



The Role of Imagery and Verbal Processing in Comprehension

Nanci Bell

IDA Conference
November 2004

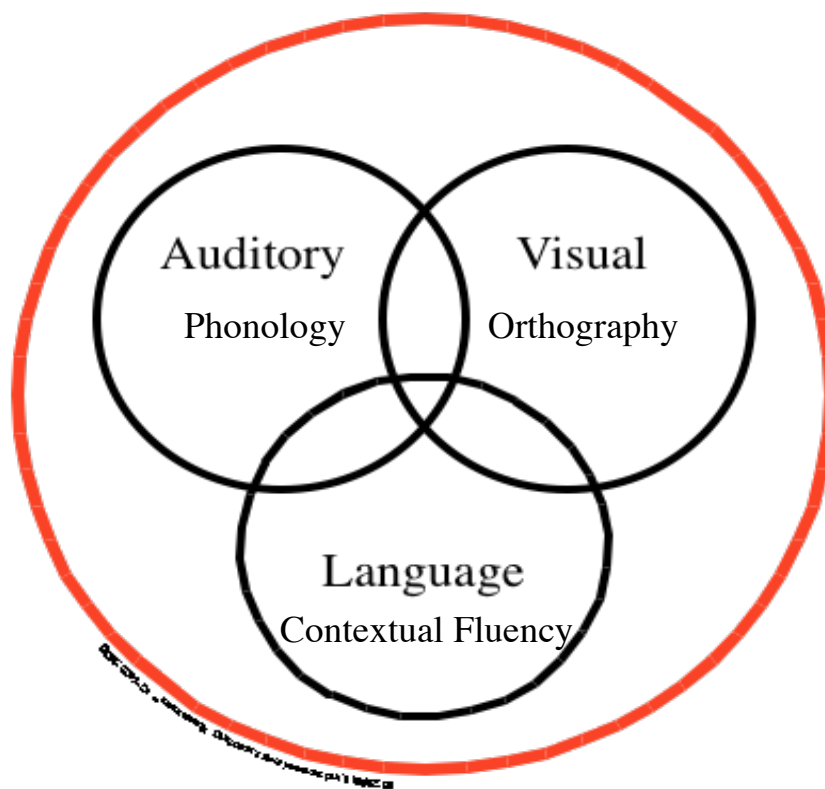


The Reading Circles

A Paradigm of Integration

Sensory-cognitive functions underlie reading and spelling skills

Comprehension





What about Natalie?

The field of reading has recently focused attention on phonological processing and word attack skills, but what about Natalie?

What is the cause of her weakness in language processing?

Is there a primary sensory-cognitive factor for reading comprehension as we believe there is for decoding?



Natalie **CA: 11-2** **Grade: 6.0**

Natalie had experienced years of frustration, hating to read, not following conversation easily, not “paying attention” in class, and by 5th grade getting ill before school. Her father said, “No one seems able to determine her problem.”

Peabody Picture Vocabulary Test.....	86 th Percentile
Woodcock Word Attack.....	86 th Percentile
Wide Range Achievement Test	
Word recognition.....	87 th Percentile
Spelling.....	96 th Percentile
Phoneme Awareness (LAC Test).....	100
Orthographic Awareness (Symbol Imagery Test).....	40/50
Detroit Test of Learning Aptitude	
Oral Directions.....	37 th Percentile
Test of Problem Solving-R.....	10 th Percentile
Gray Oral Reading Test-3	
Rate.....	84 th Percentile
Accuracy.....	95 th Percentile
Fluency.....	91 st Percentile
Comprehension.....	2 nd Percentile



A sensory component to reading comprehension?

The Reports of the Subgroups of the National Reading Panel (2000) concluded that **mental imagery instruction** was one of the few reading comprehension instructional practices with a research base sufficiently strong to recommend it.



Mental Imagery and Cognition

Mental imagery has a long history in the cognitive sciences as a critical factor in cognition.

References as far back as Aristotle, in his contemplations on the ability to reason, theorized that man cannot think without mental imagery.

“Thus, we have explained that memory or remembering is a state induced by mental images...”



Thomas Aquinas, in the 12th century, stated, “Man’s mind cannot understand thoughts without images of them.”

William James (1890) suggested the static meaning of concrete words consists of “sensory images awakened.”

Piaget (1936) wrote that “...overtime schemata become internalized in the form of imaged thought.”

The psychologist Edward Titchener wrote, “My mind, in its ordinary operations, is a fairly complete picture gallery, not of finished paintings, but of impressionist notes.”

Kosslyn (1994), in *Image and Brain*, stated, “For present purposes, all that is important is that imagery relies on topographically organized regions of the cortex, which support depictive representations.”



Albert Einstein's esteemed contributions were the result of his ability to think critically and creatively.

He made his thinking concrete with the sensory-cognitive function of mental imagery.

He stated, "If I can't picture it, I can't understand it."

This not only illuminates his genius, but also embodies a truth about language processing.

Mental imagery is a sensory process that Einstein could easily access, others cannot.

We cannot *assume* mental imagery ability.



Individual differences in Imagery Ability

There appear to be individual differences in the ability to create mental representations for letters, numbers, and language concepts.

Concept imagery is the ability to visualize the whole or gestalt and this type of imagery is related to reading comprehension.

Some individuals can quickly and easily create mental representations from oral or written language. Their sensory system rapidly brings **parts to whole through imagery**. They have good language comprehension, expression, and critical thinking.

However, other individuals have difficulty creating gestalt images. Their sensory information from imagery may be slow and dull / dim and they get stuck on parts, bits and pieces. They have a propensity to process facts.



Dual Coding—imagery and language—for Cognition

All the available reviews of mental imagery conclude that this technique consistently produces significant and sometimes large effects for readers.

Mental imagery may be of particular value in improving the inferential comprehension and comprehension monitoring of poor comprehenders, and positive results have been found with all ability levels and ages.

Almost all the studies of mental imagery cited a specific theoretical base—[Dual Coding Theory \(DCT\)](#).



Dual Coding Theory (DCT)

Paivio (1971), the father of dual coding theory, wrote extensively about the role of imagery in cognition.

“Cognition is proportional to the extent that the coding mechanisms of mental representations (imagery) and language are integrated.”

Paivio suggested that linguistic competence and performance are based on a substrate of imagery.

“Imagery includes not only static representations but also dynamic representations of action sequences and relationships between objects and events.”



Categories of Lindamood-Bell Instruction

- *Decoding Only*: Students receive a combination of instruction in Seeing Stars[®]: Symbol Imagery (SI[™]) and Lindamood Phoneme Sequencing[®] (LiPS[®]) Programs.
- *Comprehension Only*: Student receive instruction in Visualizing and Verbalizing for Language Comprehension[®] (V/V[®]).
- *Decoding Focus with Comprehension Support*: Instruction focus is on decoding (SI and LiPS) PLUS some instruction in V/V for reading comprehension.
- *Comprehension Focus with Decoding Support*: Instruction focus is on comprehension (V/V) PLUS some instruction in SI and LiPS for decoding.



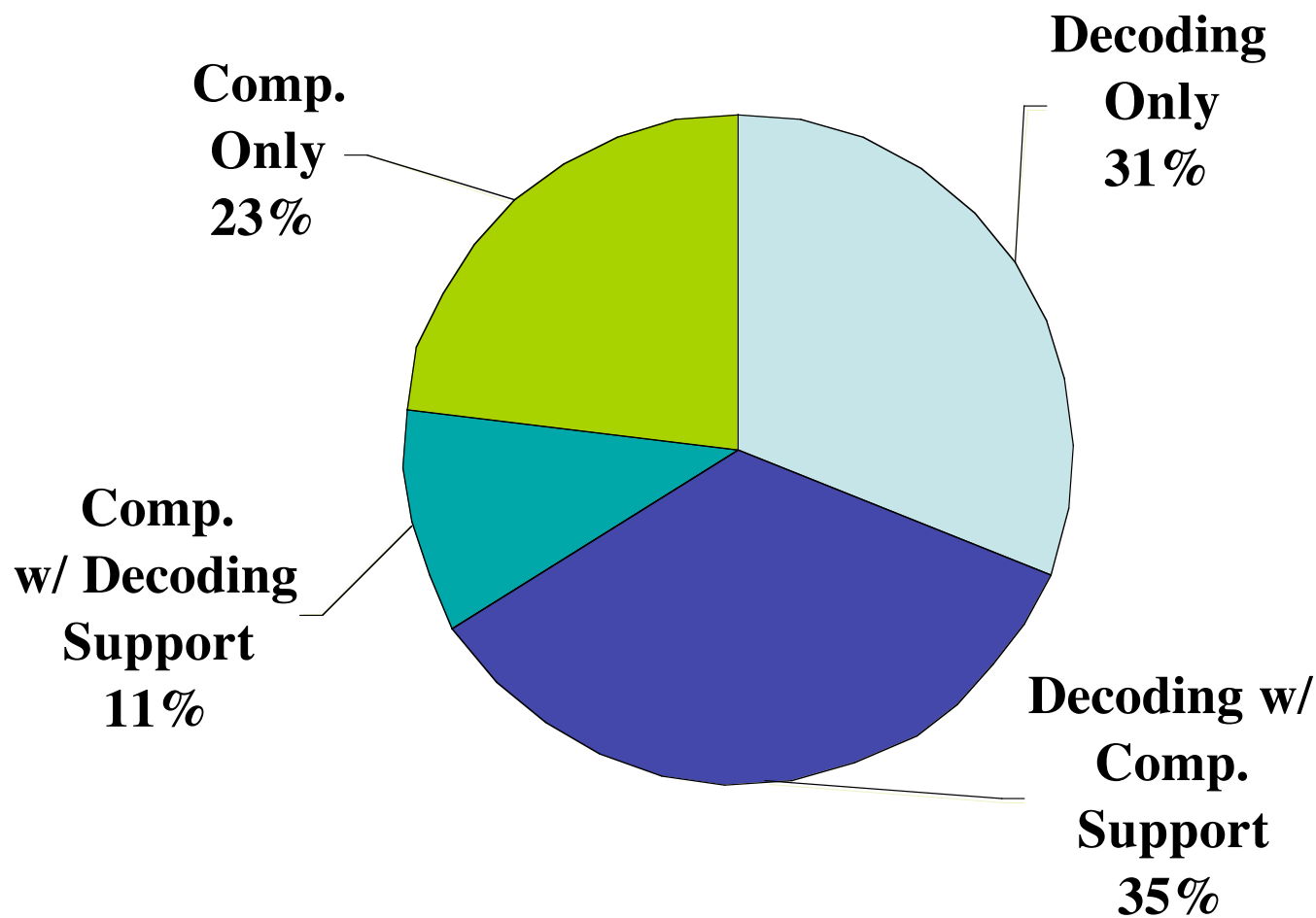
The following statistics are based on students who received instruction at Lindamood-Bell Learning Centers across the United States over the past several years*.

