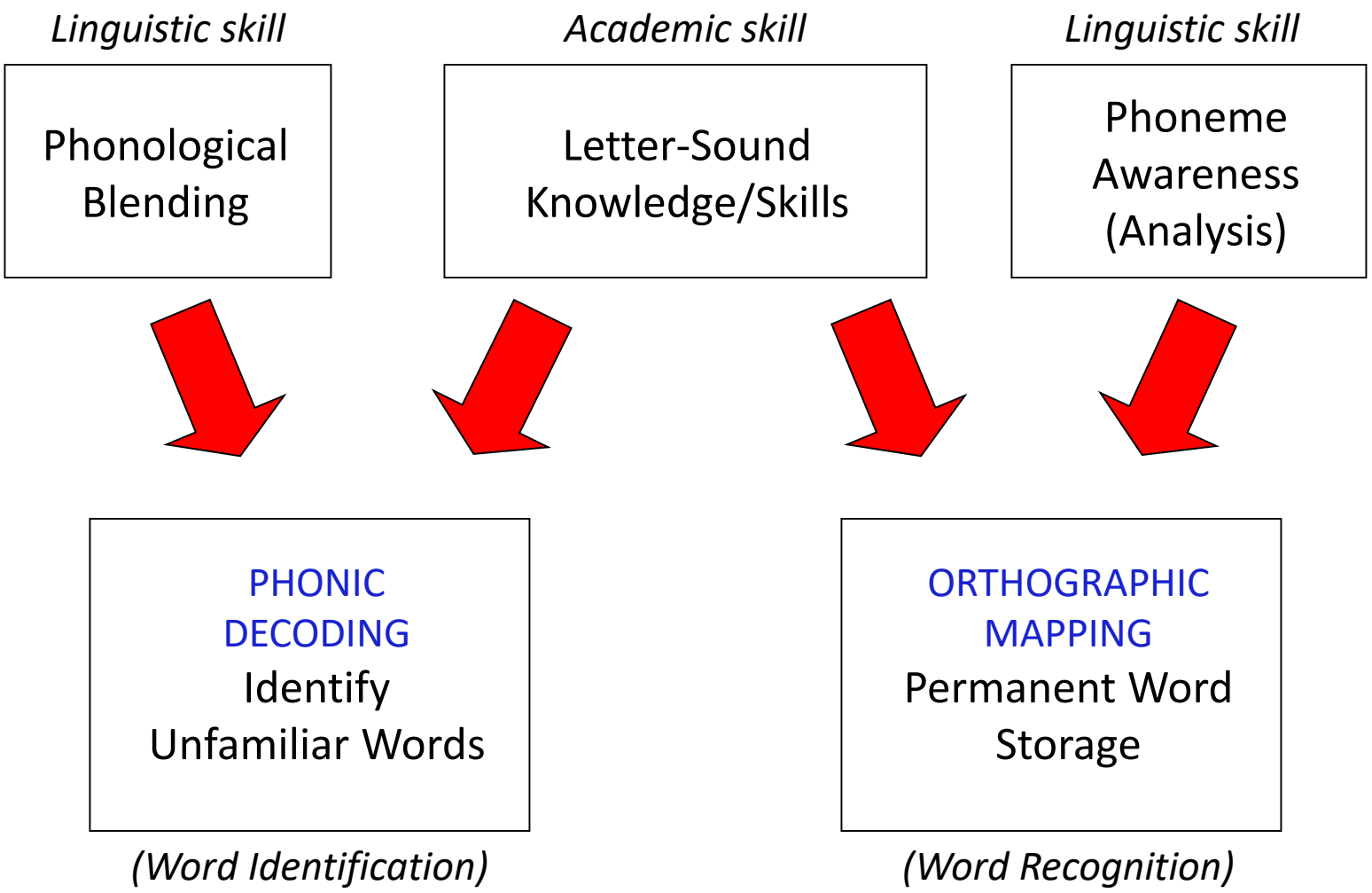
(From Section 2 page 32)

## Blending:

"The skill of blending is needed to decode unfamiliar words."

