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## Learning Center Results & Research Summaries

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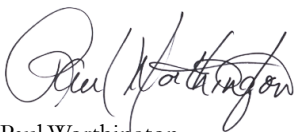
# Introduction

Over the course of three decades, Lindamood-Bell Learning Processes has been honored to work with tens of thousands of children and adults. Through our programs, intervention approaches, and research findings, we bring the Non-Verbal Code for Language and Cognition to our students to help them learn to their potential.

Our students include struggling readers who are just starting to learn sounds and letters, those who are not “getting” what they read or hear, students who simply wish to excel, some who have been previously diagnosed with dyslexia or labeled with a Specific Learning Disability, or with developmental delays and autism. Our continued success in addressing the diverse needs of these individuals is due to our comprehensive approach to differential diagnosis and increasing learning and achievement through research-validated, sensory-cognitive instruction.

This summary highlights the results of our work in our Learning Centers and our collaborative work with other research institutions. We continue to actively participate in peer-reviewed studies of our programs, and monitor the results at our Learning Centers and School Partnerships in order to ensure state-of-the-science diagnosis and instruction, and to ensure that we maintain our exceptional standard of quality.

Sincerely,



Paul Worthington  
Director of Research and Development

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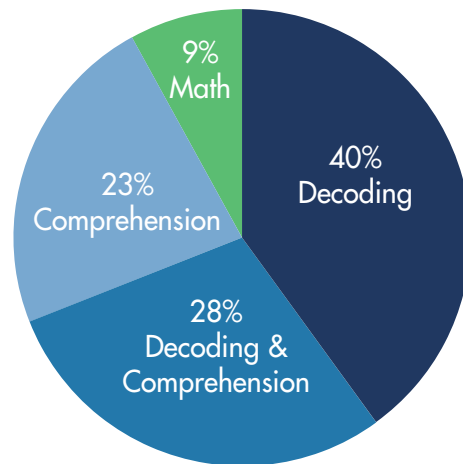
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# Lindamood-Bell Learning Centers

## Types of Instruction

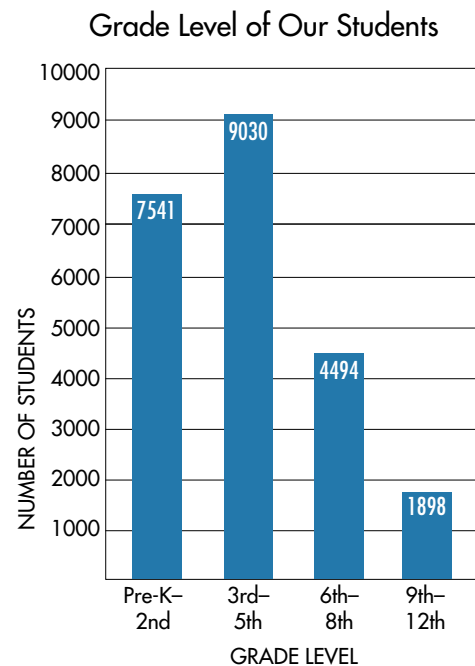
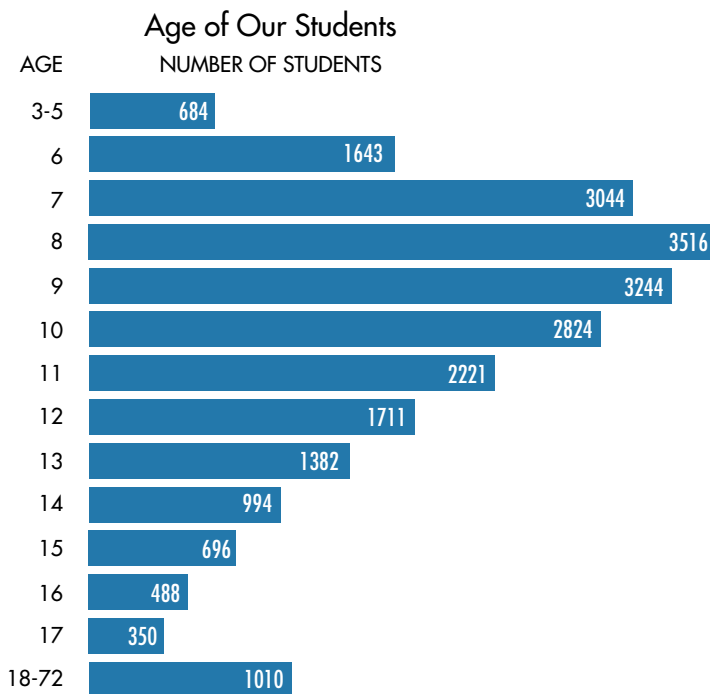
At Lindamood-Bell Learning Centers, students receive sensory-cognitive instruction differentiated to meet their learning processing needs. Some students receive customized instruction based on a need in one area, utilizing one of our intervention programs. Many students receive instruction for learning needs in two or three areas, utilizing a combination of prioritized intervention.

Decoding and encoding instruction (Seeing Stars® program) develops word attack, sight word recognition, spelling, and paragraph reading; comprehension instruction (Visualizing and Verbalizing® program) develops memory, oral and written language comprehension, language expression, vocabulary, following directions, and critical thinking; and math instruction (On Cloud Nine® program) develops math computation and math problem solving.



## Student Profile

The tables below show the distribution of the age and grade of more than 23,000 students who received instruction at our Learning Centers from 2008 to 2017.



Many individuals have sought help from their school districts and other reading instruction providers before seeking help from Lindamood-Bell.

Individuals who reported...

- Receiving speech therapy: 34%
- Receiving special education services: 33%
- Receiving remedial reading help at school: 25%
- Repeating a grade: 11%
- Being identified as Gifted: 5%

# Learning Ability Evaluation

Each student receives a Learning Ability Evaluation to determine his or her areas of strength and weakness in reading, spelling, and comprehension.

Test	Task
Symbol Imagery	Image and manipulate orthographic and phonemic patterns
Phonemic Awareness	Perceive sounds in isolation and within words
Word Attack	Read a list of progressively difficult nonsense words
Word Recognition	Read a list of progressively difficult real words
Spelling	Spell a list of progressively difficult real words
Vocabulary	Select one picture from four that matches a spoken word
Comprehension	Answer multiple-choice questions after reading a paragraph aloud
Following Oral Directions	Mark visual material after hearing spoken directions
Word Opposites	Say the opposite of a verbally provided word
Math Computation	Solve problems from basic arithmetic fractions to basic algebra
Math Story Problems	Read and solve simple to complex story problems that require computation
Paragraph Reading Rate, Accuracy, and Fluency	Read paragraphs aloud

## Percentiles

One of the most common ways test publishers provide results is through the use of percentiles. A percentile score is a ranking (1 to 99) between people of the same age range. For example, if a student scores at the 75th percentile, he scores as well or better than 75% of the people his age. The following can be used to interpret percentiles:

Percentiles	Range	Definition
Below 25 <sup>th</sup>	Below Normal	Weakness
25 <sup>th</sup> - 36 <sup>th</sup>	Within Normal	Moderate Difficulty
37 <sup>th</sup> - 62 <sup>nd</sup>	Within Normal	Adequate Ability
63 <sup>rd</sup> - 74 <sup>th</sup>	Within Normal	Ease
At or above 75 <sup>th</sup>	Above Normal	Strength

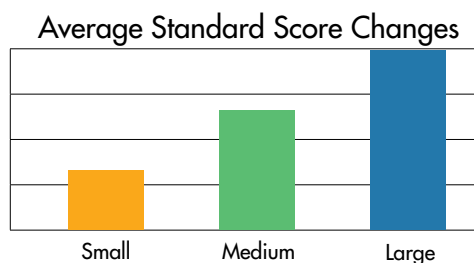
Standard scores (see Standard Scores below) are averaged and converted to percentiles based on a normal distribution. For example, an average standard score of 100 for a group of students is equivalent to the 50th percentile.

Pre- to retest results that are statistically significant ( $p \leq .05$ ), not due to chance, are noted with an asterisk. Paired  $t$  tests are performed on standard scores.

## Standard Scores

A standard score is a raw score that has been transformed to a common scale (mean of 100 and standard deviation of 15) so comparisons can be made. Standard score changes are used to determine the magnitude of change

from pre- to retest. Each student's retest standard score is subtracted from their pretest score to get a change score, and all of those scores are averaged to get an average standard score change. While there is no definitive interpretation, researchers generally agree that a standard score change of practical significance ranges from 3.0 to 4.5 points.

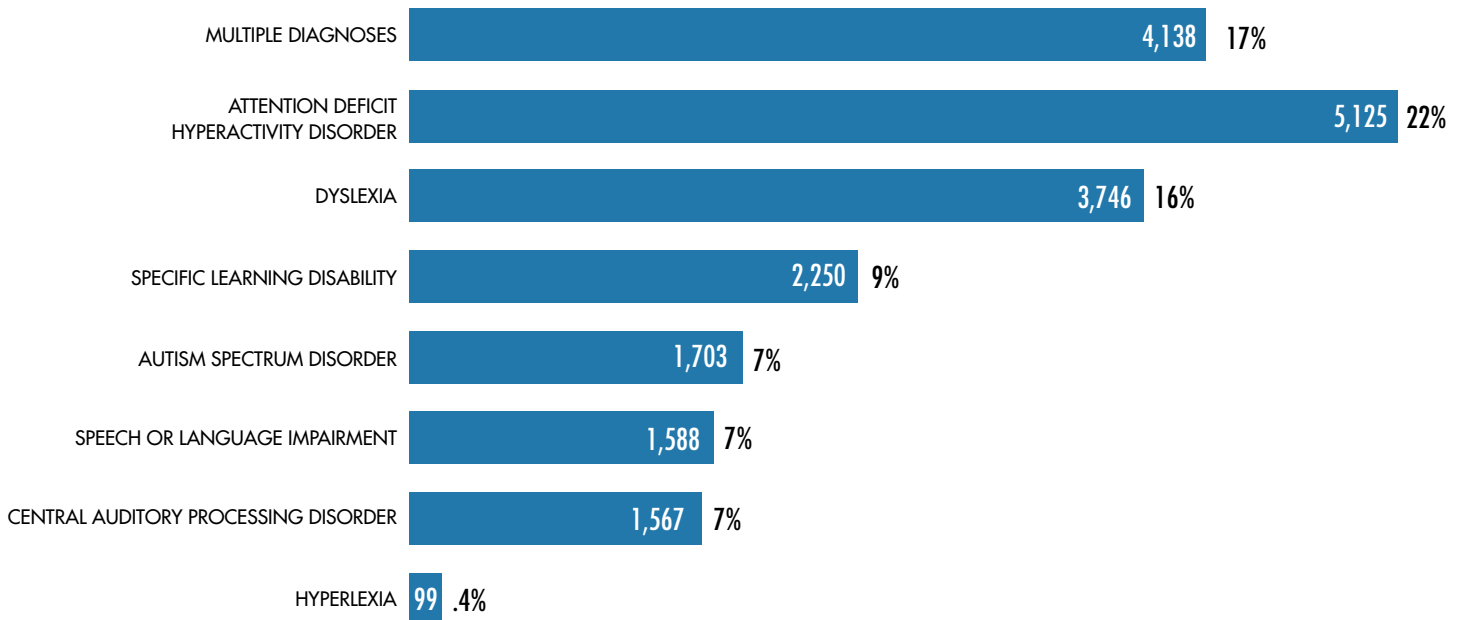


# Students with Prior Diagnoses

Approximately 43% of Lindamood-Bell students reported having received a diagnosis prior to instruction at our Learning Centers.

