

**PREREADING RESEARCH AND CASE STUDY IN 4-5 YEAR OLDS:**

**WHAT ARE PREREADING SKILLS?**

**WHAT IS THE BRAIN BASE FOR READING?**

**WHAT SCIENTIFIC READING METHODS WORK?**

**WHAT IS THE ROLE OF SELF-REGULATION?**

Sponsored by the Melody Arons Center for Applied Preschool Research and Education, Inc.

Principle Investigator: Marilyn Arons, M.S.

Assistant: Victoria Emm

June 3, 2015

## TABLE OF CONTENTS

What is Pre-Reading.....	3
Biological development of 4-5 year olds.....	4
Self-Regulation.....	5
The Neuroscience of Reading .....	6- 7
Visual Processing.....	.8
Case Study Lesson Summaries.....	9- 17
Decoding Timeline.....	18- 19
Applied Literature Review to Case Study.....	20
Case Study Outcome.....	20
Bibliography.....	21-22

## What is Prereading?

At the outset it must be understood that reading is learned at the conscious level. It is not innate like speech and must be taught. It is a Code that is man-made technology (Tallal, 2015). It is an outgrowth of oral language, ages 0-5, and includes the following skills (Chall, 1983):

Learning to flip pages

Recite memorized stories

Create their own stories as they point to pictures

Scanning L-R, top to bottom with their eyes

Learning concepts of print

Building vocabulary

Letter recognition

Copy square, triangle, diamond

Copy diagonal and V stroke

Recognize words that rhyme

The best predictor of success in early reading is familiarity with letters in the alphabet (Adams, 1998). By kindergarten, many recite the alphabet, recognize written letters and print their own name. National Institute for Health (2004) listed six pre-reading skills:

1. Narrative skills
2. Phonological awareness
3. Letter knowledge
4. Print motivation
5. Vocabulary
6. Print awareness

## **Biological development of 4-5 year olds**

From 48-60 months, the following skills emerge (Linder, 1993):

1. Sorts group of objects in different ways
2. Classified objects into categories
3. Matches/identified basic symbols
4. Knows R-L
5. Puts 3 pictures in a sequence to tell a story
6. Knows first, middle, last
7. Knows sequence of reading a book > L-R/top to bottom
8. Copies square, triangle, diamond, diagonal, V strokes
9. Copies own name
10. Assigns appropriate labels to objects in the environment
11. Uses writing implements
12. Shows understanding that letters represent sounds and are symbols for words.
13. Working memory (Dewar, 2012)
  - A. Varies from child to child
  - B. Average 4 year old has  $\frac{1}{2}$ - $\frac{1}{3}$  the working memory of an adult
  - C. Different kinds of working memory: auditory word memory
  - D. Build knowledge of written language
  - E. Increase capacity for math concepts: days of the week, months, seasons
  - F. Improved endurance: gross and fine motor
  - G. Capacity limits. No more than 5 new words per lesson in elementary (Sousa, 2012)
14. Learns what causes feelings. Shows progress in social interactions.
15. Explores creative arts. Loves to dance/move rhythmically.
16. Male brain processes language on the left side only. Females use both sides. Information pathway more efficient in girls (Sousa, 2012)

## **SELF-REGULATION**

Self-regulation is a neural system within the frontal lobes that develop from ages 4-7. It needs to be constantly used or will not develop. It functions to help children engage in mindful, intentional, thoughtful behaviors, controlling impulses and the ability to do something they don't want to do (Florez, 2011). Self-regulation:

1. Regulates thinking, emotions and behavior
2. Responds to the environment and communicates with other neural systems
3. Persists in the face of difficulty
4. Develops gradually and only with practice
5. Requires scaffolding to be successful
6. Has children learn to recognize opportunities to play and talk
7. Has children learn to know when they need help
8. Temperament is a genetic component of self-regulation
9. Forcing obedience delays internalization
10. The brain constantly senses and responds to needs of the body (Perry, 2015)
11. Children need to learn to read their own body signals.
12. Can be hypersensitive to transitions.
13. Encourage action, not passivity for self-regulation (Rice, 2015)
14. Self-regulation is difficult for children with SI problems.

