Understanding and Addressing Word-Level Reading Problems

Maine Department of Education
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David A. Kilpatrick, PhD
State University of New York at Cortland

Introducing the Field of the Scientific Study of Reading

- This "field" is huge and heavily funded
  - 1,000–1,200 scientifically-oriented research reports and reviews appear in English every year
  - Tens of millions of U.S. tax dollars are spent on it every year!

- It is international
  - Involves dozens of countries and languages

- It is interdisciplinary
  - Contributions from cognitive science, neuroscience, speech science, medicine, linguistics, education, special education

- It flies under the radar of school-related fields
  - According to studies of teachers and university professors in: General education, special education, literacy education, ELL education – even school psychology

What Reading Research Is and Is Not

- Researchers mostly study the cognitive, linguistic, and academic underpinnings of word reading and reading comprehension

- There exists no large cache of studies examining *specific* teaching strategies or techniques
  - There are some such studies, but they are mostly always "lab" studies conducted in isolation from the broader instruction

- Rather, researchers more commonly study whole general approaches to reading
  - Phonics vs. word family vs. whole word vs. whole language
  - *Within* each of these types, there can be very different teaching strategies, but those specific strategies are not directly studied

What Reading Research Is and Is Not

- Reading research can provide foundational knowledge to enhance professional practice
  - Consider an analogy from appliance repair
  - Teaching someone how to fish . . .
- This knowledge base will help teachers:
  - Make more accurate judgments about which strategies and techniques are likely to be effective
  - Select from existing resources to craft effective instruction
  - Make better "on the fly" instructional decisions with students as situations come up and students get "stuck"

How We Should Decide What Strategies to Use to Teach Reading

▸ All teaching STRATEGIES are designed to build specific SKILLS

▸ Such SKILLS are presumed to be needed based on some UNDERSTANDING of how reading works

So . . .

▸ Without an accurate UNDERSTANDING of how reading works, how do we know what SKILLS teach?

▸ And, without knowing what SKILLS are needed, how do we know what teaching STRATEGIES to use?

The Alphabetic Principle

- Chinese writing vs. alphabetic writing

- We do not write words!
  - We write characters that represent sequences of phonemes in spoken words

- Poor access to phonemes in spoken words makes learning to reading alphabetic languages very difficult

- Phoneme skills are needed for BOTH sounding out new words AND remembering the words we read

Foundational Concepts That Must Be Clearly Distinguished

Four Foundational Distinctions about Word-Level Reading

▸ These are the distinctions between:

1) The two broad skills needed for reading comprehension
   ▸ Skilled word-level reading
   ▸ Spoken language comprehension of the material being read

2) The two levels of word reading
   ▸ Identifying unfamiliar words
   ▸ Efficiently remembering newly encountered words for later, instant recall

3) The two levels of cognitive processing
   ▸ Automatic processing vs.
   ▸ Controlled processing

4) Easy-to-teach vs. hard-to-teach students
   ▸ Easy-to-teach students develop reading skills regardless of instruction
   ▸ Difficult-to-teach students need explicit skill development

Foundational Distinction 1:

The Two Broad Skills Needed for Reading Comprehension
(also known as The Simple View of Reading)