- Attention Deficit Hyperactivity Disorder
- Multiple Diagnoses
- Dyslexia
- Specific Learning Disability
- Autism Spectrum Disorder
- Speech or Language Impairment
- Central Auditory Processing Disorder
- Hyperlexia

Number and Percentage of Students by Prior Diagnosis

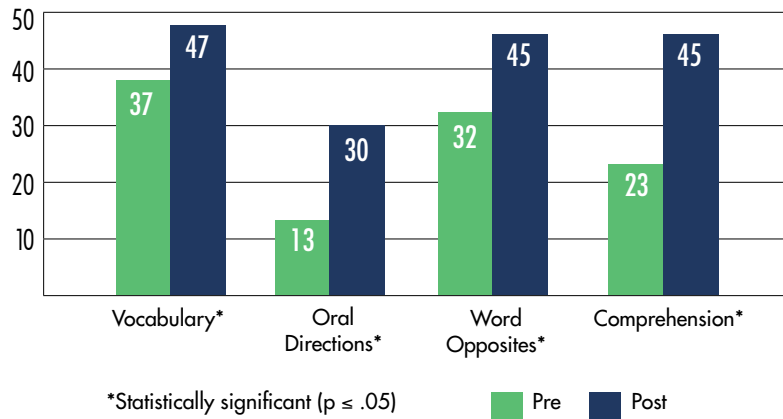


It is significant that 57% of students receiving services do not have a prior diagnoses in spite of having formative language processing issues.

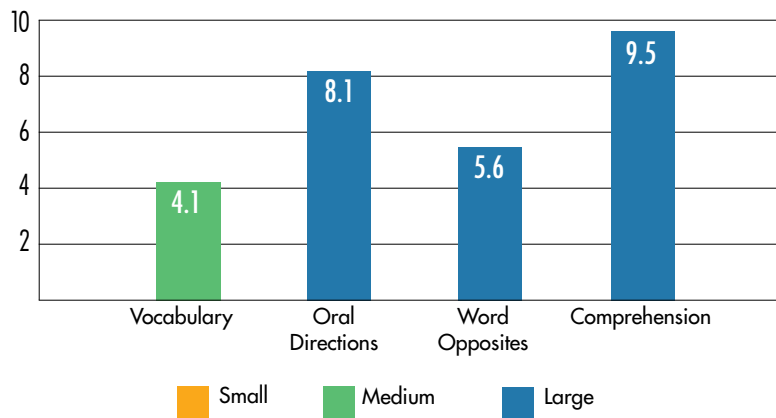
# Comprehension

## Results of Students Who Received Comprehension Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008-2017

**Average Age:** 12

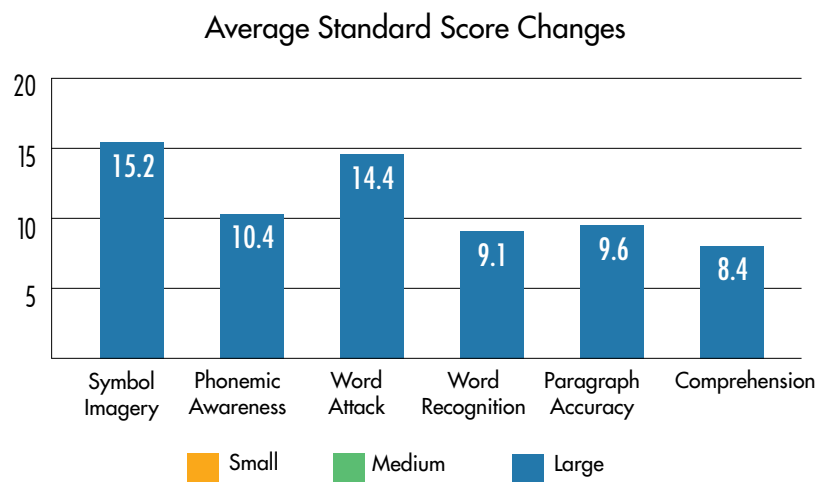
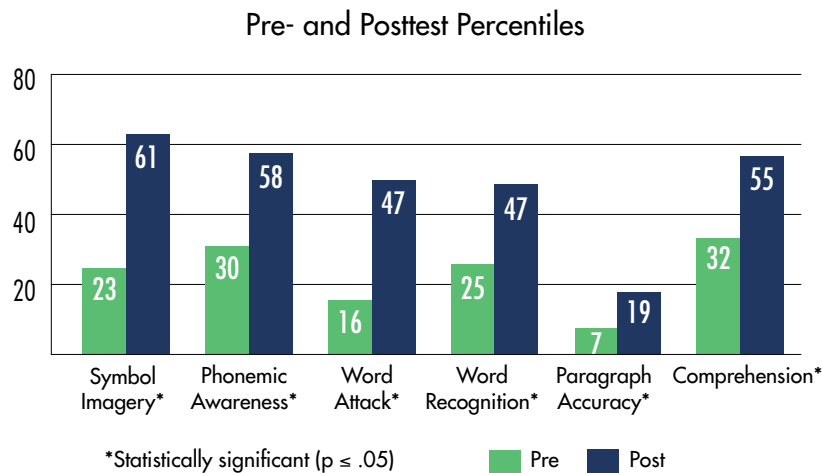
**Number of Students:** 4,682

**Average Hours of Instruction:** 99

**Results:** On average, students who received Visualizing and Verbalizing instruction achieved significant improvements in areas associated with language comprehension. They made large (significant) standard score changes on three of the four measures. Additionally, the 22-point percentile increase in comprehension put these students well within the normal range (25th-75th percentile). Their pre- to posttest results were statistically significant on all measures.

# Decoding

## Results of Students Who Received Decoding Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008–2017

**Average Age:** 10

**Number of Students:** 7,322

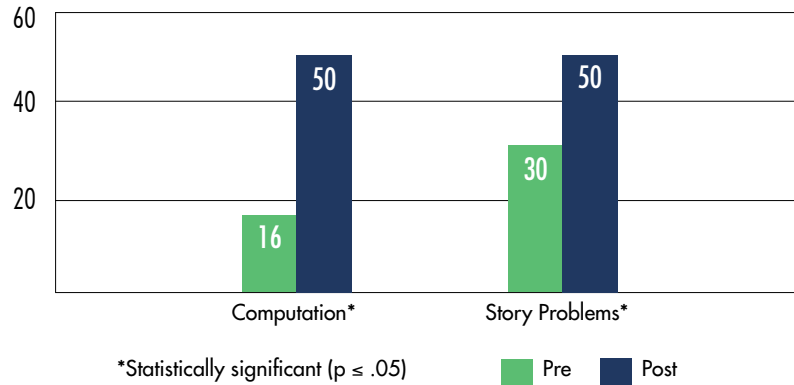
**Average Hours of Instruction:** 102

**Results:** On average, students who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on all measures. Additionally, the 31-point percentile increase in Word Attack put these students within the normal range (25th–75th percentile). Although the largest average standard score change can be seen on the symbol imagery measure, it's important to note the large average standard score change on the comprehension measure. Students' gains in decoding resulted in a great improvement in comprehension, the only reason to decode.

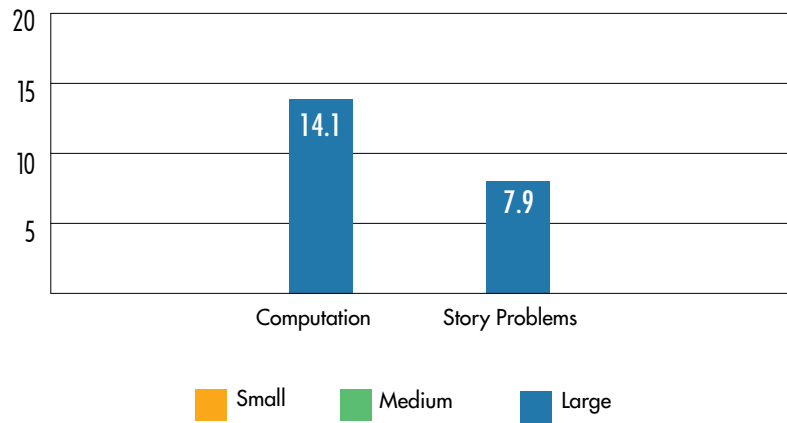
# Math

## Results of Students Who Received Mathematics Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** On Cloud Nine

**Years:** 2008-2017

**Average Age:** 11

**Number of Students:** 311

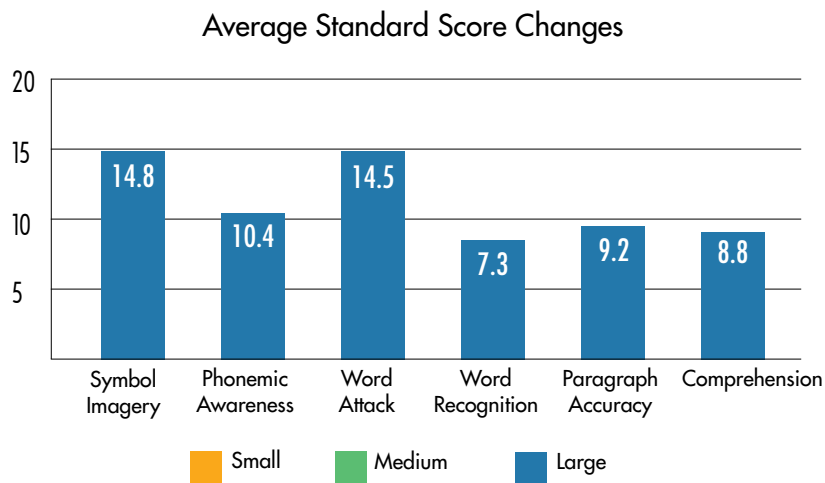
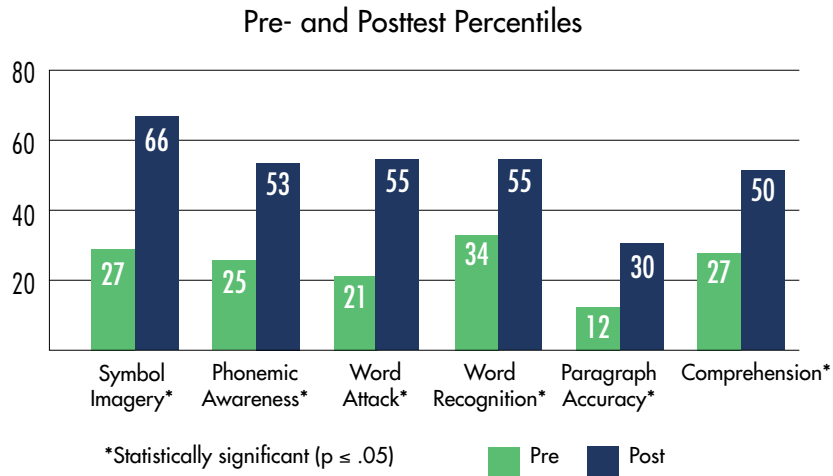
**Average Hours of Instruction:** 95

