



The Educators' Science of Reading Toolbox: Word Chaining

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Has this ever happened to you?



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Big Question

How do you know if something is aligned to the Science of Reading?



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Bigger Question

What does the body of research known as the Science of Reading suggest would be an effective instructional activity for this context AND how do I know if it's working with my student(s)?



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What is the Science of Reading?

The Definition

The **science of reading** is a vast, interdisciplinary body of *scientifically-based** research about reading and issues related to reading and writing.

This research has been conducted over the last five decades across the world, and it is derived from thousands of studies conducted in multiple languages. The science of reading has culminated in a preponderance of evidence to inform how proficient reading and writing develop; why some have difficulty; and how we can most effectively assess and teach and, therefore, improve student outcomes through prevention of and intervention for reading difficulties.

* See the chart on page 11 for a better understanding of what is meant by scientifically-based research



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Science in Practice

1. Become knowledgeable of existing research.
2. Use reason to make evidence-aligned decisions.
3. Engage in a problem-solving model and analyze your outcomes on a regular basis.



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The Educator's Science of Reading Toolbox: Instructional Approaches That Align With the Science of Reading

by Maria Murray

We all know that the science of reading, a large body of scientific research from multiple disciplines, has reached consensus on many issues regarding reading. Much of what we know about how the brain processes print and the sounds of our language, why the brain has difficulty doing so sometimes, and the kinds of assessment and instruction that are beneficial to most readers, has provided us with knowledge that we can use to improve children's reading outcomes.

Many educators who have been learning about the findings from the science of reading are eager to transform their instructional practices and implement them as soon as possible. But where do we look for the best scientifically based instructional practices? In some instances, we can look to educators and publishers who have developed intervention materials based on the tools that scientific researchers used in their studies. For example, in order to study how to best develop children's phonological awareness, scientific researchers needed to develop an activity to impart or study phonological awareness. Not only did they have to make decisions on things like how long lessons should be in terms of minutes per day and weeks per year, or whether the outcomes would be better if taught one-on-one or in small or whole groups, they had to create a tool. Many decided to illustrate how our spoken words break down into smaller phonological segments using manipulatives (e.g., Say-It-And-Move-It boards and/or Elkonin type boxes) whereby children move a disc or tile for each phoneme they perceive in a spoken word (see, for example, Ball & Blachman, 1991; Blachman et al., 1994). This allowed the researchers to actually see if the child participants were understanding the task. They often used these same tools as assessments at the end of their studies to learn if there were differences between the children who received their intervention and the students who did not receive the intervention.

As another example, to understand how children best learn phoneme awareness, let-

We can look to educators and publishers who have developed intervention materials based on the tools that scientific researchers used in their studies.

ter-sound knowledge, decoding skills, and word recognition, many scientific researchers have elected to teach children by having them manipulate graphemes (see, for example, McCandless, Beck, Sandak, & Perfetti, 2003). A grapheme is a smallest unit of a writing system (graph = writing, eme = smallest). A grapheme is the printed counterpart to a phoneme. For the phoneme /l/, the grapheme on a small card or chip could be either *for* *ph*, and for the phoneme /E/, the grapheme could be *e*, *ee*, *ey*, *ie*, etc. A tool for manipulating graphemes that researchers have used with some variation is a soundboard. The value of this tool is that it draws students' attention to letter-sound relationships and how those letter sounds work together in our language system. It allows students to build words using grapheme cards. Creative educators have developed modifications, such as using a metal cookie sheet and magnetic letters, a magnetic chaining board, or a simple, homemade pocket chart with cardboard grapheme cards to reach the same scientifically-based goal. The goal is what matters: children who have better alphabetic decoding do better on measures of word reading, fluency, and comprehension. A

A great research tool... Google Scholar

The screenshot shows a Google Scholar search result. The search bar contains the text "McCandliss 2003 focusing attention on decoding". The search results are displayed under the heading "Articles". The first result is titled "Focusing attention on decoding for children with poor reading skills: Design and preliminary tests of the word building intervention" by B. McCandliss, IL Beck, R Sandak, et al., published in 2003 by Taylor & Francis. The abstract text is partially visible, mentioning "This study examined the reading skills of children who have deficient decoding skills in the years following the first grade and traced their progress across 20 sessions of a decoding skills intervention called Word Building. Initially, the children demonstrated deficits in decoding, reading comprehension, and phonemic awareness skills. Further examination of decoding attempts revealed a pattern of accurate decoding of the first grapheme in a word, followed by relatively worse performance on subsequent vowels and consonants ...". The search result includes a star icon, the text "Save 59 Cite Cited by 297 Related articles All 12 versions", and a link to "[PDF] researchgate.net". On the left side, there are filters for "Any time" (with sub-options: Since 2022, Since 2021, Since 2018, Custom range...), "Sort by relevance", "Sort by date", "Any type" (with sub-option: Review articles), and checkboxes for "include patents" and "include citations". At the bottom, it says "Showing the best result for this search. See all results".



