Part 1a

Seeking a Theory that Solves the Mystery

ABSTRACT

How are readers able to read words as easily and quickly as they hear speech? The answer to this question has plagued scholars for ages. It has been "One of the great mysteries that has challenged researchers". (L. Ehri)

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Part Ia

Seeking A Theory that Solves the Mystery

Part Ia. (Seminar 1)

Reviewing the question and mystery described in the Introduction: How are readers able to read words as easily and quickly as they hear speech?

This question and mystery has plagued scholars for ages. It has been "***One of the great mysteries that has challenged researchers".*** (see **Introduction**) After the turmoil of the 1960s on the **Great Debate** on teaching reading, scientists began in earnest to search for the answer to this question, as well as the practical implications, in hopes that it would provide an improved understanding of how words are read. It would, in turn, help resolve the Great Debate about how best to approach teaching reading. Over decades, the solution does get found.

This group of seminar papers grew out of a short seminar on this question. They attempt to summarize the main features on how these inquiries took place, what the final solution to the mystery appears to be, and what it has contributed to the understanding of reading disabilities. Finally, it will examine implications for instruction that can be drawn from the solution.

Parts Ia & b mainly focuses on the work of Linnea Ehri, a leading researcher and prolific writer on the subject and how her theory eventually did lead, as far as it goes, to the greater part of the explanation of how words are read**.** For the final solution, it will be necessary to turn to theories of speech and brain imaging studies. Ehri's theory sets the basic framework for the solution.

Her theory addresses two aspects of the mystery:

1.) How to explain word recognition, and
2.) How it applies, on a larger scale, to the vast quantity and variety of words fluently read in texts.

Solving this mystery is critically important because reading words is the point of entry to reading and provides the essential foundation of competent comprehensive reading.

As declared in the **Introduction**, reading words effortlessly is the "quintessence" of good readers. **"Perhaps the single most distinctive characteristic of skilled reading** is the sheer and effortlessness of the word identification process....The ability to instantly and effortlessly recognize the printed word is, in many ways, the quintessence: sine qua non, of reading skill." **1.** (see other quotes in the **Introduction**)

For most people, without knowing exactly how this is done, reading words seem very natural. Shally Shaywitz, a neurobiological researcher on the subject, has noted,
"For good readers, gaining meaning from print quickly and effortlessly, like breathing and speaking, is a natural part of life. For these men and women, it is almost unimaginable how something that seems to come so naturally could be difficult for others." **2.** [an so complicated to understand]

Coincidently, lack of skills in reading words accounts for the wide variance of reading ability in the elementary grades. This precise point of entry to reading is where problems with learning to read first occur for those with dyslexia, the most prominent reading disability among beginning readers. "The past two decades have witnessed an explosion in our understanding of dyslexia (or specific reading disability), the most common and most carefully studied of the learning disabilities." **3.**

Perfetti states that problems at the word level create a "bottle-neck" in reading. A by-product of solving the mystery of reading words has been an improved understanding of dyslexia. **Thus, a prerequisite for understanding the hidden disability of dyslexia is knowledge of the science of reading words.**

As a result of studies by Linnea Ehri, and others, over the last 40 years, a consensus has been reached on the basic solution to the mystery. **The most elementary part of reading words that has most mystified educators has been uncovered.**

Putting a finer point on the mystery.

A sample teaching progression for beginners within an explicit, code-emphasis program (as defined by J. Chall 1967)[4], can provide an early glimpse of the mystery at the very point of entry of reading words. **This teaching progression has two parts that coincide with two distinct actions that show up at the first level of the mystery.**

1.) **The alphabetic set-up**, closer to the surface. (what Ehri calls "grapheme-phoneme connections)
2.) **The more hidden place, the actual recognition of words**. (what Ehri calls "cipher sight-word reading".)

1. The set-up

The set-up involves learning how to decode printed words into speech by matching letters to speech sounds in words through the alphabetic principle. In order to teach this set-up to kindergarten children within a code-emphasis approach, lead-up skills of phonemic awareness and letter/sound correspondences of a select number of letters are taught. From these skills, teaching decoding begins. It can begin as early as a month in the school year if preceded by effective teaching of the lead-up skills. They make beginning decoding of words teachable in kindergarten if they include a critical phonemic awareness instructional piece that teaches continuous slow blending of spoken words, followed by fast blending of the phonemes into words.

The advantage of this kind of phonemic awareness training is that the connected, stretched-out sounds, without pauses, helps make individual phonemes more noticeable to the ear. The momentary holding of each sound in memory, assists short-term memory, so that the word can be quickly **blended** back into a full spoken word. This lead-up practice is then easily applied to decoding by stretching out sounds for letters to also be blended back into a full spoken word. This amounts to a slow, out-loud rehearsal of the blending of letter sounds, without pauses. (see Engelmann, 1969)[5]. (**segmenting phonemes with pauses** is saved for teaching spelling, after beginning decoding has been well introduced.)

This whole procedure enables the learning of an accumulation of approximately 400 decodable words in the yearly program. The words are gradually introduced in coordination with the systematic introduction of a total of 41 letter/ sound matches.
(techniques well recognized by scholars. See M. Adams. Beginning To Read, 1990, p. 254)[6].

2. The hidden place of recognizing words.

The set-up part can be easily observed and affirmed. The mystery is briefly evident in decoding when the word is instantly recognized, almost simultaneously. This occurs only if the printed word is a part of the reader's internal oral vocabulary. The mystery becomes further evident when words become recognized without this slow, analytic decoding. This level of reading can develop spontaneously, or it can be explicitly taught through transitional activities, transitioning decoding to instant reading.

The explicitly taught, **short transitional activities, with less and less teacher cueing, will begin to be inserted** into lessons before the mid-point of the year. In this transition, the out-loud decoding is gradually transferred to a directed silent thinking of the sounding-out of words. This then gradually becomes reduced to a shorter "think time" in which the learner is encouraged to think-through the steps. This "think-time" is gradually shortened to almost instant reading of words in a story, at a rate of about 40 words per minute.

By the last quarter of the year, the out-loud decoding has disappeared in reading stories. All kindergarten children, at this point in this progression, have made the final shift **to pronouncing all words in stories, mysteriously, "the fast way", with less and less think-times. This is the first real sign, or view, of the mystery of reading words in beginning readers.** This hidden word recognition continues to be applied to more complicated words and

texts and the pace quickens in each year of instruction. So, the mystery is: what is happening at this point of "recognizing" words? It begins to be seen at this early stage of learning to read.

The Revelation of the two aspects of the mystery

Observing these instructional steps gives a glimpse of what Ehri considers to be the two aspects of the mystery at the first level, **the set-up and the actual recognition**. The question is: what happens when "think-time" is reduced to a point of disappearing? What happens to the decoding strategy that was so carefully taught? **The shift to reading words without analytic decoding, with less and less think-time, is where the hidden mystery begins to take place.**

What happens to decoding?

This point of entry into reading implies some kind of action, by the young reader, beyond what can be observed by the naked eye or ear. **Somewhere between when a word is first seen in print and when it is instantly read,** there exists, at the very epicenter, a **hidden action that is fast and getting faster**. At this point, within a carefully planned systematic teaching progression of words that have been first taught through various out-loud decoding strategies, followed with a transition time of both out-loud and silent think-time of reading words, reading words becomes starkly different. Words are read almost instantly, **as if** by instant recall, as if all words are sight words. From here on, the mystery is very evident. It first shows, as a result of decoding, where words are **first recognized,** and then this reading **begins to shift** from sounding-out decoding to a think-time transition, finally to **hidden instant real word reading**. (called "cipher sight-word reading" by Ehri)

Given this teaching progression, it doesn't seem possible that the new reader **discontinues to use** what has been taught for decoding and then resorts back to using a whole visual word-recall from memory. It's also unreasonable to think that 400 words and more, more than a 1000 per year, are memorized. Yet, any signs of decoding letters seem to disappear. If so, why teach decoding in the first place? **The question is: What exactly are the young readers doing at this critical point of learning when they first start to really read words much faster?** It is almost magical.