## Segmenting:

"Phonemic segmentation helps children *remember* how to read and spell words . . ." (emphasis added)


*Linguistic skill*
Phonological Blending
*Academic skill*
Letter-Sound Knowledge/Skills
*Linguistic skill*
Phoneme Awareness (Analysis)
PHONIC DECODING
Identify Unfamiliar Words
*(Word Identification)*
ORTHOGRAPHIC MAPPING
Permanent Word Storage
*(Word Recognition)*

# Phonemic TASKS vs. Phoneme SKILLS

- The most common synthesis task is *blending*
- For blending, TASK = SKILL
- The blending *skill* needed for phonic decoding is directly captured by an oral blending *task*
- For analysis, there is no simple correspondence between task and skill
- Tasks include:
  - Rhyming
  - Alliteration
  - Segmentation
  - Isolation
  - Manipulation
  - Categorization/Identification
    - *Note: There are two to six variants on each of these tasks*

# Phonemic TASKS vs. Phoneme SKILLS

- **Phoneme analysis** – all tasks are getting at an underlying phoneme analysis skill – not telling us separate things
  - Instant, effortless, and unconscious analysis/access to phonemes in oral pronunciations drives orthographic learning
  - This is *phoneme proficiency*
    - Why not "phoneme segmentation proficiency"?
    - Why also called "advanced phoneme awareness"?
- Ehri and the NRP quote simply refer to "segmentation," but they are describing a SKILL, not a task

# Phonemic TASKS vs. Phoneme SKILLS

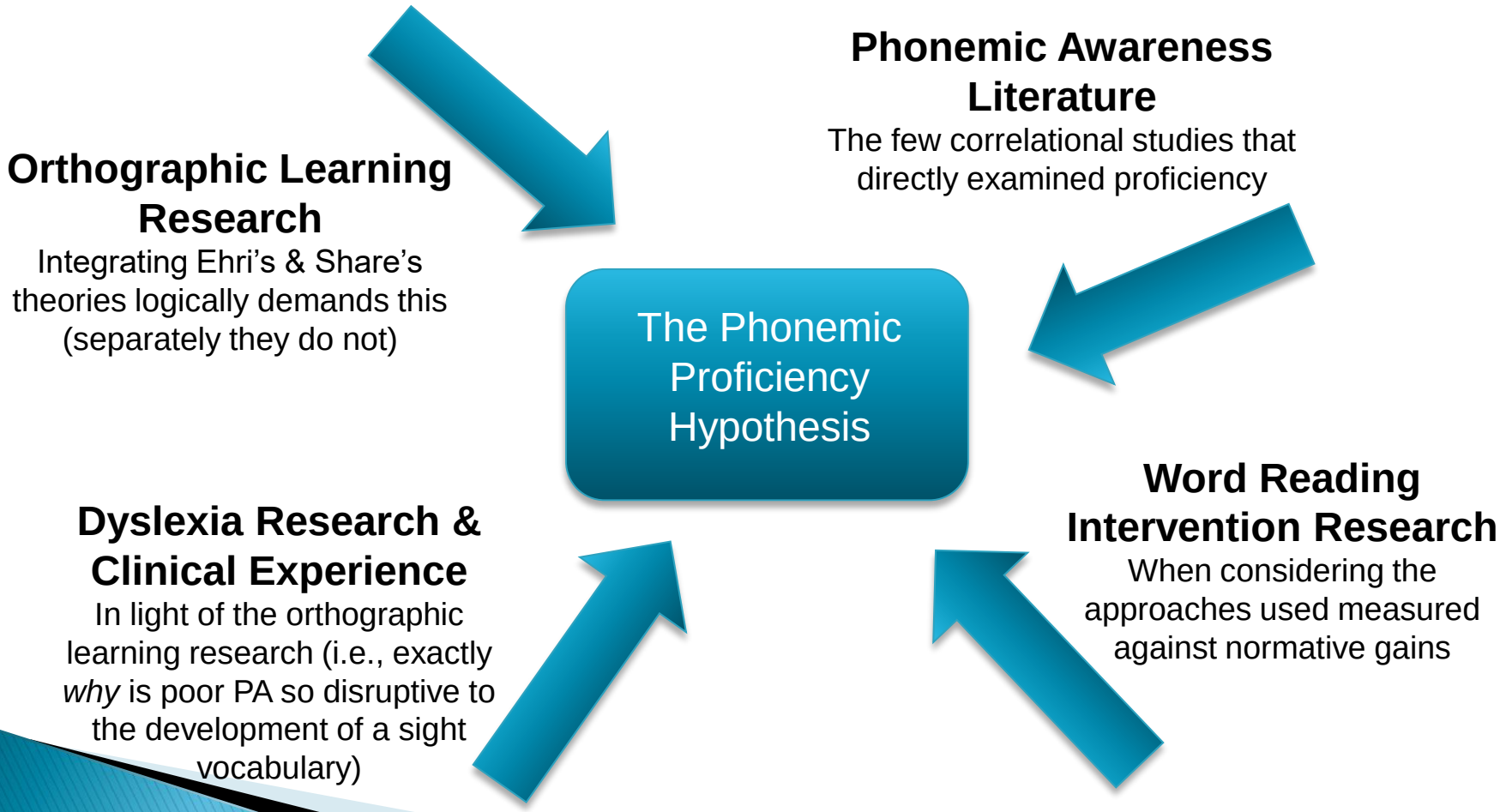
- Two phoneme SKILLS needed for reading: 1) blending & 2) phoneme (analysis) proficiency
- Segmentation tasks cannot reliably assess the highly proficient segmentation/analysis skill needed for orthographic learning
  - It is a conscious task
  - Instant responses to manipulation tasks can assess proficiency
- Segmentation tasks correlate with reading .3 to .5
- Manipulation tasks correlate with reading .5 to .8

