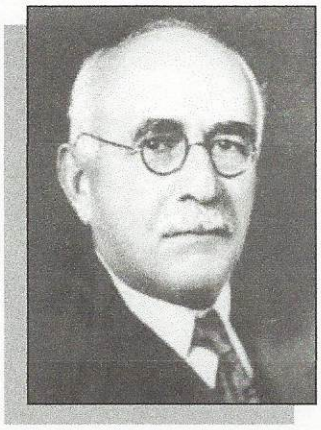
CHAPTER 3



Raymond Dodge (1871–1942): Lessons From Observations of the Eye

By Dixie D. Massey

Historical Research Process

THE FIRST QUESTIONS about Raymond Dodge for new literacy researchers and historians like me are, Who was he and what does he have to do with literacy? For me, a member of a generation raised with the Internet and easy access to tomes of material, the traditional searches yielded books about human variability, cravings for superiority, and research on the effects of alcohol. Surely I had the wrong person. So I began asking my more knowledgeable colleagues about Raymond Dodge. "Raymond who?" asked one. "Who's that?" was another response from someone who had been in the field of lit-

Shaping the Reading Field: The Impact of Early Reading Pioneers, Scientific Research, and Progressive Ideas, edited by Susan E. Israel and E. Jennifer Monaghan.
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eracy a long time. Their suggestions on how to find out more about Dodge involved getting to know and spend quantity time with the research librarian, and that is what I did. Actually, I spent time with not just one but several very talented research librarians. Their directions almost always involved actual books, rather than online resources. And the books were almost always in the dustier corners of the library—archives on the very top floor, at the back corner of the basement, and, as they described it, "Where we keep the old stuff." One helpful historian asked, "Do you speak German? These texts by Professor Dodge were written in German." Unfortunately, I do not speak German, and I did not think that I had time to learn in the short deadline I had to finish my research. The hunt only made me more curious about Raymond Dodge.

Personal and Professional Life

Born February 20, 1871, Raymond Dodge lived a life marked by wide interests in diverse fields, including reading. Dodge's invention of the tachistoscope—a device that projects an image for a given period of time—contributed to the careful study of eye movements when reading. Dodge was also interested in the processes of reading in primary and secondary languages. His questions have guided reading research for decades.

Dodge's father, George, owned a pharmacy in Woburn, Massachusetts, USA. He continued to study all his life and was awarded a Doctor of Medicine degree from Harvard University well after Raymond was born. Dodge's mother, Anna (née Pickering), was an invalid, and although Dodge is said to have favored her in looks, it was his father whom he most resembled in temperament. George Dodge has been described as "scholarly, speculative, socially minded and very religious" (Yerkes, 1942, p. 584). Raymond later described his father as "always studying something that seemed worth while" (Dodge, 1930, p. 99). George Dodge was eventually forced to retire from his pharmaceutical and medical careers due to failing health, but this did not mean that he was idle. He moved his family to West Acton, Massachusetts, USA, and began preaching in the Congregational Church.

Dodge inherited his father's interest in learning. One of Dodge's first interests was in mechanics, and he often could be found experimenting in the backyard toolshed. This interest and experience would serve him well in his development of scientific tools such as the ones he invented to measure eye

movements. Dodge also read extensively from his father's vast collection of books. In 1889 Dodge began attending Williams College, in Williamstown, Massachusetts, USA, where he supported himself through school. He spent his Thanksgiving vacation during his freshman year reading *Darwinism: An Exposition of the Theory of Natural Selection, With Some of Its Applications* (Wallace, 1891) and *A Naturalist's Voyage Round the World* (Darwin, 1889). These were not assigned readings, but as Dodge recorded in his journal, "I wanted to get a deeper insight into Darwin's theories and didn't know when I could do it if not during this vacation" (quoted in Miles, 1956, p. 65). Such interest in a wide variety of subjects and his dogged pursuit of facts marked Dodge's professional pursuits for the rest of his life, including his contributions to the field of reading perception.