With other, less explicit approaches to beginning reading, this change to quick reading, as defined by Ehri, is less clear. When beginning readers are taught their first words through whole-word memory, it is hard to determine, when and how they begin to automatically fully use the alphabetic code i.e. phonics. After this kind of teaching, which is predominantly visual word reading, with perhaps some assistance from contextual and partial phonetic clues, a dominant visual memory of words seems a reasonable explanation. On the other hand, evidence indicates that even these readers begin to use the full alphabetic principle regardless of how they were taught.

Viewing early reading from the perspective of a prior experience of detailed, step-by-step, slow-motion decoding practice, such as described above, makes the entry point of reading look less like total memory, yet, still mysterious. What part does decoding play when it seems to be no longer in use? Teaching alphabetic decoding may help in learning detailed features of printed words for accurate visual memory of whole words, but is this sustainable for the vast amount of words found in texts, even in early grades? Does the alphabet take on a hidden role at this point? If this instant reading is not a result of memorization or decoding, what else can it be?

The above sample focuses mainly on **the first level of the mystery, at the word level.** Words, learned from this progression, are then accumulated and used in stories at the **second, more advance level**. **By the end of the second year on instruction**, after learning more advanced decoding skills for slightly more complex words, **new readers** can read passages at the rate of 60-80 words a minute at 98% accuracy, composed with the most common spelling patterns

(from approximately 55 letter/sound correspondences that accounts for about 80% of all words in print) and an assortment of words with more complicated spellings. Within this approach, moving to this level involves a careful sequence of words that are varied in spelling, frequency and length. In this second year, a reading vocabulary can be accumulated to as much as 1700 words. This number continues to grow in leaps and bounds at the rate of 2-3,000 words per grade level to as much as 80,000 words, according to some estimates. (see Kilpatrick, 2019, p. 188)[7].

To summarize the questions surrounding the mystery,

1. What exactly happens at the beginning levels, at t**he hidden center** of reading words, first seen with kindergarteners, where the mysterious action can begin to be observed, when sounding-out of words changes to reading the "fast way", without observable decoding? At this point, **teachers witness something miraculous** when a child moves into an unknown aspect of reading words. How is it done at this level? What skills and knowledge enable them to begin to read words so quickly?

2. And, how is this type of reading further applied and expanded to a large volume of words, many of which have varied English spellings and yet are quickly learned, with even less instruction? The reading vocabulary can accumulate from lesson to lesson in kindergarten to include just under 400 words, containing 40 letter/sound correspondences as well as the proficiency of reading 40 words per minute. In a carefully planned explicit program, this continues to carefully grow in volume and in complexity, through carefully planned lessons, during each following year, thousands of words each year. *"For typically developing readers from second grade on, only one to four exposures are needed before a newly encountered word becomes permanently stored for later effortless retrieval."* (Kilpatrick, 2019, p. 187)[8].

How effortless reading is performed, in or out of text, is the mystery.

In order to unravel this mystery, scientists have first had to find ways of looking inside the hidden center of reading words, where the set-up or first part of the explanation lies. This was followed up with an attempted deeper look at recognition. As a result of this work, as a by-product, new information was also found that improve the understanding of what can go wrong and why some approaches of teaching are better than others.

Unraveling the mystery came from three ways of looking into and experimenting on reading words:

1.) **behavioral experimental studies**, designed to uncover the internal reading behavior to the naked eye. They attempt to focus on the connections between print and speech and memory. (described here in Part I,a and b)
2.) **neurological studies**, designed to look even deeper on how the brain reacts to various printed stimuli related to word reading that will further uncover the process. (described in Part II)
3.) **computer generated simulations** of reading that also seeks to reveal the human cognitive process of reading words. (inserted throughout Part I and II)

Some Background Knowledge on Theoretical Models of Reading.

Modern attempts to unravel this mystery have been on-going, in earnest, at an increased rate, over the last four decades. Some scientists claim that …"Scientific knowledge and technology double every one-to-two decades, depending on the discipline in which information is measured." E.O. Willson, **The Social Conquest of Earth, (**2012).[9].

This has happened in reading research. Resolving this mystery of the ages has been perhaps the most heavily researched subject in all of education. Cognitive psychologists have made advances in the search for full explanatory models of the entire process of reading, as well as on the narrower aspect of reading at the word level. This progress was reported on, up to the point of the 1984 publication of the first Volume of the Handbook of Reading Research, by Jay Samuels and Michael Kamil, "Reading research is just a little more than 100 years old. … Serious attempts at building **explicit models**- models that describe the **entire process**…- have a history of little more than 30 years." [10].

[To illustrate how large the study of word recognition was by this time, Gough's chapter included 7 pages of references, and he cites a book, published in 1982 by Henderson, entitled, *Orthography and word recognition in*

reading, that had even more references. It included 27 pages of references. Both Gough and Henderson give very detailed analysis and evaluations of studies of reading words, the findings of which seemed to have more value in eliminating failed ideas than establishing new ones.]

However, even by 2014, in the **Special Issue** of the new journal, **Scientific Study of Reading** (SSR), the editors still decried the lack of comprehensive "integrated theoretical reviews" within the "mass of high-quality empirical studies on reading development and disabilities". Comprehensive Models of reading are not easy to build. Charles Perfetti, a leading theoretician for over thirty years and a contributor to the 2014 special issue, stated, "There is no theory of reading, because reading has too many components for a single theory." "It would involve a description of 'the most intricate workings of the human mind." [11.]

A dictionary definition of a theory: a system of ideas intended to explain something, especially one based on general principles of the thing to be explained. Or a set of principles on which the practice of an activity is based.

The value of theoretical models of reading is found in the introduction to the **condensed edition** of Marilyn Adam's 1990 book, **Beginning to Read,** written by members of the commissioning group.

"Models are representations developed by researchers **to combine findings from many studies** into a whole. Models can suggest how the **parts of a system might work together**. By developing more comprehensive models of the nature of the reading system and **the interrelations of its parts**, researchers are **helping us to understand the reading process** as a whole. Anchored in psychological research and built through laboratory studies and simulations, these models are complex. However, it is because they have been **developed with such analytic care** that **their instructional implications carry special weight**." [12.]

A useful general model of "the nature of reading" as a whole was formulated in the 1985 commissioned report on reading, **Becoming a Nation of Readers**.

"The majority of scholars in the field now agree on the nature of reading. **Reading is** the process of constructing meaning from written texts. It is **a complex skill requiring the coordination of a number of interrelated sources of information.**" [13.]

From this definition, reading is considered a result of **complicated interactions** between a "number of sources of information" that the reader draws on. **Each source** can be a focus of study that examines its contribution in and interaction with "interrelated sources" for the entire "process of constructing meaning".

Word recognition is one of the essential "sources of information" for a comprehensive model of reading. It means "identifying and understanding printed words that are known on the basis of spoken language."[14.] This informational source needs a theory of its own, which can be subsumed within a comprehensive theory of reading. In his chapter review, on this topic, in the same first volume of the **Handbook of Reading Research**, Philip Gough, one of the earliest modern theorists and scholars, described some of the complications and mysteries within the process of reading words.

"Routine as it may seem, each instance of word recognition is an amazing feat. It begins with a pattern of light and dark cast onto the retina by reflection from the printed page; for the skilled reader, it ends less than a quarter of a second later and almost always with the correct words. In this time, the reader must find the word's meaning in memory, for **only this word form** associated with meaning; he must locate a single item in a mental lexicon containing tens of thousands of entries….. **How this lexical search is accomplished remains essentially a mystery after nearly a century of research.**" P. 225 [15.]

From this perspective, Gough made the following observations, "It seems clear that to solve the problem of word recognition, we must solve the problem of letter recognition; we must develop a model of how we can recognize the underlying unity in the infinite variety of forms a letter can take. …The challenge of any working model is to show "how form is processed". P. 246

In his effort of finding a working comprehensive model, Gough put forth an even simpler model, **Simple View of Reading (SVR)**, in which reading is broadly understood as a function of two actions: 1. **decoding skills** (the ability to convert printed words to speech) and 2. **listening comprehension** (using vocabulary, background knowledge and grammar to gain meaning from speech and other experiences).

