

Understanding Dyslexia: A Scientific Approach

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Things We Know

- Dyslexia is real. People with dyslexia often have other problems (ADHD, math, written expression). Not the only type of RD
- Many children at-risk for dyslexia can be taught to read with early identification and explicit, comprehensive reading instruction
- Remediation of dyslexia after Grade 2 requires high intensity and explicit, comprehensive reading instruction
- We know lots about brain function, malleability (plasticity in development and in relation to intervention) and the heritability of dyslexia

Things We Don't Know

- **Exactly** how many people have dyslexia
- The level of intensity required to remediate dyslexia
- How “dyslexia” differs from “other” word level disorders
- How to scale effective identification and intervention and translate what’s known from science
- How to use the research on brain function and heredity to identify and intervene with dyslexia (no dyslexia genes)
- Accommodations and adjuncts for people with intractable reading problems

Misunderstandings About Dyslexia

- Definition and Prevalence
- Role of IQ
- Specificity
- Effective Interventions
- Methods of Service Delivery
- Brain Structure and Function

Definition: Word Level Reading Difficulties

Most common and best understood form of LD (Dyslexia)

- A common problem: Largest single group of students in special education: almost 2/5 of all children identified for special education
- Many children not identified for special education have word level difficulties
- Addressed in IDEA as “basic reading” domain and often through 504

IDA Definition of Dyslexia

Dyslexia is a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede the growth of vocabulary and background knowledge.

Adopted by the Board of Directors: November 12, 2002

Important Research Findings

- 1. Dyslexia occurs primarily at the level of the single word and involves the ability to decode and spell printed words in isolation (accurately and automatically). It leads to problems reading text, but is not a text level disability.**

Important Research Findings

- 2. Single word decoding problems in reading and spelling are strongly associated with problems segmenting words and syllables into phonemes.**

Alphabetic Principle

- Print represents speech through the alphabet or other visual symbol
- Regardless of surface appearance (orthography), words represent internal units based on sound (phonemes)
- In learning to read, the child makes explicit an implicit understanding that words have internal structures linked to sounds (phonological awareness)
- **Reading is parasitic on language**

Important Research Findings

- 3. Dyslexia occurs as part of a natural, unbroken continuum of ability—what causes good reading also causes poor reading (Shaywitz et al., 1992).**

The attributes of dyslexia are dimensional: variations on normal development. One theory explains success and failure in reading. Prevalence depends on the threshold

What Is the Prevalence?

- Most estimates are 3-7% (often assume effective intervention, exclusions, no comorbidity), but still depends on threshold
- Snowling and Melby-Lervag (2015) meta-analysis of genetically sensitive designs:
 - + family risk < 10th %tile (34%); > 10th %tile (53%); about 45% overall
 - family history <10th %tile (11%); > 10th (16%)

Important Research Findings: IQ

- 4. Dyslexia is best identified through assessments of reading and spelling skills, and instructional response**

IQ tests are not necessary (Dyslexia is uncoupled from IQ): Methods for identification of LD based on IQ-discrepancy or patterns of cognitive strengths and weaknesses lack validity.

Important Research Findings: Weak relation of outcomes with IQ

5. Children Do *NOT* Outgrow Dyslexia

- Over 70% identified as dyslexic in Grade 3 remained dyslexic as adults
- Without adequate intervention, dyslexia is a lifelong, chronic disorder
- IQ is weakly related to intervention outcomes (Stuebing et al., 2009; 2014)