The Simple View of Reading
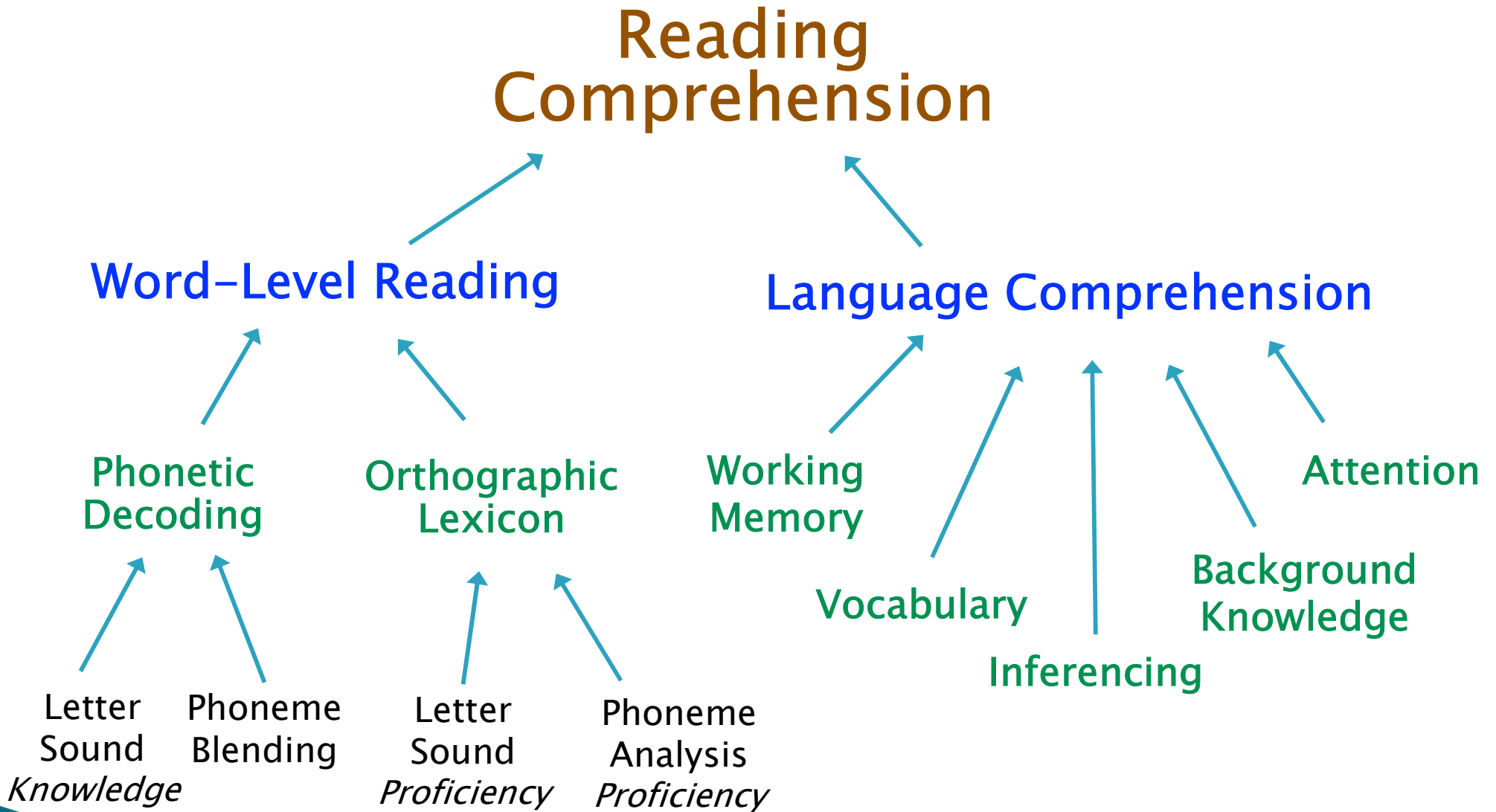
Reading Comprehension
is the product of:

LANGUAGE COMPREHENSION

and

WORD–LEVEL READING

The Simple View of Reading*

Reading Comprehension

Word-Level Reading

Language Comprehension

Phonetic Decoding

Orthographic Lexicon

Working Memory

Vocabulary

Inferencing

Background Knowledge

Attention

Letter Sound *Knowledge*

Phoneme Blending

Letter Sound *Proficiency*

Phoneme Analysis *Proficiency*

*Originated by Philip Gough and colleagues and expanded by others based upon later research. This version by David A. Kilpatrick.