The SVR model equates reading as the product of the following skills. [16.]

Decoding	**X**	**Listening Comprehension**	**= Reading**
Converting print to speech	X	meaning experientially gained	= meaning from print

This view is based on the acknowledgement that beginning readers are already able to understand spoken language and have accumulated a body of knowledge. Once skills of word recognition are acquired, they can be applied to what is known from listening comprehension, as long as the comprehension levels of print and listening comprehension are aligned. If so, the young reader gets the comprehension part mostly for free, at least at the beginning. Word recognition, the entry access to reading, requires instruction. It does not come free.

As conceded by Gough, the basic SVR framework may be an over-simplification, but it has proved a useful framework over the last 35 years as a working model, a way of thinking about reading. Comprehension in reading can go beyond what is typically understood from listen comprehension, but it is all contingent on the coordinated growth of recognizing and comprehending sequences of words accurately and efficiently.

Linnea Ehri's Proposed Theory of Reading Words

In the early 1980's, Linnea Ehri proposed a working theory of the word recognition side of the model, **Grapheme-Phonemic Correspondence** (GPC), based on her empirical studies of observable reading behavior that demonstrated or inferred the inner workings of the mystery of reading words.[17.] She explained her focus on reading words: "I began to realize that, if I wanted to understand how children learn to read text effectively, I should study **how they learn to read words**, because this was obviously the major hurdle in gaining reading skill." [18.]

Ehri has played a leading role in studying this subject and represents the emerging group of researchers at the time. She has been a prolific writer and eventually became the primary writer of chapter 2, Alphabetics: Phonemic Awareness and Phonics, of the **National Reading Panel 2000 Report**. **However, before she could describe how children best learn to read words in the Panel's 2000 review, the mystery of how words are read had to be solved prior to this report.** Her work on this began on this aspect of reading in the late 1970s.

One of her most recent publications, appeared in the 2014 special issue of *Scientific Studies of Reading* and described her work. In this publication, her theory was re-named "Orthographic Mapping", implying that letters are maps of the underlying sound or speech structure of words, illustrated in Fig. 1, page 9. [19.] The earlier term, **Grapheme-Phonemic (letter/sound) Correspondence (GPC),** first named in her 1980s publications, is used in this writing.

Ehri's theory is seen as a "Phonological Model" for word recognition because it stresses the importance of how alphabetic print represents speech in written language at the smallest level. With some minor differences, many others have put forth models with similar scientifically founded assumptions: Charles Perfetti, "Verbal Efficiency" [20.] of the "Lexical Quality Hypothesis" (LQH); [21.] John Rack, Charles Hulme, et al, "Direct Mapping"; [22.] and David Share "Self-Teaching". [23.] Keith Stanovich uses the terms "Interactive-Compensatory". [24]

For Phillip Gough, a broad understanding of the term, "cipher reading", is used to depict an advanced kind of phonologically based reading, without know how it works or how it is attained.[25.] Ehri also uses the term, "cipher reading", with a theory about how it works. This was derived from experimental studies of reading behavior. They represent a rare consensus among researchers on how words are read. It has changed the way reading words is understood. Prior to this, reading was primarily a visual activity, not an aural phonological activity. According to Perfetti, "In the 1970's, skilled reading was seen mainly as a matter of visually recognizing a familiar letter string (in memory) as a word, whose access was said to be 'direct'." [26.] Understanding this theoretical shift helps understand how the mystery has been solved.

A more technical and detailed account of the phonological base for word reading can be found in Marilyn Adams' 1990 landmark book, **Beginning to Read**: Thinking and Learning about Print, Chapters 5-8. Her account is based on the "Connectionist Model" of James, L. McClelland, David E. Rumelhart and Mark Seidenberg who, publishing in the 1980s, used computer simulations of reading to study how words are read. [17.] In this approach, a complex analytic computer model was programmed and used. According to Adams, it was programed to "understand (how words are read) from the inside out…. (It) was anchored on psychological minutiae and built through laboratory studies as (computerized) simulations" that attempt to demonstrate how people read words. [28.] p. 93-94

In a recently published summary of this approach, "Connectionist Models of Word Reading" (2016), Seidenberg states, "Readers are experts at [this] complex, uniquely human skill, yet people's intuition about how they read are very limited. …. My theory of reading is based on connectionist models that attempt to simulate the reading process at a level that intuition does not easily penetrate. Such models serve several functions. They provide a strong test of one's theoretical assumptions. … (They) also provide a unique way of testing causal hypotheses about reading impairments and instructional practices. .. Finally, the models are beginning to converge with evidence about the brain bases of reading." [29.]

Seidenberg acknowledges, however, that… "The main drawback of these[connectionist] models is that people find them difficult to understand. The technical aspects can be intimidating; the fact that they conflict with intuitions about reading doesn't help. … Our reading models …. have led to a very different understanding of this seemingly familiar skill."

In his new book, Seidenberg attempts to describe, **in less technical language,** how his model developed, along with its applications and implications. [30.] This approach has provided another way of confirming previous research on the prevailing phonological models and has been able to fill in additional details, especially in how it applies to problematic English words and how to treat the handicapped condition of dyslexia. The claim is that programed "computational models (can) **specify the mechanisms that underlie basic reading skills**".[31.] And thus, solve the mystery.

Linna Ehri has sought to find the answers.

Ehri calls skillful instant reading, "cipher sight-word reading", a new kind of sight-word reading. On the surface, it looks like memorization, but it isn't. How does this work, and how is its workings made known? At this point in the teaching, **at the very epicenter of reading each word**, **it is almost impossible to know for sure what readers do when they read words**. What they do, between seeing the words and recognizing them, is hidden to the naked eye. But, when teaching is taught in a detailed phonetic way, it is hard to believe that they are just memorizing and leaving behind what was learned from decoding. What else can it be? How is the alphabet used in this kind of fluent reading? What's its role? Ehri's theory seeks to explain.

Ehri's Theory, Applied at the First Level of Reading Words

In an early publication, Ehri describes her theory as follows.

> "[Reading words] involves establishing systematic visual-phonological (letters and sounds) connections between the spellings of words and their pronunciations in memory. Readers use their knowledge about letter-sound relations to form these connections. … As a result, the words are accessed directly in memory from their printed forms ……, information about spellings of specific words is retained in memory and amalgamated (mixed in) with information about pronunciations and meanings. It is this amalgamation (mix) that is accessed directly when sight words are seen." [32.] (parenthesis added)

At the first level, **this theory essentially asserts that reading requires applying the alphabetic principle of how letters represent sounds in speech** through **two distinct actions**.

1. **The act of setting- up the alphabetic principle**. It is reasoned that once the match, or joining, between letters and sounds is made and learned in memory, **the sight** of particular letters, or strings of letters, that spell a word **can stimulate or gain access to and link up to particular speech sounds (phonemes)** in words stored in memory.
2. **The act of finally recognizing words**. The L/S linkage **means that many words, held in memory, or the mental dictionary, learned through speech or reading, must be somehow by-passed** in the search, find and retrieval, i.e., recognize, of the correct word **seen in print**.

These are the two actions that a reader makes in a flash in reading words at this first level: letter to sound stimulation **for access** and word **finding for recognition** in the mental dictionary.

An illustration of letter/sound bonded connections.