*2001 through mid-2004.



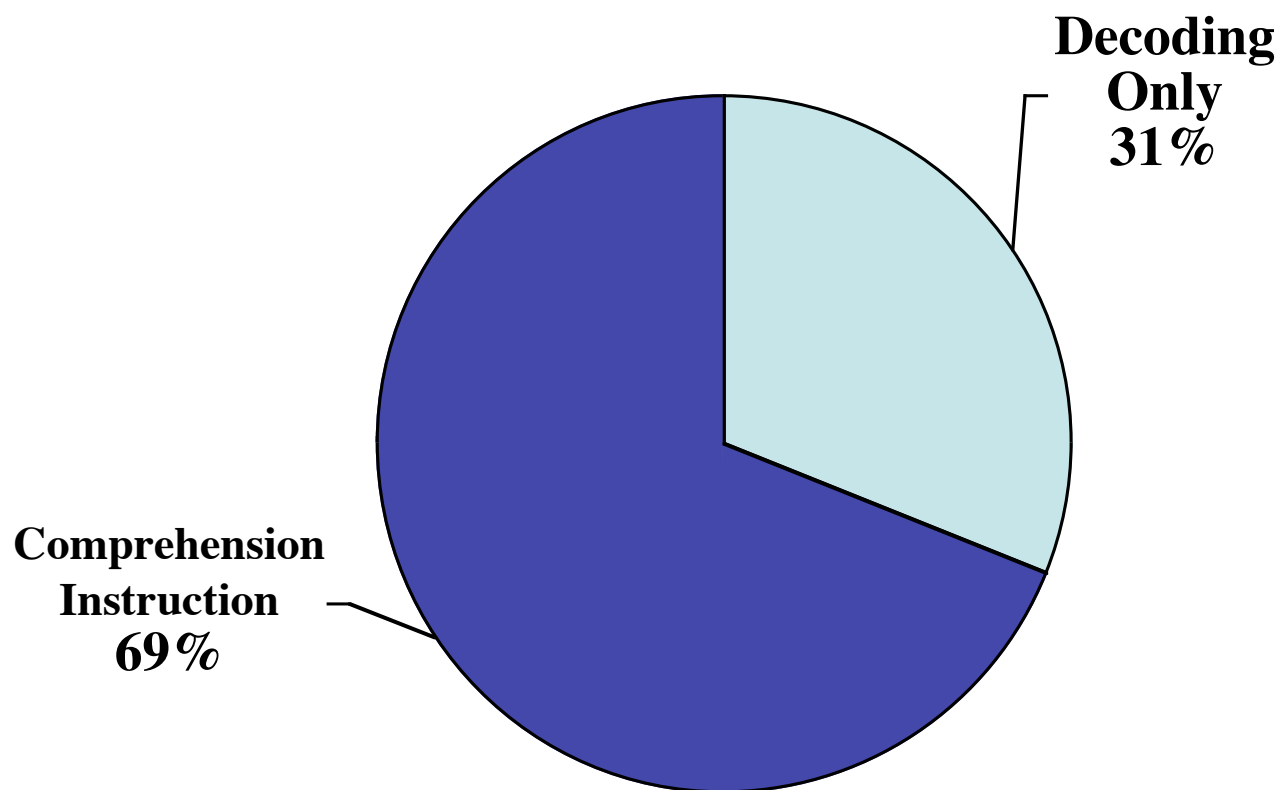
Percentage of Students Per Instruction Category

($N = 4,912$)





Students Receiving Comprehension Instruction





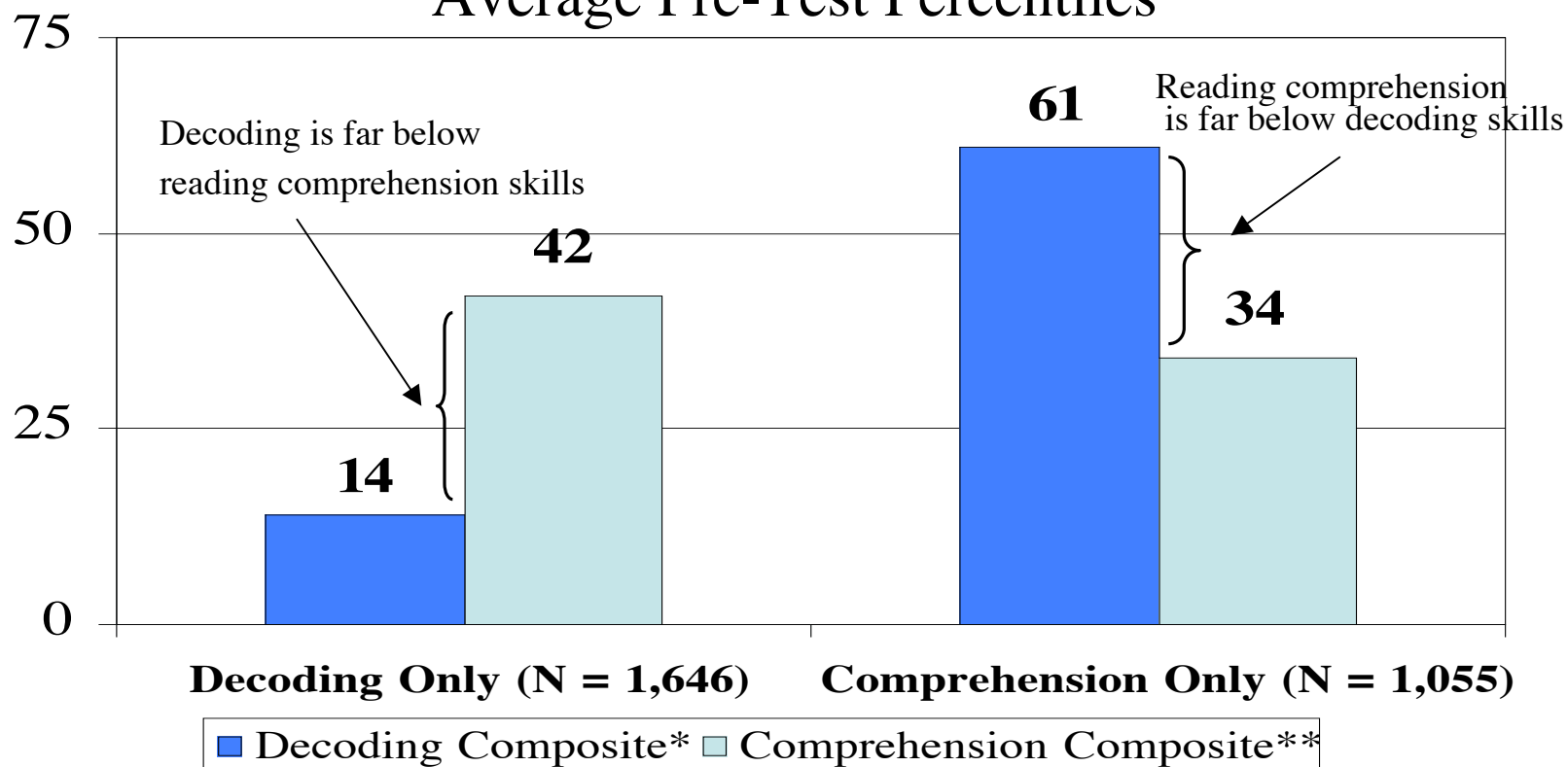
How do the pre-test profiles compare between *decoding only* and *comprehension only* students?