Dodge was known as a serious student with a sharp mind. One of his classmates, Charles Sewall, wrote,

> In our Junior year...when we were introduced to subjects fitted to the mentality of an upper-classman, such as logic and psychology, and more particularly in the Senior year, when we were subjected to philosophy, we began to realize that Dodge had one of the best minds in the class. His questions and his answers often amazed us...I think that all of us felt, when we graduated, that Dodge was likely to outstrip any of us in the field which peculiarly attracted him, because of his philosophical bent. His career since graduation has justified that opinion. (quoted in Yerkes, 1942, p. 585)

In Dodge's senior year, he met Henrietta Cutler at the railroad station while waiting for a train to West Acton, and they talked briefly. Their discussion was obviously important enough to cause them to exchange addresses because they began seven years of correspondence. They became engaged after Dodge finished his undergraduate studies but decided not to marry before he finished his graduate studies (Miles, 1956; Yerkes, 1942).

Dodge graduated from Williams College in 1893 with a Bachelor of Arts in philosophy. After graduation, he took a job as an assistant librarian at his alma mater to earn enough money to attend graduate school. While working at the library, he wrote a thesis on conceptions of space. This thesis was sent along with his letters of application to both Harvard University and Columbia University and was rejected by both institutions. Dodge decided to pursue other avenues of education and, less than a year after his graduation from Williams College, he traveled to Germany, where he attended the

University of Halle and studied with philosopher Benno Erdmann. Dodge (1930) describes this time:

> My decision to go to the University of Halle was determined by a misfortune, a conviction, and an accident. The misfortune seems instructive. During the year of graduate study at Williams I prepared a thesis on certain differences between psychological and philosophical conceptions of space, which I presented with applications for scholarship aid at both Harvard and Columbia. It was one of the few great disappointments of my life when I was refused at both institutions. That experience may be the background of my distrust of predictive tests. The conviction that influenced me was that if I was to become a philosopher I must know the German language, and if I was ever to learn the German language with my linguistic handicap [that German was not his native language] I must learn it where it was spoken. The argument was probably sound. It was an accident that the copy of Kant's *Kritik der reinen Vernunft* [1956] which was given to me by Professor Russell was edited by Benno Erdmann. After my disappointment, the conviction and the accident led me to Halle-an-der-Saale. (p. 101)

Once in Halle, Dodge's resources were very limited. He survived for two years with $500 he had saved during his time as an assistant librarian. But what he lacked in monetary means, he gained in professional resources (Dodge, 1930, pp. 100–101).

Dodge was focused on receiving a PhD in philosophy but changed to psychology through his work with his teacher and mentor Benno Erdmann, who was teaching a seminar in philosophy. Dodge described a paper that he wrote for Erdmann in which he missed some key points. Erdmann responded (kindly, as Dodge pointed out), "Herr Dodge, I fear you will never make a philosopher" (Dodge, 1930, p. 102). During the same semester, Dodge sat in on a seminar Erdmann taught on the psychology of reading. In this course, Erdmann began discussing a need in the newly emerging field of experimental psychology. He spoke to his students about the need for a tachistoscope, an instrument that could control the length of time that a stimulus was presented to a viewer. Erdmann followed his description of this need with the caveat that such a device was probably a physical impossibility. Yerkes (1942) writes of Dodge's reaction to this challenge,

> This problem and need fitted into the mechanical bent and immediate intellectual interest of the newly arrived American student, and, as he said,

> "I adopted it as my own, lived with it, and gradually evolved the Erdmann/Dodge tachistoscope...My initiation into experimental psychology may be said to have started with that technical problem." (p. 587)

One may perhaps miss the importance of this event. Dodge (1930) wrote that he had resolved to leave graduate studies and return to his father's pharmacy, even reimbursing the college all funds, should the experiment fail (p. 104). But it did not fail. The Erdmann-Dodge tachistoscope was Dodge's first invention. This device could expose an object to a viewer for a brief period of time that could be precisely measured. The two men would conduct many research investigations together, and most of Dodge's initial publications were coauthored with Erdmann.

Dodge was awarded a PhD in psychology in 1896, following his dissertation *Die Motorischen Wortvorstellungen* (1896) (translated as *The Kinesthetic Imagination*). This project examined the relations between verbal imagery and the sensation of muscular movement (i.e., kinesthesia).