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"As professionals, teachers can become more effective and powerful by developing the skills to recognize scientifically based practice and, when the evidence is not available, use some basic research concepts to draw conclusions on their own."

(Stanovich & Stanovich, 2003)

How do we know?

“Our problem is not information; we have tons of information. What we need are quality control mechanisms.”

Stanovich offers 3 scientific criteria for evaluating knowledge claims:

1. Publication of findings in peer-reviewed journals
2. Duplication of the results by other investigators
3. A consensus within a particular research community on whether there is a critical mass of studies that point toward a particular conclusion

(Stanovich & Stanovich, 2003)



Research + Reason

“The principle of connectivity means that the teacher now has another question to ask: “OK, there is no direct evidence for this method, but how is the theory behind it (the causal model of the effects it has) connected to the research consensus in the literature surrounding this curriculum area?”

“Even in the absence of direct empirical evidence on a particular method or technique, there could be a theoretical link to the consensus in the existing literature that would support the method.”

(Stanovich & Stanovich, 2003)



What is Word Chaining?

84 McCANDLISS ET AL.

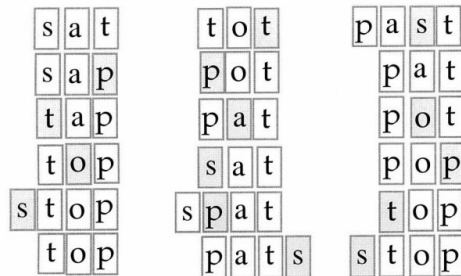


FIGURE 1 Illustration of the progression of word transformations in the word decoding activity of the Word Building intervention. After creating an initial word from letter cards, children are given instructions to change a particular letter card (e.g., take away *t* and put *p* in its place) and then to read the newly formed word. The new grapheme card in each trial is highlighted in gray to illustrate how each word transformation focuses a child's attention on different positions in the word form by holding constant the other letters from the previous word.

(McCandliss, et al., 2003)



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How does Word Chaining support Reading Acquisition?

"By continually providing children with an opportunity to form and decode a word by manipulating a single grapheme within the previously decoded word, this intervention might scaffold the process of successfully attending to and decoding each grapheme position within a word, especially those positions the child might habitually neglect, such as the medial and final positions."

(McCandliss, et al. 2003)

"The goal is what matters: children who have better alphabetic decoding do better on measures of word reading, fluency, and comprehension. A soundboard, sometimes referred to as a chaining board or word building mat, is a concrete instructional tool that educators can use to help children reach this goal."

(Murray, 2021)



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McCandliss, et al.(2003) Intervention Components

77 lessons (each incorporating more difficult grapheme-phoneme units and word forms), each included:

- A set of 5 to 16 letter cards
- explicit instructions on how to form a chain of words that differed by a single letter transformation
- A set of flashcards of each word formed in the lesson
- A set of sentences consisting mostly of words formed in the lessons
- Progress monitoring completed every 3-5 lessons
- After word chaining sequence, tutor administered a brief flashcard assessment to determine whether child could read at least 80% of the lesson words correctly. If criterion not met, more activities were carried out with the same words. Children progressed through the materials at their own pace. Could skip a lesson with a unit pretest (flashcards of words from lessons) of 90% accuracy.



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McCandliss, et al.(2003) Intervention Results

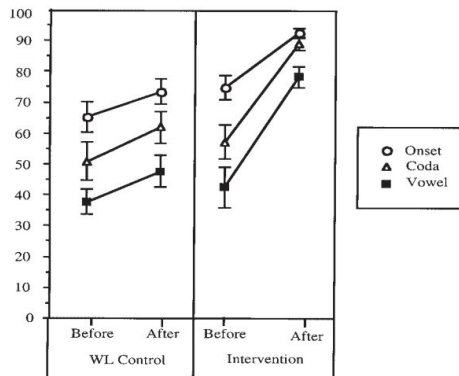


FIGURE 2 Mean accuracy (with standard error bars) for the Pseudoword Reading Task before and after the intervention, as a function of region within each pseudoword (Onset, Vowel, Coda).



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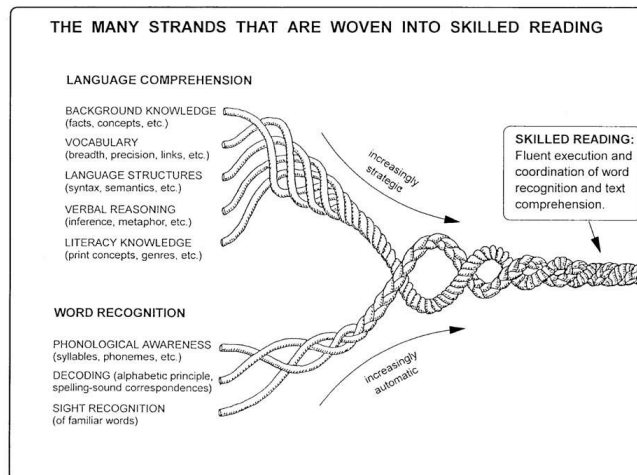
Word Chaining Video - UFLI



Word Chains
for Encoding &
Decoding Practice



How does Word Chaining align to Science of Reading Frameworks?