**Results:** On average, students who received all or most of their instruction in On Cloud Nine achieved significant improvements in math. They made large (significant) standard score changes on both measures. Additionally, the 34-point percentile increase in computation put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on both measures.



# Decoding & Comprehension

## Results of Students Who Received Decoding & Comprehension Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars and Visualizing and Verbalizing

**Years:** 2008–2017

**Average Age:** 11

**Number of Students:** 5,083

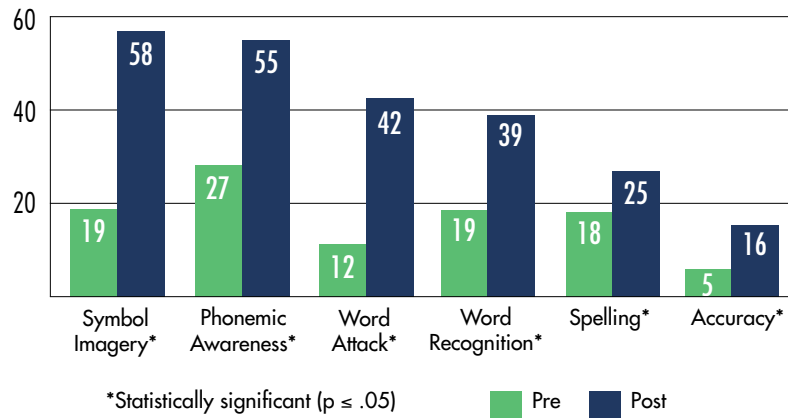
**Average Hours of Instruction:** 125

**Results:** On average, students who received Seeing Stars and Visualizing and Verbalizing instruction achieved significant improvements in reading and comprehension. They made large (significant) standard score changes on all measures. Although the large average standard score gain on the word attack measure is notable, it's equally, if not more, important to note the large average standard score gains in paragraph reading accuracy and comprehension.

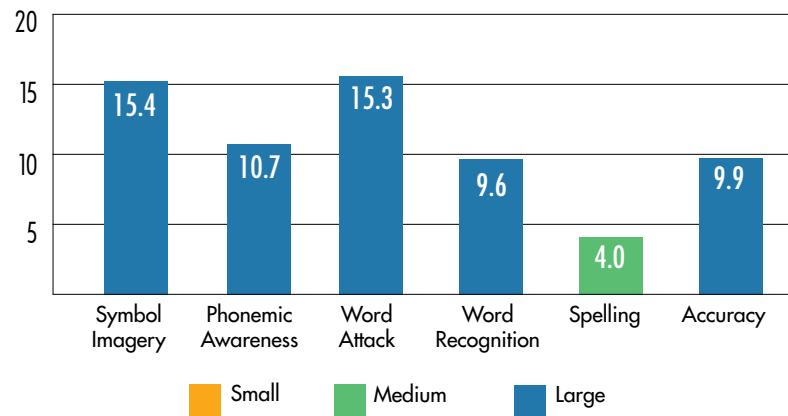
## Results by Prior Diagnoses: **Dyslexia**

### Students With Dyslexia Who Received Decoding Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008–2017

**Average Age:** 10

**Number of Students:** 1,676

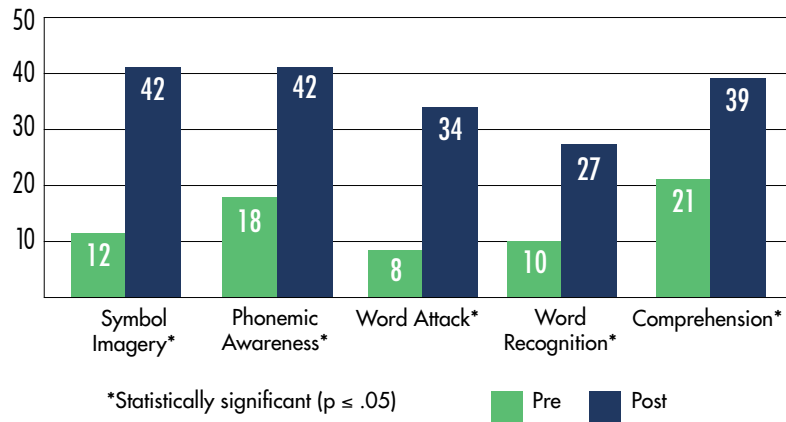
**Average Hours of Instruction:** 113

**Results:** On average, students with Dyslexia who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on nearly all measures. The 30-point percentile increase in word attack put these students well within the normal range (25th–75th percentile). The large average standard score change in word recognition should be noted, as students now performed within the normal range on this measure as well. Their pre- to posttest results were statistically significant on all measures.

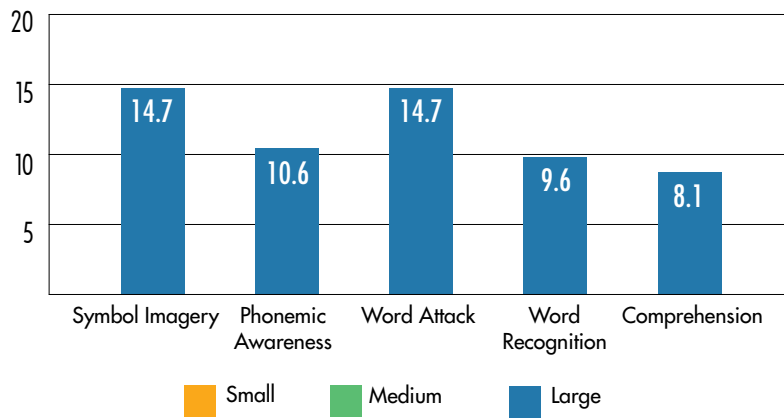
# Results by Prior Diagnoses: Specific Learning Disability

## Students With a Specific Learning Disability (SLD) Who Received Decoding Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008–2017

**Average Age:** 11

**Number of Students:** 725

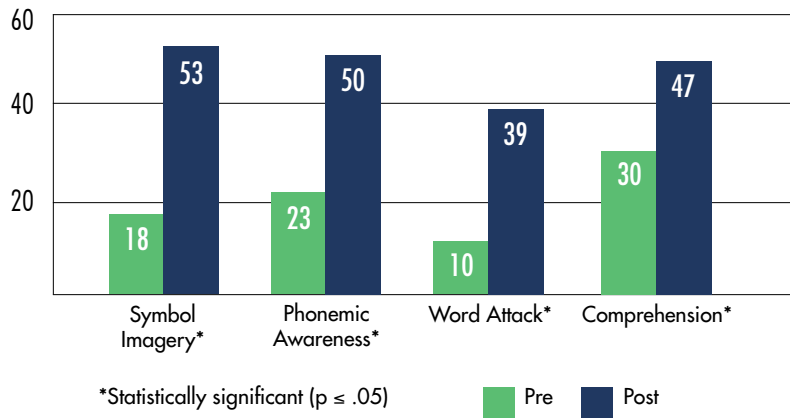
**Average Hours of Instruction:** 119

**Results:** On average, students with an SLD who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on all measures. Additionally, the 26-point percentile increase in word attack put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

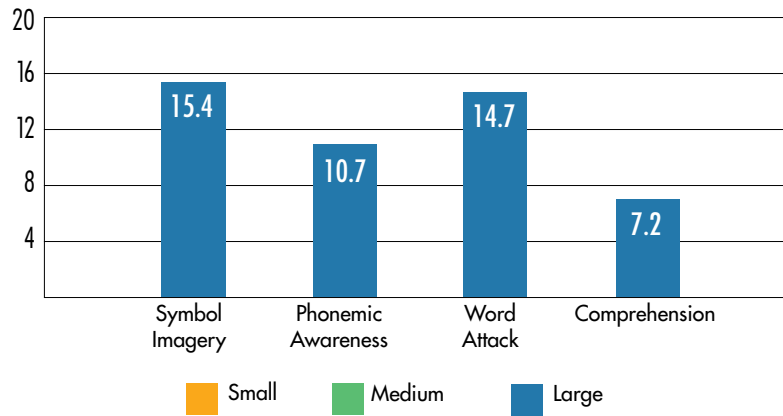
# Results by Prior Diagnoses: Attention Deficit Hyperactivity Disorder

## Students With Attention Deficit Hyperactivity Disorder (ADHD) Who Received Decoding Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008-2017

**Average Age:** 10

**Number of Students:** 1,394

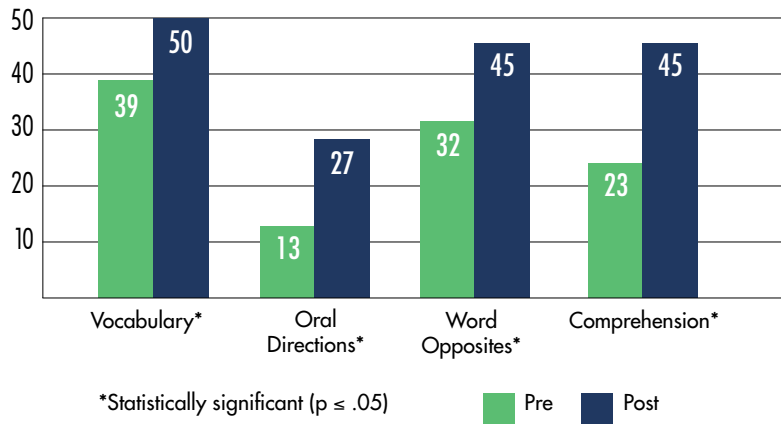
**Average Hours of Instruction:** 112

**Results:** On average, students with ADHD who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on all measures. Additionally, the 27-point percentile increase in Phonemic Awareness put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

