

Orthographic Mapping

By Dr. Katie Pace Miles

Introduction

A teacher recently asked me, “What is the one thing you want reading teachers to understand?” Without flinching, I said, “The Theory of Orthographic Mapping!” She looked back at me a bit confused because, as a veteran literacy specialist, she had never heard of this concept. That is completely understandable considering this theory was developed by a renowned educational psychologist, Dr. Linnea Ehri, and for decades knowledge of this theory and the empirical research that supports it lived in academic journals of psychology (educational psychology, neuropsychology, cognitive psychology) instead of in academic journals of education.

Since completing my doctoral fellowship with Dr. Ehri, I have dedicated my career to ensuring that teachers understand this theory and that curricula use the theory as a north star to ensure students receive effective word-reading and spelling instruction to lift them off into proficient reading. With the shift in literacy instruction toward evidence-based practices, it is heartening to see knowledge of the theory of orthographic mapping being used as a guiding principle in curriculum design and professional development trainings for educators. The purpose of this document is to extend readers’ basic knowledge of the concept.

Adult Proficient Readers

Have you ever considered how many words you are able to read automatically — meaning you don’t put any effort into saying them when you see them? Mather and Jaffee (2021) explain that the average skilled reader has a “database” of between 30,000 and 70,000 words that they can read instantly and effortlessly. This

database enables you to read everything you come in contact with over the course of a day (street signs, emails, a novel) without causing too much mental strain.

It's only when we come upon a word we haven't seen before that we have to figure out a way to deal with the unfamiliar word. Take, for example, these two low-frequency real words:

Nudiustertian

Sesquipedalian

Try to read them aloud. If you have a willing adult near you, ask them to read the word too. Again, these are real words, but it is likely that very few, if any, of us have ever heard these words or seen them in print. When you or the other adult tried to read them, what did you notice?

It is typical for proficient adult readers to fall back on their decoding skills to try to read these words. With little cognitive awareness, you likely tried to break the word into manageable syllables, each with one vowel sound. Then you probably applied your grapheme-phoneme (letter-sound) knowledge. It would have been reasonable to segment the words into Nud-i-us-ter-tian and Ses-qui-ped-al-ian...or some close approximation of those segmentations.

- **Nudiustertian** / noo-dee-uhs-TUR-shuhn / the day before yesterday
- **Sesquipedalian** / seh-skwuh-puh-DAY-lee-uhn / a long word or a person who uses long words or is long-winded

While you may never see these words again, if you were exposed to them a few more times, decoded them, spelled them, learned the meaning, and used them in sentences, you would be able to store them in memory and likely retrieve them effortlessly. This, in its most practical sense, is the theory of orthographic mapping.

Defining the Theory of Orthographic Mapping

Let's start by making sure we all understand the definition of the words that comprise the theory, starting with *orthographic*. The morpheme *orth* means "right" or "correct," such as in the words *orthodontics*, *orthopedics*, *orthodox*. The morpheme *graphy* means "drawn" or "written," such as in the words *biography* and *epigraph*. Put together, the word *orthography* means the conventional spelling system of a language. For reading, the spelling system is converted into pronunciations so the spelling holds the letter-sound relationships for each word.



Now let's add the word *mapping*. As it pertains to *orthography*, the word *mapping* refers to the connections made between the spelling (or orthographic representation) of the word, the pronunciation of the letter combinations in the word, and the meaning of the word or how the word is used in the English language. In simpler terms, the theory of orthographic mapping refers to the cognitive process of storing the spelling, pronunciation, and meaning of a word in memory (Ehri, 1992, 1998, 2005, 2014, 2020). As I mentioned, this theory was established by Dr. Linnea Ehri, and it has been substantiated by hundreds of research articles. In fact, it is the most well-supported theory of how words are stored in memory.

Understanding the Theory

To better understand this concept, we need to understand how we read words. Ehri recognizes that words can be read in four ways. Starting from the least reliable, Ehri acknowledges that words can be read by prediction (Ehri 1992, 1998, 2005, 2014, 2020; Miles & Ehri, 2019). Emergent readers are able to use partial letter-sound knowledge combined with context clues to guess at words. Now, to be clear, this is NOT a reliable way to read words, but it is possible. A slightly more reliable way to read words is by analogy. Emergent readers can use parts of words they know to read words they don't know. For example, they can use *-ottle* part of *bottle* to help them read *throttle*.

Using prediction and using analogy both have their limits. They will quickly falter as the expectation to read more words accurately increases. A reliable way to read words is to apply decoding skills, or your ability to segment the grapheme-phoneme relations in a word and blend them back together to read the word (Ehri 1992, 1998, 2005, 2014, 2020; Miles & Ehri, 2019). Emergent readers apply this knowledge to grapheme-phoneme relationships (c-a-t, b-a-g-s, ch-i-p, wh-a-le, s-ea-t). Eventually, as word reading skills improve, decoding progresses from grapheme-phoneme relationships to syllable and morpheme units that enable more efficient reading of longer words.

Finally, the most reliable way to read words is from memory by sight (Ehri 1992, 1998, 2005, 2014, 2020; Miles & Ehri, 2019). To be clear, this does not mean memorizing words as whole units. The ability to read words from memory by sight occurs after you have encountered the word, possibly several times, and decoded it or did some sort of analysis to store the grapheme-phoneme relationships in the word into long-term memory. This means that to read a word by sight, the word must be familiar. In contrast, when students encounter unfamiliar words, they apply the previously mentioned approaches: prediction, analogy, and/or decoding.



If the most reliable way to read a word is from memory by sight, and this requires storage of the grapheme-phoneme relationships in the word, which of the approaches for unfamiliar words should be prioritized?