Scientific Support for The Simple View

- The Simple View of Reading has received support from well over 100 *direct* studies and hundreds of *indirect* studies

- Research shows the Simple View applies to:
  - All age levels
  - All skill levels
  - All educational disabilities
  - All languages studied
  - All students learning to read a non-native language

- Today's focus will be on the word-level reading side of the Simple View equation

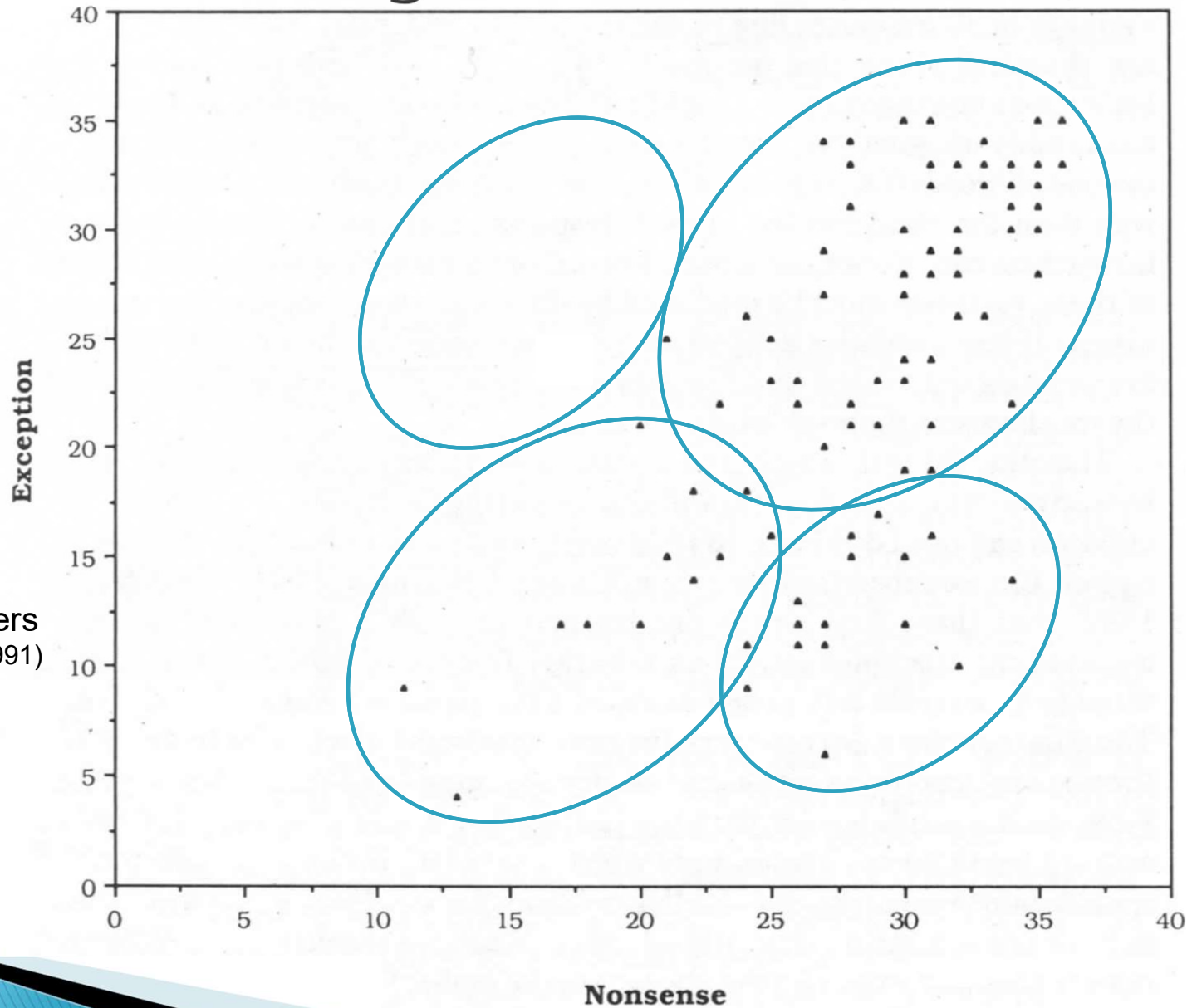# Foundational Distinction 2:

The Two Levels of Word Reading
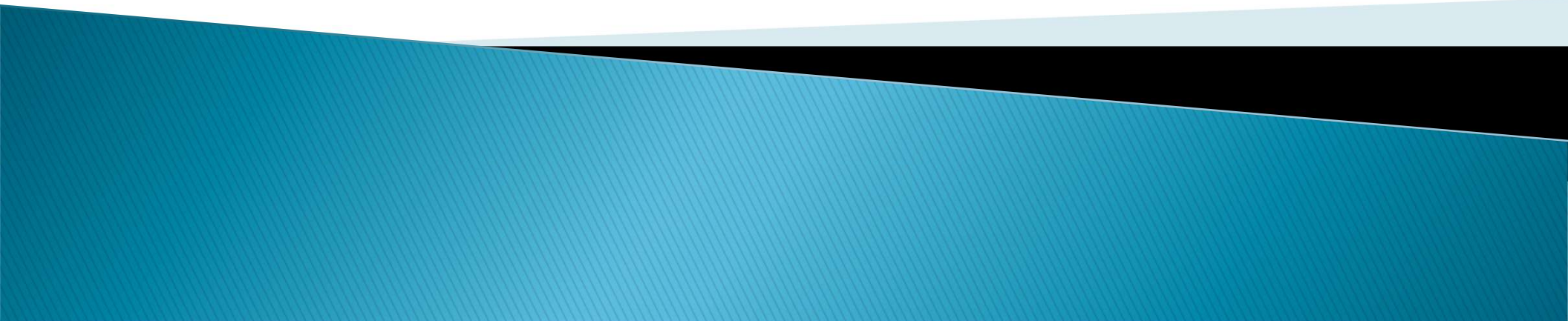
Two Levels of Word Reading Skill

1) The ability to *identify unfamiliar words* by sounding them out

2) The ability to *remember written words* for later, instant and effortless retrieval

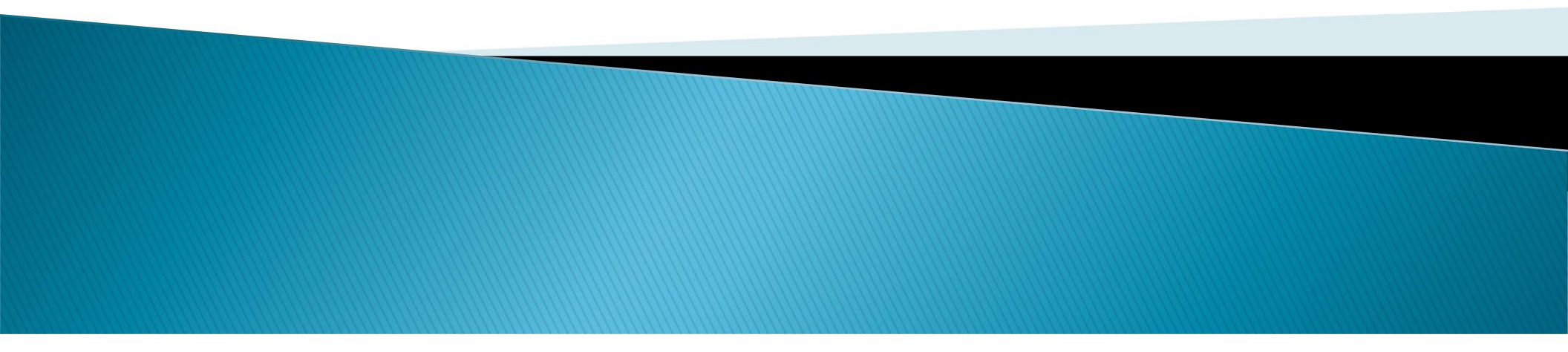   *As we will see (and contrary to our intuition), the first level of skill is required for the second*

Two Levels of Word–Level Reading Skill Deficits

Study of 93
1st through 3rd graders
From Gough & Walsh (1991)

Foundational Distinction 3:

The Two Levels of Cognitive Processing

Two Levels of Cognitive Processing

- Automatic processing
  - Unconscious—done without thinking
    - Limited or no burden on working memory
  - Most of what we do all day ("autopilot")
    - Motor skills, language reception and production, daily habits

- Controlled processing
  - Conscious thinking required
    - Some or very much use of working memory
  - Many things we do during the day
    - Higher-level mental and linguistic tasks, learning new things

A Question Science Needs to Answer

- Of the 20,000 to 70,000 words in your orthographic lexicon:
  - What percentage of them, upon first encounter, did you apply conscious effort in order to remember them for the future?
- Thus, the process of remembering written words is automatic, unconscious, and occurs "behind the scenes" while reading
  - This was not true for the math facts you learned in elementary school, or learning state capitals, or the Spanish or French flash cards you used in high school and college!