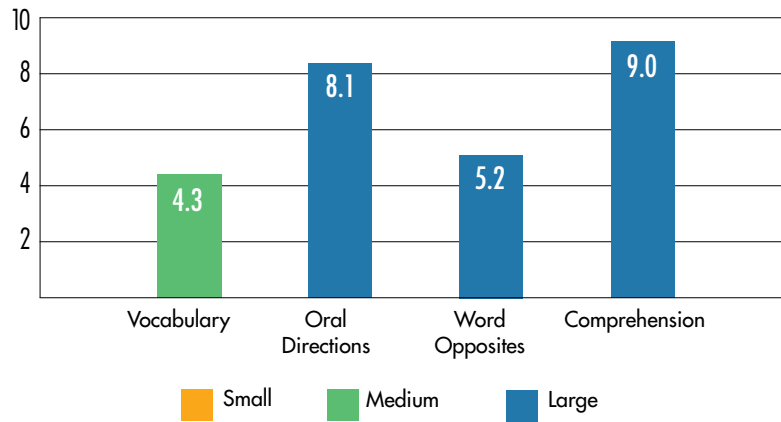
# Results by Prior Diagnoses: Attention Deficit Hyperactivity Disorder

## Students With Attention Deficit Hyperactivity Disorder (ADHD) Who Received Comprehension Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008–2017

**Average Age:** 12.7

**Number of Students:** 1,103

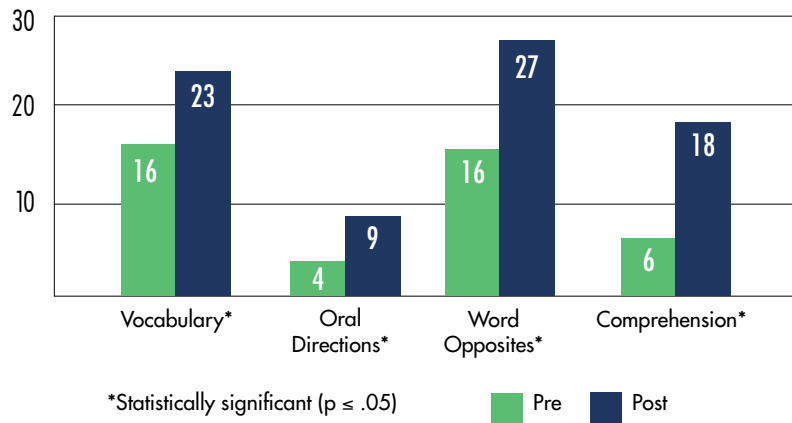
**Average Hours of Instruction:** 104

**Results:** On average, students with ADHD who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on three of the four measures. Additionally, the 22-point percentile increase in comprehension put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

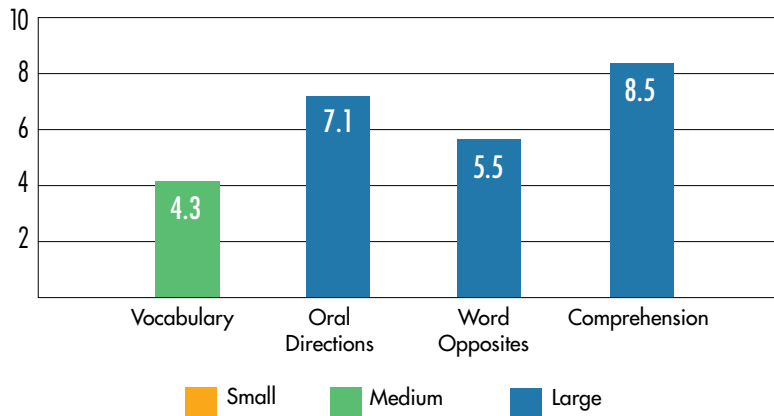
# Results by Prior Diagnoses: Autism Spectrum Disorder

Students With Autism Spectrum Disorder (ASD) Who Received Comprehension Instruction  
(Including Students Diagnosed With Asperger's Syndrome and Pervasive Developmental Disorder)

Pre- and Posttest Percentiles



Average Standard Score Changes



## Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008–2017

**Average Age:** 12

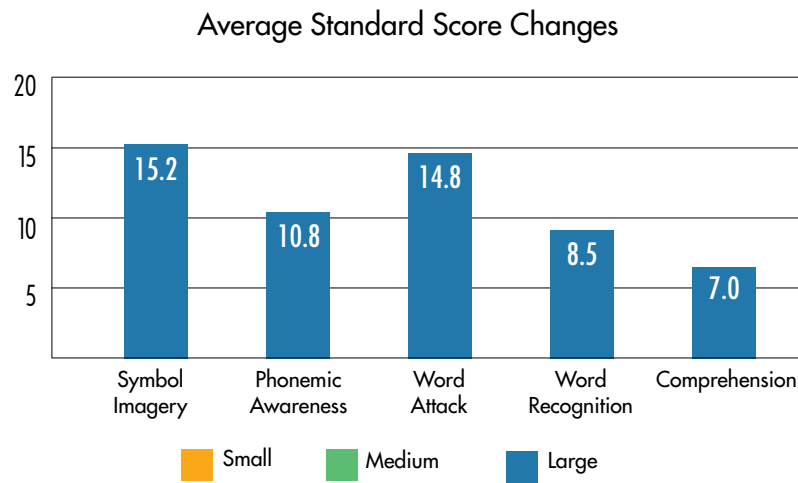
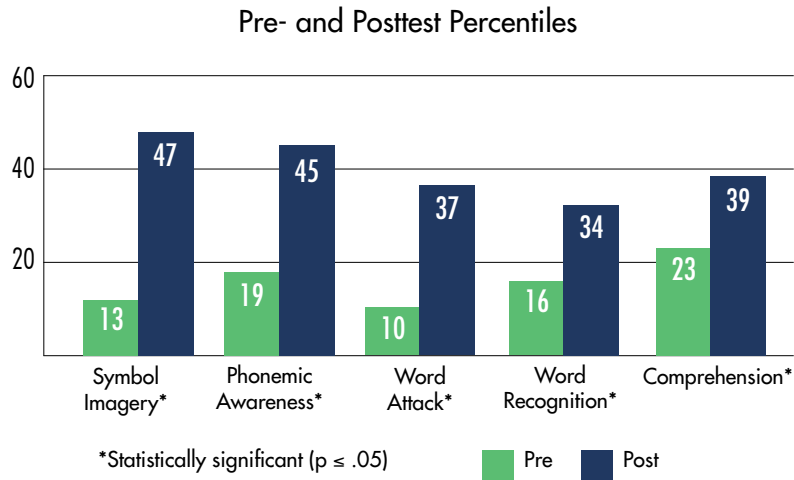
**Number of Students:** 724

**Average Hours of Instruction:** 123

**Results:** On average, students with Autism Spectrum Disorder who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on three of the four measures. Their pre- to posttest results were statistically significant on all measures.

# Results by Prior Diagnoses: Central Auditory Processing Disorder

## Students With Central Auditory Processing Disorder (CAPD) Who Received Decoding Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008–2017

**Average Age:** 10

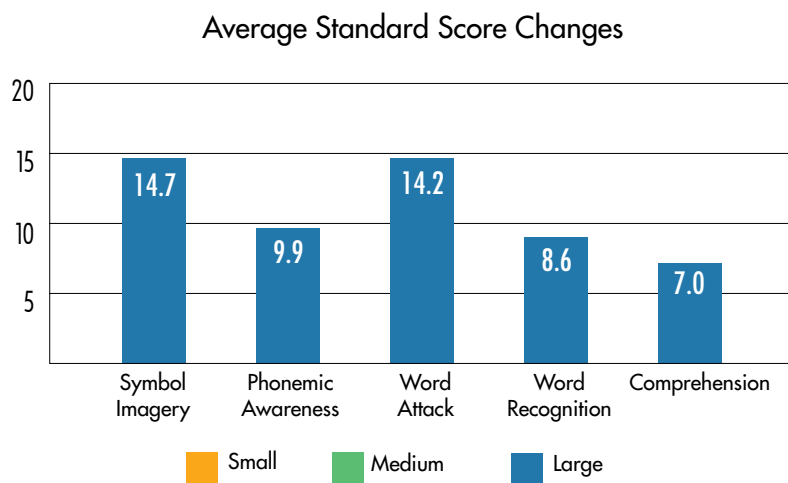
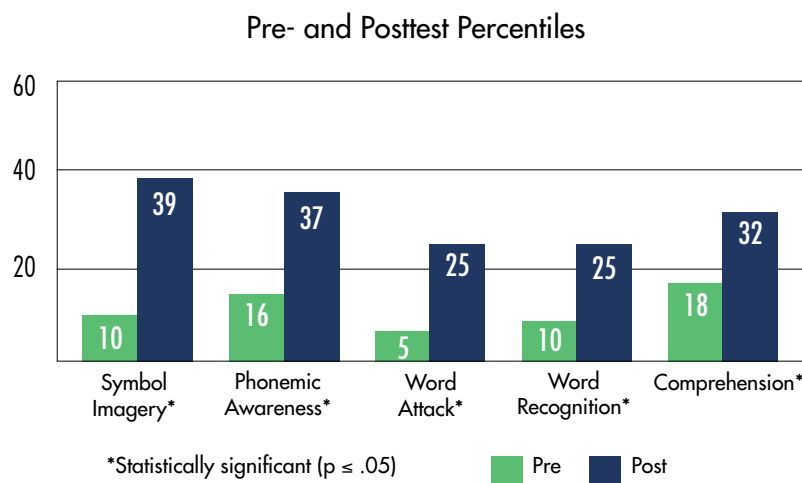
**Number of Students:** 330

**Average Hours of Instruction:** 113

**Results:** On average, students with Central Auditory Processing Disorder who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on all measures. The 27-point percentile increase in word attack put these students within the normal range (25th–75th percentile). Additionally, students' large increase in average standard scores on the word recognition and word attack measures indicate a significant gain in sight word reading and paragraph reading. Their pre- to posttest results were statistically significant on all measures.