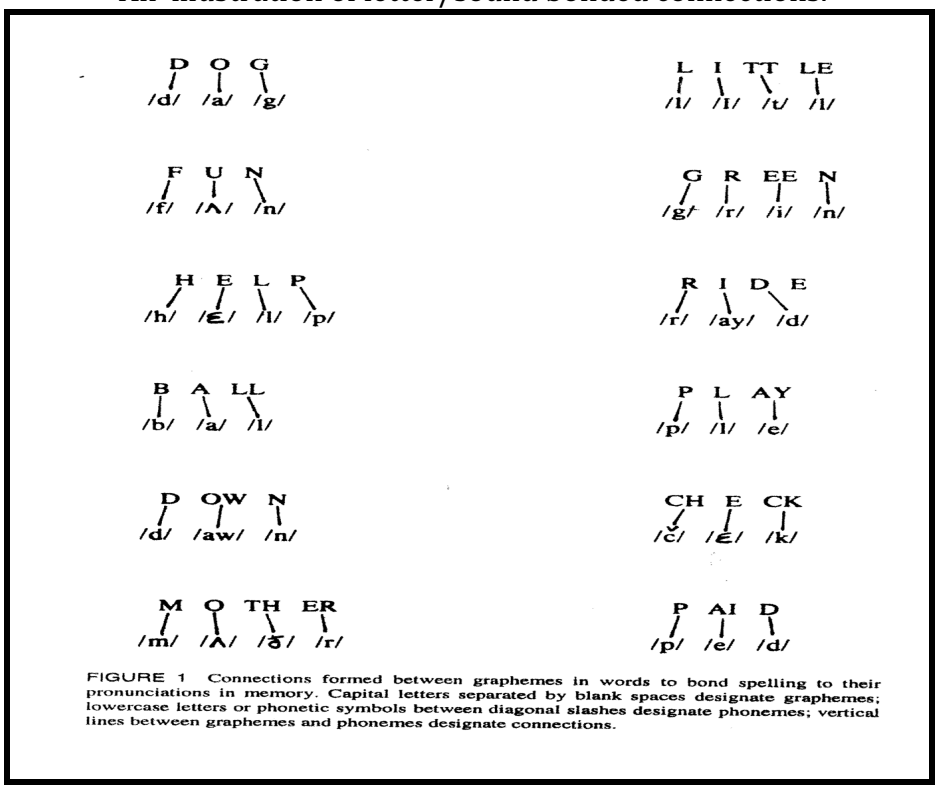

FIGURE 1 Connections formed between graphemes in words to bond spelling to their pronunciations in memory. Capital letters separated by blank spaces designate graphemes; lowercase letters or phonetic symbols between diagonal slashes designate phonemes; vertical lines between graphemes and phonemes designate connections.

Fig. 1. connections formed between graphemes in words to bond spelling to their pronunciations in in memory. [33.]

Ehri's theory asserts that reading is made possible by learning how to **bond connections between print and speech in an alphabetic writing system at the smallest units**. It focuses on how spellings (graphemes) of words and individual speech sounds (phonemes), found in their pronunciations, can be bonded in memory in order to find the printed words in memory storage. This bonding **first provides a cognitive "access route**" to **words stored in memory**. This **enables the reader to perform the second action of finding and recognizing the words, instantly, as "sight words"**. Because of the need for speed and ease to keep up to and attend to thought processes during reading, reading requires this automatic, rapid double action, **1. access and 2. recognition** for reading words.

Understanding this theory entails understanding how sight-word reading, redefined as "cipher sight-word reading", **an instant application of alphabetic knowledge**, is distinguished from both memorization and decoding of words. The bonded L/S connections are referred to as alphabetically based or grapheme-phonemic based reading of words, "cipher reading". This **is a "reconceptualization", a deeper understanding, of sight-word reading**.

For help in explaining this L/S relationship, Elri relies heavily on the early work of Isabel Liberman and W. Shankweiler, at the Haskins Laboratory, regarding the role of speech sounds, i.e., phonemes in reading words. They studied the difficulties a new learner has in becoming aware of these phonemes in speech. Their work found that increasing phonemic sensitivity and knowledge, through training, assists in **learning to read**. [34.] This work gave new phonological models of reading a start towards unraveling the solution to the mystery. It encouraged researchers to **look into the most vital, entry points of reading words, that exists at the deepest and most basic level of speech.**

In Ehri's work, the phonological studies led to the realization that letters and speech sounds **meet and bond in memory, under the controll of a "cognitive phonological module"**, the lowest of a "hierarchy of component modules", for reading. This bonding makes possible the entry into the complicated process of reading words, as well as its continuous operation. [35.] The most important contribution of this work was in establishing the importance of phonemic awareness teaching early reading. The most effective and efficient way of teaching this awareness remains uncertain, confirmed by Ehri. (see Where Research Has Failed)

From this work, Ehri formed her assertion that **the first key** to the mystery lies gaining foundational **information from the pronunciation of words** in **making the L/S connections**. As vital as the knowledge and input of letters are, in interacting with the phonological information from speech, they are usually not a source of problems in learning. They are visible and tactile. As the theory goes, if the two realms are firmly joined in place, through L/S bonding, the sight of printed letters of words spark the action of accessing the storage of words from their pronunciation in speech and previous learning of the printed form.

This bonding serves the learning of words and the repeated recognition in fluent reading. **It is the set-up for the search, finding and retrieval, or recognition of the correct spoken word in the mental lexicon** that will match the printed letter patterns of the word. The letter/sound bonding makes word recognition possible. This has been demonstrated through various experimental procedures by Ehri. (see list of studies in Addendum.)

An attempt to explain the second action

The recognition is where the deepest mystery lies and is the most difficult part to explain. Ehri accounts for the **second action** of recognition by first latching the alphabetic base onto the deeper realm of speech, "written language must penetrate and gain a foothold in the central equipment used to process speech. Graphemes must become attached to 'deep' phonemes, not simply to 'surface' sounds within words." [36.] (surface or acoustic sounds do not expose all phonemes, Part I-b.)

Ehri is less clear in her explanation about this deeper action for recognition. She tends to stop at the door of memory, without explaining. The memory bank of words is initially stored with oral vocabulary from speech, from early oral, pre-literate, learning. As a reading vocabulary is learned, it is assumed that the bank of words in storage includes a mix of both oral words, from speech, and visual images from print. The learned printed words forms become attached and latched together with the oral form at the phonemic level. Any pre-literate words remain oral in memory for speech only. Therefore, because of the grapheme-phoneme bonding, words stored in memory are either only oral, yet to be learned for reading, or a mixed memory of visual images and oral memory. The words stored in memory become one of two kinds, pre-literate oral or learned visual and oral mixed. Ehri's theory asserts that the L/S bonding allows instant entry and recognition of words in memory without accounting for how this happens.

This action is difficult to explain from experimental studies alone. If found, it would provide a more complete explanation of the mystery and understanding of the hidden piece of reading at both levels.

One take-away from this is, according to Ehri, all reading, for each word, uses hidden, innate, phonological information from speech, held in memory, **to attach** print to at the most minute, letter/sound level. The printed letters provide the access to this connection if bonded firmly to phonemes. What happens, in reading a word, once the access is made, **is a deeper mystery**. According to Ehri's theory, reading words takes two kinds of instant action, the alphabetic connection or set-up and the actual recognition of words in memory. (still needing clarity). In the process Ehri has "reconceptualized" the meaning of "sight-word reading", from a mostly visual implication, to an "alphabetic implication" or cipher sight-word meaning. This aspect of the theory is well agreed on by most researchers.

The simplicity of the theory is deceptive. However, if one digs deep into Ehri's writing, the **two actions at this level of the mystery of are evident**. **The first**, the alphabetic connections, or set-up, is the first concern. This involves **letters and speech sounds meeting and becoming joined. It occurs hidden** beneath the surface of reading words**. It's a joining action and is the key** to gaining **cognitive access into the vast storage of oral words and written word images. This is the set-up** that is necessary for the **second, deeper action**, which involves the **search and actual recognition, which is the result of finding and retrieving a particular word held in the vast memory of words, that is seen in print**.

This whole process happens for skilled readers, no matter what their intuition leads them to believe, and it happens even in spite of the method used in teaching, either directly or incidentally. One way or the other, **this foundation for reading words must be obtained** in order to be a skilled reader. **"**Studies suggest that the activation of phonological information **is a ubiquitous feature** of skilled word recognition." [37.]