Dodge stayed in Halle for another year as assistant to Erdmann, with monetary assistance from the Berlin Academy of Sciences. He and Erdmann continue to collaborate on research and writing (Yerkes, 1942). Dodge returned to the United States in 1897, and he and Henrietta were married that August. Yerkes (1942) describes their marriage as a partnership that continued throughout their lives:

> To all who knew them early or late in their decades together, it was clear that each contributed more than a fair share to their contentment. Each evidently was enriched by giving. Crosses, physical ills, bitter disappointments came, but nothing seemed to upset the calm and serenity of their life. (p. 588)

Following their wedding, Dodge and his wife moved to Pennsylvania, USA, where he took his first job at Ursinus College in Collegeville. He was expected to carry a heavy teaching load in subjects outside his specialty, including logics, the history of philosophy, ethics, aesthetics, pedagogy, and the history of English literature. After one year, in the fall of 1898, Dodge took a position at Wesleyan University in Middletown, Connecticut, USA, where he was promoted to professor in only four years. He stayed at Wesleyan for the next 26 years. During this time, he served in a variety of roles at the local and national level, including serving as president of the American

Psychological Association in 1916 and chairman of the Division of Anthropology and Psychology of the National Research Council. Henrietta faithfully supported his work, even serving as his research assistant and a subject in his experiments (Miles, 1956, p. 79).

Although Dodge and Henrietta never had children of their own, they "adopted" many students from Wesleyan, frequently inviting them into their home. Students saw Dodge as playing an almost fatherly role. One student wrote of him, "His personality so impressed me in the introductory courses that I resolved to take as much work under him as I could" (quoted in Yerkes, 1942, p. 589). Another student reflected, "From my earliest contacts with the charming personality and the lucid teaching of Professor Dodge, together with the fascination of the subject as he developed the science of psychology, I found myself changing the entire course of my future" (p. 589). Yet another wrote,

> His kindliness in troubling moments, his inexhaustible patience with my periods of error and inactivity, the inspiration of his skill in laboratory technique and insight in experimental problems, the example of his utter caution in method and interpretation—these are but a few among those [qualities] I might enumerate. (p. 589)

Yerkes (1942) describes Dodge as a born teacher—sympathetic, patient, enthusiastic, and with a gentle sense of humor. He was also a man of great kindness and humility, facets of his personality that are reflected in his correspondence. Among the papers preserved at the Archives of the History of American Psychology are numerous notes by him of thanks and appreciation to colleagues regarding an article, accomplishment, or personal event (Archival Records, 2004).

Dodge's teaching at Wesleyan was interrupted by World War I, during which Dodge served in the U.S. Navy and also worked as a consultant with the Army. As Yerkes (1942) notes, "Few American psychologists rendered as valuable professional service to our military establishments in the war as did Raymond Dodge" (p. 593). While in the service, Dodge was again presented with a problem: Could a test be devised to select naval gunners? Dodge committed himself to this problem with as much enthusiasm as he had to creating the tachistoscope with Erdmann. Four days after the problem was presented to him, Dodge presented a solution. The result was a highly successful method not only of testing gunners but also of training them. He also served as a consultant psychologist to the Chemical Warfare Service

and conducted a study of the effects of frequent gas mask wearing. This study reportedly influenced the subsequent design and development of new gas masks. Dodge was promoted to the rank of lieutenant commander as a result of his achievements. He was never able to publish the tests that he used, however, because they were classified.

As an interesting side note, during the 1930s Dodge was contacted by Neely Mashburn about the use of a test for selecting candidates for flight training (Mashburn to Dodge, 1934). He was quick to respond that he had no practical knowledge of flying but offered some suggestions for Mashburn to pursue regarding the creation of such a test (Dodge to Mashburn, 1934). When the United States entered World War II, the Navy tried to find Dodge's original tests again but failed to do so. Because this was around the time of Dodge's death, Dodge's tests remained a mystery to the public and to the Navy (Wesleyan University, n.d.).

Rather than being a pause in his professional career, Dodge's experience in World War I became a pivotal point in his thinking and work. For three years after returning to Wesleyan University, Dodge's publications focused on the application of science to military issues, including titles such as "Mental Engineering During the War" (1919a), "Mental Engineering After the War" (1919b), and "The Educational Significance of Army Intelligence Tests" (1920).

In 1924, Dodge accepted a professorship at Yale University. His appointment to the Institute of Psychology left no time for teaching but greater resources for research. As Yale expanded, he gained more elaborate laboratories, including his final office at the Yale Medical Center. Yerkes (1942) remarked, "I think that the elaborateness of his laboratories and their equipment, in contrast with what he had worked with for thirty-five years, somewhat disturbed him by offending his habitual frugality and economy of materials and space" (p. 595).