Comparative Profiles

Decoding Only vs. Comprehension Only Students

Average Pre-Test Percentiles

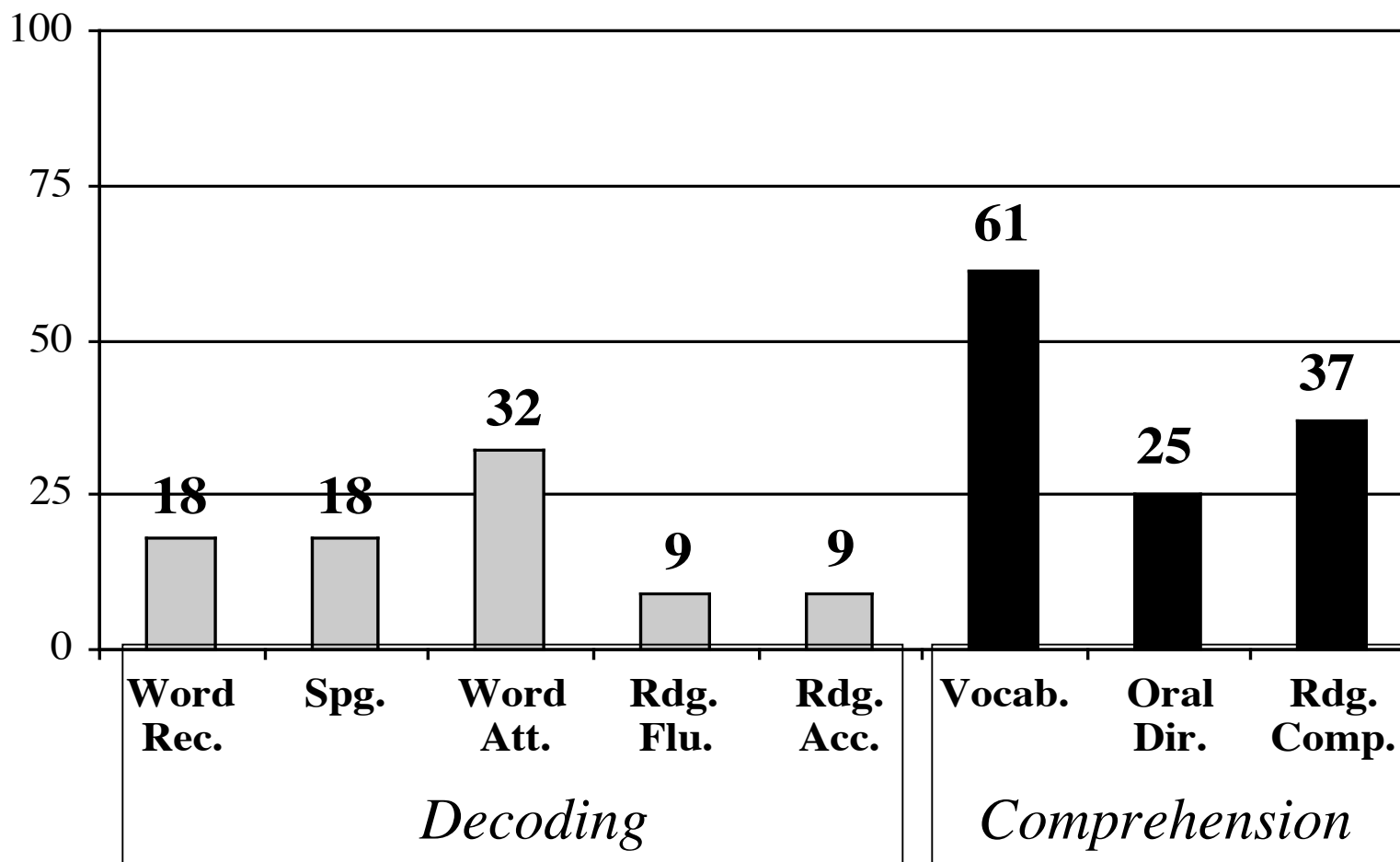


*Decoding composite—average across five measures (word recognition, spelling, word attack, reading rate, and reading accuracy)

**Comprehension composite—average across three measures (vocabulary, oral directions, and reading comprehension)



Decoding Only Students
Average **Pre-Test** Percentiles
($N = 395$)





Assessing Predictive Qualities

- Predictive qualities can be assessed by examining coefficients of determination.
- The coefficient of determination, or the correlation coefficient squared (r squared), shows the proportion of common variance between two variables, or the degree to which one variable can predict another.
- Coefficients of determination in the **mid-.60's** and above are usually considered adequate for individual prediction purposes.
- Stepwise multiple regression is an analysis that determines which independent variable (word recognition, word attack, etc.) best predicts a dependent variable (reading comprehension).



The predictors of word recognition are*:
($N = 921^{**}$)

	R-Squared
Symbol Imagery	.78
Word attack	.07
Reading comprehension	.03
Oral directions	.003
Vocabulary	.005

*Phonological awareness was statistically excluded in the final step of the stepwise regression analysis.

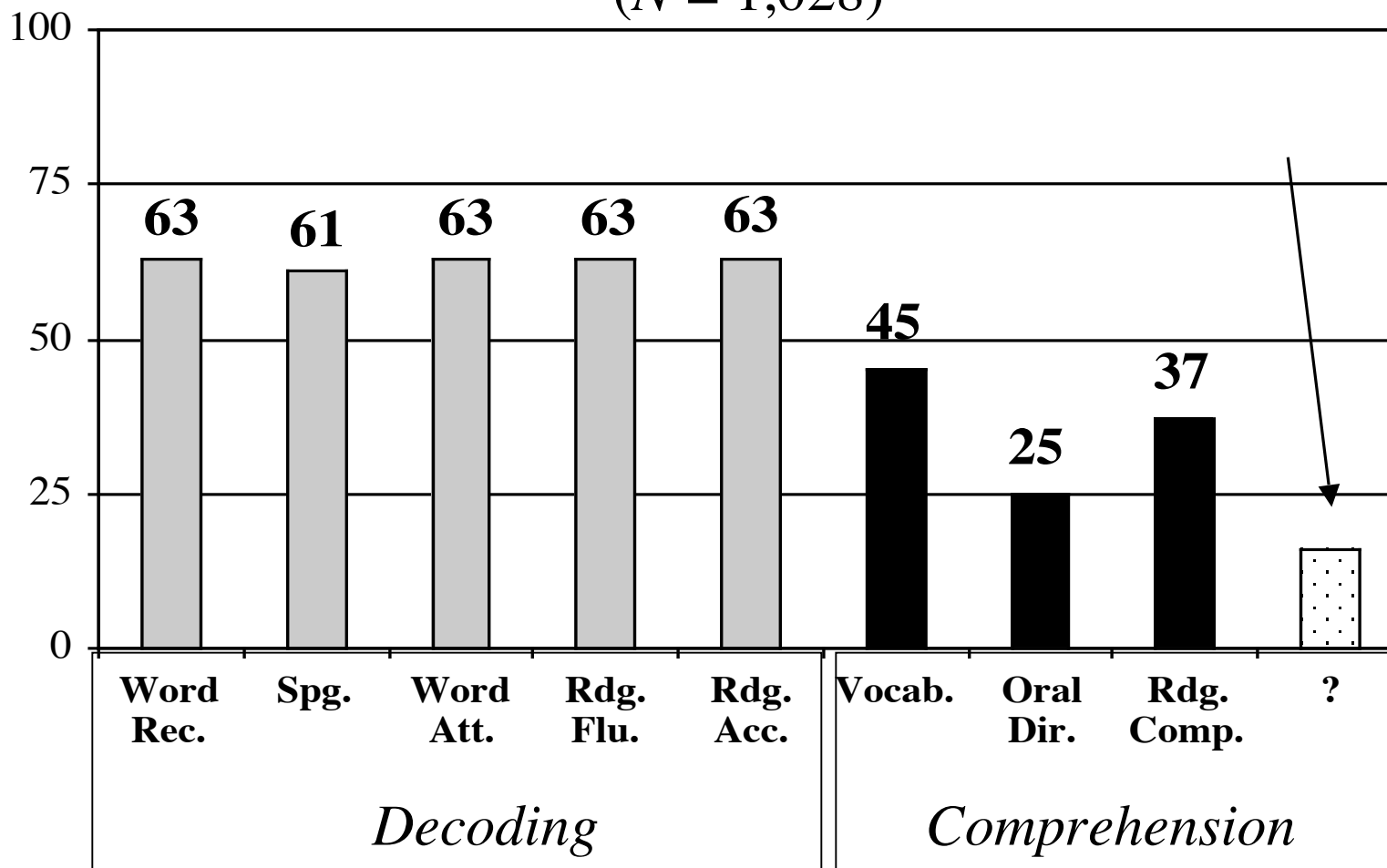
**Includes all students assessed on all six measures.