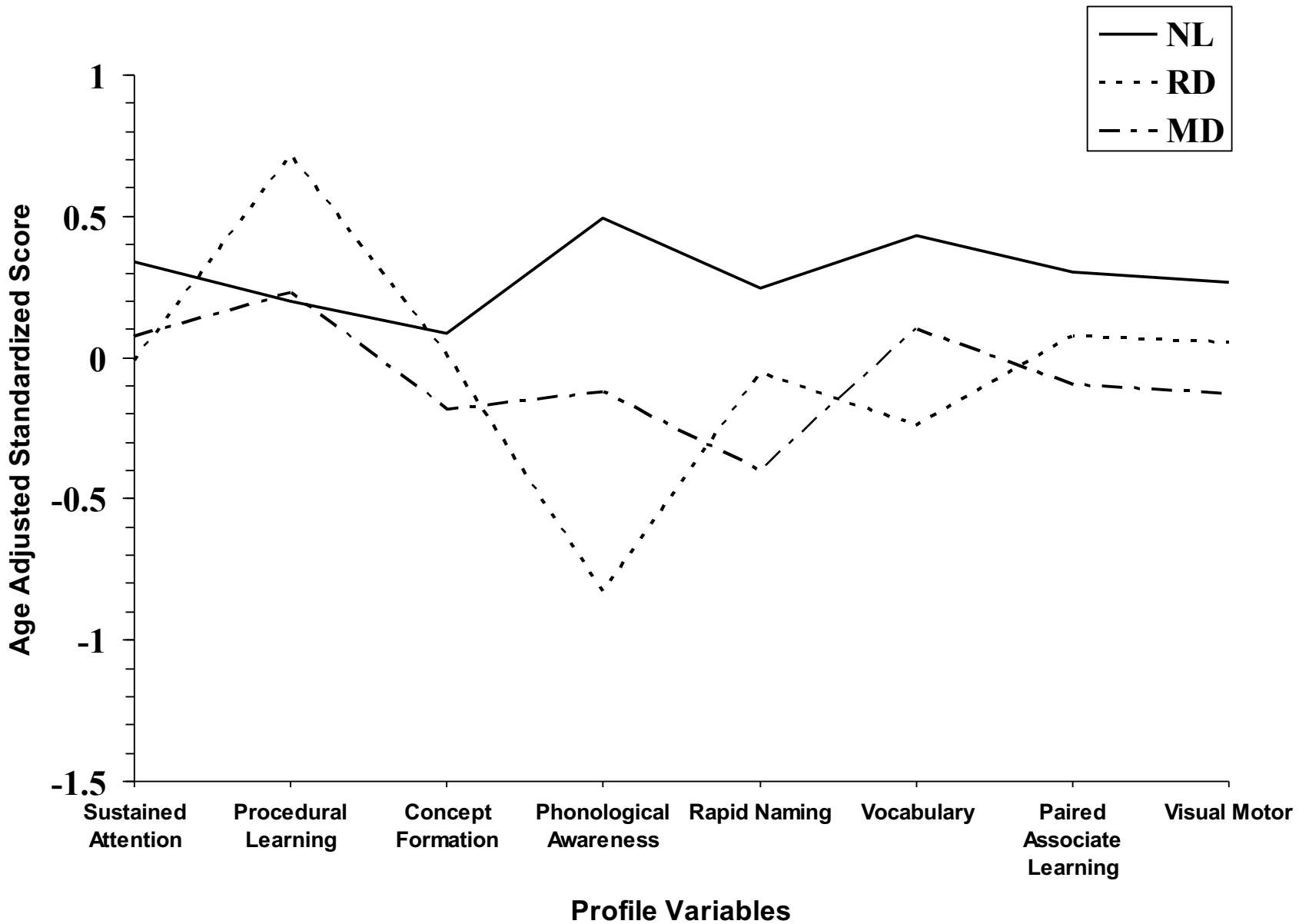
Important Research Findings

6. People with dyslexia have problems outside phonology

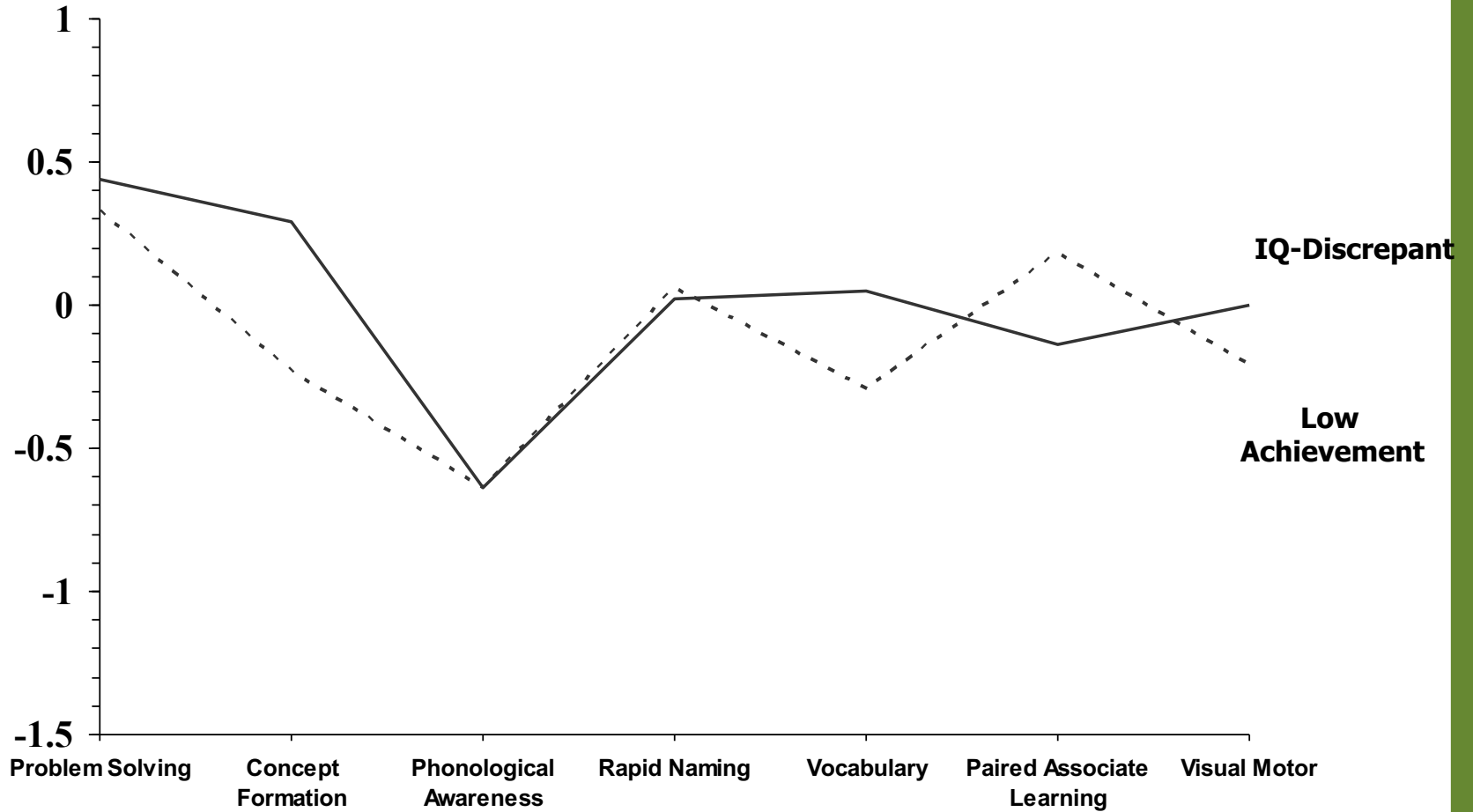
- *Comorbidity*- academics, ADHD, oral language
- Word recognition not the only type of RD (text level disorders are not dyslexia)

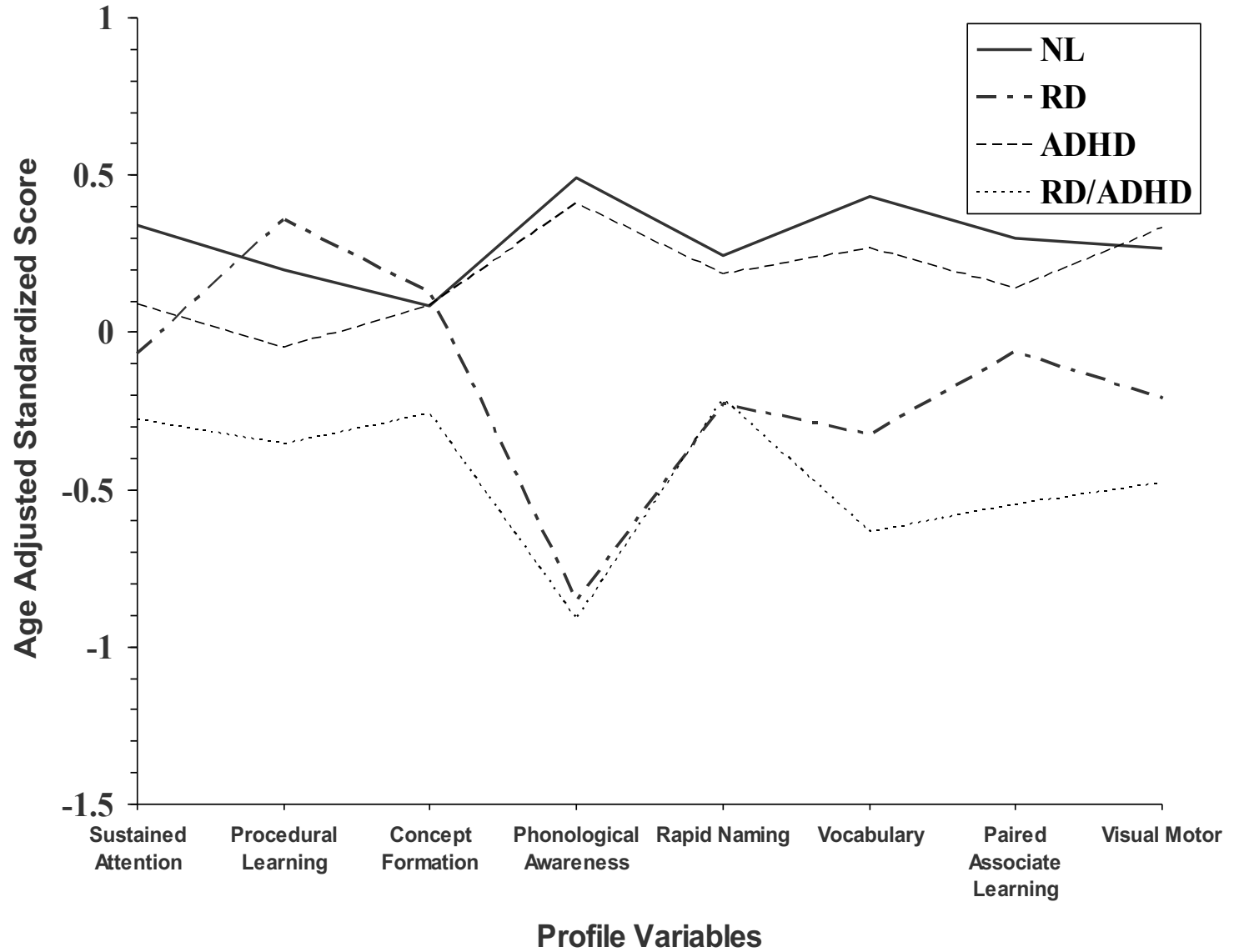
Specificity

- Dyslexia is real; consensus definition is narrow
- Dyslexia is often part of a complex presentation; generalist genes affect multiple LDs and ADHD (continuity hypothesis)
- Comorbidity: ADHD common; if language and working memory problems significant, math impaired; anxiety is common. Written expression and reading comprehension almost always impaired
- Phonological processing/decoding presentation shines through the glare of complexity