As the theory goes, the bonding of the corresponding smallest units of speech and print makes *accessing and recognition of words* in memory possible, at the very epicenter of reading each word. In explaining the details of how this bonding takes place and works, Ehri's theory clearly solves the first essential action in the mystery of reading words. It describes the requirements for the set-up so that the second and final action of finding and retrieving the words can occur. The final action is left somewhat vague in Ehri's writings. It tends to be covered by the phrase, "words are activated in memory". What happens here, once the access is gained? How is action of search, find and retrieval done? **With the help of other scholars of speech, Ehri makes attempts at describing this second level of word recognition (seen below). However, how this final action takes place will ultimately require new technology that looks into the brain for confirmation, clarification and illumination.**

Two important distinctions.

Two kinds of distinctions help in understanding these two aspects of Ehri's theory at the first level. It seeks to make a distinction from two kinds of common conceptions of what reading is. It does this by stating what reading is not. It's not…

1. whole word recall memorization, even though it may look like it is, Or….
2. decoding, even though "phonological information **is a ubiquitous feature"**.

These two distinctions help explain both the access and the harder task of explaining the instant and automatic recognition. In attempting to make these distinctions clear, Ehri defines each kind of action.

1.) **decoding,** (Ehri prefers the term, phonological recoding, as seen with the first distinction.) Decoding is "determining the pronunciation of a word by analyzing the vowels and consonant combinations within the word." (this may include a variety of techniques of analysis.)
It is a way of learning or establishing the bonded relationships in memory and a way of applying this information to new or unfamiliar words in order to determine their correct pronunciation and meaning.
2.) "**sight-word reading**" in the "**visual-phonological route"**. (using L/S knowledge) Once the required letter-sound connections are learned and made firm from "decoding skills", **their connections become automatic and the word that enters the memory bank of words, is recognized in memory and is read** instantly as a **sight- word**. **Because this kind of word reading is alphabetically and phonologically based,** which can become automatic in learning and practice, often referred to as **"ciphering skills"**, it is better than memorization words. Yet it's done without any analytic thought or decisions about the alphabetic code being used. If so, then how do the L/S learnings become automatic and used in memory?

First Distinction: it's NOT memorization.

For the first distinction, with reliance on the Haskin's studies, Ehri challenged the dominant visual view of reading words at the time. Ehri argued that skilled reading is not a result of rote memory of thousands of alphabetically organized visual distinctions, without any referrence to letter relations to speech sounds. "Although memory is clearly involved, I question whether the memory process is a rote process. Rote memory is used to learn relationships that are arbitrary and unsystematic." **38.** A strictly visual process would not give the letters the significance for what they were invented. They would simply be for making fine visual distinctions between words. They work deeper than that. English words are written in alphabetic print to systematically represence the inner structure of spoken language, which innately comes systematically organized in units called phonemes (about 43).

Ehri reasons that learning words by rote would eliminate any use of the alphabetic system or reason to learn alphabetic knowledge, a principle well established by I. Liberman and associates. Volumes of research demonstrate how learning Letter/sound connections, "grapheme-phonemic knowledge", provide more reliable clues for the pronunciations. She relies heavily on the research done at the Haskin Laboratory on phonemic awareness to demonstrate this relationship.

In the diagram below, Ehri demonstrates her view of the difference between a dominant visual, plus semantic (word meaning) route and a mix of visual and phonological route of word recognition.

1.) a direct "**visual-sematic route**", **whole-word and meaning**, a memorization of words in which no use is made of the phonetic relationship of the letters to sounds, and
2.) an interactive "**visual-phonological route**" (print and speech) "paved with phonological information" from speech. **39.** (**cipher sight-word reading**, which involves the interactive bonding of letters and sounds,) .

The kind of word reading described by the GPC theory is based on connections of **letters seen in print** ("belt") **to sounds residing within the hidden oral structure of words, pronunciations, held in memory** (/b/e/l/t/). Letters can be individually, or in groups, paired with or attached to the smallest unit of sound that makes up a word stored in memory (words are stored in oral form). Learning these connections gains access to the storage of words in memory

for initial learning and continuous in fluent reading. If the letters and sounds are well bonded from **various learning experiences** (not identified), **access is instantly made, and recognition of the correct words, somehow, takes place**. These connections, **made in accordance with alphabetic knowledge**, are a result of interactions between phonological information from speech and visual information from print, as described in the initial definition of reading.

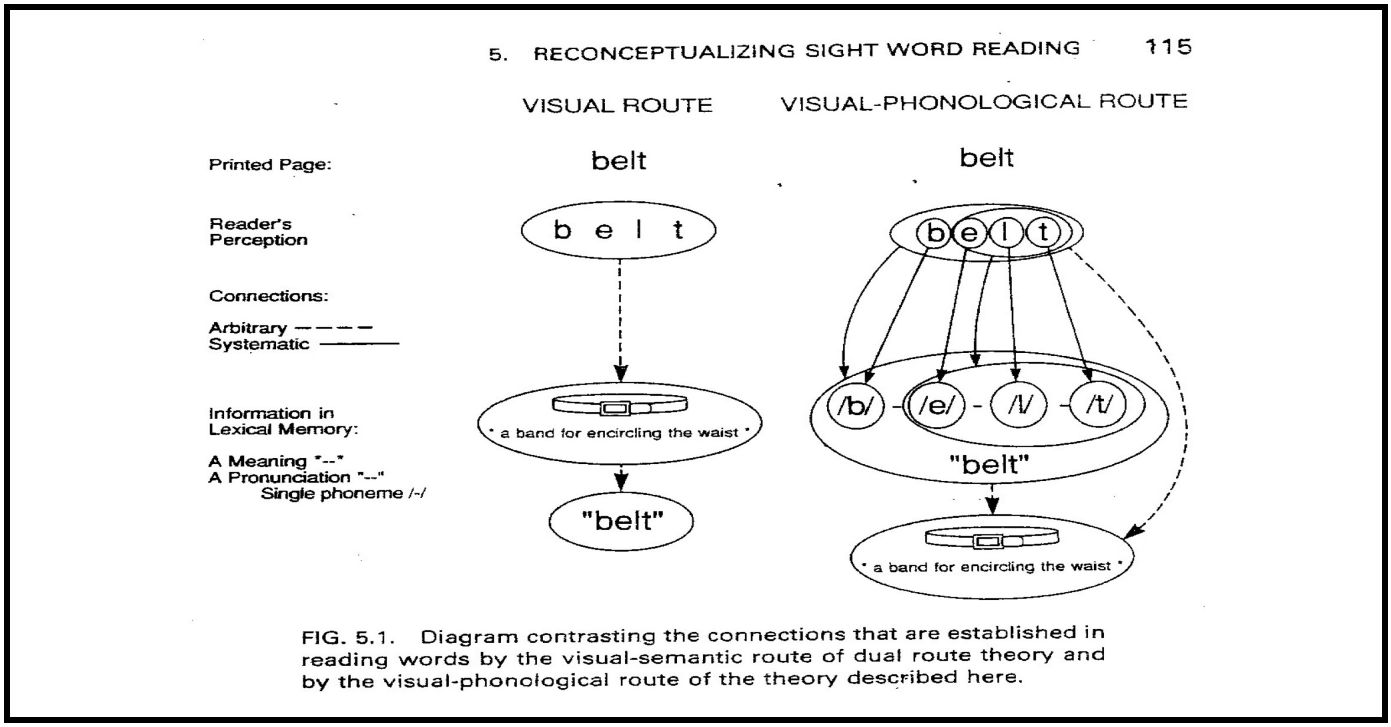

FIG. 5.1. Diagram contrasting the connections that are established in reading words by the visual-semantic route of dual route theory and by the visual-phonological route of the theory described here.