Scarborough's Reading Rope (2001)



Does Word Chaining align to the elements of effective intervention?

1. Explicit Instruction
 - a. I do, We do, You do; Systematic Scaffolding; Quick Pace
2. Appropriate Level of Challenge
 - a. "Goldilocks Rule" = Just Right
3. High Opportunity to Respond
 - a. "Increased OtR was the aspect of intervention most directly related to positive outcomes"
4. Correctly Targeted Based on Student Skill
 - a. Acquisition, Fluency Building, or Generalization
5. Frequent, Immediate, Accurate Feedback
 - a. "Where incomplete learning trials are prevalent, learning suffers"

(Burns, VanDerHeyden, Zaslofsky, 2014).



What reading skills can be strengthened with this activity?

- Concepts about print
- Phonics
- Letter naming automaticity
- Letter sound automaticity
- Segmenting phonemes
- Blending phonemes
- Manipulating phonemes
- Orthographic mapping
- Decoding
- Encoding
- Spelling
- Vocabulary
- Comprehension!!



What Makes a Good Word Chain?

- Changes only one phoneme at a time
- Uses only one pronunciation of a grapheme
- Targeted level of difficulty (reinforces new learning or previews what they will encounter in texts)
- Utilizes consistent instructional routines
- Builds both encoding and decoding skills
- Immediate, corrective feedback



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How do you know your students are benefiting from this activity?

Monitor their Progress!

Informal

- Accuracy tally marks on word chaining tasks or reading the whole words

Formal

- Validated tools for progress monitoring (i.e. curriculum-based assessments)
 - Letter sound fluency, nonsense word fluency, and/or oral reading fluency probes



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Ideas to Tailor Your Word Chains

- Considerations for multi-language learners or students with language delays: Define the words you are building, have pictures available to confirm meaning, use the words in context, give examples of synonyms, make connections to home language when possible.
- Reinforce learning by reading the words as whole words, in sentences, transcribing them, pointing them out in books, etc.
- How could this be utilized in a whole group setting? Small group setting? Individual intervention?
- Virtual blending board from UFLI adapts this activity to be used as a remote instructional activity or in a whole group setting



Ideas to Tailor Your Word Chains

- Move from simple to more complex.
 - Beginning → Final → Medial Sounds
 - Start with a few known consonants/vowels in a CVC pattern and move to more complex graphemes and syllable types
- Try this activity with morphemes with older students
- Color code consonants and vowels
- Add transcription element by using dry erase boards + markers
- Use what you have! (i.e. pocket charts + index cards, magnetic letters + cookie sheet, post it notes, banagram or scrabble tiles, etc.)



Science and Practice

“Scientific studies of reading development provide us with underlying principles, and sometimes the experiments conducted by scientists to implement these principles provide us with tools we can use in our instruction. Other times, it is the savvy practitioners and publisher who create instructional tools so that the improved outcomes generated within the body of the science of reading can be replicated in classrooms. **Science and practice - - working together - - make for a winning team.**”

(Murray, 2021)



Group by The Reading League

The Reading League Cafe: Coffee and Tea with TRL Journal and Me!

Private group · 2.4K members



Joined + Invite

About Discussion Guides Featured Rooms Topics Members Events Media Files Questions



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- [Stanovich, P. J. \(2003\). *Using research and reason in education: How teachers can use scientifically based research to make curricular & instructional decisions*. Partnership for Reading \(Project\), National Institute for Literacy, US Department of Education.](#)
- [University of Florida Literacy Institute \[https://www.youtube.com/channel/UCxzUU3RmTSIw4YlpFWTg\]. \(2021, February 14\). *Word Chains for Decoding and Encoding* \[Video\]. YouTube. <https://www.youtube.com/watch?v=IjHQEc0YEck&t=507s>](https://www.youtube.com/channel/UCxzUU3RmTSIw4YlpFWTg)



Additional Resources on Selecting Evidence-Aligned Practices

[The Reading League Journal](#)

[Science of Reading: The Defining Guide](#) (The Reading League, 2022)

[Using Research & Reason in Education](#) (Stanovich, 2003)

[Understanding Statistics and Research: Even if You Really, Really Hate Math](#) (Dykstra, 2018)

[Google Scholar](#)



Additional Resources on Word Chaining

[Kastner Literacy Collection Wakelet](#) by Erin Eighmy

[UFLI Virtual Blending Board](#)

[Sample Word Lists](#) by Dyslexic Logic

[Printable Letter Tiles](#)

[The Switch It Game](#) Video by Marnie Ginsberg