## THE NEUROSCIENCE OF READING

1. **The brain responds to novelty and sensory involvement which is why we learn better by doing than listening. (Willis, 2008)**
2. Developing brains imitate learning through activation of mirror neurons in Broca's area and the frontal lobe- the brain center associated with expressive aspects of speech. They may build the foundations for babies to imitate lip and tongue movements of others. Concepts of print awareness, L to R eye movements across the page, connecting words on a page to lip movements of the reader, are caused by activating mirror neurons. Three proposed brain areas activated in reading are:
  - A. *Frontal lobe*- implicated in phonological processing and where Broca's area is found. Neuron activation increases when words are spoken.
  - B. *Temporal and occipital lobes* most associated with orthographic processing (visual and phonological processing) of the pattern and form of words. System is more activated in English speakers.
  - C. Reading systems encompass parts of the *parietal and temporal lobes*, especially the *angular supramarginal and posterior superior temporal gyri*. These regions are implicated in word analysis by integrating visual features of print rather than the whole word. This is likely what pre-readers use when linking letters to sounds.
  - D. Sensitivity to sound structure in language correlates with MRI activity in *left superior temporal lobe and lower frontal lobe*. These are the same areas that show increased metabolic activity in direct relationship to phonological processing.
  - E. **The auditory response centers respond earliest in the development of reading in these same areas.** When children are not aware of sound differences they have more difficulty applying sound symbol relationships in reading.
  - F. Reading acquisition changes behavior and cerebral systems (Kolinsky, 2015) Core brain systems are "recycled" when learning to read,

*reorganizing the ventral occipito-temporal pathway.* Responses to print increase in the *left occipito-temporal sulcus*, while response to faces shifts to the R hemisphere.

- G. **The human brain is not wired to make sound to letter connections** (Sousa, 2012).
- H. Effective practices build new neural networks.
- I. No research shows the benefits of silent reading.
- J. Written language stands on the shoulders of oral language (Tallal, 2015)
- K. **Neurons that fire together will wire themselves up. The more they fire the more they will do it again.**
- L. **There is a sensory threshold in hearing very rapid signals. We need to organize language sounds very quickly because the acoustic changes tell us which speech sound we have just heard. The brain recognizes differences in sound in time.**
- M. Consistency is important to the brain.
- N. Teachers would teach differently if they understood how the brain works.

## **VISUAL PROCESSING**

1. Human visual attention is limited to space (how many) and time (how fast). (Maratos, 2011)
2. Visual processing in reading is correlated with short term memory and reaction time.
3. Visual processing speed correlates with attention, memory, and global processing.
4. **Perceptual and conceptual cues appear more strongly liked in hearing than in vision. The auditory system prefers perceptual cues. Visual prefers conceptual cues.**
5. **Mode of presentation strongly influences categorization responses in children.**



## **CASE STUDY LESSON SUMMARIES**

DONOVIN, DOB: 8/4/10

Status: Not know letters, not spell name or know letters in his name, not able to rhyme, heightened sensory needs, in a placement where he did not have access to activities w/o alphabet knowledge, very bright, poor fine motor skills, self-regulation difficulties.

### **Session 1, 3/12/15:**

Did not recognize his name posted on the playhouse.

Introduced name rhyme

Introduced using language to replace behavior

He refused any activity in which a letter was used verbally.

Used "straight" and "curvy", having him ride bike on the rope line that made a large letter D saying "straight" "curvy".

He had down time, intense sensory play and input, wanting to paint the outline of his body. Showed poor tripod grasp.

He would not attempt to sing alphabet song, clearly phobic about any reference to alphabet. He sulked when asked again.