From, **Reconceptualizing the Development of Sight Word Reading and Its Relationship to Recoding.** L. Ehri. Chapter 5, Reading Acquisition, Gough, Ehri, Treiman (Eds) 1992

Ehri describes **this understanding as a "reconceptualization" of sight-word reading that is "paved with phonological information stored in lexical memory".** P. 114 [40.] This is in contrast to what is believed to be a dominantly visual process held by practicing educators for most of the history of modern education."Most educators have assumed that reading is purely visual and that phonology is something that poor readers fall back on." [41.] P. 126 Perfetti Ehri…."proposes **an alternative conception of sight word reading** that involves establishing **systematic** visual-phonological connections between the spellings (letters) of words and their pronunciation (sounds) in memory . . **..**My conception of sight word reading differs from the sight word route ….. in that the kind of **connection, enabling readers to find** specific words in memory, **is a systematic connection** between spellings (letters) and pronunciations (sounds) (decoding) rather than an arbitrary (rote) connection between spellings (letters) and meanings (no L/S connections used)." P. 108 (1992)

This kind of reading, although slower at first, enables the new reader to learn far more words, at a faster rate, than trying to memorize a large body of words. This is a strong argument for learning to read through decoding from the start to begin accumulating a large reading vocabulary added to the memory bank. (see Part III) An alphabetic writing system is not just a visual code. It is a printed **code linked to a speech code,** that can be decoded (ciphered). As Ehri prefers the term, **phonologically recoded** (recoding the printed code back into the innate speech code). In reality, there are two codes that are joined for reading, the **alphabetic printed code** and the internal **phonological code of speech, that the alphabetic written code was invented to represent**.

In any case, as an instructional implication, learning to decode printed words into their matched spoken pronunciation, which eventually extends well beyond the single letter-by-letter

sounding out in the above illustration, is the way in which the letter/sounds become bonded in the memory of readers. However this bonding is taught, the printed word must eventually be decoded well in order to read words efficiently and accurately. As will be explained below, decoding continues to work in reading, beyond the initial learning of words. So, although some theorists believe that it is strictly a tool for early learning and to be used as a back-up role for unfamiliar or difficult words, Ehri argues that it has a more pervasive role that goes beyond these functions, "…evidence suggests that "phonological recoding" skills are not a mere facilitator (for learning new words) but rather are a **prerequisite for becoming a successful reader**." They are an essential building block for learning to read beyond this level. This opens the door to part of the mystery.

Ehri calls this kind of phonetic reading "cipher reading" and gives these reasons for the extended value of decoding. "why should (letter-sound relations) drop out of processing when memory takes over? Why should arbitrary, non-phonological, visual-to-semantic (meaning) connections form the newly established route into memory? Being arbitrary, the visual cues are much harder to associate with particular words in memory in order to know how to read them. In contrast, letter-sound cues are not arbitrary. **They connect the visual form of the word directly t**o **its pronunciation in memory**, because readers know how to interpret letters as symbols for sounds." (parenthesis added) **42.** (the next few pages are based on this reference.)

Ehri continues to describe cipher sight-word reading, which includes the continued participation of decoding over visual memory. "Because letter-sounds were used initially **to recode the word**, it makes good sense that they would be **retained and would participate in the reading-memory operation**. **Setting up a visual-phonological** route **into memory** involves **forming specific connections** between visual cues seen in the word and its **pronunciation stored in memory**. The visual cues consist of a sequence of letters. The connections linking the letters to the pronunciation **are formed out of readers' knowledge of letter-sound correspondences** (**from spoken language**) and other orthographic regularities **linking print to speech**. When readers see a word they have never seen before **they phonologically recode the word**." (parenthesis added)

Some may argue that directly teaching the alphabetic code (phonics) may be the way in which a visual memory of words is learned in detail. Phonics forces the reader's attention to the spelling details and thus enabling the visual memorization. The argument is made that in an alphabetic written language, where letters matter, where attention to detailed spellings is therefore necessary, the decoding process forces attention to spelling details, otherwise glossed over by many new readers. This enables better, more detailed and accurate visual discrimination for memorization. Given the close similarities in word, is a necessary reading skill. This gives added importance to decoding, which is dropped after visual memorization is secure. **However, a phonological model** argues that, beyond these legitimate concerns, **there is more taking place than detailed visual learning**. It will be found that **the connection to speech is the key factor that links the spellings to a word in oral and written memory**.

Ehri further describes **how the connections are made** and their importance.
"**The matter of connections is a crucial one**, for this is what **determines how easy it is for readers to retrieve words in memory** from the visual forms that they see. **Connections are formed and set up in memory from prior experiences reading words**…. . Readers who have full knowledge of how the orthographic (alphabetic) system symbolizes units in speech, form many systematic connections (thousands) **linking** visual spelling units in print to (oral) pronunciations (of words) **stored in memory**. …

> **As a result of prior recoding experiences with the wo**rd, **individual letters are connected to individual phonemes within the word**. **Knowledge** of letter-sound correspondences is used **to form these connections**. Also, individual letters are connected to the whole pronunciation because each letter-phoneme (L/S) connection **occupies a position within the pronunciation**, making it an intrinsic part of the whole. Moreover, the whole spelling is connected to the whole pronunciation in that **the sequence of letters corresponds to the sequence of blended phonemes in the pronunciation.** P. 114 (parenthesis added)

How does this get to be so fast?

A Second Distinction: It's Not Decoding either.

Ehri explains the transition from the "**set-up**" part to the recognition part of cipher sight-word reading. [Learning L/S connections]…"..begins the process of **setting up a visual-phonological route**

(pathway?) for that word **leading from its spelling directly to its pronunciation in memory**. **Once such routes are set up, readers can look at spellings and *immediately retrieve* their specific pronunciations without resorting to translation rules and recoding." (this last part is yet to be fully explained: what enables the immediately retrieve of specific pronunciations?)**

The above may appear to be the full solution. Yet, so far, this explanation unravels **just the first part of the answer**. Connecting **print to speech, through the L/S bonding,** is the **set-up for reading words**. It explains **everything up to the second point or the final act of recognizing or retrieving words, that involves sorting through a vast storage in memory**. **This is where the most hidden part of the mystery lies, that accounts for this last action**. (A clear example of this lead-up for making the connections was illustrated in the teaching progression from the K program on page 2.)

This second distinction digs deeper into the process of word recognition. In spite of the importance of learning and using various decoding strategies, cipher sight-word reading is not the same as decoding words, which involves the **deliberate analysis** of the letter/sound match. Reading must be done faster than this. Reading involves instant decoding and **goes beyond decoding.** The first distinction emphasizes how decoding various letter/sound connections in **words gains access to the storage of words and brings the reader up to the point of retrieval and recognition**. It also points out the importance of learning phonological knowledge for this L/S connection in reading words, to be discussed in even further detail in Part Ib. **Making this second distinction requires a deeper look into the instant action of finding and recognizing words in memory.** The challenge here is to show how the act of decoding disappears and **transforms** to instant decoding, without the reader reverting to the visual-semantic route. This enables the reader to keep up the pace of a normal thought process.

The question here is: what enables the transformation to instant decoding and enables the speed of sorting, finding and "immediate retrieval" of the correct word once the alphabet link has broken into the storage of words? How is this done? What happens after the bonding of "The sequence of letters corresponding to the sequence of blended phonemes in the pronunciation"? **At this exact point**, there must be **something more that enables the action from there**. The learned L/S bonding makes it possible. Ehri tends to see this as a simple notion of memory. Yet, **What force enables the sorting, finding and retrieval of words so fast in the memory of words that have been previously learned?** These questions concern the **second distinction** between cipher-based sight-word reading and decoding. Cipher sight-word reading is not decoding, but it requires the knowledge gained from decoding, performed instantly. (In Part II, it will be shown that phonologically based sight-word reading uses a different part of the brain than visual memorization, providing an even sharper distinction between it and visual memory, even with the spelling details, also giving added reinforcement for the importance of learning L/S bonding.)