Comprehension Only

Average Pre-Test Percentiles

($N = 1,028$)





The predictors of Comprehension Only weakness are*:
($N = 978^{**}$)

	R-Squared
Word recognition	.29
Vocabulary	.11
Oral directions	.03
Word attack	.001

*Phonological and orthographic awareness (symbol imagery) were statistically excluded in the final step of the stepwise regression analysis.

**Includes all students assessed on all eight measures.



Do comprehension only students make significant progress from pre to post-test in reading comprehension, vocabulary, and oral directions?



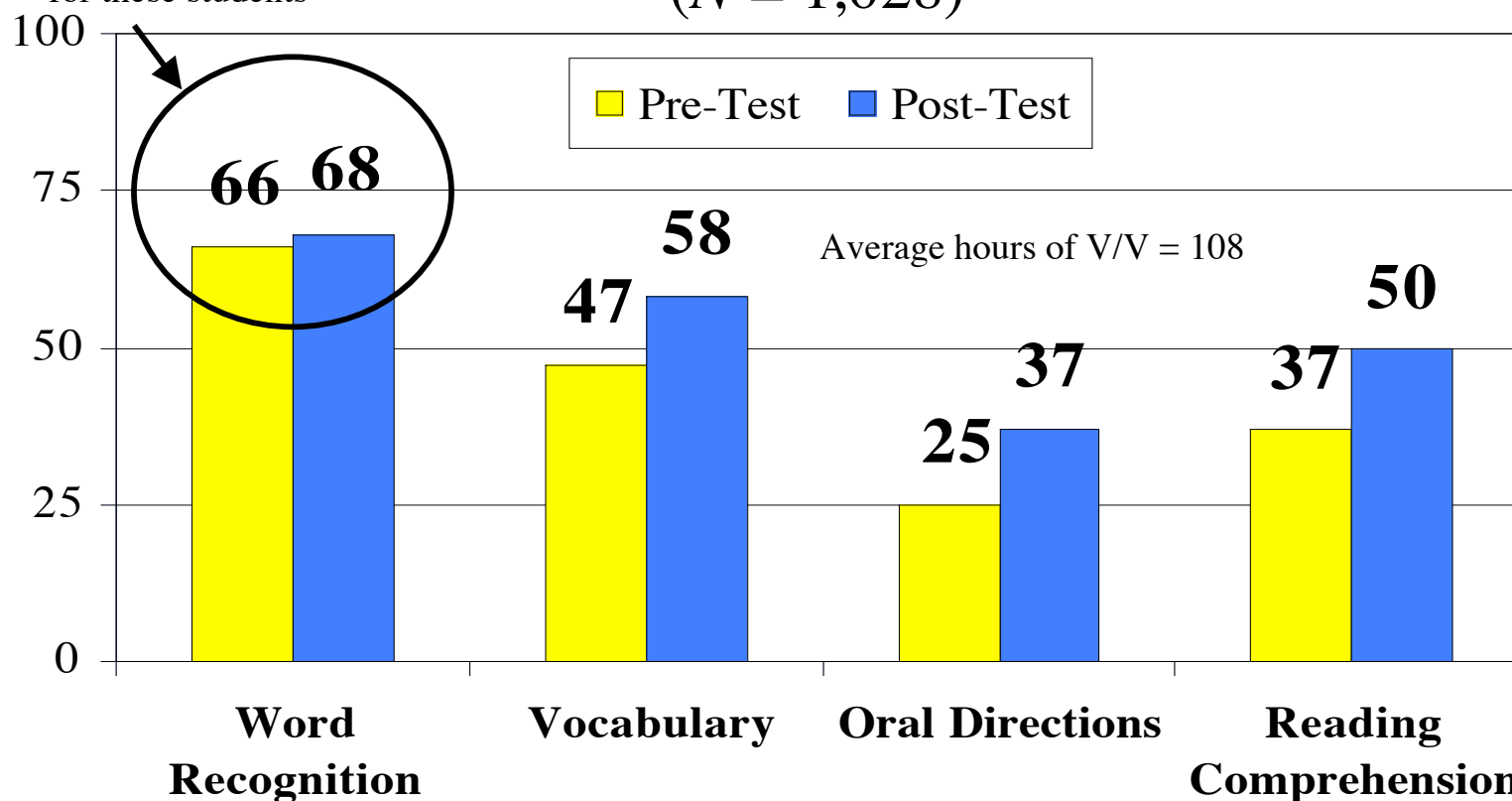
Results

Comprehension Only

Average Pre and Post-Test Percentiles*

Again, decoding is not an issue
for these students

($N = 1,028$)



*All results from pre to post-test are statistically significant ($p < .0001$)



Analysis of Comprehension Only Students

The Comprehension Only students were categorized into three groups based on the GAP between their word recognition (WR) and their reading comprehension (RC) skills:

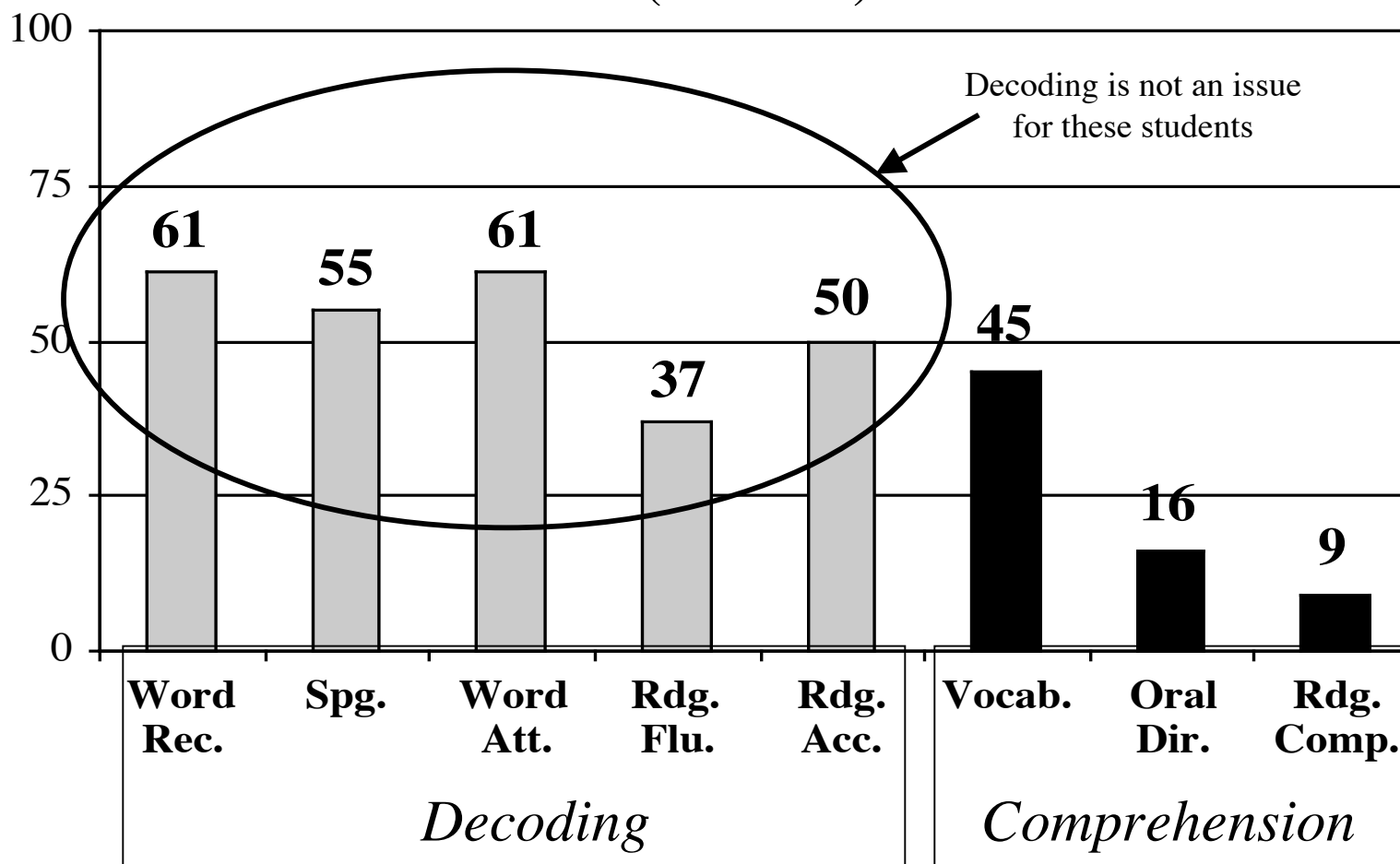
- **Mild** (RC at-or-below the 25th and WR above the 37th percentile)
- **Moderate** (RC at-or-below 25th and WR above the 50th percentile)
- **Severe** (RC at-or-below 25th and WR above the 75th percentile)



Mild (25th-37th)

Average Pre-Test Percentiles

(N = 638)





Do poor comprehenders but adequate decoders, the MILD category of students, make progress from pre to post-test in reading comprehension, vocabulary, and oral directions?