RD Groups





Important Research Findings

7. Dyslexia can (often) be prevented.

Remediation requires much more intensity

Skills that prevent dyslexia must be taught early in school

Remediation after Grade 2 demonstrably less effective (Connor; Lovett): diminishing returns

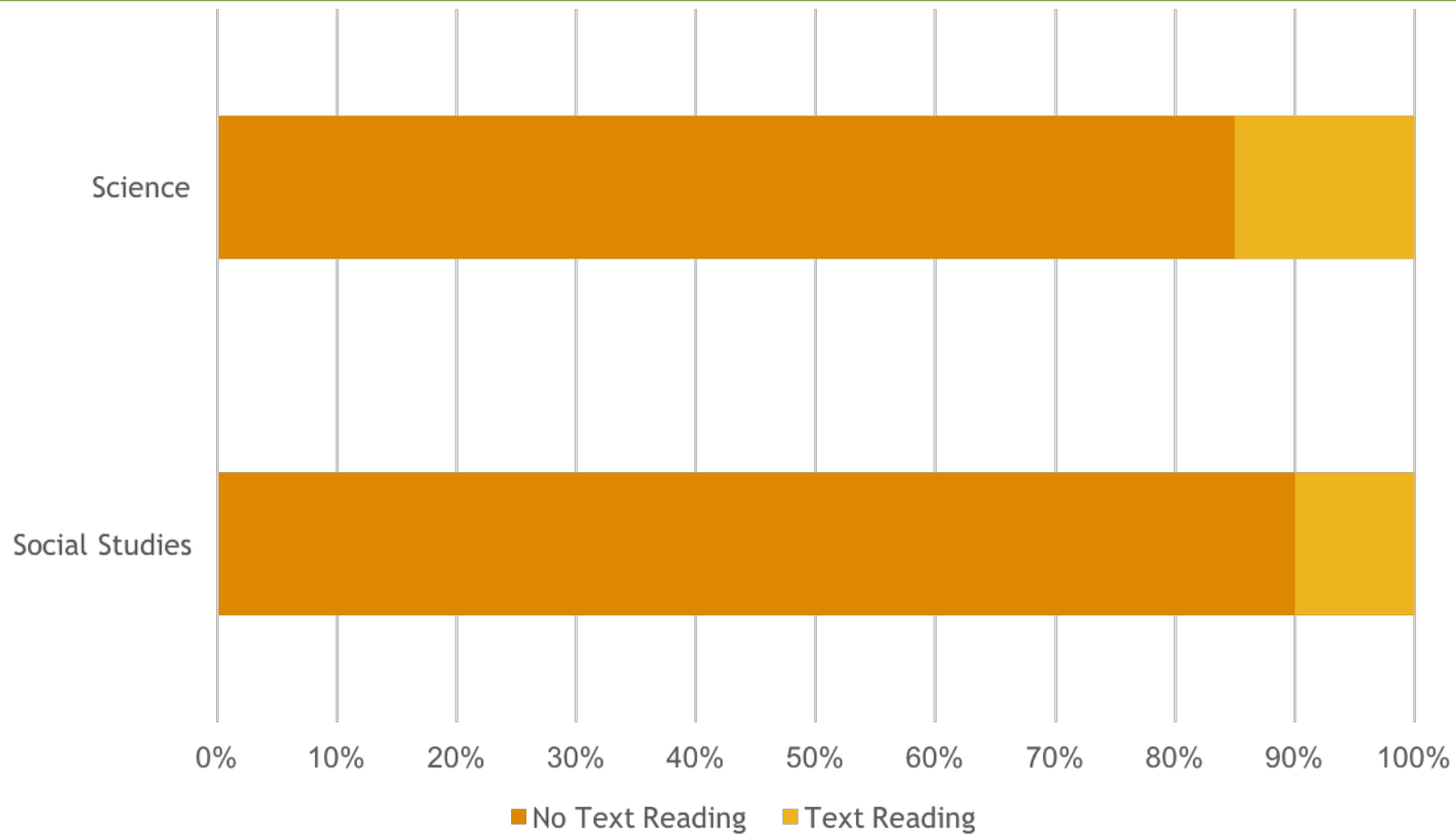
Important Research Findings

- **Some children placed in special education are instructional casualties because they did not get the needed instruction early in development**
- **Dyslexia (or any LD) should not be identified in the absence of documentation of adequate instruction (IDEA 2004)**
- **We know very little about effective accommodations and adjuncts for children and adults with severe reading problems**

8. Effective Intervention

- Teach phonics EXPLICITLY with an approach that includes comprehension and fluency components (NRP about explicitness, not phonics). **Differentiate** based on student needs
- No specificity of appropriate interventions. Research supports **explicit, comprehensive, differentiated** approaches at classroom and supplemental level
- Research does not support **multisensory** (in traditional sense), **balanced systematic, manualized, multiple cuing systems, discovery or constructionist or rule-based approaches**
- Traditional service delivery models ineffective; **Screen, prevent, remediate, accommodate** (MTSS: opposite of typical sequence)

Text Reading in the Content Areas



How can we address both goals?