Parkinson's disease forced Dodge's retirement in 1936, and he and Henrietta moved to Tryon, North Carolina, USA. He had already been fighting the effects of the disease for at least six years, yet he had carried on his research. He died in Tryon on April 8, 1942.

Philosophical Beliefs and Guiding Principles

Dodge was guided by his interest in psychology and experimentation. As he reflected on his years of research, he wrote, "I still remain primarily an exper-

imentalist," stating that all of his work was focused on an effort "to record with accuracy the behavior of normal and abnormal human organisms at various levels" (1930, p. 121). In his later years, however, he became more interested in the practical and theoretical implications of his experimental data. In spite of his focus on experimentation, Dodge consistently acknowledged the importance of meaning in reading. During his early work with Erdmann, he and Erdmann conceptualized reading as three processes: (1) the optical perception of the words, (2) the reproduction of sounds associated with the perceived words, and (3) the reproduction of meaning (Franz, 1900).

During the late 1800s and early 1900s, reading processes were beginning to be of interest to many researchers but only as a subset of psychological studies. Edmund Burke Huey (see chapter 7, this volume), a colleague of Dodge at the Wesleyan University of Western Pennsylvania, reviewed all of the research on reading at the time. In his single volume, *The Psychology and Pedagogy of Reading* (1908), Huey was easily able to cover the 40 studies published by other researchers up to that point, including Dodge's work on eye movements. In all the research, reading was seen as a visual process, which is why the research concentrated on this particular issue.

In his text, Huey extended the experimental data, including Dodge's work on eye movements, and concluded that the research supported practical pedagogical conclusions such as that the home is a natural place to learn to read, the school should focus on reading for meaning, reading should always be for the intrinsic interest of what is read—never for exercise—and speed drills should emphasize rate and reading for meaning. Still, neither Dodge nor Huey was able to make the immediate contributions to reading pedagogy that they believed were important. In spite of this, Dodge's research on eye movements formed the foundation for reading research and instruction.

Contributions to the Field of Reading

Dodge was perhaps best known as a psychologist. His most common works include *Conditions and Consequences of Human Variability* (1931) and *The Craving for Superiority* (Dodge & Kahn, 1931). His research included such topics as the effects of alcohol on human neuromuscular processes, the conditions for protracted happiness, and an experimental study of cancer. It was his early works that were focused on eye movement and perception. Yerkes (1942) believed that Dodge showed some regret later in his life over not pursuing the practical application of these eye-movement studies to the

pedagogy of reading. Yerkes believed that had Dodge chosen to do so, the methods of teaching reading would have been revolutionized.

As it was, Dodge contributed much to the field of reading. During their time together in Halle, Dodge and Erdmann examined the way adults read, first through the mirror method of observation and later through the use of Dodge's tachistoscope. They observed the way readers looked at words and found that readers recognized words by whole parts, not by individual letters or syllables. They based their conclusion on the following observations. First, subjects recognized words that were printed in type too small for individual letters to be identified. Second, subjects recognized words that were too far into their peripheral vision for recognition of their individual letters. Third, readers recognized words at a distance from which individual letters could not be recognized. Dodge and Erdmann stated that it is the word form and shape that make a word recognizable, not the reader's recognition of individual letters (Tinker, 1965, p. 14). Today's practical application of this discovery is that vision is tested with isolated strings of letters, not words, because the mind naturally tries to group letters into words to make meaning.

Much of Dodge and Erdmann's early work on eye movements was conducted using the mirror method of observation. The reader held a mirror toward the page opposite to the one that he or she was reading. The researcher looked over the reader's shoulder and observed the eyes' movements along a line of text. During these observations, Dodge and Erdmann noted that the eyes did not move continuously from left to right across the page. Instead, they observed that the eyes moved in a short succession of movements toward the end of the line of text (movements called *saccades*) and then returned in one quick movement back to the left before sweeping to the next line. The movement toward the end of the line was broken up by pauses. The number of pauses per line did not change a great deal. Using themselves as subjects, the researchers noted that Dodge paused 3 to 5 times per line of text, while Erdmann averaged 5 to 7 pauses per line of text. The more familiar the reading material, the fewer pauses the reader required. They noted that pauses were also present in writing, except that pauses in writing seemed to be more frequent, making it hard to note all of the eye movements (Huey, 1908, pp. 20–21).