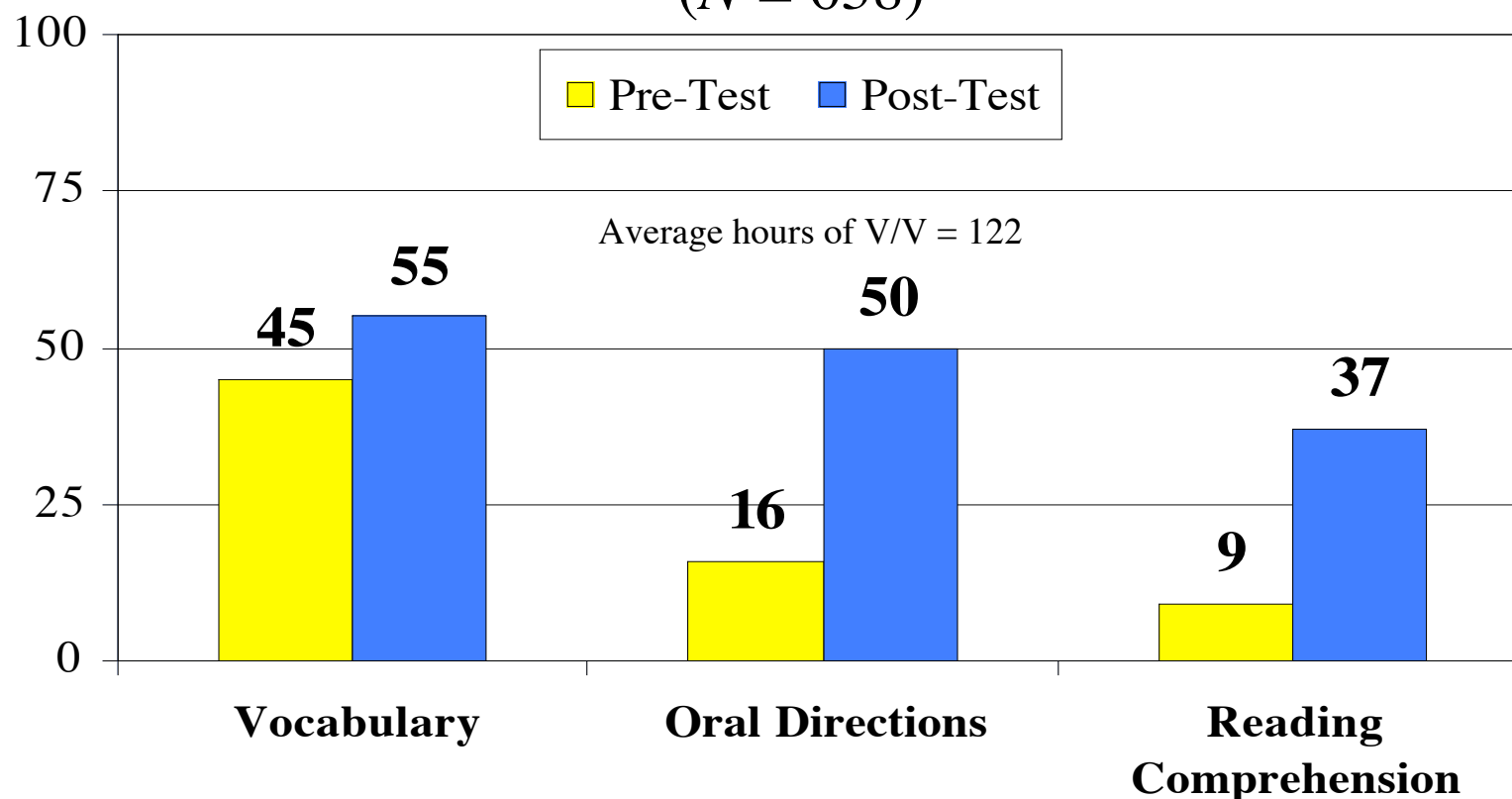


Results for MILD Category of Students

Poor Comprehenders but Adequate Decoders

Average Pre and Post-Test Percentiles*

($N = 638$)



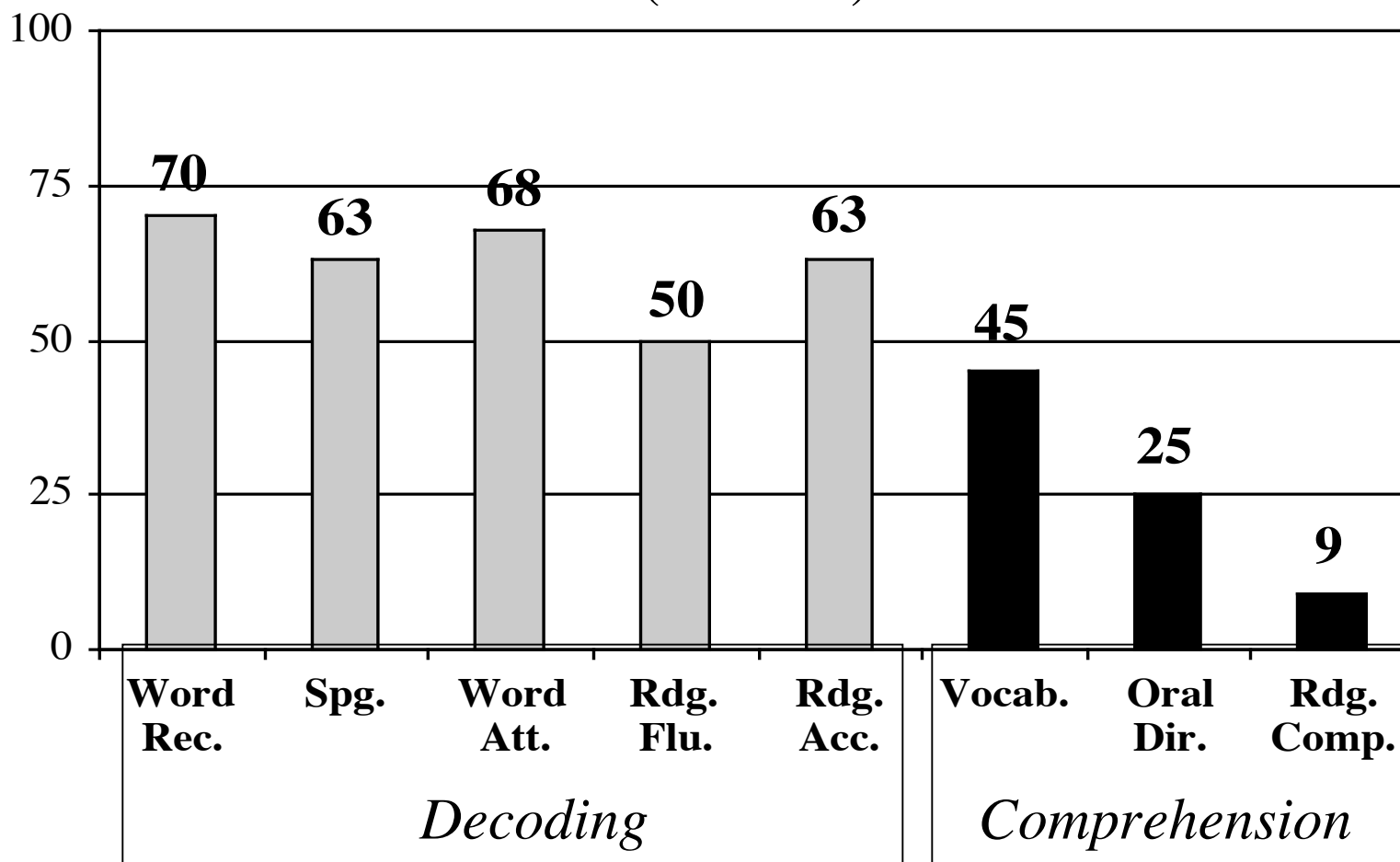
*All results from pre to post-test are statistically significant ($p < .0001$)



Moderate (25th-50th)

Average Pre-Test Percentiles

($N = 448$)