**Objective 5:**
Understand the *Phonemic Proficiency Hypothesis*

# The Phonemic Proficiency Hypothesis

## of Orthographic Learning

# Current Evidence for The Phonemic Proficiency Hypothesis



# Research Support for Phonemic Proficiency and Sight-Word Learning

- Vaessen & Blomert (2010)
  - 1400 students, grades 1-6, over 200 at each grade
  - Phonemic manipulation – accuracy and timing
  - High frequency words and Low frequency words
    - Low frequency words estimate size of sight vocabulary
  - PA accuracy and high frequency words, correlations dropped off quickly
  - PA timing showed steep continued growth 1-5
  - PA timing and sight vocabulary correlated .5 or higher right up to 6th grade
- Other studies showed timing provides a better index of the phonemic skills underlying reading

# Research Support for Phonemic Proficiency and Sight-Word Learning

- Studies I've done
- 132 1st graders
  - Phonemic manipulation – accuracy and timing
  - TOWRE-2 Sight Word Efficiency
  - Instant responses to PA and SWE = +.58
  - Accurate, non-instant responses = +.004
- 60 5th graders
  - Instant responses to PA and SWE also = +.58
  - Accurate, non-instant responses = -.25
- Similar result with 26 high school students
  - Nearly identical to 5th grade results

# Sight Vocabulary and Reading Fluency

- S*ight words* are effortless & pre-cognitive—words "pop out"
- The elusive key to reading fluency is:

  **SIGHT VOCABULARY SIZE**

  - With a large sight vocabulary:

    Most (or all) words "pop out"; reading is *fast* and *accurate*

  - With a limited sight vocabulary:
    - Reading is effortful and often inaccurate because too many unfamiliar words require attention and strategic decoding
    - Poor fluency is NOT about speed of access to known words

# The "Path" to Fluent Word Reading

- **Word reading fluency** is primarily based on the . . .
- Size of the **sight vocabulary/orthographic lexicon**, which is based on . . .
- How skilled a student is in remembering words (**orthographic mapping skills**) combined with reading experience, and orthographic mapping is based on . . .
- **Letter–sound proficiency**/automaticity (unconscious access to the sounds letters represent) AND
- **Phonemic proficiency**/automaticity (unconscious access to phonemes in spoken words)
- This latter skill is a universally missing element
- (Develops in typical readers, but not in struggling readers)

# PREVENTION AND INTERVENTION

# The Basis for Intervention

"Any well-founded educational intervention must be based on a sound theory of the causes of a particular form of learning difficulty, which in turn must be based on an understanding of how a given skill is learned by typically developing children."

*Snowling & Hulme (2011)*

Snowling, M. J., & Hulme, C. (2011). Evidence-based interventions for reading and language difficulties: Creating a virtuous circle. *British Journal of Educational Psychology, 81,* 1–23.