He did not initiate social greeting or language, and was slow to respond to this request.

He had a major meltdown at end of session. Very sensitive to transitions.

## Session 2, 3/19/15

Continued “straight” and “curvy” as alternate to letter naming of D.

Goal to recognize/write Donovan by end of study. Walked, rode bike on D shapes.

He saw his name on the playhouse and said “That’s my name” while bouncing a ball. It was there the prior week but he did not have this sensory input.

He knows his colors.

Introduced shapes and their names, many of which he know. Some problems with short term memory.

Loved finger painting. Preferred brush instead of fingers. Invested in not having paper tear.

Used large wooden letter D w/o naming it, traced the straight and the curvy parts “of the road” with his finger.

Continued emphasis on using words to replace behavior.

He needs to lead the activity so he feels in control.

### Session 3, 3/26/15

He spontaneously greeted at the door.

Engaged in name rhyme

Traced triangle, drew circle, square, rectangle, diamond. He's better when tracing inside the shape.

Introduced auditory segmentation. Asking him to make the first sound of R words. Able to get the "R" sound. No letter reference.

Read an Easter story. He only listened and did not look at the book. Preferred shape books w/o narrative. Knows l-r, up/down.

Decorated Easter eggs using circle, triangle, rectangle and square, naming each shape.

Perfect transition because of allotting enough time. The comfort of his body determines time on task.

Beginning to get idea of rhyme.

Engaged in extended free play, dropped balls through basket for Victoria to catch. This pattern was repeated from the prior week. He seeks a schedule and the ritual of repetition.

Extraordinary pretend play in content/length. Made cooked eggs, cracking them open for his family's breakfast. Story had beginning, middle, end.

He gets very stressed when outcome not perfect or restrictions placed on him.

I am increasingly worried about his school placement and its forcing of pre-reading skills, creating negative reactions to letter use.

## Session 4, 4/2/15

Focus on self-regulation as underpinning for pre-reading skills.

Paired use of sensory tunnel with rhymes, increasing speed with repetitions.

Read an Easter story he chose. Beginning to look at the pages.

Colored Easter eggs using shapes he names as he plays.

Make a D Easter basket, tracing straight and curvy. Answered "Whose name starts with D?"

Bye-bye song. Smooth transition outside and into car.

I introduced the first 4 letters by singing ABC song secondarily as he played with toys. No reaction.

No tripod grasp with smaller tool. Writing/coloring extremely difficult.

Made first huge D with his arm through indirect play.

Loves numbers/counting.

Knows colors.

## Session 5, 4/16/15

He expanded circles of communication at door to scaffold regulation. Emphasis on feelings, sequencing of his day.

Made cookies. Had first direct instruction of alphabet. Used letters R (recipe), F (flour), (S) sugar, and B (butter). (show video) Began to destigmatize interaction with sounds matched letter shapes through play.

Yard tour. Looked for things starting with F (flower) S (spoon) B (bee)

Growing concern about his placement

Asked to make a site visit.

## **Session 6, 4/23/15 + site visit to school**

School visit. Horrifying, punitive, deeply destructive for Donovan's needs. Nothing about it fostered regulation, comfort, addressed his sensory needs, or pre-reading skills. It was a daily aversive to which he reacted with avoidance to any mention of letters or alphabet. His session here was 2 hours after we were in his school. He made no reference to our visit.

Entrance began to expand his reciprocity. Discussed idea of a "conversation", taking turns.

Painting. Used Y, yellow, B, blue, R, red paint. Used Richard Scarry book on colors. Made G, green, P, purple, O (orange) He was to say the first sound of each letter that he heard and repeat it.

Blowing bubbles. Make the sounds of each word. What letter makes that sound?

D book. Read the D book. He traced the straight and curvy, counting Ds on each page now looking with interest at print and saying "D".

## **Session 7, 4/30/15**

Mother has removed Donovan from his school based on site visit.

Demeanor much calmer.