## Results by Prior Diagnoses: Speech or Language Impairment

### Results of Students With Speech or Language Impairment Who Received Decoding Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008-2017

**Average Age:** 10

**Number of Students:** 343

**Average Hours of Instruction:** 121

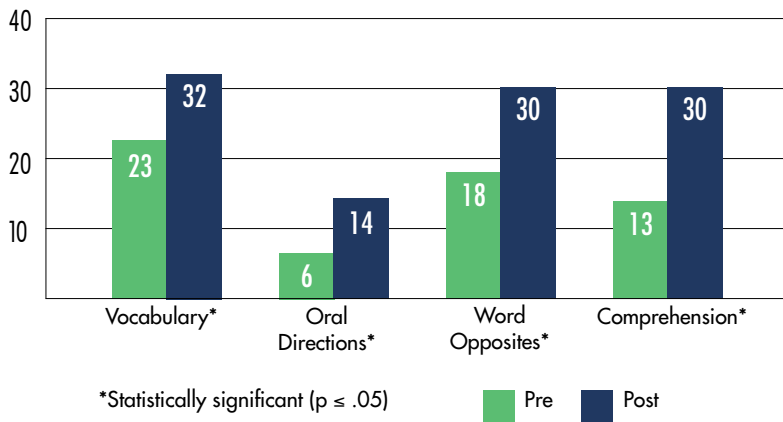
**Results:** On average, students with an SLI who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on all measures. Additionally, the 29-point percentile increase in symbol imagery put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.



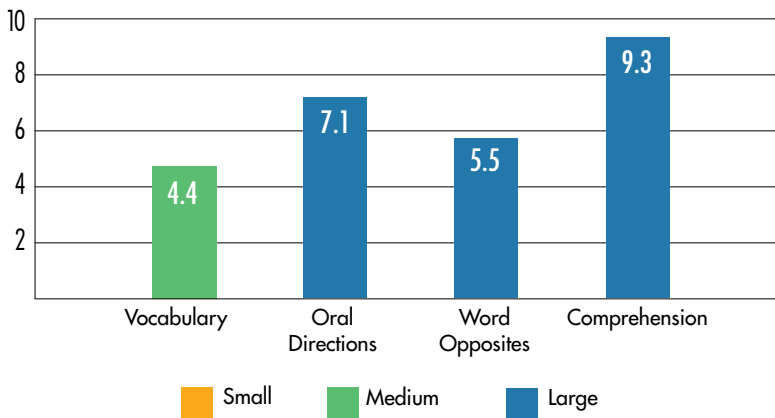
# Results by Prior Diagnoses: Speech or Language Impairment

## Results of Students With Speech or Language Impairment (SLI) Who Received Comprehension Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008-2017

**Average Age:** 12

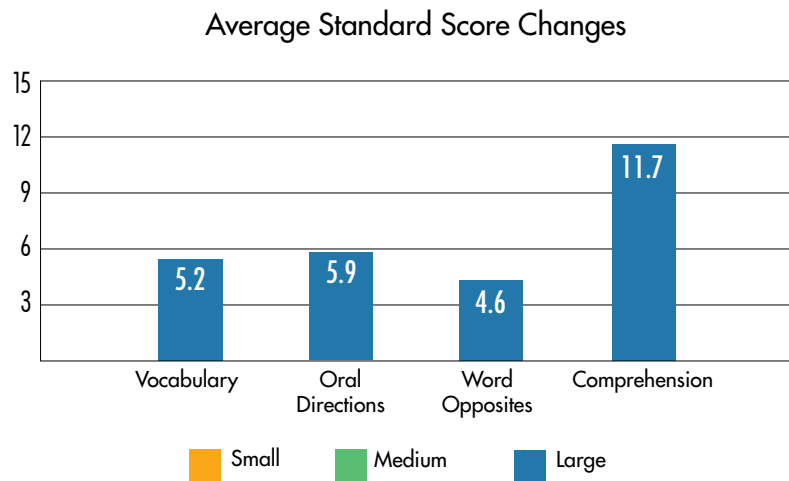
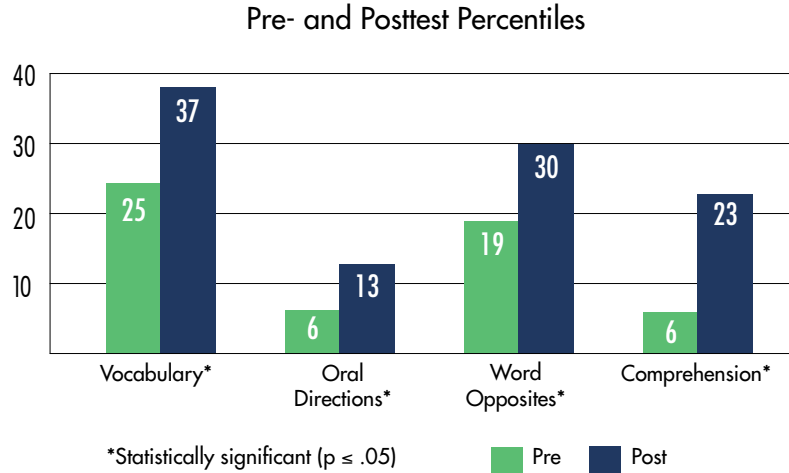
**Number of Students:** 402

**Average Hours of Instruction:** 112

**Results:** On average, students with an SLI who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on three of the four measures. Additionally, the 17-point percentile increase in comprehension put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

## Results by Prior Diagnoses: **Hyperlexia**

### Students With Hyperlexia Who Received Comprehension Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008-2017

**Average Age:** 12

**Number of Students:** 69

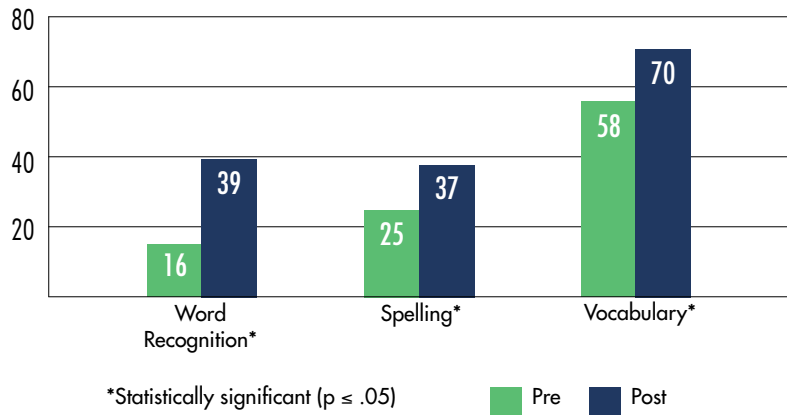
**Average Hours of Instruction:** 116

**Results:** On average, students with Hyperlexia who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on all measures. Additionally, the 17-point percentile increase in comprehension put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

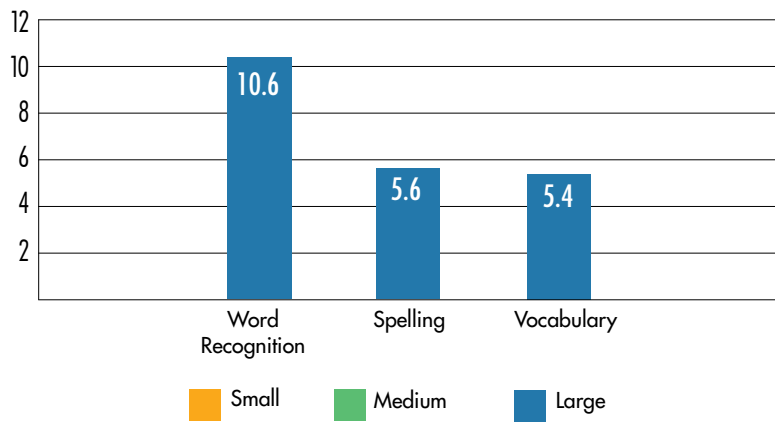
## Results for Specific Groups of Students: Pre-Kindergarten

### Results of Pre-Kindergarten Students Who Received Decoding and Comprehension Instruction

#### Pre- and Posttest Percentiles



#### Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars and Visualizing and Verbalizing

**Years:** 2008-2017

**Average Age:** 6

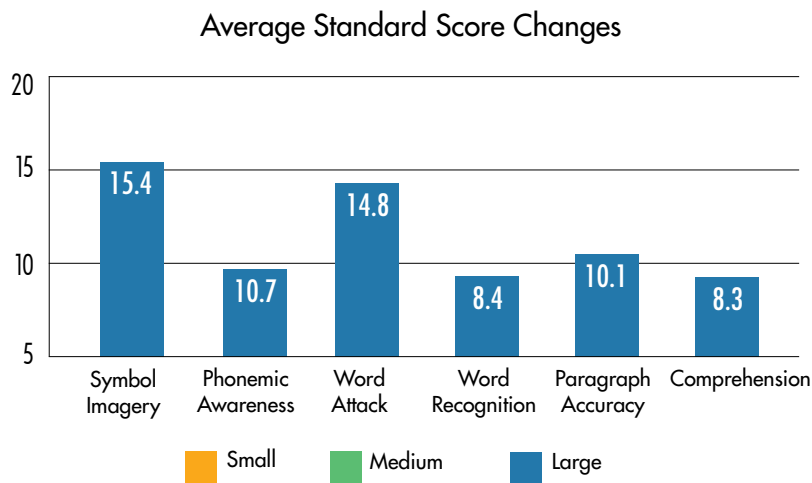
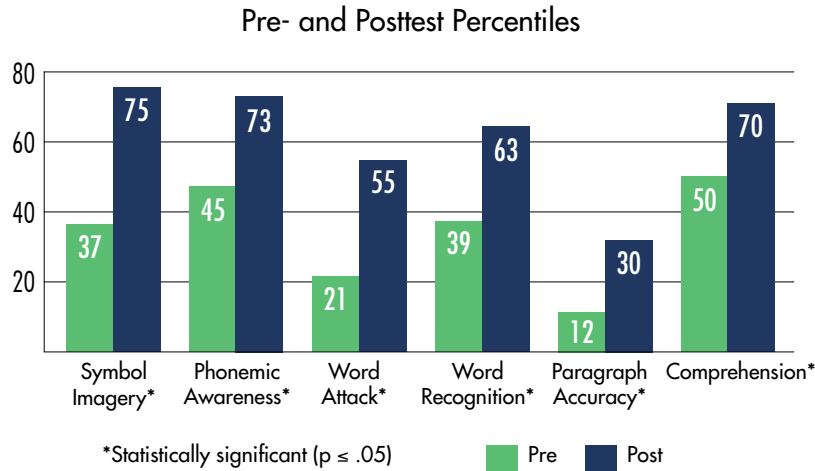
**Number of Students:** 112