# Caveat Emptor: Determining Intervention Effectiveness

- Raw score improvements
- Statistical significance
  - Normally, "statistically significant gain" ≠ "closing the gap"
  - Many abstracts are misleading
  - "Significant" often means 3 standard score point gains
- Effect sizes
  - The most unsuspectingly misleading index of improvement
    - *E.g., 0 SS improvement on national norms = 22 SS improvement?!*
    - *A <1 SS gain (.96) is nearly twice as effective as 22 SS gain (.53)*
- Standard score gains
  - Some high profile intervention researchers recommended this
    - The only one to indicate if a student is closing the gap

# Research-Based Principles vs. Research-Based Programs

- The problem with the term "research based"
- No Consumer Reports-style opportunity exists
  - *What Works Clearinghouse, bestevidence.org*, etc. have major problems
    - Use of effect size to determine efficacy
    - Very limited number of studies for any given program
- The National Reading Panel (NRP) avoided this by focusing on principles and approaches, not programs
- IES Practice Guides focus on principles and approaches
- There is no substitute for well-informed educational professionals
  - Analogy of carpenter and tools

# Role of Socio-Economic Factors

- Socioeconomic Status (SES) is moderately correlated with reading outcomes
  - But correlation does not mean causation
- Effective instruction and intervention have been shown to be highly effective with low SES students
  - However, reading comprehension (RC) difficulties may continue
    - Yet word reading no longer compromises reading comprehension, so there are RC improvements
- Often blame is misplaced – inadequate instructional philosophies and practices get conflated with low SES

# English Language Learners

- Hundreds of studies with consistent findings
  - Findings support the Simple View of Reading
  - Word reading develops similarly to native speakers (in the absence of the phonological-core deficit)
  - Perhaps brief time lag, depending on age, previous reading acquisition, similarities across languages, etc.
  - PA transfers across languages
  - Comprehension lag (5-6 years) due to language development

# Tier 1 Results

## K-1 phonological Awareness Instruction

- *Overall* improvement in reading scores
- Average of 8 standard score point equivalent
  - (Standard score point equivalent based upon effect sizes comparing groups, not national norms)
- Results did not always last after 1-2 year follow ups

HOWEVER . . .

- At-risk students averaged a gain of the equivalent of 13 standard scores!
- Gains increased to an average of 20 point equivalent at 6 month to 2 year follow ups!

# I. Prevention of Word-Level Reading Difficulties

- Tier 1 instruction – What is effective K-1?
  - KEY COMPONENTS
  - Phonological Awareness
  - Letter-Sound Knowledge
  - Connecting phonological awareness to word-level reading
  - Good teaching techniques based on general learning principles
    - Seems to be the focus of RTI efforts
- Early, rigorous development of PA and LS skills in K-1 dramatically reduces the number of struggling readers
- Quick Survey:
  - How many of you work in schools that have a formalized, systematic, whole class, Tier 1 PA training in K-1?

# Examples of Successful Prevention Programs

- Programs used in studies with highly successful outcomes
  - Experimenter designed – not commercially available ☹
  - Florida Center for Reading Research (pieces of these experimenter designed approaches) – all free! www.fcrr.org
  - *Road to the Code* (Benita Blachman et al.)
  - *Phonemic Awareness in Young Children* (Adams et al.)
  - *Ladders to Literacy* (O'Connor et al.)
  - *Interactive Strategies Approach* (Scanlon, et al.)
  - Other programs:
    - Rosner program – long track record of success in schools
    - *Equipped for Reading Success* (studies underway; based on Rosner)

    www.equippedforreadingsuccess.com
- Most of these programs are effective for K-1 prevention & early intervention, but not for Gr. 2-12 remediation
  - Other programs are more well suited for intervention (see below)

# A Recent Finding about Intervention Research

- Numerous reviews of intervention research and meta-analyses have been conducted since 1999
- They routinely look at the obvious factors:
  - Socioeconomic Status (SES)
  - Age of students (e.g., 2nd graders vs. 5th graders vs. 9th graders)
  - Length of intervention (e.g., 35 hours? 65 hours? 110 hours?)
  - Group size (e.g., 1:1? 1:3? 1:5? 1:8? whole class?)
  - Severity of problem (2nd percentile? 10th? 20th? 30th?)
- Contrary to the expectations, the first two show small effects and the other three show no consistent effects
  - SES showed much impact with reading comprehension, however