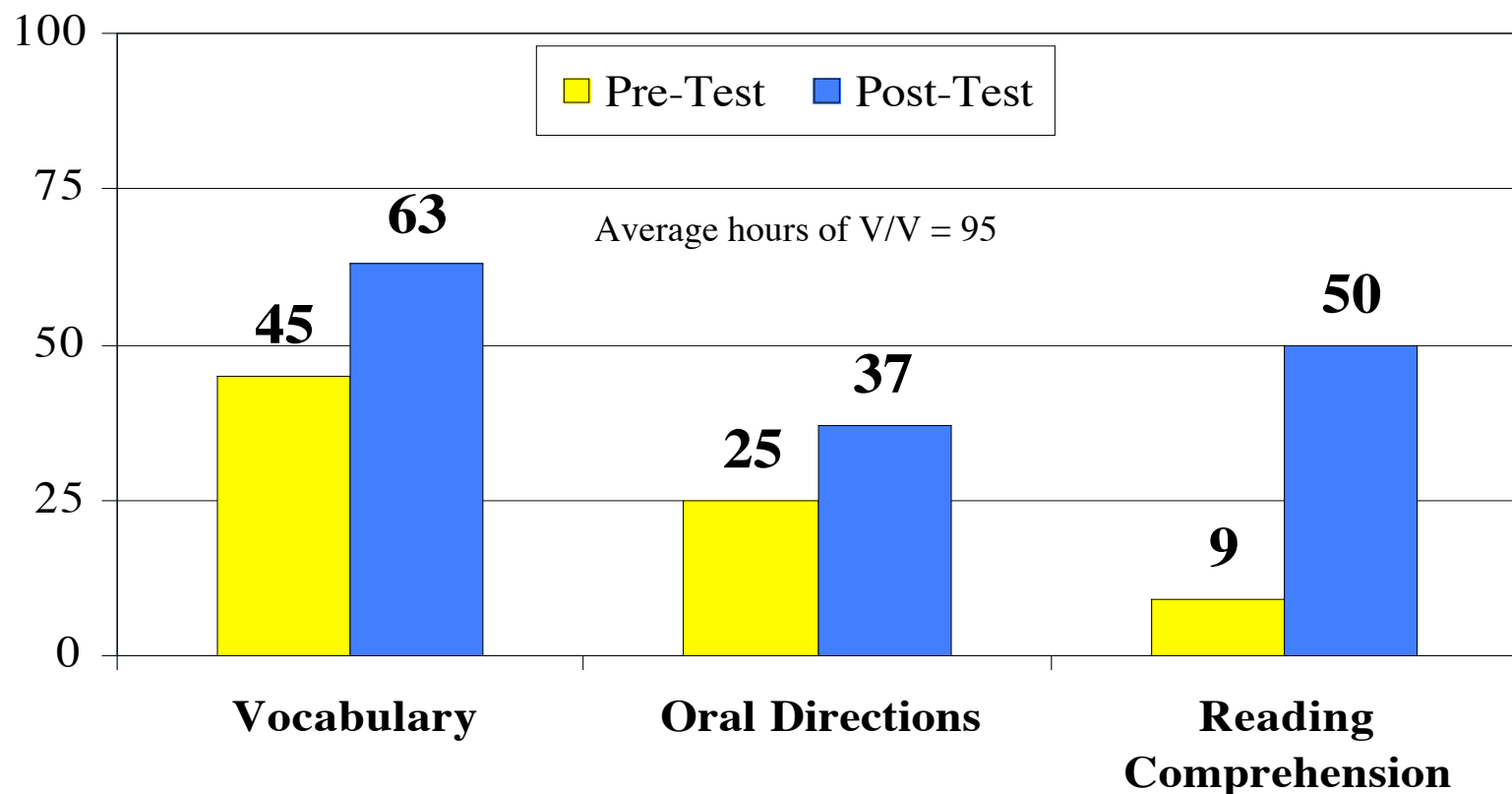




Results for Moderate Category of Students

Average Pre and Post-Test Percentiles*

($N = 448$)



*All results from pre to post-test are statistically significant ($p < .0001$)



Severe (25th-75th)

Hyperlexia?

3% of the students seen at Lindamood-Bell were poor comprehenders (less than or equal to the 25th percentile on reading comprehension) but strong decoders (greater than or equal to the 75th percentile on word recognition).

What does their pre-test profile look like?

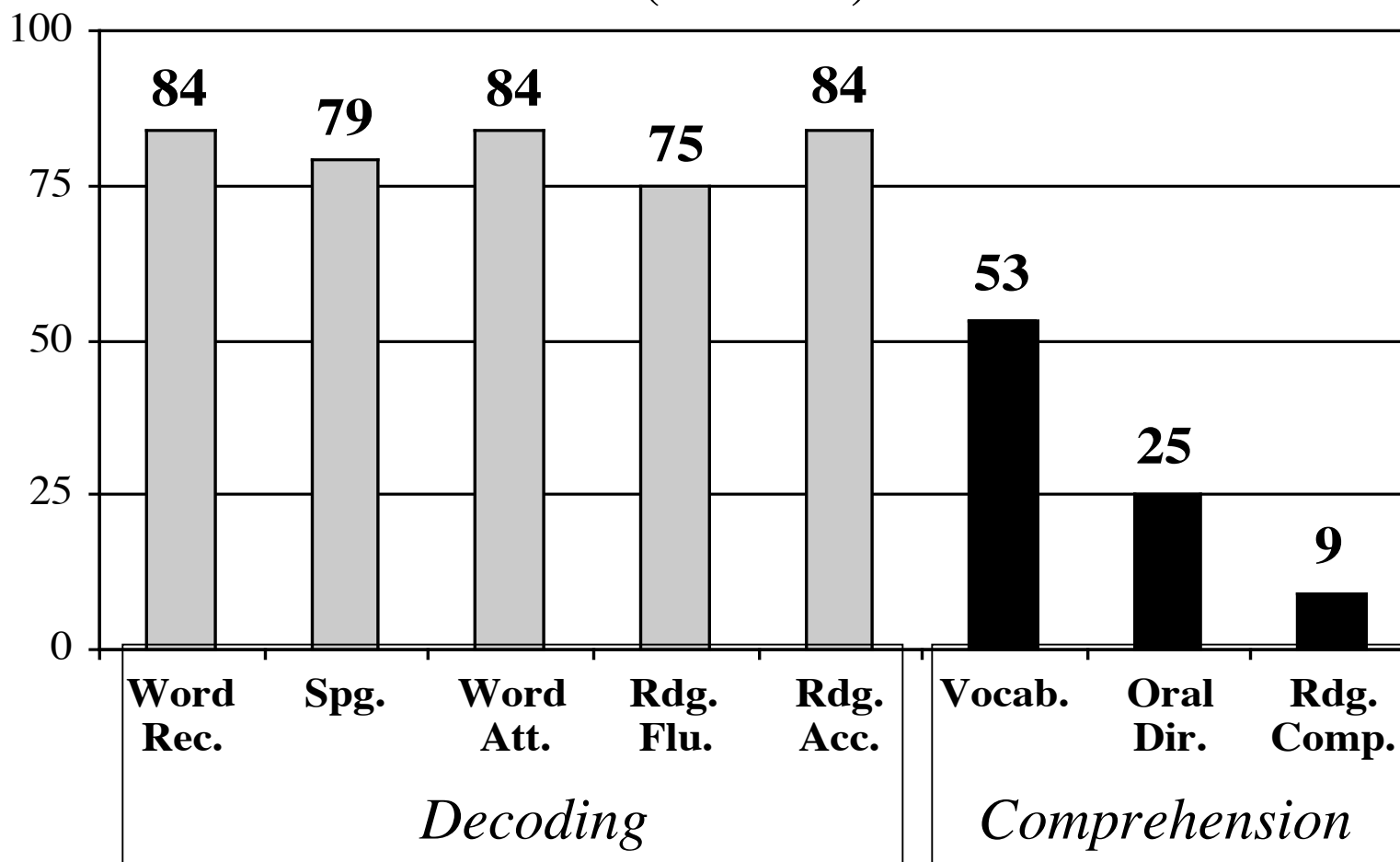
What happened to their language comprehension after developing their imagery and verbal processes—their ability to dual code?



Severe Category of Students

Average Pre-Test Percentiles

($N = 121$)