- *This highly efficient memory process requires explanation!*

- *Also, understanding this process should direct our instructional and intervention efforts and our assessments*

Concluding Thoughts on Automatic vs. Controlled Processes

- In skilled word–level readers, both REMEMBERING written words and RETRIEVING written words are automatic processes

- Weak readers are not good at remembering words

- Consider terms for memory from cognitive psychology:

    INPUT ➡ ENCODING ➡ STORAGE ➡ RETRIEVAL

- These get intermingled (jumbled!) when we use terms like "memory" and "remember"

- In reading, encoding and retrieval are automatic and unconscious

Foundational Distinction 4:

Some Clarifications about Word-Level Reading Difficulties

(also known as "dyslexia")

How Researchers Understand Dyslexia

▸ Basic definition found in studies of dyslexia:

Word-level reading difficulty despite adequate opportunity and effort (not due to blindness, deafness, emotional disturbance, brain damage, or extremely low IQ)

- All else is popular lore that has been with us for over 100 years

• Many researchers are shifting from the term "dyslexia" to "**word-level reading disability**" (WLRD)

- This (1) avoids the folklore and (2) applies across disability areas

• A problem translating research to practice:

- *Where do we draw the line?*

The Phonological-Core Deficit of Dyslexia

From the "most common cause" to the "universal cause"

"[A]lthough some individuals with dyslexia have weaknesses in a variety of areas, impaired phonological processing appears to be a universal cause of dyslexia."

Ahmed, Y., Wagner, R. K., & Kantor, P. T. (2012). How visual word recognition is affected by developmental dyslexia. In J. S. Adelman (Ed.), *Visual word recognition: Vol. 2. Meaning and context, individuals and development* (pp. 196–215). New York, NY: Psychology Press.

1) Weakness in one or more of the following (often more than one-sometimes all of these):
   ◦ Phonemic awareness/analysis
   ◦ Phonemic blending/synthesis
   ◦ Rapid automatized naming
   ◦ Phonological working memory
   ◦ Nonsense word reading & letter-sound knowledge acquisition

2) Well established with no substantive alternatives

▸ This is consistent with our phoneme-based writing system

Combining The Foundational Concepts

- Sounding out unfamiliar words
  - Requires controlled processing initially, but in typical readers it shifts to automatic processing (i.e., fast nonsense word reading)
  - Most kids with poor word reading struggle with this and it is perpetually controlled processing—for few it becomes automatic

- Remembering and then recognizing written words
  - Except for rare occasions, the process of remembering words is automatic, unconscious, and goes on "behind the scenes"
  - Recalling familiar words is automatic—no conscious effort required
  - No poor word readers automatize remembering words and thus they recognize few words. If they did automatize word memory and recognition, they would not be poor word readers!

- Whether skilled or not skilled in word reading, language comprehension is still essentials for reading comprehension

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 1/20th 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
  ◦ Once we learn a word, we don't forget it
▸ 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

How We Remember the Words We Read

Our Multiple Memories

- **Working memory** (limited, temporary storage)
  - Three components: central executive, phonological loop, visuo-spatial sketchpad
- **Long-Term Memory**
  - Semantic Memory
  - Episodic memory
  - Motor memory
  - Procedural memory
  - Auditory memory ← Oral INPUT yet two different aspects of long-term MEMORY
  - Phonological memory ←
  - Face memory ← Visual INPUT yet three different aspects of long-term MEMORY
  - Orthographic memory ←
  - Visual memory ←