# The Significance of the "Big W"

- Numerous reviews of intervention research and meta-analyses have been conducted since 1999
- They routinely look at the obvious factors:
  - Socioeconomic Status (SES)
  - Age of students (e.g., 2nd graders vs. 5th graders vs. 9th graders)
  - Length of intervention (e.g., 35 hours? 65 hours? 110 hours?)
  - Group size (e.g., 1:1? 1:3? 1:5? 1:8? whole class?)
  - Severity of problem (2nd percentile? 10th? 20th? 30th?)
- Contrary to the expectations, the first two show small effects and the other three show no consistent effects
  - SES showed greater impact with reading comprehension, however

# A Recent Finding about Intervention Research

- Using standard scores to determine effectiveness
- This results in three groups of intervention results
  - *Minimal results group:* 0 to 5 standard score improvements
    - Mostly 2–4 points
  - *Moderate results group:* 6 to 9 standard score improvements
    - Mostly 6–7 points
  - *Highly successful group:* 10 to 25 standard score point improvements
    - Mostly 14–17 points

# A Recent Finding about Intervention Research

*These three groups approached instruction differently!*

- Minimal Group (0 – 5.85 SS improvements)
  - None formally trained phonological awareness/analysis
  - Most did explicit, systematic phonics
  - All provided reading practice with connected text
- Moderate Group (6–9 SS improvements)
  - All did explicit, systematic phonics
  - All provided reading practice
  - All trained phonological segmentation and/or blending
    - This is "basic phonological awareness" (mastered by most at end of 1st grade)
- Highly Successful Group (10–25 point improvements)
  - Aggressively addressed and "fixed" PA issues using advanced PA training
  - All did explicit, systematic phonics
  - All provided reading practice with connected text

# Interventions We are Using Now
## (Why RTI is having limited results)

- The following interventions have been studied in the empirical reading literature and have been shown to yield 2 to 4 standard score point improvements:
  - Repeated Readings, READ 180, Reading Recovery, Fast ForWord, Read Naturally, Failure Free Reading, Seeing Stars, and Great Leaps
  - School psychologists recommend these not knowing they have already been studied and shown to have limited results
    - Students almost never “catch up” with these approaches
    - Most of these have studies with “statistically significant” results!
      - So they can all themselves “research based”!

# Interventions We are Using Now
## (Why RTI is having limited results)

- "Gold Standard" phonic programs

  (i.e., Wilson, DISTAR/Reading Mastery)
  - These can yield huge improvements in Word Attack (15-25 SS points), but modest improvements in general word identification (e.g., 3-5 SS points)
  - They do not develop phonological proficiency, which is needed for orthographic mapping/sight word development
  - *Phonological-core deficit students only develop PA skills to the level that we teach them*
- Also, reading comprehension interventions in the presence of significant word reading difficulties are minimally helpful

# Examples of Successful Programs

- Programs used in studies with highly successful outcomes
  - Experimenter designed – not commercially available ☹
  - Lindamood (ADD now LiPS)
    - Be cautious about the one they are promoting now – has limited results
  - Interactive Skills Program (now in book form)
  - PhonoGraphix
  - Read, Write, Type (only one study so far)
  - Discover Reading (Reading Foundation, Alberta, Canada)
  - Other programs using advanced PA training not in these studies:
    - Rosner program – long track record of success in schools
    - Equipped for Reading Success (studies underway) is the only program based upon Orthographic Mapping–should have equivalent results to the others but is easier to implement (based on the Rosner program)
  - *All studies with highly successful outcomes (12–25 groups) did "advanced" phonological awareness training!*

# The Phonological Awareness Screening Test

(PAST)

# The Phonological Awareness Screening Test (PAST)

- Not to be confused with another online test with the same acronym
  - "Phonological awareness Skills Test"
- Materials available
  - Data on reliability and validity
    - Tends to correlate with reading better than anything on the market (at worst, equal to what is on the market) yet it is free
  - Five alternate versions for progress monitoring
  - Detailed instructions on administration and scoring

# The PAST Assessment

- Phonological Awareness Screening Test (PAST)
  - Acronym has double meaning
- Based on Rosner & Simon (1971)
  - Reworked and improved by McInnis
  - It is “third generation Rosner”
  - *CTOPP* Elision is “first cousin once removed”
- Outstanding correlation with reading
  - .6 to .8 elementary students; .5 adults