**Average Hours of Instruction:** 86

**Results:** On average, pre-kindergarten students who received instruction achieved significant improvements. They made large (significant) standard score changes on all three measures. Additionally, the 23-point percentile increase in word recognition put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

## Results for Specific Groups of Students: **Gifted**

### Results of Gifted Students Who Received Decoding Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Seeing Stars

**Years:** 2008-2017

**Average Age:** 10

**Number of Students:** 394

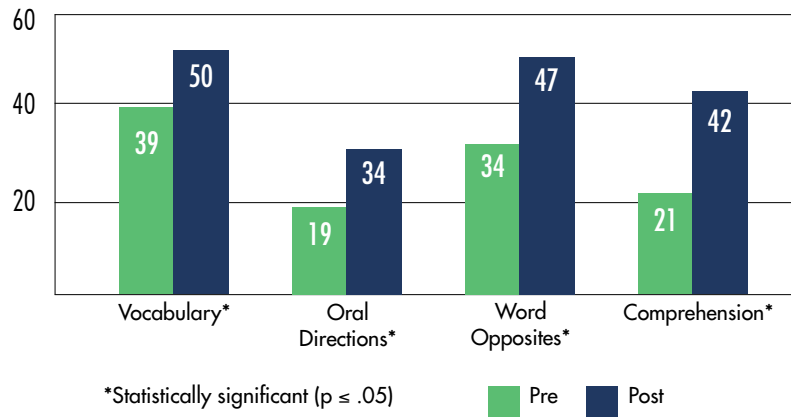
**Average Hours of Instruction:** 91

**Results:** On average, gifted students who received Seeing Stars instruction achieved significant improvements in reading. They made large (significant) standard score changes on all measures. Their pre- to posttest results were statistically significant on all measures.

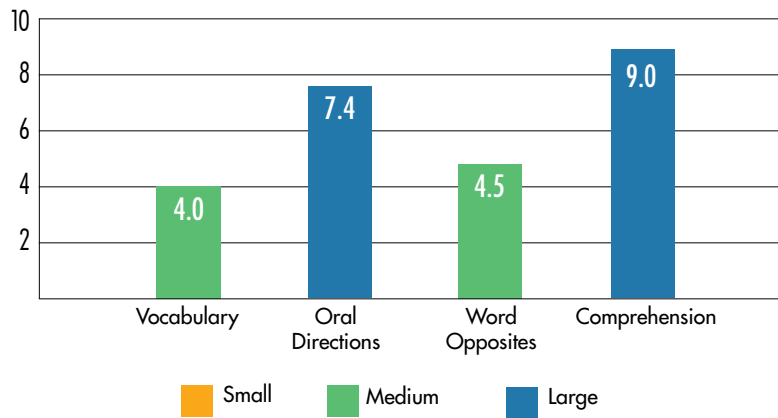
## Results for Specific Groups of Students: **Middle School**

### Results of Middle School Students Who Received Comprehension Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008-2017

**Average Age:** 13

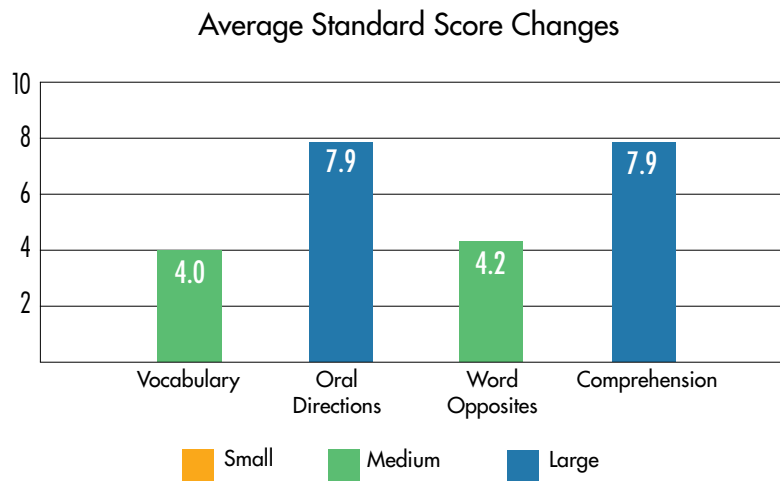
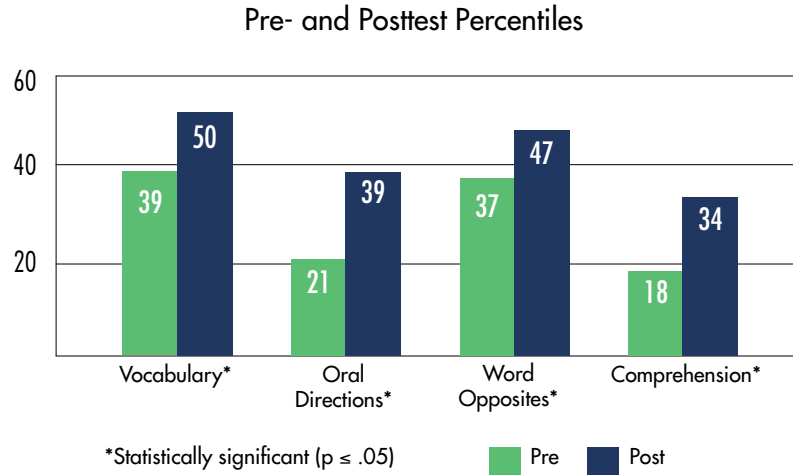
**Number of Students:** 1,221

**Average Hours of Instruction:** 100

**Results:** On average, middle school students who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on two of the four measures. Additionally, the 21-point percentile increase in comprehension put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

## Results for Specific Groups of Students: **High School**

### Results of High School Students Who Received Comprehension Instruction



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008–2017

**Average Age:** 16

**Number of Students:** 662

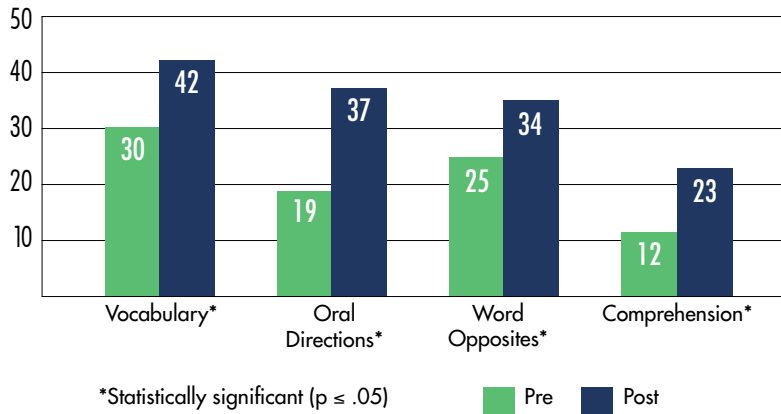
**Average Hours of Instruction:** 98

**Results:** On average, high school students who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on two of the four measures. Additionally, the 16-point percentile increase in comprehension put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

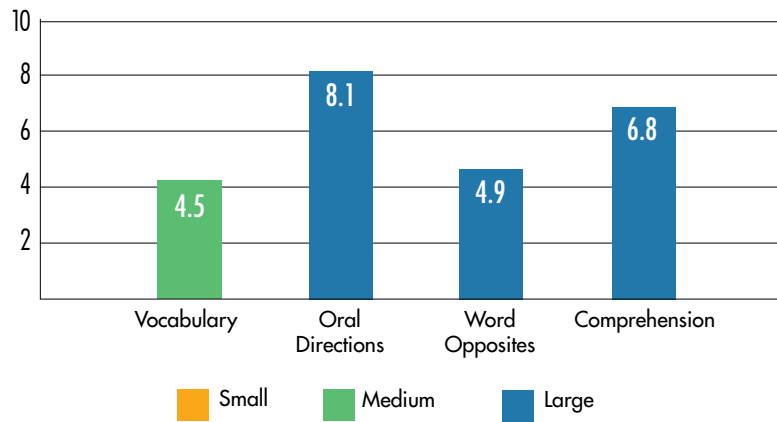
## Results for Specific Groups of Students: **College-Aged**

### Results of College-Aged Students Who Received Comprehension Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008-2017

**Average Age:** 20

**Number of Students:** 195

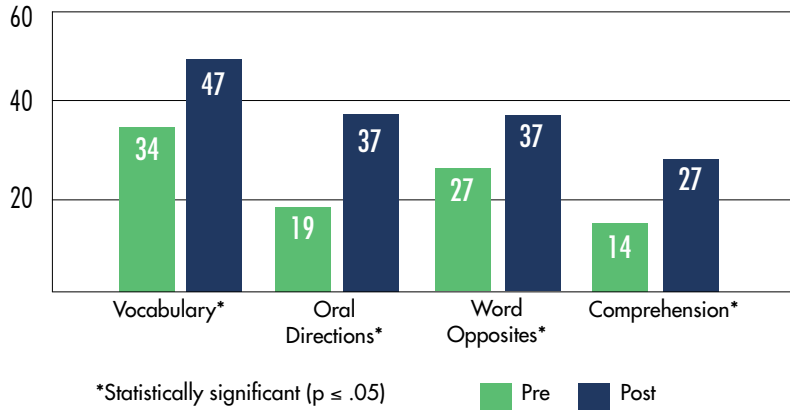
**Average Hours of Instruction:** 110

**Results:** On average, students who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on three of the four measures. Additionally, the 18-point percentile increase in oral directions put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.

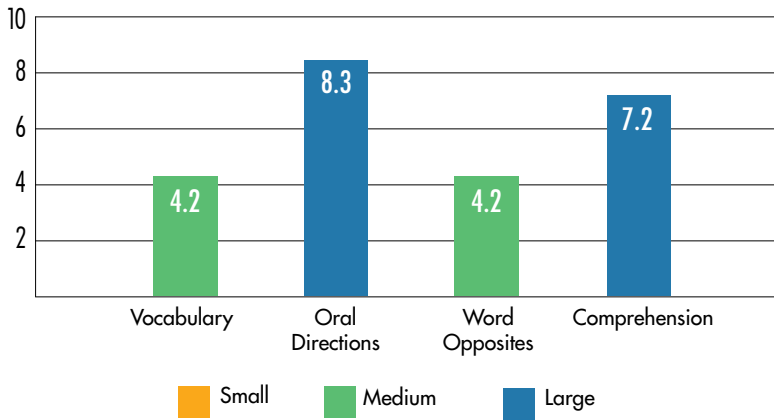
## Results for Specific Groups of Students: **Adult**

### Results of Adult Students Who Received Comprehension Instruction

Pre- and Posttest Percentiles



Average Standard Score Changes



### Summary

**Lindamood-Bell Instruction Implemented:** Visualizing and Verbalizing

**Years:** 2008–2017

**Average Age:** 27

**Number of Students:** 324

**Average Hours of Instruction:** 104

**Results:** On average, students who received Visualizing and Verbalizing instruction achieved significant improvements in comprehension. They made large (significant) standard score changes on two of four measures. Additionally, the 18-point percentile increase in oral directions put these students within the normal range (25th–75th percentile). Their pre- to posttest results were statistically significant on all measures.