Content
Knowledge

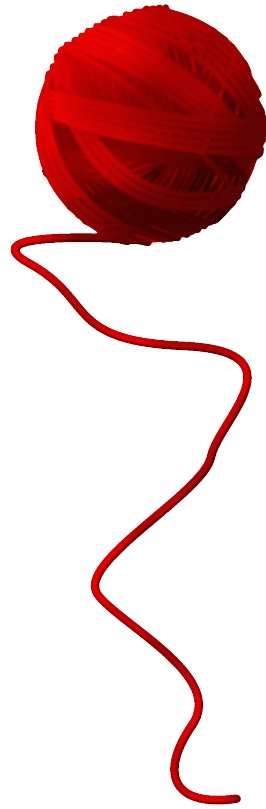
&

Comprehend
Information
Presented in
Text

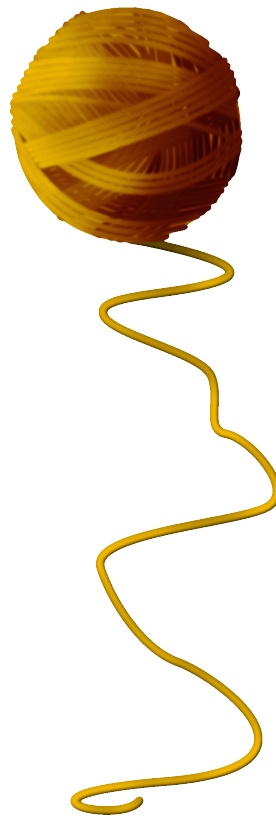
PACT

We Started With Four Strands of Research

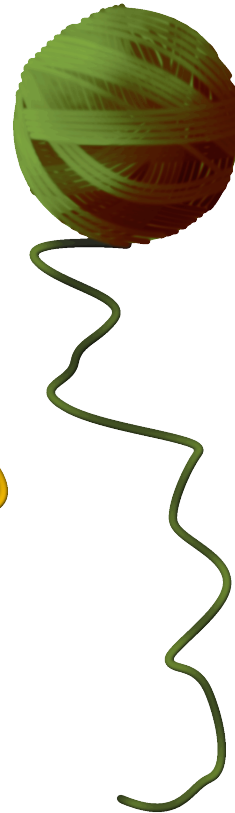
Intervention
Design
Experiments



Cognitive
Processing
Studies



Motivation
Studies



Reading
Engagement
Studies



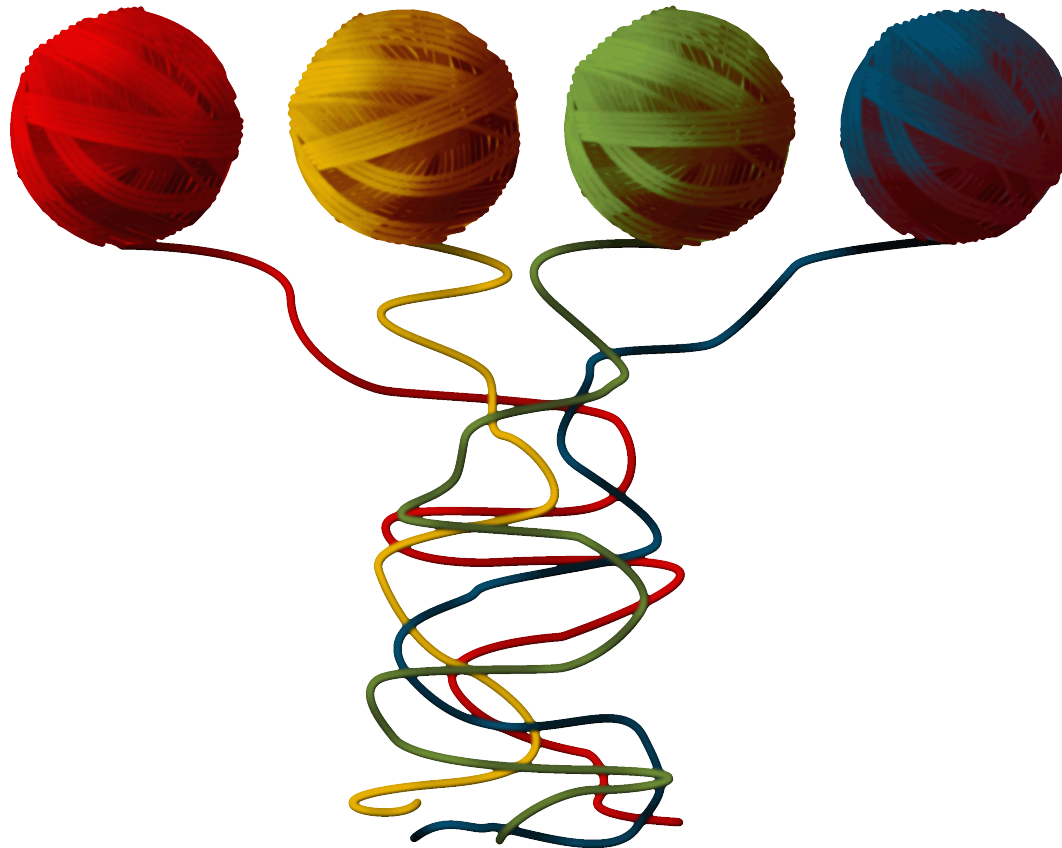
Continued With Interwoven Experimental Studies

Intervention
Design
Experiments

Cognitive
Processing
Studies

Motivation
Studies

Reading
Engagement
Studies



PACT Components



Comprehension Canopy



Explicit Vocabulary Instruction



Text-Based Classroom Discourse



TBL Comprehension Check



TBL Knowledge Application

Grade 7

Life Science Sample Lessons



Ecology

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Comprehension Canopy Routine *7–10 minutes*

Materials

Springboard images: marine ecosystem, desert ecosystem, Amazon rainforest

Introduction and Prior Knowledge

When you see a picture of a forest or desert, it can look calm and peaceful, as if nothing is happening. But forests, deserts, and other ecosystems are full of life and activity.

In this unit, we will learn about relationships between living things and the environment.

Springboard

- Introduce the springboard images.

I will show you some pictures of different places.

- Provide a purpose for viewing the images.

As you look at each image, write one thing you know about the place just by looking at the picture.

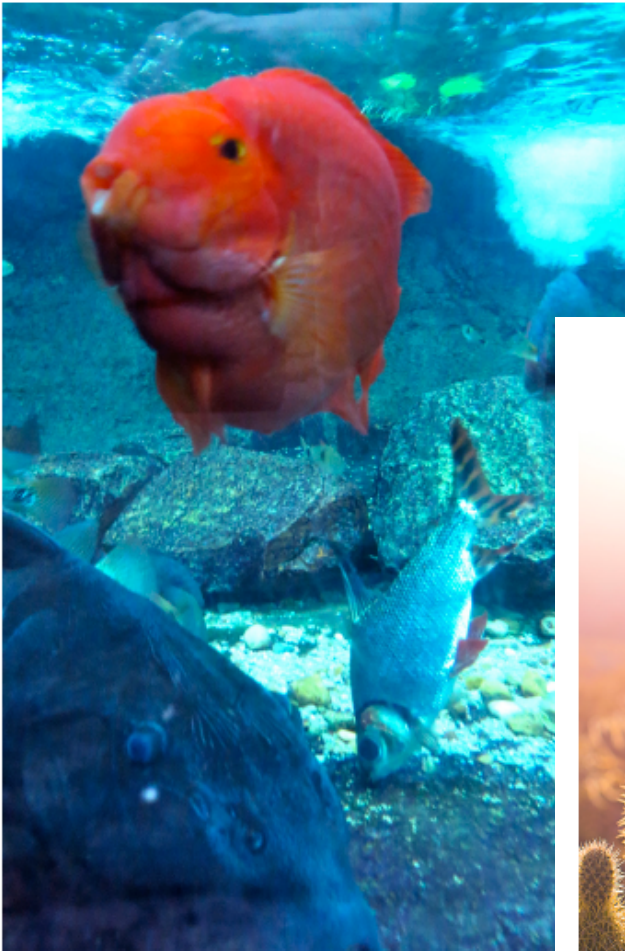
- Display the springboard images one at a time. After showing each image, have students begin a “turn and talk” activity by using one of the following prompts.
 - *Tell your partner what kinds of plants and animals might live here.*
- OR
- *How does the weather affect what lives in this environment?*

Comprehension Question

State the comprehension question that will guide students’ learning throughout the unit.

How do interactions between living and nonliving things affect ecosystems?