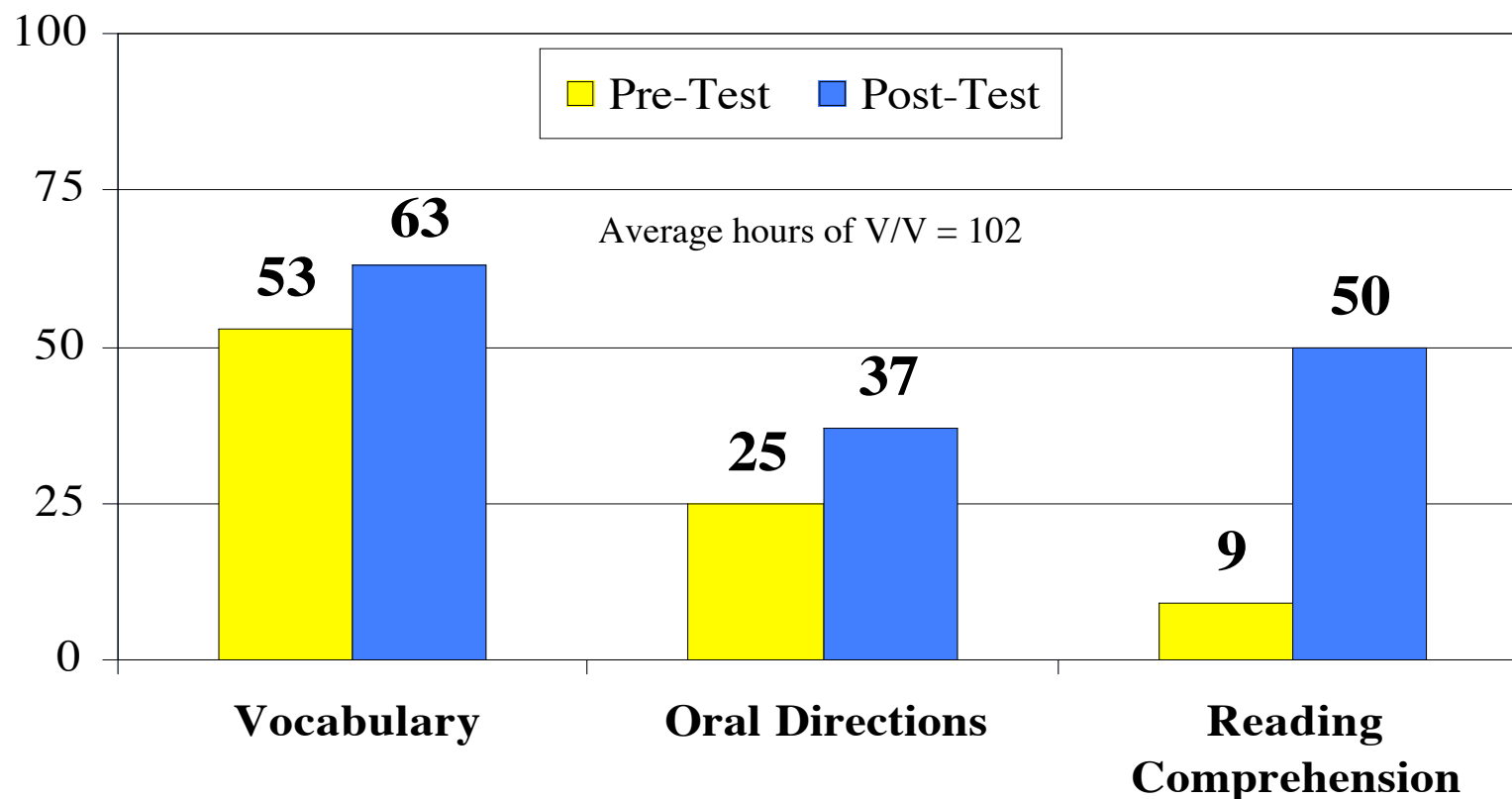




Results for Severe Category of Students

Average Pre and Post-Test Percentiles*

($N = 121$)



*All results from pre to post-test are statistically significant ($p < .0001$)



A Skill Double Deficit

32% of the students seen at Lindamood-Bell were poor comprehenders (less than or equal to the 25th percentile on reading comprehension) **and** poor decoders (less than or equal to the 25th percentile on word recognition).



Demographics

Poor Comprehenders **and** Poor Decoders

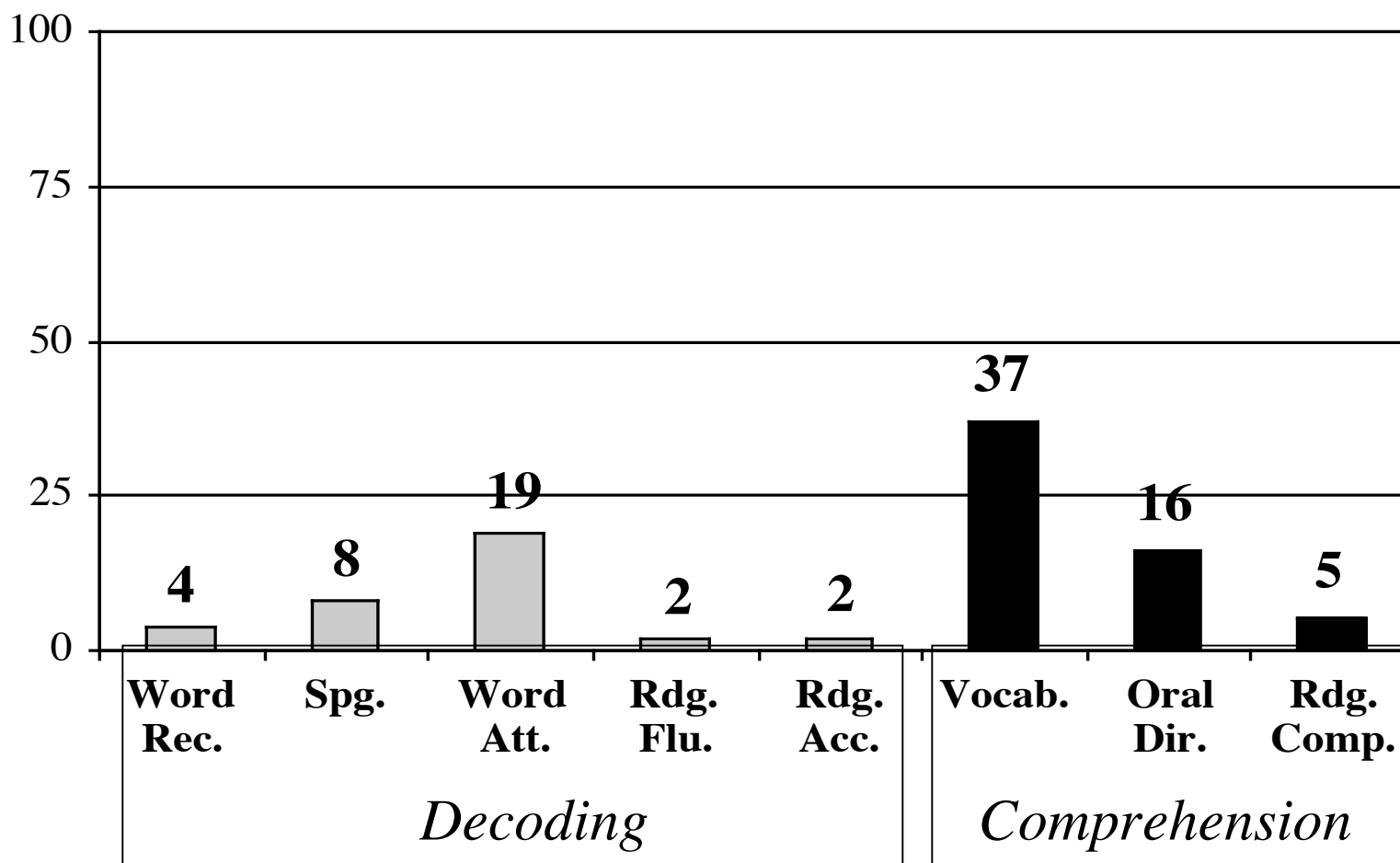
Number of Students	1,105
Percent Females	33%
Percent Males	67%
Average Pre-Test Grade Level	5.4
Average Pre-Test Age	11.6



Poor Comprehenders **and** Poor Decoders

Average Pre-Test Percentiles

($N = 1,105$)