This second distinction between decoding words and cipher sight-reading is harder to make. The evidence is hidden. It forces a look into the hidden epicenter of words where words are read quickly and easily. Can science look deeper? How is the hidden evidence demonstrated and exposed, given the speed of a word's recognition, **once the set-up is in place**? Cipher sight-word reading, as Ehri reasons, is too fast for decoding. If deliberate decoding strategies were still being analytically worked out and used in reading, they would slow reading down, making comprehension difficult. The following is Ehri's attempt to describe this second distinction, as far as it goes. "This process differs from phonological recoding (decoding) in that **word-specific connections,** rather than translation of rules, are used to read words. As a result, the words **are accessed directly in memory** from their print forms, **rather than indirectly** from pronunciations, (sounding out and pronouncing first) and **information** about the spellings of specific words is retained in memory and **amalgamated** (mixed) with information about pronunciation and meanings. **It is this amalgam (mixture of both oral and written words in memory) that is accessed directly** when sight-words are seen." P. 108

> "The visual-phonological connections that **readers have formed for a word make that spelling a visual symbol for its pronunciation.** This means in effect that **readers "see" the pronunciation** when they look at the spelling, and **this event creates direct links** between the spelling and its meaning. " P.116

Still a little vague, hard to understand? It just happens. The difficulty, in making this second distinction, is due to the unobservable primary phonological basis of reading words, learned from decoding. If decoding is more than a device for learning visual features of words or for learning L/S bonding, but transforms in reading words, what happens to the knowledge learned? (it become automatically performed do to its connection with phonemes of speech?) It's role is to operate automatically. If cipher sight-word reading is **"paved with phonological information",** how is this information continually put to use in the final instance of the recognition of words, if not by some kind of internal decoding? **The answer is elusive and difficult to explain clearly through behavioral experiments**.

In Ehri's writings, the answer seems bound up in human speech and how it functions. Although the letter/sound connections are necessary, do the **readers somehow continue to use this learning, through their innate, inborn, capacity for speech? Does this innate capacity, or mechanism, for speech pick up the act of reading and perform for reading what it does for speech and therefor drive reading at this deeper level? How does it work?** This needs further examination and elaboration. It's unclear in Ehri's writing. For her, the concept of memory seems sufficient.

It's NOT a "two step", indirect process, either.

One possible explanation to this refined understanding of word reading is to see decoding and word recognition as two **separate** actions. This is called "Phonological Mediation". Ehri refers to this as an access that occurs "indirectly from pronunciations". This process involves, first a translation, made (via decoding/recoding) of the print to speech (pronunciation) and, second, from the pronunciation, the word is recognized **in the mental lexicon of vocabulary held in storage, after this translation has been made**. Sounds reasonable. It probably works in the learning process, but does it continue in normal reading when speed is of the essence?

Ehri and others, including Phillip Gough, a fellow scholar, have rejected this intermediary process, **as a final explanation** of how reading words works. It's too slow. It may be a necessary learning step for new readers, but must be abandend for more skilled reading. Gough came to this point of veiw as early as 1984 in his report on "Word Recognition", in Volume I of the Handbook of Reading Research, in which he examines the arguments for and against this explanation. Both he and Ehri ultimately discounted this "mediation" view for skillful reading but acknowledges its importance in learning new, unfamiliar and difficult words. [43.] For Gough, it remaind a mystery.

As early as 1985, Perfetti, clearly makes this point and ends up touching on the two major distinctions made in Ehri's analysis. He sees it as an **"obligatory speech activation."**

"I believe that in skilled reading lexical access **involves phonemic information obligatorily**. Neither 'direct access' nor 'speech recoding' quite captures this idea of **obligatory speech activation**. **It is not that letters are recoded (changed) into phonemes and then phoneme strings are used to access a word**, and it is not that a string of letters (visually) directly accesses the word.

Rather phonemic information is activated during lexical access (cognitively) as an intrinsic part of the process. This activation of speech codes (due to the cognitive access) occurs almost always because speech codes are part of the lexical representation. (see brain image research)

However, because letters and letter strings are also associated with phonemes, the opportunity for phonemic activation is doubled: activation of the phonemes by letters and activation of phonemic word shapes by words. **An interactive model extends naturally to allow such activation**." p. 150. [44.]

According to Ehri, "**phonological recoding**" (decoding) (as seen with beginning readers,) "involves applying letter-sound rules (or learnings) to transform a spelling into a blend of phonemes that is used to

enter lexical memory and locate the real word with that pronunciation. The word is not recognized until the full phonological match is achieved." i.e. set-up. P. 120,

This sounds a lot like a two-stage process, at least, for beginning readers. Transforming a spelling into a blend of phonemes is used to perform two actions, **to enter and locate**. Demonstrating how this distinction works, that does not involve a separate step, is hard to do in normal reading of words.

How is this action accounted for? Why are humans able to perform the action at the epecenter of reading words?

As a side issue, The Persistent use of Decoding can be Problematic and Informative.

It should be noted that decoding is a broad preliminary learning process of bonding letters and sounds for reading words. It can include a variety of strategies that sets up and establishes the necessary bonded links to a wide variety of words stored in memory, so that instant, automatic recognition can take place. If decoding strategies continued to be used, without progressing to the next level, they can be problematic and can interfere with the necessary speed. This slows down and weaken comprehension. Lines of thought can be disrupted by decoding, especially as words increase in difficulty.

If decoding strategies continue with particular words, without making a shift to the next level, they can indicate the incomplete learning of words. This can be a **characteristic of children poorly taught or who have more serious learning problems.** It prevents the reader from simultaneously concentrating on words and meanings in texts, a required ability for comprehension. It can also be mistaken for difficulties with learning comprehension skills.

Thus, the shift to cipher sight-word reading of particular words indicates a **complete learning of those words with firm and completed letter/sound connections**. The resulting quick and automatic connections of letters to sounds to words, with little thinking necessary for these connections, in order to keep up to the pace of "meaning making" in a text, like with speech, is required for skillful reading. Yet, it needs a clearer explanation for how it happens at the deepest, hardest to observe, level. The two-stage, intermediary process, translating print to speech and then recognizing the word, implies that a separate decision is made for word recognition. This process has been rejected because it is inefficient, and eventually doesn't happen with skilled readers. It would still slow reading. Word recognition is instant, word after word in a text.

Ehri, explains the critical difference in cipher sight-word reading. "In contrast, when words are read by a **visual-phonological sight route** the spelling itself is used **to enter** lexical memory **and locate** the word's pronunciation. (by-passing other words in storage) **No intermediate translation step is required. Connections are established** between letters in the word's spellings and phonemes in it pronunciation, **making direct access to that specific word possible."**

For Ehri, the question of recognizing words so quickly, once letter/sound connections are made, is first an **"access problem". The L/S connections make it possible to mentally unlock and "enter lexical memory and (then) locate the real word".** She asks the question and then explains:"How can readers look at a spelling and instantly find that particular word in lexical memory while ignoring thousands of other words? **Readers need an access route that is highly selective and that clearly targets one word and bypasses all others. Visual-phonological access routes do this easily**." "In English, spellings systematically symbolize pronunciations of words not meanings. Letters in spellings symbolize a **sufficient number of phonemes** to distinguish words from even their closest phonological neighbors." P.116

This appears to be an alphabetic process, like looking up a word in the dictionary. The letters and phoneme are the keys. "**The access question**", according to Perfetti, "is how a printed word comes to cause a reader's mental representation of a word (what is imagined or visually held in memory from oral or print learning) to be activated (retrieved?) and accessed (found?) by a printed stimulus." [45.] (an external alphabet that can match the internal alphabet held in memory.) This, again, seeks to explain the

economy and efficiency of an alphabetic writing system, over whole word memorization. Letters bonded to matched phonemes provides **the entrance key** to the storage of spoken words. **This makes speedy recognition possible. What accounts for the speedy entry, finding and producing the word?**

Decoding is an analytical thinking process that needs to be learned. It makes the connections. In time, this thinking **drops out**. Does this happen spontaneously or from some kind of directed instruction?