You got it—decoding! Through the process of decoding the parts of the word over time, the word will eventually be stored in long-term memory for automatic retrieval when the student sees the word. Importantly, all words, when practiced, become read from memory by sight (Ehri 1992, 1998, 2005, 2014, 2020; Miles & Ehri, 2019).

Thus far, it's clear that an important connection must be made between the spelling (graphemes) and pronunciation (phonemes) to store a word in memory. However, there is one more feature of the word that helps strengthen and clarify the storage of the word: the meaning of the word, and more specifically, either the word's semantic meaning and/or its syntactic use. Taken together, orthographic mapping is the cognitive process of forming grapheme-phoneme connections to bond spellings (graphemes), pronunciations (phonemes), and meanings of specific words (Ehri, 2014). The process enables words to be securely stored in long-term memory so they can be automatically retrieved by sight.

The Glue

This cognitive process is set in motion when we see a printed form of a word, connect what we know about the letter-sound units in the word, and then read the word and identify it from our vocabulary. If what we pronounce doesn't form a real word or a word that we know, we try variations of some of the sounds in an effort to pronounce a recognizable word. This is where the theory of set for variability comes in and why having an extensive oral language vocabulary is critical for reading development.

The relationship between the spelling and pronunciation of a word is so integral to the process of storing the word in memory that Ehri refers to this connection as the "glue" (Ehri 1998, 2005, 2014, 2020). This glue is specific to the composition of each word (r-ai-n vs. r-eig-n). To attach the word's meaning to the spelling-pronunciation glue, semantic associative learning occurs because you need to associate words with other words. When all of this occurs, the within-word spelling to pronunciation connection and the associative learning connection to meaning, an amalgam, or a representation of the word, is formed. Over time, the amalgam is clarified, strengthened, and stored in long-term memory for automatic retrieval when you see the word. It is worth noting, however, that even when you automatically say the word when you see it, this cognitive process is working behind the scenes.



When and How Does this Happen?

Just as Ehri acknowledges that there are multiple ways to read words, she also explains there are multiple ways that the cognitive process of orthographic mapping is facilitated. As previously explained, it happens when a reader decodes a word. It can also happen when a student studies the grapheme-phoneme relations in the spellings of words— either during a word analysis or spelling activity. In addition, the cognitive process of orthographic mapping can also be activated even when students simply look at a word and hear the way it's pronounced (Ehri, 2022).

Importantly, students need to have specific literacy skills in order for the cognitive process of orthographic mapping to be activated (Ehri 1998, 2005, 2014, 2020; Miles & Ehri, 2019). First, Ehri explains that students must have phoneme segmentation skills, or the ability to segment words into their individual sounds. Students must then have knowledge of grapheme-phoneme correspondence, or knowledge of the letter-sound units of the writing system. However, it's not just having phoneme segmentation and letter-sound knowledge that enables students to read and spell words. It's opportunities to practice connecting letters to sounds and blending those sounds together within a specific word that enables that word to be stored in long-term memory. Over multiple exposures seeing, saying, spelling, and using a word, emergent readers analyze a word's spelling to pronunciation connection, or the “glue” between the spelling and pronunciation, to get that word into long-term memory (Ehri 1998, 2005, 2014, 2020; Miles & Ehri, 2019). Even when a word has an irregular spelling, there are reliable letter-sound connections that should be used as the anchor to help securely store the word. Finally, students need to know the meaning of the word (semantics) or how to use the word (syntax) to strengthen and clarify the word in long-term memory.

Conclusion

In summary, the theory of orthographic mapping is the most well-substantiated explanation of how words are stored in memory. The cognitive process of storing the glue between a word's spelling and pronunciation and further clarifying the word's identity by including the meaning of the word, enables readers to store words in long-term memory for automatic retrieval when seeing the word. For most emergent readers, this doesn't happen during one exposure to the word. Instead, it takes multiple opportunities analyzing a word's spelling, pronunciation, and meaning to get it into long-term memory. Therefore, emergent readers need strong phoneme segmentation and blending skills, complete letter-sound correspondence knowledge, and an extensive oral language vocabulary so that they are ready to effectively apply these skills when the cognitive process of orthographic mapping is activated.



References

- Ehri, L. C. (1992). Reconceptualizing the development of sight word reading and its relationship to recoding. In P. B. Gough, L. C. Ehri, R. Treiman, P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 107–143). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- Ehri, L. C. (1998). Grapheme-phoneme knowledge is essential to learning to read words in English. In J. L. Metsala, L. C. Ehri, J. L. Metsala, & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 3–40). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.
- Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading*, 9(2), 167–188.
- Ehri, L. C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading*, 18(1), 5-21.
- Ehri, L. C. (2020). The science of learning to read words: A case for systematic phonics instruction. *Reading Research Quarterly*, 55(S1). <https://doi.org/10.1002/rrq.334>
- Ehri, L. C. (2022). What teachers need to know and do to teach letter–sounds, phonemic awareness, word reading, and phonics. *The Reading Teacher*, 76, 53–61. <https://doi.org/10.1002/trtr.2095>
- Mather, N., & Jaffe, L. (2021). Orthographic knowledge is essential for reading and spelling. *The Reading League Journal*, 2(3), 15-25.
- Miles, K. P., & Ehri, L. C. (2019). Orthographic mapping facilitates sight word memory and vocabulary learning. In D. A. Kilpatrick, R. M. Joshi, & R. K. Wagner (Eds.), *Reading development and difficulties: Bridging the gap between research and practice* (pp. 63–82). Springer International Publishing. https://doi.org/10.1007/978-3-030-26550-2_4

Learn more at:

mheonline.com/scienceofliteracy