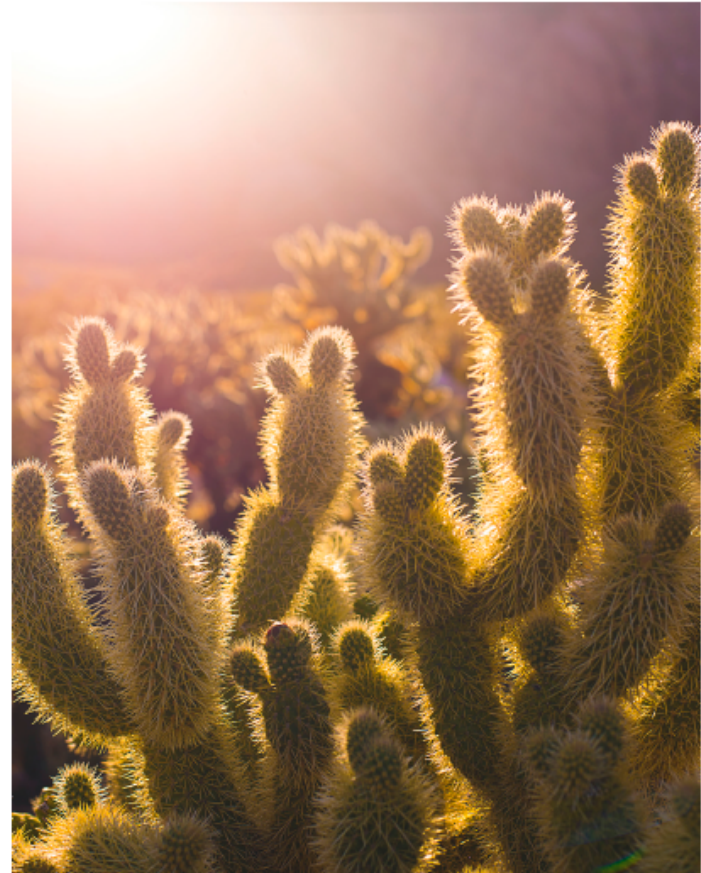
Marine Ecosystem



Amazon Rainforest



Desert Ecosystem



interact

When two or more things have an effect on one another



www.wikimedia.org

Related Words: *interaction, influence, relate, connect*

Example Usage:

Ecology is the science of how living things **interact** with their environment.

Example: *A deer eating the flowers in your neighborhood because the forest where it lived burned down*

Nonexample: *Watching a news report about a forest fire*

Turn and Talk:

In what different ways do you **interact** with members of your family?



ecosystem

A community of organisms that live and interact in a particular area



www.pxabay.com

Related Words: *ecology, environment, habitat*

Example Usage:

Rainforest **ecosystems** rely on tropical bats to pollinate flowers and disperse seeds for trees and shrubs.

Example: *A stream with fish, insects, frogs, and water grasses*

Nonexample: *A puddle on the sidewalk from a recent rain shower*

Turn and Talk:

Is our classroom an **ecosystem**? Why? Why not?



Ask an Amazon Expert: Why Can't We Afford to Lose the Rainforest?



www.wikimedia.org

(1)

You've worked in the Amazon for more than 50 years. How have you seen the region change?

Fifty years ago, there were 3 million people and one highway in the entire Amazon basin. That's an area as large as the United States! Today, there are between 30 million and 40 million people, countless roads, and it's about 20% deforested. The combination of new roads and deforestation has fragmented the rainforest and affected the region's **biodiversity**. **Species** lose their habitat or

can no longer subsist in the small fragments of forests that are left. We know that **ecosystems** with a lot of **biodiversity** are generally stronger and more able to adapt than those with fewer **species**.

But on the plus side, 50 years ago there was only one national park—in Venezuela—and one national forest and one reserve in Brazil. Today, more than 50% of the Amazon is under the protection of national parks and reserves. The real challenge is to move toward a much more unified approach to managing the Amazon.

What changes have humans made in the Amazon region over the past 50 years?

What effects have those interactions had on the region's biodiversity?

(2)

When we talk about protecting the Amazon, it's hard for many people to relate because they don't feel connected to the region. How can we change that?

There are actually a lot of **interactions** between our lives and the Amazon, no matter how far away we are.

For example, there's a big, nasty viper called the bushmaster that lives in the Amazon. This snake kills its prey with venom that causes the prey's blood pressure to drop to zero. Scientists in Brazil discovered how this venom affects a human body system called the angiotensin (AN GEE OH TEN SIN) system. This discovery then allowed pharmaceutical scientists to design medicines to treat high blood pressure. Today, millions of people use these medicines. They now have longer, fuller, and more productive lives and they have the venom of a nasty snake far away in the Amazon to thank for it.

An **interaction** that affects everyone on the planet is climate change. Trees absorb carbon dioxide through photosynthesis. When deforestation occurs, there are far fewer trees to absorb carbon dioxide from the atmosphere. Reforestation—replanting a forest—is an important way of removing carbon dioxide from the atmosphere. The Amazon is a carbon sink, meaning it stores carbon dioxide that would otherwise contribute to climate change. If the Amazon were destroyed, climate change would dramatically increase.

Why would a person living in Washington, D.C., care about what happens in the Amazon?

How is climate change connected to the health of the Amazon rainforest?

NAME(S) _____

Comprehension Check #1**Individual Directions:** Mark your answer to each of the following questions.**Team Directions:** For each question, (1) read, (2) discuss, (3) justify your answer, and (4) scratch off your card.

- ## Procedure
1. Complete the Comprehension Check individually.
 2. Turn in the Comprehension Check.
 3. Move into teams.
 4. Complete the Comprehension Check as a team, using scratch-off cards. For each question, group members
 - a. suggest an answer;
 - b. cite evidence from unit text or notes;
 - c. agree on an answer; and
 - d. scratch off the answer—if incorrect, repeat the process.

21. The Proclamation of 1763 angered colonists because it:

- A** Placed duties, or import taxes, on various goods brought into the colonies
- B** Imposed taxation without representation
- C** Tried to prevent colonists from forming representative governments
- D** Tried to prevent colonists from moving west in search of land

Team Explanation of #21: Why is ___ the correct answer?

22. The Sons of Liberty and other angry colonists protested the Stamp Act by:

- A** Sending a petition to the House of Burgesses
- B** Destroying three ship loads of tea by throwing it into Boston Harbor
- C** Throwing rocks and ice balls at troops guarding the Boston Commons
- D** Attacking customs officials and organizing a boycott of British goods

23. The British decided to tax the colonists in an effort to raise revenue. They needed this revenue to pay off debt caused by:

- A** The high price of sugar
- B** Loans to failing banks during the early 1750s
- C** The high cost of fighting the French and Indian War
- D** Mercantilist trade policies

24. The Sons of Liberty used news of the killings in the Boston Massacre as propaganda to:

- A** Encourage colonists to organize and fight the British
- B** Discourage colonists from boycotting taxed goods
- C** Discourage colonists from meeting in public places
- D** Encourage colonists to follow British law more carefully

NAME(S) _____

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IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT®)

Name _____

Test # _____

Subject _____

Total _____

SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	Score
1.					_____
2.					_____
3.					_____
4.					_____
5.					_____
6.					_____
7.					_____
8.					_____

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Competition of Causes of the American Revolution

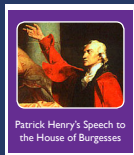
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The French and Indian War



Colonists Moving Into the Ohio River Valley



Patrick Henry's Speech to the House of Burgesses



The Stamp Act

is more important because:

Semifinalist

**Round 1:
Early Causes**

is more important because:

Semifinalist

is more important because:

Finalist

is more important because:

Finalist

is more important because:

Semifinalist

**Round 2:
Late Causes**

is more important because:

Semifinalist



The Boston Massacre



The Boston Tea Party



The Intolerable Acts



The First Continental Congress

is the most important cause of the American Revolution because:

**Round 3:
The Most Important Cause**

Randomized Control Design Blocked on Teacher With Classes Assigned to T or BAU

Vaughn et al., 2013

5 teachers
419 students
27 classes

Vaughn et al., 2014

19 teachers
1,487 students
85 classes

PACT

261 students
16 classes

BAU

158 students
11 classes

PACT

790 students
47 classes

BAU

652 students
38 classes

Sample Sizes

	Teachers	Classes		Students	
		T	C	T	C
Vaughn et al., 2013	5	16	11	261	158
Vaughn et al., 2014	19	47	38	790	652
Vaughn et al., 2017	18	49	45	845	784
Wanzek, Swanson et al., 2015	14	23	18	468	374
Swanson et al., 2017	1	na	na	45	33
Wanzek et al., 2014 (TBL only)	7	15	11	266	150
Wanzek et al., 2015 (TBL only)	6	13	11	196	162
TOTAL	70	297		5,184	

Fidelity of Implementation

Efficacy Trial	Comprehension Canopy	Essential Words	Knowledge Acquisition	TBL Comprehension Check	TBL Knowledge Application
Vaughn et al., 2013	3.8	3.5	3.0	3.7	3.4
Vaughn et al., 2014	2.9	3.1	2.2	2.9	2.2
Vaughn et al., 2017	3.3	3.4	2.8	2.9	3.1
Wanzek, Swanson et al., 2015	3.0	3.3	2.3	3.1	2.5
Wanzek et al., 2014 (TBL only)	na	na	na	3.9	2.8
Wanzek et al., 2015 (TBL only)	na	na	na	3.9	2.3

Results From RCTs




Student Sample	Efficacy Trial	Content Knowledge	Content Reading Comprehension	Broad Reading Comprehension
General Education	Vaughn et al., 2013	.17	.29	.20
	Vaughn et al., 2014	.32	.02	.01
		.29		
		.26		
	Vaughn et al., 2017	.40	.20	.12
	Wanzek, Swanson et al., 2015	.36	.02	.04
.22				
	.24			
Wanzek et al., 2014 (TBL only)	.19	na	.03	
Wanzek et al., 2015 (TBL only)	.31	na	na	

Studies With Struggling Readers

Student Sample	Efficacy Trial	Content Knowledge	Content Reading Comprehension	Broad Reading Comprehension
Struggling Readers	Swanson et al., 2015	.26	.34	.09
	Wanzek et al., 2015	.51	.04	.02
	Swanson et al., 2017	.35	.59	.10
	Kent et al., 2015 (TBL Only)	.50	.38	na

Study Highlight: Vaughn et al., in press

- Summary: PACT students consistently demonstrate:

Content Knowledge	
Content Reading Comprehension	
Broad Reading Comprehension	

- How important is heterogeneity in classrooms?
 - When high achievers are present teachers have higher expectations and they alter instruction accordingly.
 - All students benefit from participation of peers with a range of achievement levels.
 - Academic engagement and motivation to learn are higher when there is a range of achievement levels.

Study Highlight: Vaughn et al., in press

What happens to intervention effects as heterogeneity decreases?

Research Questions:

- How do students with reading difficulties perform on reading outcomes after participating in PACT instruction?
- To what extent does the proportion of students with reading difficulties in a class moderate outcomes?