# Research Summaries

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PUBLICATION  
NeuroImage-2011

TITLE  
Gray Matter Volume Changes Following  
Reading Intervention in Dyslexic Children

LINDAMOOD-BELL® PROGRAM(S) RESEARCHED  
Seeing Stars® for Symbol Imagery (SI)

**Abstract:** Studies in children and adults with the reading disability developmental dyslexia have shown behavioral improvements after reading intervention. In another line of work, it has been shown that intensive training in a variety of cognitive and sensorimotor skills can result in changes in gray matter volume (GMV). This study examined changes in GMV following intensive reading intervention in children with dyslexia using voxel-based morphometry (VBM). Eleven dyslexic children underwent an eight week training focused on mental imagery, articulation and tracing of letters, groups of letters and words, which resulted in significant gains in reading skills. This was followed by an eight week null period (control) where no intervention was administered and no further significant gains in reading were observed. Structural scans were obtained before the intervention, after the intervention, and after the null period. GMV increases between the first two time points were found in the left anterior fusiform gyrus/hippocampus, left precuneus, right hippocampus and right anterior cerebellum. However, these areas did not change between time points two and three (control period), suggesting that the changes were specific to the intervention period. These results demonstrate for the first time that (1) training-induced changes in GMV can be observed in a pediatric sample and (2) reading improvements induced by intervention are accompanied by GMV changes.

**Conclusions:** This study showed gains in reading skills and increased gray matter volume (GMV) in dyslexic children after an eight week reading intervention [using Lindamood-Bell's Seeing Stars® program]. GMV increases were observed in the left hemisphere in anterior fusiform/hippocampus and precuneus. The left anterior fusiform region is commonly engaged in tasks involving object processing and object naming and may suggest that the dyslexic students are relying on this region to help improve their processing of words. The left precuneus has been implicated in visual imagery and specifically in tasks involving imagery of individual letters. Right hemisphere GMV changes following the intervention were found in the cerebellum and hippocampus. There is a theoretical framework implicating the cerebellum in dyslexia and this study adds a novel contribution to this theory. Finally, the GMV increases in the left hippocampus (extending from the cluster reported for the anterior fusiform gyrus) and right hippocampus may reflect more general learning that is occurring during the intervention. The increases in GMV were restricted to the intervention period and were not observed after the intervention ended, suggesting that these increases in GMV are related to the intervention. This is the first longitudinal VBM analysis in children and demonstrates that changes in brain structure are brought about by intervention. These findings provide encouragement that learning can result in both lasting behavioral and structural changes in children who struggle in learning to read. Further investigation will improve understanding not only for how the brain responds to learning, but in how these findings may be translated into refining interventions and improving the learning experience.

**Reference:** Krafnick, Anthony J., D. Lynn Flowers, Eileen M. Napoliello, and Guinevere F. Eden. Gray matter volume changes following reading intervention in dyslexic children. NeuroImage (2011).

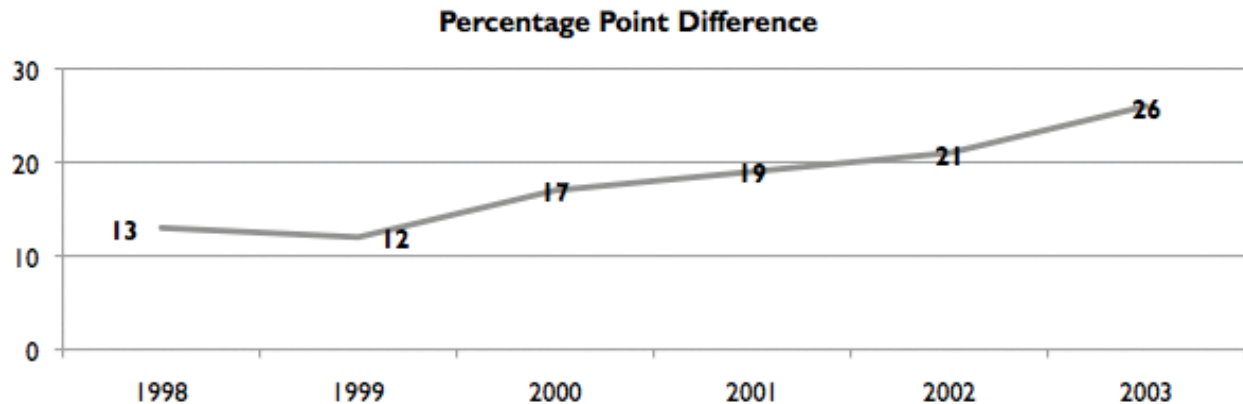
# Research Summaries

<b>PUBLICATION</b> American Educational Research Journal—2006
<b>TITLE</b> Effects of a Theoretically Based Large-Scale Reading Intervention in a Multicultural Urban School District
<b>LINDAMOOD-BELL® PROGRAM(S) RESEARCHED</b> Seeing Stars® for Symbol Imagery (SI) Visualizing and Verbalizing® (V/V®) Lindamood Phoneme Sequencing® (LiPS®)

I schools. Program intervention was implemented generally following the Comprehensive School Reform model (Borman, Hewes, Overman, and Brown, 2003). This study focused on grades 3, 4, and 5 in which CSAP testing was conducted most years from 1997-2003. A series of repeated measures analyses of covariance, controlling for school size, minority student percentage, SES, and number of years a school was involved in the intervention were conducted between PSD60 schools and the statewide CSAP average. In both overall and Title 1 school analyses, statistically significant and increasing gains favoring the intervention were found. Both practical and theoretical implications are discussed.

**Abstract:** In 1997 Lindamood-Bell Learning Processes partnered with Pueblo School District 60 (PSD60) in Pueblo, Colorado to implement a theoretically based program to improve low reading achievement on the Colorado Student Assessment Program (CSAP). PSD60 is an urban district with large percentages of minority enrollment and Title

**Reference:** Sadoski, M. and Willson, V. (2006). *Effects of a Theoretically Based Large-Scale Reading Intervention in a Multicultural Urban School District. American Educational Research Journal, 43, 1, 137-154.*



The line in the chart above shows the percentage point difference (in percent proficient and advanced on the state reading test) between Pueblo (Lindamood-Bell) schools and comparison schools. By 2003, schools partnering with Lindamood-Bell were 26 percentage points above the average of the comparison schools.

# Research Summaries

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<b>PUBLICATION</b> San Diego Association of Governments (SANDAG)—2005
<b>TITLE</b> A Project of Hope: Lindamood-Bell Center in a School Project Final Evaluation Report
<b>LINDAMOOD-BELL® PROGRAM(S) RESEARCHED</b> Seeing Stars® for Symbol Imagery (SI) Visualizing and Verbalizing® (V/V®) Lindamood Phoneme Sequencing® (LiPS®)

**Abstract:** In September 2002, a literacy program for juvenile male wards was implemented in San Diego County through a partnership between the Juvenile Court, the County Office of Education, the District Attorney’s Office, and the Probation Department. Many youth under Probation supervision read below their appropriate grade level and this deficit can have long-lasting effects on their later chances for success. This final evaluation report describes the Lindamood-Bell Center in a School (CIS) project, outlines the research

methodology, and presents research findings from the process and impact evaluations that were completed by the San Diego Association of Governments (SANDAG). As part of the project, 198 adjudicated juvenile males received program services. Many of these youth entered the program below grade level, had a history of truancy problems, and had a negative view toward school. Through the CIST™ project, participants received approximately 89 hours of intensive, specialized, literacy services. Positive outcomes measured through standardized tests and record searches revealed that participants achieved significant gains in their decoding and comprehensive skills, were doing better in school, and were slightly less likely to have contact with the juvenile justice system. Some of the challenges associated with the project related to short commitment times, working with youth who had multiple needs, and lack of aftercare services.

**Reference:** Burke, C., Howard, L. & Evangelou, T. (2005). A Project of Hope: Lindamood-Bell Center in a School Project Final Evaluation Report. Retrieved December 13, 2006, from [www.sandag.org](http://www.sandag.org).

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<b>PUBLICATION</b> Neuron—2004
<b>TITLE</b> Neural Changes Following Remediation in Adult Developmental Dyslexia
<b>LINDAMOOD-BELL® PROGRAM(S) RESEARCHED</b> Seeing Stars® for Symbol Imagery (SI) Visualizing and Verbalizing® (V/V®) Lindamood Phoneme Sequencing® (LiPS®)

**Abstract:** Brain imaging studies have explored the neural mechanisms of recovery in adults following acquired disorders and, more recently, childhood developmental disorders. However, the neural systems underlying adult rehabilitation of neurobiologically based learning disabilities remain unexplored, despite their high incidence. Here we characterize the differences in brain activity during a phonological manipulation task

before and after a behavioral intervention in adults with developmental dyslexia. Phonologically targeted training resulted in performance improvements in tutored compared to nontutored dyslexics, and these gains were associated with signal increases in bilateral parietal and right perisylvian cortices. Our findings demonstrate that behavioral changes in tutored dyslexic adults are associated with (1) increased activity in those left-hemisphere regions engaged by normal readers and (2) compensatory activity in the right perisylvian cortex. Hence, behavioral plasticity in adult developmental dyslexia involves two distinct neural mechanisms, each of which has previously been observed either for remediation of developmental or acquired reading disorders.

**Reference:** Eden G.F., Jones K.M., Cappell K., Gareau L., Wood F.B., Zeffiro T.A., Dietz N.A., Agnew J.A., Flowers D.L. (2004). *Neural changes following remediation in adult developmental dyslexia*. *Neuron*, 44(3), 411-22.