# The PAST Assessment

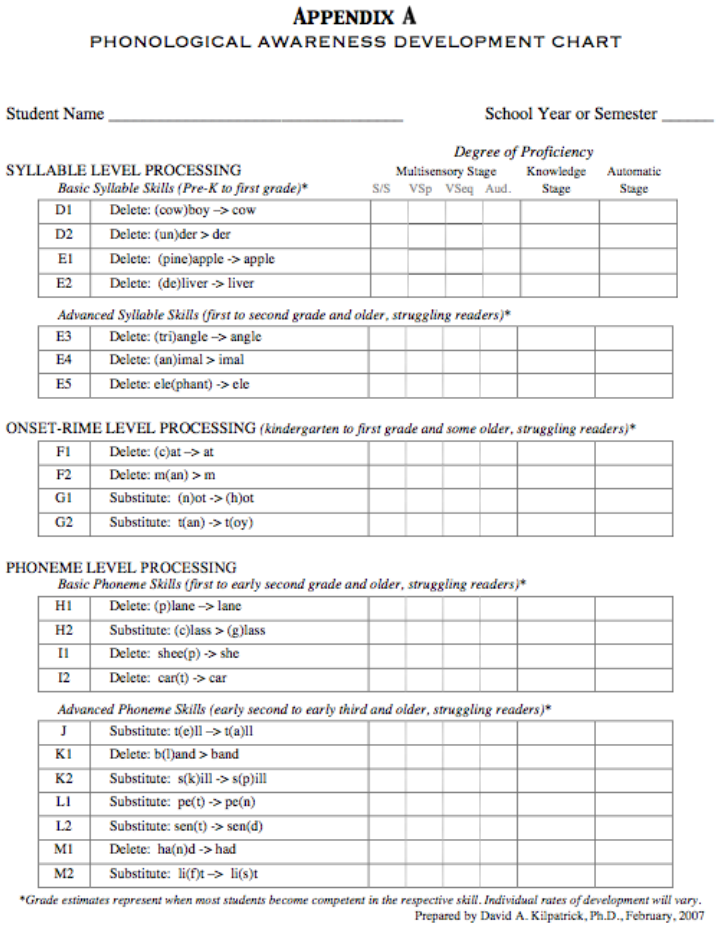
- Based on phonological manipulation
  - Uses segmentation, isolation, & blending
- Also looks at automaticity of PA
- Provides feedback for every item
- Takes 6-10 minutes to give
- Keyed into remediation program
- Five versions for progress assessment
- Great supplement for *CTOPP*
- Requires some training
- Currently free to use
- Not normed – criterion based

# Administering the PAST

- Two scoring systems: timed, untimed
  - 0, 1, X
  - Timing
- Routing - to speed administration
- Correction for each incorrect item
- Discontinuation rule
- Pacing
- Tabulation

# Equipped for Reading Success

Student progress chart for tracking progress



**APPENDIX A**

PHONOLOGICAL AWARENESS DEVELOPMENT CHART

Student Name _____ School Year or Semester _____

*Degree of Proficiency*

SYLLABLE LEVEL PROCESSING — Multisensory Stage (S/S, VSp, VSeq, Aud.); Knowledge Stage; Automatic Stage

*Basic Syllable Skills (Pre-K to first grade)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| D1 | Delete: (cow)boy –> cow | | | | | | | |
| D2 | Delete: (un)der > der | | | | | | | |
| E1 | Delete: (pine)apple -> apple | | | | | | | |
| E2 | Delete: (de)liver -> liver | | | | | | | |

*Advanced Syllable Skills (first to second grade and older, struggling readers)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| E3 | Delete: (tri)angle –> angle | | | | | | | |
| E4 | Delete: (an)imal > imal | | | | | | | |
| E5 | Delete: ele(phant) -> ele | | | | | | | |

ONSET-RIME LEVEL PROCESSING *(kindergarten to first grade and some older, struggling readers)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| F1 | Delete: (c)at –> at | | | | | | | |
| F2 | Delete: m(an) > m | | | | | | | |
| G1 | Substitute: (n)ot -> (h)ot | | | | | | | |
| G2 | Substitute: t(an) -> t(oy) | | | | | | | |