Design and Intervention Procedures

Vaughn et al., 2017

18 teachers
1,629 students
94 classes

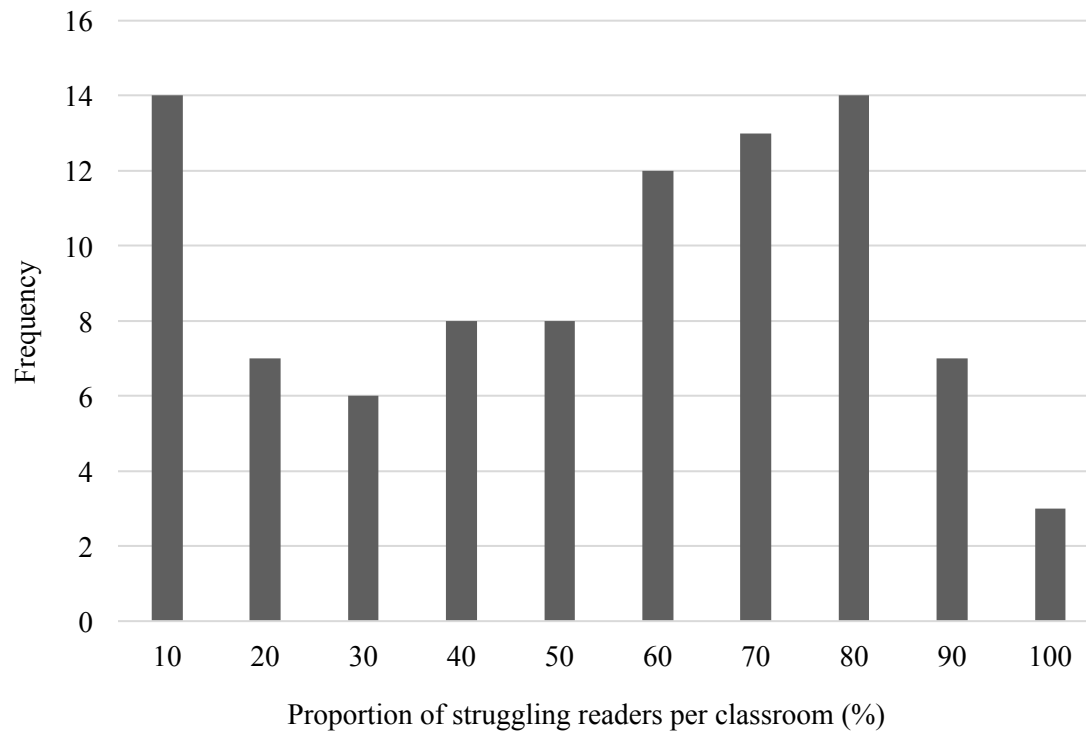
PACT
845 students
49 classes

BAU
784 students
45 classes

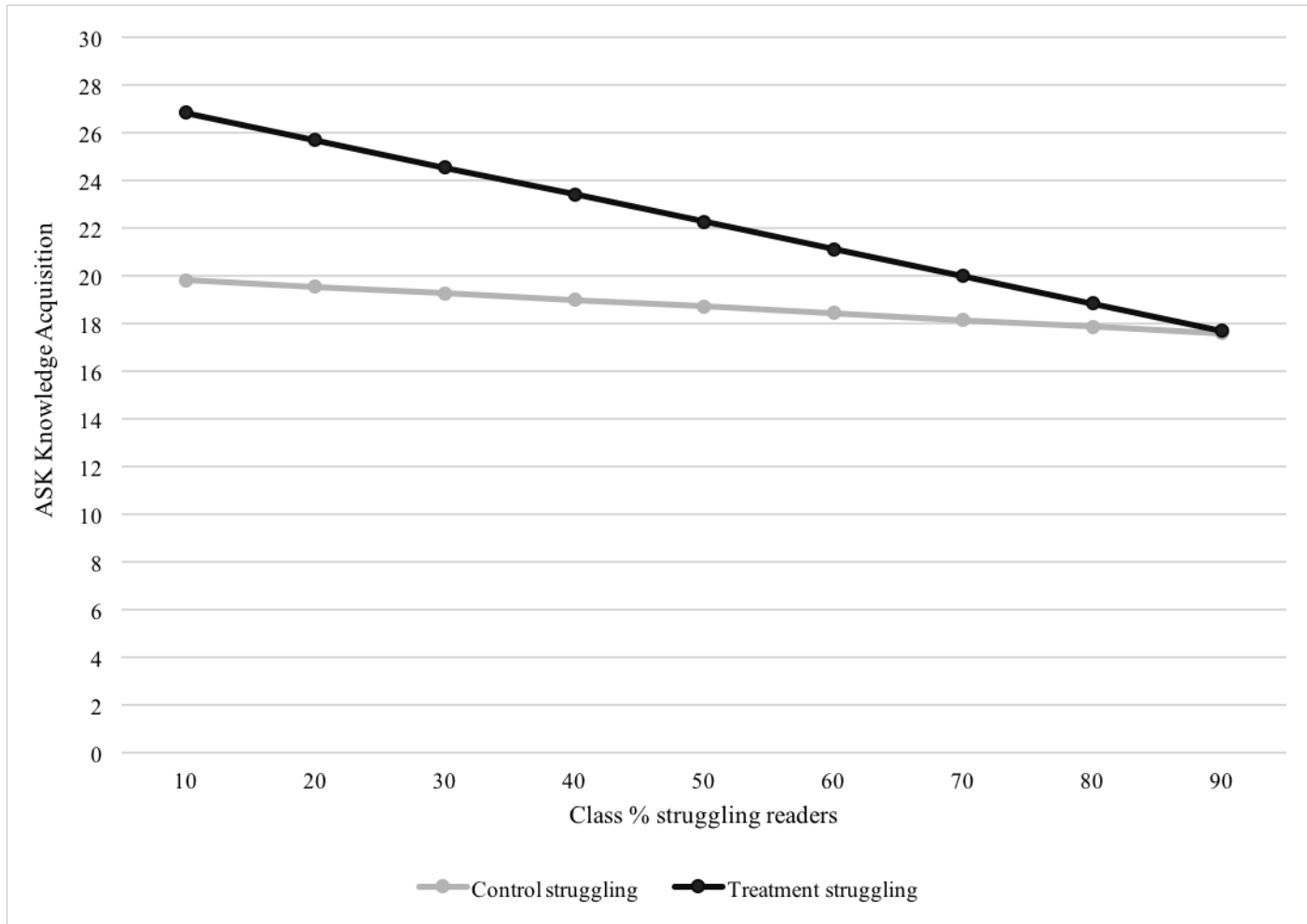
PACT Instructional Practices

- Across 6-8 weeks
- 50 minutes daily or 90 minutes every other day

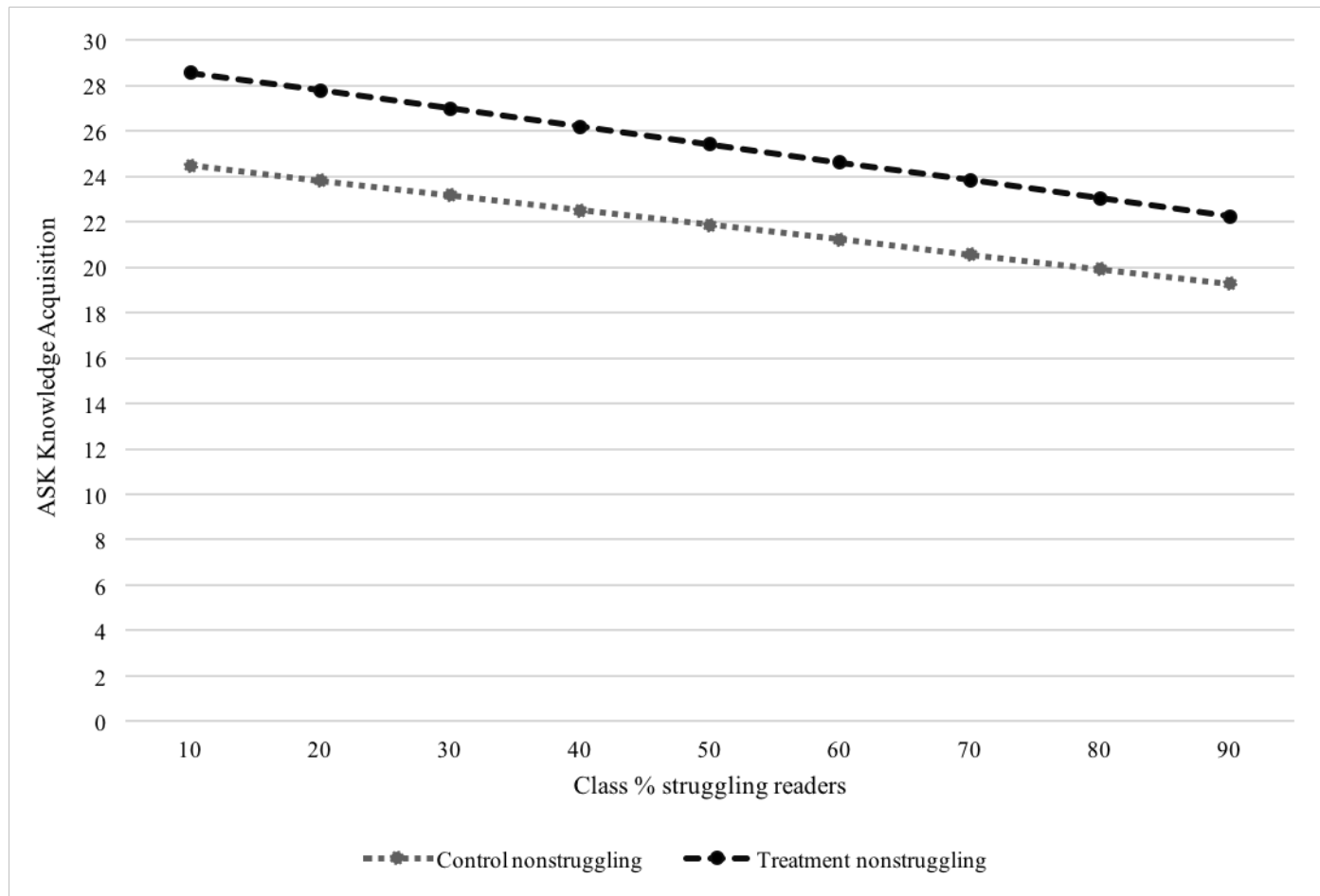
Proportion of Struggling Readers Per Classroom



Identify areas along the continuum of class proportion of struggling readers where intervention status & struggling reader status interact significantly.