# Research Summaries

## PUBLICATION

Journal of Developmental and Learning Disorders—1997

## TITLE

Sensory-Cognitive Factors in the  
Controversy Over Reading Instruction

## LINDAMOOD-BELL® PROGRAM(S) RESEARCHED

Visualizing and Verbalizing® (V/V®)  
Lindamood Phoneme Sequencing® (LiPS®)

**Abstract:** This paper presents information on the historical background of the long-standing controversy over methods of teaching reading, and cites findings on the current seriously inadequate levels of literacy documented in America. It is argued that the low literacy levels and the controversy over teaching methods are likely to continue until attention turns from reading methods to the reading process, and the direct development of two important sensory-cognitive functions that support and enhance oral and written language processing. Evidence is presented that, although genetic differences exist in individuals' spontaneous access to these sensory-cognitive functions,

they can be developed through appropriate intervention either preventively or remedially. Descriptions are provided of specific instructional procedures that develop these sensory-cognitive functions, to illustrate the conscious level of sensory feedback and integration that must be experientially elicited through Socratic questioning. This questioning must respond to students' responses to meet students at the level of their processing. It enables both children and adults to be moved by small steps of reasoning to discover concepts involved in becoming self-correcting in language and literacy learning. The position is taken that the direct development of these sensory-cognitive functions needs to be widely addressed, and that the conceptual base they provide permits students to experience success in learning to read regardless of which reading method is used. This would help to dissipate the controversy over reading methods and allow attention and effort to focus on the process of reading.

**Reference:** Lindamood, P., Bell, N., & Lindamood P. (1997). *Sensory-cognitive factors in the controversy over reading instruction. The Journal of Developmental and Learning Disorders, 1 (1), 143-182.*

## PUBLICATION

Annals of Dyslexia—1991

## TITLE

Gestalt Imagery: A Critical  
Factor in Language Comprehension

## LINDAMOOD-BELL® PROGRAM(S) RESEARCHED

Visualizing and Verbalizing® (V/V®)

**Abstract:** Gestalt imagery—the ability to create imaged wholes—is a critical factor in oral and written language comprehension. Despite good decoding, good vocabulary, and adequate background experiences, many individuals experience weak gestalt imagery,

thus processing “parts” rather the “wholes,” from verbal stimuli, spoken or written. This contributes to a Language Comprehension Disorder that may be accompanied by a commonality of symptoms: weak reading comprehension, weak oral language comprehension, weak oral language expression, weak written language expression, difficulty following directions, and weak sense of humor. Sequential stimulation using an inquiry technique develops gestalt imagery and results in significant improvement in reading comprehension.

**Reference:** Bell, N. (1991). *Gestalt imagery: A critical factor in language comprehension. Annals of Dyslexia, 41, 246-260.*

*For information on how to obtain a complete copy of these articles or other research articles on the programs used by Lindamood-Bell, visit: <http://www.lindamoodbell.com/research/research-articles>.*

# Research Summaries

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## PUBLICATION

Autism Research-2015

## TITLE

The Impact of Reading Intervention on Brain Responses Underlying Language in Children With Autism

## LINDAMOOD-BELL® PROGRAM(S) RESEARCHED

Visualizing and Verbalizing® (V/V®)

**Abstract:** Deficits in language comprehension have been widely reported in children with autism spectrum disorders (ASD), with behavioral and neuroimaging studies finding increased reliance on visuospatial processing to aid in language comprehension. However, no study to date, has taken advantage of this strength in visuospatial processing to improve language comprehension difficulties in ASD. This study used a translational neuroimaging approach to test the role of a visual imagery-based reading intervention in improving the brain circuitry underlying language processing in children with ASD. Functional magnetic resonance imaging (MRI), in a longitudinal study design, was used to investigate intervention-related change in sentence comprehension, brain activation, and functional

connectivity in three groups of participants (age 8-13 years): an experimental group of ASD children (ASD-EXP), a wait-list control group of ASD children (ASD-WLC), and a group of typically developing control children. After intervention, the ASD-EXP group showed significant increase in activity in visual and language areas and right-hemisphere language area homologues, putamen, and thalamus, suggestive of compensatory routes to increase proficiency in reading comprehension. Additionally, ASD children who had the most improvement in reading comprehension after intervention showed greater functional connectivity between left-hemisphere language areas, the middle temporal gyrus and inferior frontal gyrus while reading high imagery sentences. Thus, the findings of this study, which support the principles of dual coding theory [Paivio 2007], suggest the potential of a strength-based reading intervention in changing brain responses and facilitating better reading comprehension in ASD children.

**Reference:** Murdaugh, D. L., H. D. Deshpande, and R. K. Kana. 2015. *The Impact of Reading Intervention on Brain Responses Underlying Language in Children With Autism*. Autism Research. doi: 10.1002/aur.1503.

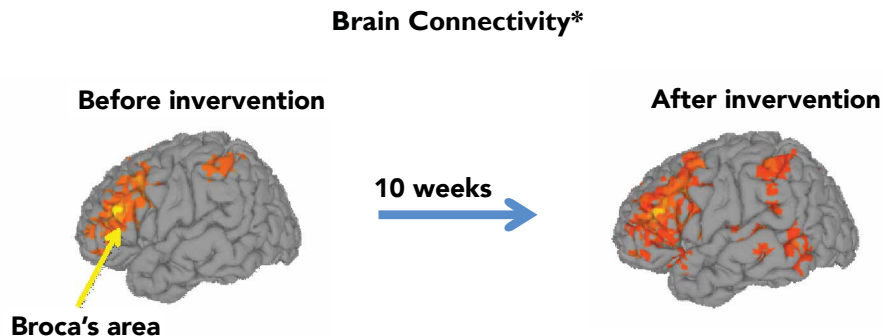
# Research Summaries

<b>PUBLICATION</b> Human Brain Mapping-2015
<b>TITLE</b> Changes in Intrinsic Connectivity of the Brain's Reading Network Following Intervention in Children with Autism
<b>LINDAMOOD-BELL® PROGRAM(S) RESEARCHED</b> Visualizing and Verbalizing® (V/V®)

**Abstract:** While task-based neuroimaging studies have identified alterations in neural circuitry underlying language processing in children with autism spectrum disorders [ASD], resting state functional magnetic resonance imaging [rsfMRI] is a promising alternative to the constraints posed by task-based fMRI. This study used rsfMRI, in a longitudinal design, to study the impact of a reading intervention on connectivity of the brain regions involved in reading comprehension in children with ASD. Functional connectivity was examined using group independent component analysis (GICA) and seed-based correlation analysis of Broca's and Wernicke's areas, in three groups of participants: an experimental group of ASD children (ASD-EXP), a wait list control group of ASD children

(ASD-WLC), and a group of typically developing (TD) control children. Both GICA and seed-based analyses revealed stronger functional connectivity of Broca's and Wernicke's areas in the ASD-EXP group postintervention. Additionally, improvement in reading comprehension in the ASD-EXP group was correlated with greater connectivity in both Broca's and Wernicke's area in the GICA identified reading network component. In addition, increased connectivity between the Broca's area and right postcentral and right STG, and the Wernicke's area and LIFG, were also correlated with greater improvement in reading comprehension. Overall, this study revealed widespread changes in functional connectivity of the brain's reading network as a result of intervention in children with ASD. These novel findings provide valuable insights into the neuroplasticity of brain areas underlying reading and the impact of intensive intervention in modifying them in children with ASD.

**Reference:** Murdaugh, D. L., J. O. Maximo, and R. K. Kana. 2015. "Changes in intrinsic connectivity of the brain's reading network following intervention in children with autism." *Human Brain Mapping*. doi: 10.1002/hbm.22821.



Note: \*Statistically significant ( $p \leq .05$ ). Broca's area is a region of the brain involved in comprehension. Figure used with author's permission.

# Research Summaries

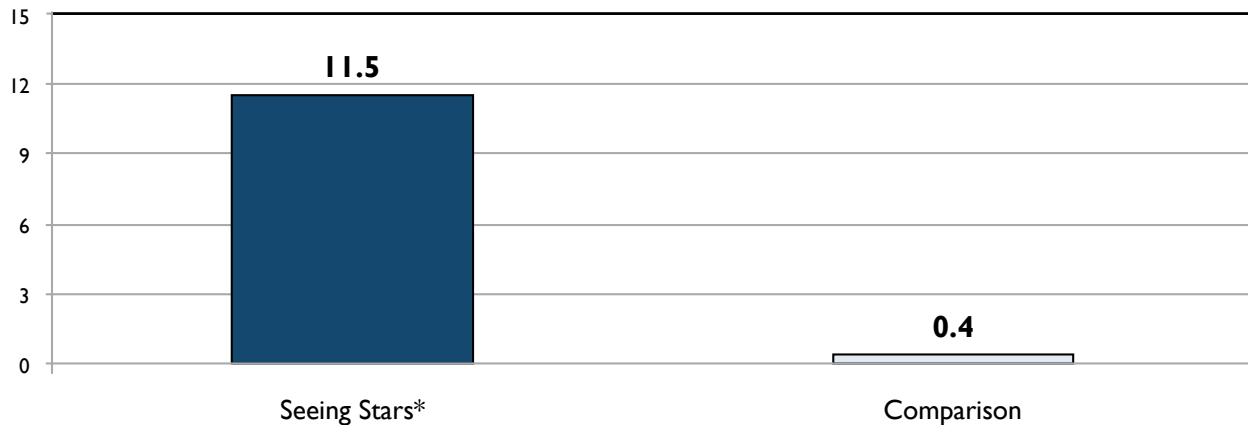
<b>PUBLICATION</b> Journal of Learning Disabilities-2015
<b>TITLE</b> Impact of Intensive Summer Reading Intervention for Children With Reading Disabilities and Difficulties in Early Elementary School
<b>LINDAMOOD-BELL® PROGRAM(S) RESEARCHED</b> Seeing Stars® for Symbol Imagery (SI)

and pseudoword reading, timed pseudoword reading, oral reading fluency, and symbol imagery. The interactions mostly reflected (a) significant declines in the nonintervention group from pre- to posttesting, and (2) no decline in the intervention group. The current study offers direct evidence for widening differences in reading abilities between students with RD who do and do not receive intensive summer reading instruction. Intervention implications for RD children are discussed, especially in relation to the relevance of summer intervention to prevent further decline in struggling early readers.

**Abstract:** Efficacy of an intensive reading intervention implemented during the nonacademic summer was evaluated in children with reading disabilities or difficulties (RD). Students (ages 6-9) were randomly assigned to receive Lindamood-Bell’s Seeing Stars program (n = 23) as an intervention or to a waiting-list control group (n = 24). Analysis of pre- and posttesting revealed significant interactions in favor of the intervention group for untimed word

**Reference:** Christodoulou, J.A., A. Cyr, J. Murtagh, P. Chang, J. Lin, A. J. Guarino, P. Hook, and J. D. Gabrieli. 2015. “Impact of Intensive Summer Reading Intervention for Children With Reading Disabilities and Difficulties in Early Elementary School.” *Journal of Learning Disabilities*. doi: 10.1177/0022219415617163.

**Oral Reading Fluency**  
Average Raw Score Changes





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