Dodge concluded that it was when the eyes paused, rather than when the eyes moved, that the reader was actually seeing and assimilating the letters into words and meaning:

> In every change in the point of regard in a complex field of vision the eye distinguishes nothing during the actual movement. That this statement seems to be contradicted many times daily suffices to explain how the erroneous conceptions of the eye movements could have remained unchallenged so long and how so many false interpretations could have clustered around them...[These facts] explain the regular alternation of pause and movement in the reading eye. (Dodge, 1899, p. 477)

Dodge continued to refine the tachistoscope with mirrors (Dodge, 1930, p. 109) and create new instruments. Dodge and Erdmann recognized a need for "graphic registration" of eye movements (Dodge, 1930, p. 109) so interpretation of the eye movements was not reliant solely on immediate observation, but it was not until Dodge's time at Wesleyan University that he was able to develop a falling-plate camera with an air-cushion control that could record eye movements photographically. This instrument allowed a beam of light to be directed into the reader's eye. Once the light struck the eye, the light was reflected from the cornea's surface into a camera and the image was recorded on a photographic plate. From this image, the changes in the movement of the reader's eye could be interpreted from examining the changes in the direction of the beam of light. Timing data were obtained by interrupting the beam of light at regular intervals. Technological advances in film and cameras made Dodge's work widely used and repeated.

Dodge continued his own analysis of eye movements, in particular the saccadic eye movements, the rapid jerky movements of the eyes between pauses in reading and when shifting from one line to another. Dodge and Cline's (1901) published findings show that abductive saccadic movements were faster than adductive movements—that is, the eyes moved faster toward the temples than toward the nose. Dodge's studies of eye movements led him to conclude that readers focus on whole words, not letters; more specifically, readers focused most upon the middle of a word.

Dodge further examined the role of peripheral vision in reading (as described in Huey, 1908, pp. 17, 39). He believed that readers began seeing the words on a page indistinctly through peripheral vision, beginning the perceptual process before the actual direct reading of the words. Dodge found that persons with good peripheral vision had a greater reading speed and fewer and shorter fixation pauses during reading than those with decreased peripheral vision.

Still another area of interest for Dodge centered on increasing the speed of "intelligent reading" among adults. This work was never published, but in a letter to Magdalen Vernon of Cambridge, who was interested in experiments on reading speed, Dodge described his work:

> Two particular methods seem to increase the speed of intelligent reading. One was by training to increase the span of reading at each fixation point, taking particular note of what could be seen on the page, on the line and in the immediate vicinity of the fixation point. The other method was to train the eye movements to a greater speed by first drawing lines down the page and seeing what one could remember of 4–5 fixation points per line, forcing the eye to move as rapidly as possible without waiting for the sense to clear up. The latter proved to be very much the better device for increasing the speed of reading and the subjects finally nearly doubled their normal speed with little loss of details in easy text. So much of our lives is spent in reading that I feel that the subject is worth investigation. (Dodge to Vernon, 1932)

Speed of reading was connected to inner speech in Dodge's work. Dodge found that in his own typical silent reading, almost every word was pronounced, but in his fastest silent reading, only the beginnings of words were pronounced. He felt that the speed of his reading seemed to be determined by the speed he could comprehend what he read. Huey (1908) commented,

> The fact of inner speech forming a part of silent reading has not been disputed, so far as I am aware, by any one who has experimentally investigated the process of reading. Its presence has been established, for most readers, when adequate tests have been made.... Purely visual reading is quite possible, theoretically...yet it is perfectly certain that the inner hearing or pronouncing, or both, of what is read, is a constituent part of the reading of by far the most of people, as they ordinarily and actually read.... It is of the greatest service to the reader or listener that at each moment a considerable amount of what is being read should hang suspended in the primary memory of the inner speech.... [T]he attention [of the reader] may [thus] wander backward and forward to get a fuller meaning. (pp. 117, 148)

Dodge's work in the field of reading was primarily theoretical in scope. Yet he did speculate as to the practical application of his studies of visual processes. One unique example may be found in an exchange with his fellow

researcher Miles Tinker in which Dodge discussed the matter of license plate identification:

> It seems to me that the use of numbers is based on a false assumption that numbers can be remembered better than letters. Four or five letters are probably much more easily remembered than six or seven numbers and four or five letters would give approximately nine million permutations and combinations. I have not put the matter before the authorities in Connecticut for the simple reason that I shall have to fight the uncritical use of capital letters. They would be correct in saying that the capital letter was more easily read than the small letter in isolation, but I believe that the small letter may have the advantage in combinations.... Of course, a good many combinations would have to be eliminated as being unsuitable for dignified people to use, but many words would be available and of course they would be easily read and remembered. Combinations that do not make words would often have some significance as abbreviations of longer words. In fact, as you know, letter combinations that have no significance are very rare and difficult to find for memory experiments. (Dodge to Tinker, 1934)

Dodge and Tinker continued to correspond about the use of letters and numbers on license plates, with Dodge advocating the use of letters on license plates and opposing the use of a combination of letters and numbers.

Through Dodge's commitment to the rigorous study of human behavior, particularly eye movements, others began making direct pedagogical suggestions that have influenced reading instruction for over a century.

Lessons for the Future

What is the significance of Dodge's work? Some emphasis on the role of visual processes in reading remains in many reading models. One of the most widely known models is the Laberge-Samuels model. This model consists of three memory systems: (1) the visual memory system, (2) the phonological memory system, and (3) the semantic memory system. The visual memory system includes the translation of incoming visual information from the words by the eye into meaningful letters. Coupled with the phonological memory system, the brain then makes sense of word parts or the whole word (the semantic memory system), depending on the familiarity with the word and/or parts of the word (Samuels, 2004). Samuels suggested that this mod-

el helps explain why students can recognize words but fail to comprehend text: They may spend so much attention focusing on visually processing words that they have little attention left for comprehension. Ken and Yetta Goodman and colleagues have coupled eye-movement research with miscue analysis (e.g,. Paulson, Flurkey, Goodman, & Goodman, 2003) to conclude that readers use syntactic and semantic context to predict and confirm words and contextual meaning.

There is some controversy regarding the utility of the eye-movement studies. On one hand, some current researchers view eye movements as an important area for further research. *The European Journal of Cognitive Psychology* recently dedicated an entire issue to reporting the current research on eye movements in reading. In their rationale, Radach, Kennedy, and Rayner (2004) state,

> The measurement and analysis of eye movements is one of the most powerful ways to study the workings of the human mind.... We believe that eye movements provide a unique opportunity to examine principles of human information processing in a well-structured visual environment while people engage in a natural cognitive task. At the same time oculomotor measures can be used as a tool to develop and test psycholinguistic hypotheses on the processing of written language. (p. 1)

Contributors to the journal suggest further research should include the analysis of word-based viewing time measures and fixations for dyslexic readers (Radach & Kennedy, 2004), speed reading (Radach & Kennedy, 2004), discourse processing (Rayner & Juhasz, 2004), and the eye movements of children (Rayner & Juhasz, 2004).

On the other hand, several researchers view eye-movement research as merely observational and not the basis for reading instruction. Tinker (1965) summarized his 30 years of eye movement studies by saying, "There is no evidence to support the view that eye-movements determine reading proficiency" (p. 111). Merely noting that one reader has more regressive eye movements than another does not indicate that one is a poor reader and the other is not. However, poor readers often have more regressive eye movements than more able readers. Regressive eye movements might be the result of a reader's failure to recognize the word. In 1970, Albert Harris wrote that if a reader's comprehension is acceptable, eye movements may be ignored. If eye movements are poor, remediation should stress comprehension instruc-

tion, not eye-movement training (pp. 492–493). Stanovich (2004) writes that eye-movement studies have been incorrectly interpreted as evidence that efficiency of eye movements indicate reading ability; that is, a more skilled reader has fewer pauses and fixations per line of text. Although poor readers do show inefficiency in eye movements, they are also poorly comprehending what they see. But an able reader also makes many pauses per line of text, with more pauses when the text becomes more difficult, so that he or she can focus on the comprehension of the text. Harris (1970) points out that eye movements "are not the cause of poor reading; they are symptoms of the fact that the reader is reading poorly" (p. 493) because the eyes are merely servants of the brain.