Reciprocal conversation much expanded.

Continued/expanded work on rhyming.

Worked in garden using D words. Goal to get him to decode D and recognize/write his name voluntarily placed on a sensory stream. Invented expanded stories about worm families, working with real worms. He watched and felt their shapes in his hand as they moved.

While working on a bye-bye card for Victoria, I showed him letters A, B, C, D and asked him to name them. Could only name D.

Some auditory processing issues.

Improved tripod grasp.

Sensory load must be consistent for improved outcome.

## Session 8, 5/7/15

Spoke in compound/complex sentences upon greeting

Broke the Code and understands sound/symbol relationship of D. This has quickly expanded the sound-symbol concept to other letters/words.

Read him a story in which he was very engrossed. He then retold the story.

Able to spell his name, count the letters, and indicate which number the Os are.

Expanded perception into concepts: age and height.

Planted radish and lettuce seeds in the garden. Traced letters in the dirt and planted seeds in those shapes. Looked at the letters on the seed packet/identified vegetable.

Demeanor very changed. Extremely proud of himself.



## Session 9, 5/21/15

Expanded expressive language/sentence structures with outpouring of information upon entrance.

Continued work on rhyming, finding pictures whose words rhymed. Jump up when hear a rhyming word

Read Little Boy Blue. Found B words

Sang ABC song for the first time willingly, while on the swing. He did perfectly 3 times.

Sang Twinkle Twinkle. Problems with repeating the middle sequence/short term memory.

Heard that ABC song and Twinkle Twinkle had the same melody. "They sound the same."

Made a Smell Book. Clipped herbs, smelled them, glued into book, labeled the smell.

Explained next week was our last week. He was upset by this and immediately wanted to stop.

## DECODING TIMELINE

### Session 1:

Refused any reference to letters, spoken or sung  
Required extensive sensory play for regulation  
Did not initiate social greeting at door  
Did not hear rhyme patterns  
Did not recognize his name printed on the wall

### Session 2:

Spoke greeting at door with prompt  
Began naming/drawing shapes  
Recognized name while bouncing ball  
Continued work on feeling the D shape  
Improved expressive language to replace behavior  
Finger painted his body shape

### Session 3:

Said name rhyme at door  
Began auditory segmentation, repeating "er" of R words while playing  
Used shapes as Easter decoration  
Began formal concept of rhyme  
Extended pretend play  
Perfectionistic  
Needs 2-3 times of play/sensory activity to balance energy used in language activity

### Session 4:

Expanded door greeting  
Paired sensory tunnel with rhymes  
Began to look at pages while story is read  
Recognizes letter D  
Loves numbers. Knows colors

### Session 5:

Much expanded expressive and social language  
Direct instruction of R, F, S, B through making cookies  
Explored yard to find F, S, B words.  
Asked for school site visit due to concerns.

**Session 6:**

School visitation. Horrific placement. All activities based upon knowing letters and the alphabet. Huge class, very noisy in gym to the degree that Donovan experienced pain and could not function. Sensory system completely overloaded.

Painted with primary colors behind Y, B, R.

Combined colors to make G and P.

Continued working on finding the first sound of a word.

Read D book. He looked at pages, counting Ds.

**Session 7:**

Parent removed him from the school.

He is much calmer, more focused

Expanded rhyming ability

Used D words in the garden, while shown his large D.

Some auditory processing issues

Improved tripod grasp.

**Session 8:**

Broke the alphabetic code.

Able to write his name independently.

Exploring concepts of age and height.

Planted seeds in the garden, drawing letters in dirt, planting seeds in those shapes.

Demeanor dramatically changed.

**Session 9:**

Continued work on rhyming

Found B in Little Boy Blue

Sang ABC song willingly. Did three times without error.

Sang Twinkle Twinkle. Commented that the songs had the same melody.

Made Smell Book of herbs, labeling each smell.