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

- Input and storage are not the same thing
    - Input is visual, storage is orthographic (via a phonological process)
- 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
- Word reading correlates strongly with phonological skills
- 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 is difficult to explain if it is visual memory
- Neuroimaging studies show different activation patterns for visual memory and orthographic memory

Orthographic Mapping

- The *process* involved in remembering words for later, instant and effortless retrieval
  - Also applies to word parts, not just words

- Orthographic mapping is the mechanism that builds the sight vocabulary/orthographic lexicon

- Other than visual input of the letters into the system, it is not a visual memory process

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 teaching ourselves "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
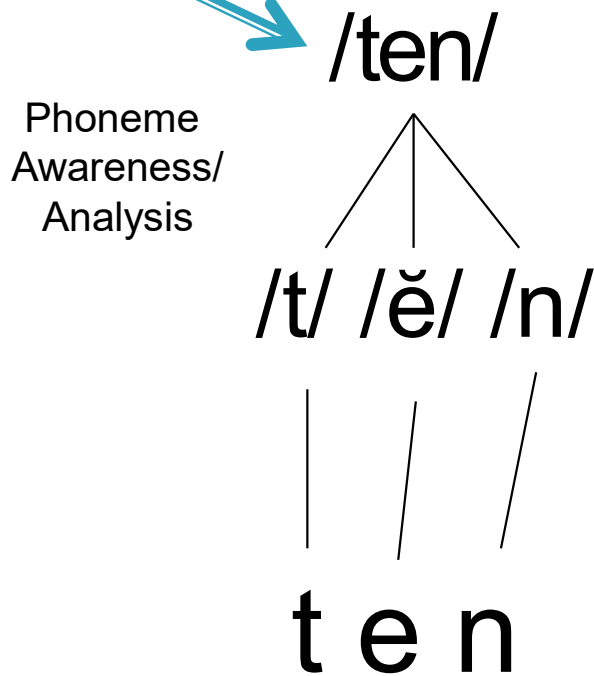
Linnea Ehri's Orthographic Mapping Theory

- 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 grapho-phonemic connection forming process

- We connect something well established in LTM (the word's pronunciation) to the stimulus that needs to be learned (the letter sequence in the word's spelling)

- Phoneme-level analysis and letter-sound knowledge are central to this connection-forming process
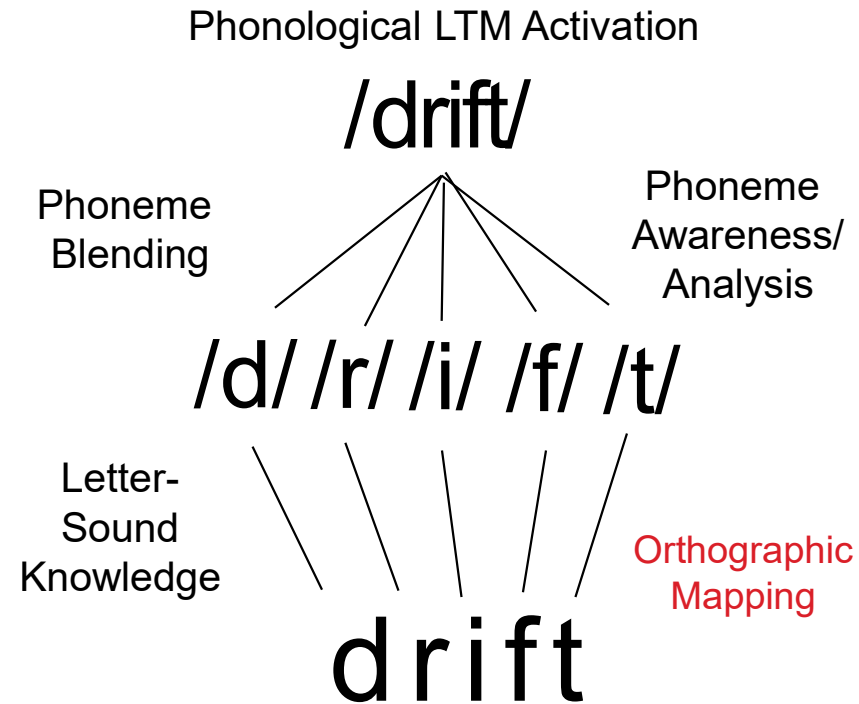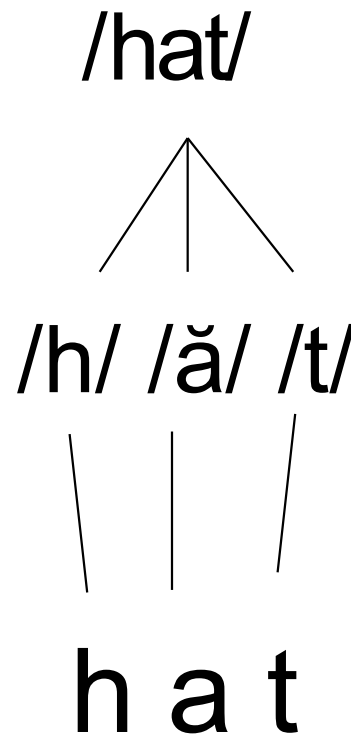
How We "Map" Words