What has happened with the eye-movement studies is that they have been erroneously applied to programs that are touted as ways to improve reading speed by reducing the number of fixations and pauses (e.g., Stepware, Inc., 2004). Dodge's data seemingly contradict such programs in that he never claimed that certain eye movements made for a better or poorer reader. He recognized early on that there were more pauses when reading certain kinds of text (e.g., unfamiliar text or text in foreign languages) than when reading familiar material. The key for Dodge was so-called intelligent reading, or reading with comprehension.

Because of Dodge, inner speech is still considered an area for further research (Sadoski & Paivio, 2004). Although studies since Dodge's, and later Huey's, have demonstrated that inner speech is not necessary for comprehension, its role is recognized but not understood:

> Inner speech may serve a needed rehearsal function in an alternative modality without which reading could not optimally occur. Educationally, this implies that inner speech should be encouraged and taught, when in fact, many instructional programs have been introduced to eliminate it. (Sadoski & Paivio, 2004, p. 1351)

Another area pioneered by Dodge that remains largely unstudied is that of reading in a second language. Dodge and Erdmann studied the differences in eye movements when reading one's primary language and when reading a second language. They found that one's eye fixations and pauses increase when reading in the secondary language. Again, differences in rates and eye movements are to be expected when reading becomes more challenging. From the earliest pedagogical interpretations of reading, Huey

(1908) recommended that reading of primary and secondary languages should be for real purposes, with the focus on essential meanings. According to Huey, speed (which he equated to the efficiency of eye movements) was to be encouraged and practiced only if the student could understand the text (p. 381).

Although Dodge made no claim to be developing a pedagogy of reading through his experimental studies of eye movements, he did offer some ideas about pedagogy that have proved influential on those developing reading pedagogy:

> The importance of word form in reading has been exploited in the modern pedagogy of reading [i.e., the "whole word" or "sight" approach]—to my mind somewhat over-exploited. The participation of peripheral or prefixational vision in the reading process was determined in a later study but has been practically ignored in the psychologies of reading...I have also been disappointed that pedagogy has done so little to develop a better technique for adult reading. Exploratory, unpublished experiments convince me that such applications of our knowledge are entirely practicable and that with a little patience and ingenuity both the speed of reading and the understanding of what one reads could be notably improved for the average adult. (1930, p. 107)

The question remains as to why the field of reading in the United States has shifted away from eye-movement studies. One reason may be found in our ever-increasing technological advances. Sophisticated machines can now be used to measure eye movements while computers track each pause (e.g., Adams, 1990). Because we now understand the physiology of reading, which remains generally consistent in readers, we may turn our attention to the internal processes of reading, where there are many unexplained inconsistencies in word recognition and comprehension. Today's society requires a much greater level of literacy, and so our research has also had to change.

In spite of the changes, many of the tenets of Dodge's work can be seen in today's research on reading. Although the issue of visual perception may now focus less on how the eye moves than when Dodge was conducting research, thanks to Dodge's description of eye movements we now know that to obtain optimal comprehension readers need to be able to move visually through a text at varying rates. This awareness forms one basis of the current focus on metacognition and our decisions about how we can make stu-

dents aware of their own thinking. Increasing instruction in decoding may enhance readers' abilities to move through a text at optimal rates. This premise forms the foundation for many of the current curricular phonics and direct instruction programs. Familiarity with text may also help readers move through a text, leading to the current look at fluency. Dodge would not argue against the emphasis of comprehension in the current literature, either. In his work, he was always mindful of the comprehension of text. One gets a sense that this was such a basic requirement for Dodge that he assumed one was not reading unless one understood what was being read.

Whether we believe that visual processes are crucial aspects of reading or we determine that much of the work is of historical significance only, Dodge provides an admirable model of high standards and rigor in reading research, caring in teaching, and service to the professional community.

Reflection Questions

1. Why do you think many of the early reading pioneers have been forgotten? Do you think this is positive or negative for the field of reading? If negative, what can be done to keep the early reading pioneers' work more visible?
2. How did Dodge's early interests in philosophy shape his research on reading?
3. Early reading researchers were interested less in practical pedagogy from their research and more in observing and collecting data on observable processes of reading. Is there a need for more formal experiments in the field of reading today? Why or why not?
4. Dodge identified reading in a second language as an important area of study. Why do you think his research was not pursued? Describe the current thoughts on reading in a second language.
5. Dodge emphasized "intelligent reading." What did he mean by this? Do you think this is still emphasized in the field of reading today?

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