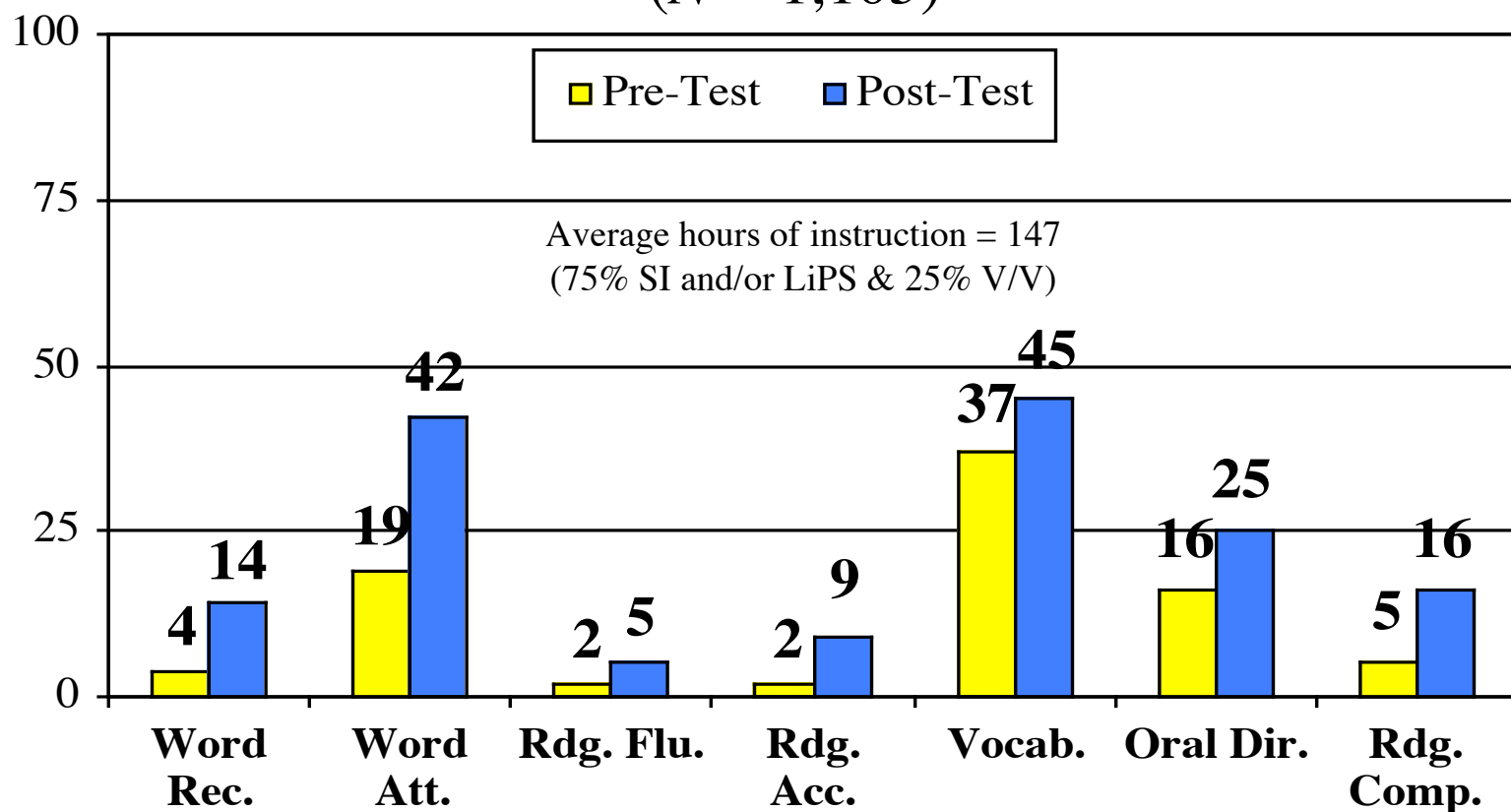


Results

Poor Comprehenders **and** Poor Decoders

Average Pre and Post-Test Percentiles*

($N = 1,105$)



*All results from pre to post-test are statistically significant ($p < .0001$)



Controlled Classroom Study

Bell (1994) compared the V/V program with a no-treatment control condition with fourth grade students in Long Beach, California.

The V/V group received 26 training sessions, small group, over a 3 month period.

The two groups did not differ significantly on any of the measures at the pre-test (all had adequate decoding skills). The only significant improvement at post testing was in reading comprehension.

The V/V group made statistically significant improvement in reading comprehension compared to the control group.

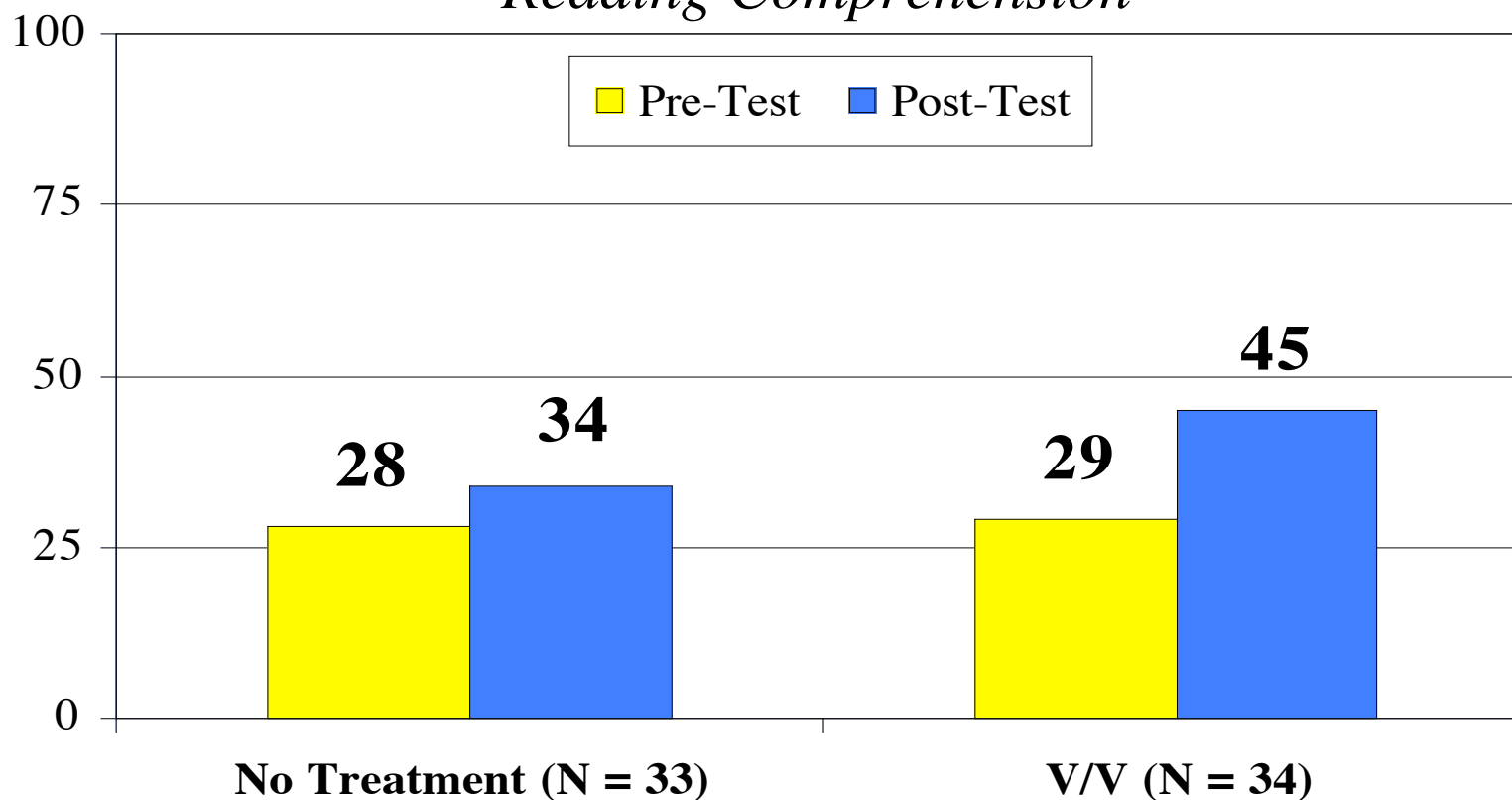


Classroom Comparative Results

V/V Study (1994)

Average Pre and Post-Test Percentiles*

Reading Comprehension



*V/V group outperformed the no treatment control group at post-test ($p = .04$).



Comparative Study with Male Juveniles

In a 2003-2004 study with male juveniles, the V/V group (N=31) was compared to a control group (N=23) in the language arts curriculum.

The two groups did not differ significantly on any of the measures at the pre-test.

After approximately 8 weeks of small group instruction, the V/V group outperformed the control group in reading comprehension.

The average post-test percentiles in reading comprehension on the Gray Oral Reading Test-4 were the 25th percentile for the V/V group and the 5th percentile for the language arts curriculum group. The results were statistically significant, $<.0001$, with a moderate effect size of .06.

*These are preliminary findings. This data is being independently analyzed by an outside evaluator.



Johnson-Glenberg Comprehension Study

Johnson-Glenberg (2000) compared the V/V program and Reciprocal Teaching (RT) (which includes self-questioning) with a no-treatment control condition for students from grades 3-5 who were adequate decoders but poor comprehenders. The experimental groups differed significantly on only one measure, vocabulary, which was included as a covariate in an ancillary analysis.

Both groups received 27 training sessions and made significant gains on 11 reading, memory, and cognitive processing measures while the control group made only one significant gain.

Johnson-Glenberg concluded that the RT group seemed to gain facility in recalling factual, verbal, text-explicit material, while the V/V group gained in integrating concrete, visually mediated material and tended to answer more inferential questions. It was further concluded that the results were consistent with DCT (i.e., comprehension can be facilitated both verbally and nonverbally by integrating language and imagery).



What happened to Natalie?

Peabody Picture Vocabulary Test.....	86 th Percentile
Woodcock Word Attack.....	86 th Percentile
Wide Range Achievement Test	
Word recognition.....	87 th Percentile
Spelling.....	96 th Percentile
Phoneme Awareness (LAC Test).....	100
Symbol Imagery Test.....	40/50
Detroit Test of Learning Aptitude	
Oral Directions.....	37 th Percentile
Test of Problem Solving-R.....	10 th Percentile
Gray Oral Reading Test-3	
Rate.....	84 th Percentile
Accuracy.....	95 th Percentile
Fluency.....	91 st Percentile
Comprehension.....	2 nd Percentile



Natalie came to the United States from London to receive sensory-cognitive stimulation in concept imagery. She received 103 hours (3.5 weeks) of intensive instruction with the goal of stimulating her ability to dual code—integrate imagery and language—for application to oral and written language comprehension, critical thinking, and following directions.

	Pretest	Post-Test	
Detroit Test of Learning Aptitude			
Oral Directions.....	37 th	95 th	Percentile
Test of Problem Solving-R.....	10 th	38 th	Percentile
Gray Oral Reading Test-3			
Rate.....	84 th	50 th	Percentile
Accuracy.....	95 th	95 th	Percentile
Fluency.....	91 st	84 th	Percentile
Comprehension.....	2 nd	75 th	Percentile

Natalie learned to comprehend oral and written language, began to read for pleasure, and became highly successful in school—she also began to DREAM.



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