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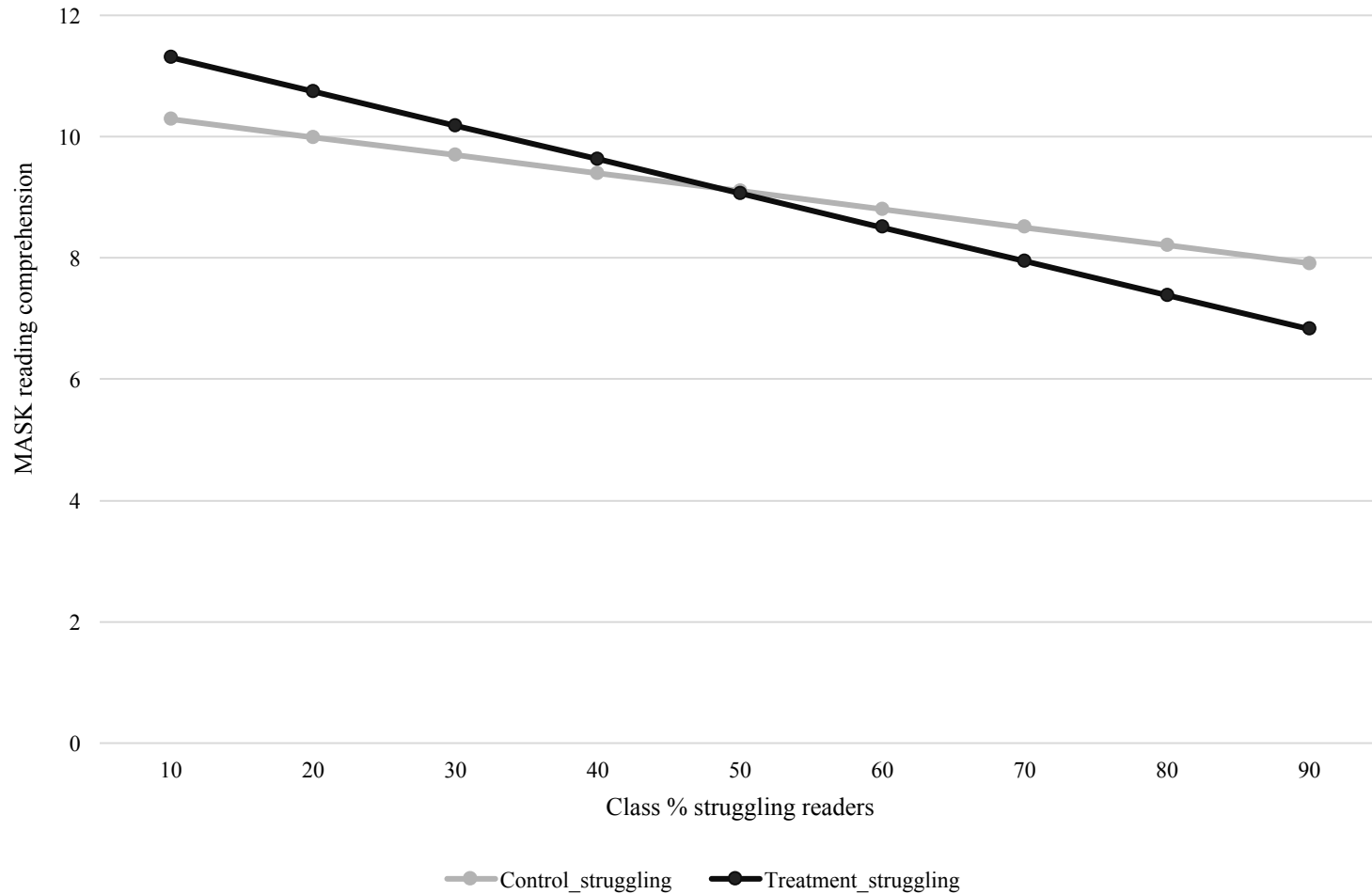
Results: Reading Comp

For each 10% increase in proportion of struggling readers, posttest scores decreased by .78 points.

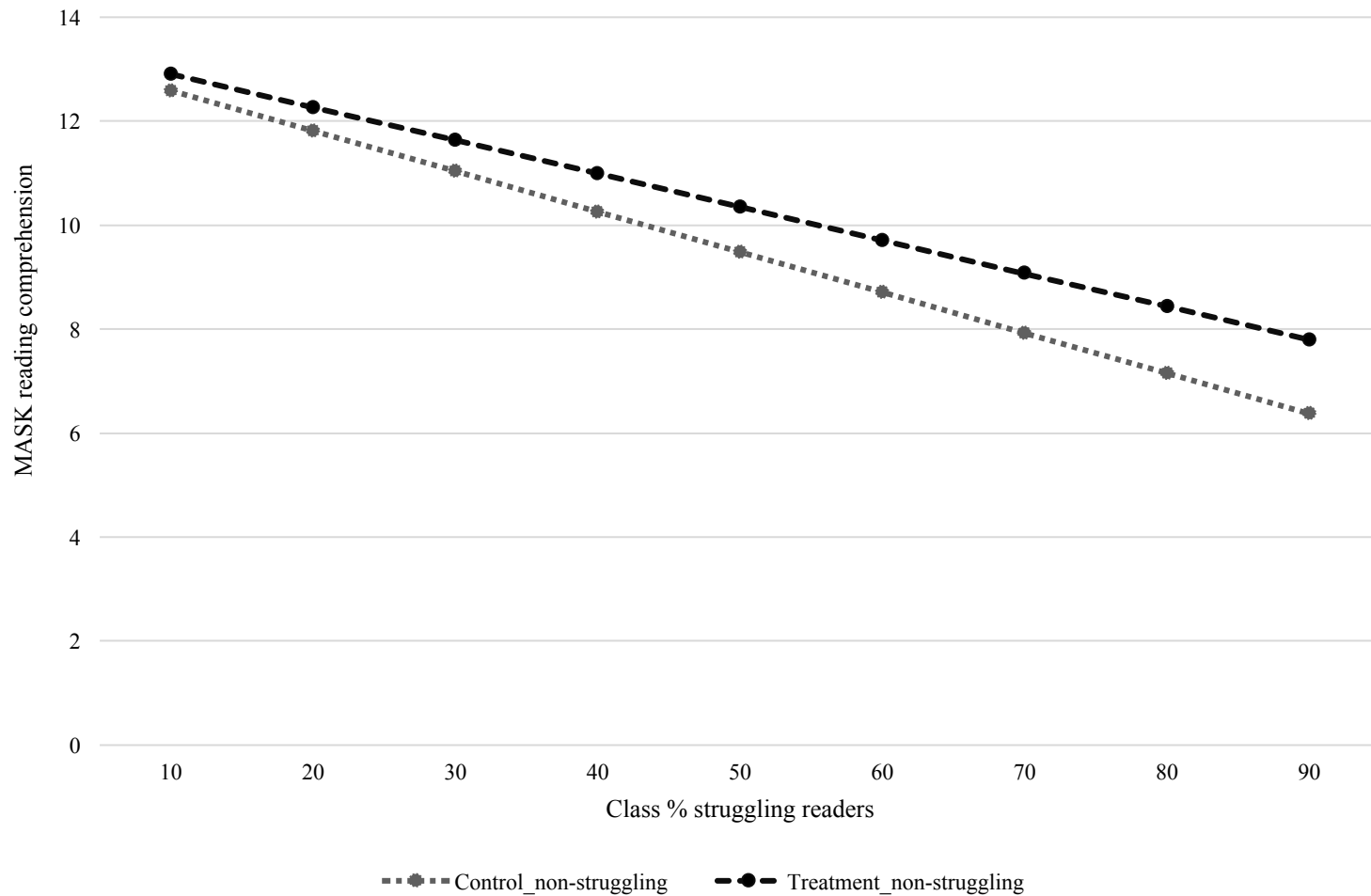
MASK

Intercept	9.48	.28	< .001	
Pretest	.53	.05	< .001	
Intervention	.87	.41	.03	.17
Struggling reader	-.38	1.10	.73	-.09
Class % of struggling readers	-.78	.12	< .001	
Intervention X struggling reader	-.90	1.29	.48	
Intervention X class % of struggling readers	.14	.12	.26	
Struggling readers X class % of struggling readers	.48	.16	< .001	
Intervention X struggling readers X class % of struggling readers	-.40	.24	.09	

Identify areas along the continuum of class proportion of struggling readers where intervention status & struggling reader status interact significantly.



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THANK YOU!

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