## **APPLIED LITERATURE REVIEW TO CASE STUDY BASELINE**

1. Donovin began with only narrative skills and vocabulary. He did not have phonological awareness, letter knowledge, print motivation, or print awareness.
2. He did not use writing implements.
3. He did not show understanding that letters represent sounds and are symbols for words.
4. He had capacity limits for language use.
5. His self-regulation was difficult due to sensory integration problems.
6. His body responded to its environment and communicated with other neural systems
7. His temperament was a genetic component of his self-regulation.
8. He was hypersensitive to transitions
9. He needed action for self-regulation.
10. He responded to novelty.
11. Decoding ability changed his behavior
12. Repetition of sensory motor and auditory segmentation fired neural networks that wired themselves up. This expands to visual regions when letters are introduced that represent sounds.
13. He responded to consistency.
14. Following his perceptual growth in decoding, he began to explore conceptual cues of age and height. "I am 4 years old. So why am I only 3 feet high?"
15. The mode of presentation of sound-symbol correlations strongly influenced his responses.

## **OUTCOME**

1. Had all 6 pre-reading skills
2. Used writing tools.
3. Decoded alphabet letter sounds
4. Improved self-regulation
5. Wrote his first name independently
6. Began to explore concepts

## BIBLIOGRAPHY

Activities for Visual Perception, [www.shirleys-preschool-activities.com](http://www.shirleys-preschool-activities.com). Last visited 3/24/15

Berger, C., Donnadieu, S., (2008) Visual auditory processing and categorization preferences in 5 year old children and adults. V. 24. Issue 2. Behavior, Brain and Cognition

Bodrova, E., Leong, D. (2008) Developing Self-regulation in Kindergarten. Beyond the Journal. Young Children on the web

Cook, J.L. (2009) Child Development Principles and Perspectives. pp. 246-250. Pearson Education Inc.

Cook, J.L., Cook, G (2014). Self-regulation, Prentice Hall

Crocker, S., Maratos, F. (2011). Visual Processing Speeds in Children. Child Development Research. Article ID 450178

Dehaene, S., Cohen.L., Morais, J., Kolinsky, R., (2014). Illiterate to literate: behavioral and cerebral changes by reading acquisition. Nature Reviews Neuroscience 16. Pp. 234-244. [www.nature.com](http://www.nature.com). Last visited 3/24/25

Dewar, D. (2012). Working Memory in Children, [www.parentingscience.com](http://www.parentingscience.com). Last visited April 13, 2015

Florez, I. (2011). Developing Young Children's Self-regulation through everyday experiences, Young Children

Four Year Old Developmental Tracker (2015)  
[www.pbs.org/parents/childdevelopmenttracker/four/](http://www.pbs.org/parents/childdevelopmenttracker/four/) . Last visited 4/11/15

Gewertz, C., Sawchuk, S.,Heitin, L. (2015) Early Grade Reading Instruction. Education Week. 5/13/15

Linder, T (1993). Transdisciplinary Play-Based Intervention. Brookes Publishing Co.

Moats, L (1998) Teaching Decoding. American Educator

NIH (2004) Every Child Ready to Read. The Early Literacy Initiative

Perry, B. (2015) Self-regulation: The Second Core Strength,  
<http://teacher.scholastic.com>. Last visited 4/8/15

Reading Readiness Milestones for 4 year olds (2015). Nemours Health System.  
[www.readingbrightstart.org](http://www.readingbrightstart.org). Last visited 3/24/15

Rice, M. (2015). Understanding the importance of self-regulation for preschoolers, Virginia DOE

Sousa, D.(2012) How the Brain Learns to Read. [info@ebli.com](mailto:info@ebli.com). Last visited 4/2/15

Tallal, P. (2015). Neuroscience, phonology and Reading: The Oral to Written Language Continuum. [www.childrenofthecode.org](http://www.childrenofthecode.org). Last visited 5/15/15

Willis, J. (2008) Teaching the Brain to Read. ASCD