"Recoding rules may be used **to set up this sight route**. However, once the word has been **recoded several times**, the rules and the translation and phonological matching routines **drop out to be supplanted by specific connections linking the spelling directly to its pronunciation in memory**. … **spellings become amalgamated to pronunciations** and are **retained in memory as orthographic "images" of the words**, that is, visual letter-analyzed representations. …. **It is this amalgam that is accessed directly** when sight words are read and recognized by means of **visual-phonological connections**." **44.**

Ehri infers from her studies that "spellings become amalgamated to pronunciations and are retained in memory as orthographic images of the words". The dictionary definition for amalgam is: "to combine or to be combined into a more or less **uniform whole**." Thus **the amalgamation of spelling and pronunciation is retained in memory as an orthographic "image".** The full internal action seems to be that the L/S connections get stuck and continue to quickly set-up or find words. This is only part of it. It does not adequately explain the workings of the speed and retrieval of words, the final recognition**.**

Access is just an essential part of the complete action of reading words. Although the speed of entry remains somewhat mysterious, **it seems that, from an observational experimental point of view, this is as clear an explanation of the mystery that a theory like Ehri's can make of an unobserveable process.** Word recognition is observed to happen immediately after a word has been orally "recoded serveral times", or thoroughly learned through "decoding". Learning and practicing words establishes the connections between spellings and their oral form in memory. This **"enables readers to access pronunciations directly from the spellings rather than indirectly through recoding rules."** P. 120-21 The connections no longer need to be analyzed through decoding. They're firmly stuck together, **ready for fast action**. This connection part of the explanation can be demonstrated.

The final question remains: **How is the rapid access made and after it's made, how is the final retrieval or recognition so quick and easy? What force makes this happen automatically? What force performs the speedy access, search, find and recognition of the correct word so quickly and easily? This was the very first question asked in the Introduction that has now only partially been explained in Ehri's theory. The rest is only hinted at.**

Ehri repeatedly makes an attempt to identify this final action, most recently in a **February 2014 email** to SSR listserve members.

"Readers **store sight words in memory** by forming connections between the spellings of individual words and their pronunciations. **The glue that bonds them is provided by the reader's knowledge of the letter-sound mapping system, that is, knowledge of grapheme-phoneme relations**. **This glue secures letters in the spelling of that word to sounds detected in its pronunciation.** For example, four connections secure the graphemes in 'stop' to phonemes in the pronunciation, /s/-/t/-/a/-/p/." Three connections secure the graphemes in 'check' to its phonemes, /č/-/ɛ/-/k/. Connections would not be formed if the spelling 'bot' was given this pronunciation. Connections between spellings, pronunciations and meanings are stored as **amalgams** representing individual words in memory. " (emphasis added)

In summary, regarding the second distinction that instant cipher sight-word reading is not decoding. It is somehow the result of what has been learned from decoding. From the bonded letter/sound connections, learned from various decoding strategies, word recognition, at some point, *in some way*, becomes instant and automatic, too fast for decoding strategies or separate

decisions. At some point, this shift in action becomes involuntary. (Can it be taught directly, illustrated in the page 3 description of teaching the transitional shift from decoding to whole word reading?) It is part of what is referred to as the "obligatory speech activation" by Perfetti, that is initiated by the sight of letters in familiar words - somewhat **still mysterious**? **What makes it "obligatory"?**

The attempt to explain the speed of the action, after the connections have been learned, still remains somewhat unsettled. The theory thus far explains what is necessary for setting up this speed, but **what force does the letter/sound connections trigger to perform the speed**? "**Something more" seems to be at play beyond the bonding of letters and sounds. This needs to be identified more fully. Some other force seems at play that explains the second action in the theory.** For this to happen, at some point, somehow, decoding must shift to an automatic drive. How is this automatic drive accounted for?

According to Ehri, all words can and must become identified quickly and easily as "cipher sight-words" for proficient reading. [47]. **Just as little attention is given to phonemes in speech, little attention is then given to letters in reading.**

"Words have to be read with sufficient fluency to achieve the forward momentum needed to comprehend phrases, sentences, and larger blocks of text." Seidenberg. P. 164 [48].

"Being able to read words by sight automatically is the key to skilled reading of text. This allows readers to process words in text quickly, **without attention directed at the word itself**." [49].

The speed in reading words can be easily seen. **The problem is in explaining it. What human capacity explains and accounts for how it is done**? This capacity is illusive. The "set-up" and the "recognition" are almost indistinguishable. According to Ehri's theory, the phonetic connections (the set-up) **makes "cipher sight-word reading" possible,** not the memory of the visual features of words or the act of decoding. Yet, the claim is: **the amalgamation is retained in memory as an orthographic "image".** The theory states that, due to the systematic alphabetic connections, the letters **gain cognitive access** to the phonemic structure of words, stored in memory. **They are then changed instantly, lightning fast, almost involuntarily, into words,** the same way oral words are instantly recognized in hearing speech. Perfetti reports that **"phonemic effects can be observed within the first 40 ms of word identification"**. [50]. Instant cipher sight-word reading can be at a rate of five words a second or 200msec per word. [51].

As will be explored in Part Ib, Ehri points in the right direction for the explanation by referring to reading's relationship to speech as a driving force. In some way, in reading words, once the appearance of the print is made, **some capacity** with **phonemic information**-in spoken language takes over, that explains the **lightning fast recognition**. **But this needs further explanation, clarification and confirmation.**

Ehri's work was instrumental in opening the door to unraveling of the mystery, yet it leaves some ambiguity regarding the final hidden action **that produces the speed and ease** of **recognizing words** that is automatic and must be applicable on a large scale. The explanation of the hidden action, as an attachment to speech, was alluded to, but needs clarity and confirmation in explaining how automaticity of reading words works.

Coming from research on speech from the Haskin Laboratory speech researcher and theorists, Alvin Liberman, husband of Isabelle and the writing of Sally Shaywitz on brain imaging, it will be explained in Part 1b that, in the interaction between spoken and written alphabetic language, contrary to what it seems intuitively, speech is the primary force because language is primarily oral. **"Writing is not language, but merely a way of recording language by visible marks."** Seidenberg begins his analysis of the science of reading words with this sentence: "**We read with our eyes, but the starting point for reading is speech**." [52].

References, Part Ia The Search for a Theory

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EXTENSION A
In Extension A, eight samples of behavioral experiments are briefly describe to illustrate some of the experimental activities performed to expose the mysterious aspects of reading words.

1. **Does the Word Training Increase or Decrease Interference in a Stroop task**? Ehri, 1979, *Journal of Experimental Child Psychology*, 27,352-364. (it increases interference, it makes it harder to name the picture)
2. **The Mnemonic Value of Orthography Among Beginning Readers**. Linnea Ehri & Lee Wilce. *Journal of Educational Psychology, 71,*26-40 (1979) (new names for letters are learned better if briefly seen spelled correctly)
3. **Movement into reading: Is the first stage of printed word learning visual or phonetic?** Ehri, L. and Wilce (1985) (both, but the phonetic matching makes it easier to learn words and it's spontaneous at first.
4. **The Role of Phonology in Young Children Learning to Read Words: The Direct-Mapping Hypothesis.** John Rack, Charles Hulme, Margaret Snowling and Joanne Wightman**.** *Journal of Experimental Child Psychology* 57, 42-71 (1994). (a cleaner replication)
5. **Cipher versus cue reading: An Experiment in decoding acquisition.** Ehri and Wilce 1987a. *Journal of Educational Psychology*. 79, 3-13 (instruction in decoding improves beginning reading, why?)
6. **Does Learning to Spell Help Beginners Learning to Read Words**? Ehri and Wilce, 1987b Reading Research Quarterly, 18, 47-65. (yes, but only a little)
7. **Visual Patterns in Fluent Word Identification**. Lee Brook, 1977, in Toward a Psychology of Reading. A.S. Reber & D.L. Scarborough. (How well do adults learn a new alphabet vs. just memorizing the words?)
8. **Development of word identification speed in skilled and less skilled beginning readers,** Ehri and Wilce**,** *Journal of Educational Psychology 75, 3-18 (***1983)** (to demonstrate the difference between decoding reading and phonetically based sight word reading)