PHONEME LEVEL PROCESSING

*Basic Phoneme Skills (first to early second grade and older, struggling readers)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| H1 | Delete: (p)lane –> lane | | | | | | | |
| H2 | Substitute: (c)lass > (g)lass | | | | | | | |
| I1 | Delete: shee(p) -> she | | | | | | | |
| I2 | Delete: car(t) -> car | | | | | | | |

*Advanced Phoneme Skills (early second to early third and older, struggling readers)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| J | Substitute: t(e)ll –> t(a)ll | | | | | | | |
| K1 | Delete: b(l)and > band | | | | | | | |
| K2 | Substitute: s(k)ill -> s(p)ill | | | | | | | |
| L1 | Substitute: pe(t) -> pe(n) | | | | | | | |
| L2 | Substitute: sen(t) -> sen(d) | | | | | | | |
| M1 | Delete: ha(n)d -> had | | | | | | | |
| M2 | Substitute: li(f)t –> li(s)t | | | | | | | |

**Grade estimates represent when most students become competent in the respective skill. Individual rates of development will vary.*

Prepared by David A. Kilpatrick, Ph.D., February, 2007

*Degree of Proficiency*

## SYLLABLE LEVEL PROCESSING

| | | Multisensory Stage | | | | Knowledge Stage | Automatic Stage |
|---|---|---|---|---|---|---|---|
| | *Basic Syllable Skills (Pre-K to first grade)** | S/S | VSp | VSeq | Aud. | | |
| D1 | Delete: (cow)boy –> cow | | | | | | |
| D2 | Delete: (un)der > der | | | | | | |
| E1 | Delete: (pine)apple -> apple | | | | | | |
| E2 | Delete: (de)liver -> liver | | | | | | |
| | *Advanced Syllable Skills (first to second grade and older, struggling readers)** | | | | | | |
| E3 | Delete: (tri)angle –> angle | | | | | | |
| E4 | Delete: (an)imal > imal | | | | | | |
| E5 | Delete: ele(phant) -> ele | | | | | | |

## ONSET-RIME LEVEL PROCESSING *(kindergarten to first grade and some older, struggling readers)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| F1 | Delete: (c)at –> at | | | | | | |
| F2 | Delete: m(an) > m | | | | | | |
| G1 | Substitute: (n)ot -> (h)ot | | | | | | |
| G2 | Substitute: t(an) -> t(oy) | | | | | | |

## PHONEME LEVEL PROCESSING

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Basic Phoneme Skills (first to early second grade and older, struggling readers)** | | | | | | |
| H1 | Delete: (p)lane –> lane | | | | | | |
| H2 | Substitute: (c)lass > (g)lass | | | | | | |
| I1 | Delete: shee(p) -> she | | | | | | |
| I2 | Delete: car(t) -> car | | | | | | |
| | *Advanced Phoneme Skills (early second to early third and older, struggling readers)** | | | | | | |
| J | Substitute: t(e)ll –> t(a)ll | | | | | | |
| K1 | Delete: b(l)and > band | | | | | | |
| K2 | Substitute: s(k)ill -> s(p)ill | | | | | | |
| L1 | Substitute: pe(t) -> pe(n) | | | | | | |
| L2 | Substitute: sen(t) -> sen(d) | | | | | | |
| M1 | Delete: ha(n)d -> had | | | | | | |
| M2 | Substitute: li(f)t –> li(s)t | | | | | | |

# SUMMARY AND CONCLUSIONS

# Summary

- Word-level reading is primarily phonological
- This is based upon the alphabetic nature of our writing system
- Visual skills not a source of reading problems
- Skilled readers are all good at phonic decoding and orthographic mapping – neither is optional
  - Weaker readers are weak in both
  - Phonics skills are essential, but not enough
  - Skilled readers have large sight vocabularies, weak readers do not

# Summary

- Fluency is a function of sight vocabulary size
  - And a few other smaller contributors
- For poor orthographic mappers, practice does not improve reading
- For skilled orthographic mappers, reading does not improve without practice
- Reading problems are very preventable
- The most highly effective word-reading intervention outcomes trained advanced phonemic awareness, letter-sound skills, and did reading practice
- There are tests on the market to assess the key component skills of reading