"Transparent" Words

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

PLTM

Phoneme
Awareness/
Analysis

/ten/

/t/ /ĕ/ /n/

t e n

Oral First: A mind
prepared to store words

/hat/

/h/ /ă/ /t/

h a t

Phonological LTM Activation

/drift/

Phoneme
Blending

Phoneme
Awareness/
Analysis

/d/ /r/ /i/ /f/ /t/

Letter-
Sound
Knowledge

Orthographic
Mapping

d r i f t

Self-Teaching
Hypothesis

How We "Map" Words

Words that are "Opaque"
(i.e. words without a one-to-one correspondence)

/n/ /ā/ /m/

n a m e

/t/ /ē/ /m/

t e a m

/c/ /ō/ /m/

c o m b

What about irregular words?

- Irregular and opaque words take a little longer to learn
    - Perhaps 1-2 extra exposures for typical readers; many more for RD

- Most irregular words are off by only one element
    - E.g., *said, put, comb, island*; multiple violations are rare: *of, one, iron*

- Irregular words are not a challenge for orthographic mapping
    - "Exception words are only exceptional when someone tries to read them by applying a [phonetic] 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)

- Many regular words require mapping "adjustments," just 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*)

How Words are Learned for Instant, Effortless Retrieval

▸ Orthographic mapping is a grapho-phonemic connection forming process that occurs automatically

▸ To do this, it requires:

　◦ Letter-sound proficiency

　◦ Phonemic proficiency

　◦ The ability to automatically/unconsciously establish a relationship between phonemes and graphemes while reading

Sight Vocabulary and Reading Fluency

- *Sight 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

PREVENTION AND INTERVENTION

Prevention: Tier 1 Results

K-1 phonological Awareness Instruction

- *Overall* improvement in reading scores

- Average of 8 standard score points

- Results did not always last after 1-2 year follow ups

HOWEVER . . .

- At-risk students averaged 13 standard score point gains!

- Gains increased to an average of 20 points 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/Phonemic Awareness Instruction
  - Letter-Sound Knowledge Instruction and Practice
  - 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

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 with rigorous PA training
  - All did explicit, systematic phonics
  - All provided reading practice with connected text

Summary

- Word-level reading is primarily phonological in nature
    - This is based upon the alphabetic nature of our writing system
    - Visual memory is not a significant contributor to word reading

- Skilled readers are all good at 1) phonetic decoding and 2) orthographic mapping, neither is optional
    - Efficiently remembering words via orthographic mapping appears to require 1) letter-sound *proficiency* and 2) phonemic *proficiency*

- Fluency appears to be primarily a function of sight vocabulary size

- Reading problems are very preventable
    - Teach all kids letter-sound skills and phonemic skills in general education

- The most highly effective intervention outcomes addressed all three of the following: 1) rigorous phonemic awareness training, 2) letter-sound skills, and 3) reading practice
    - Studies that neglected any one of these three had lesser results

For Further Reading

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