EYE MOVEMENTS AND THE FUNDAMENTAL READING PROCESS

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A pioneer in the introduction and use of technology to improve reading/listening in the classroom, Mr. Taylor designed, manufactured, and distributed a variety of reading improvement devices; initiated the concept of the reading lab; and introduced the first mobile reading lab.

He previously served as a reading technology supervisor in the Bethpage, New York, schools, a reading technology instructor at Wagner College in Staten Island, New York, director of the Amackassin School in Blairstown, New Jersey, director of the Taylor Center for Reading Research in Huntington, New York, and comprehension skills editor for *Popular Science* magazine. He is an honorary member of the International Reading Association and the author of the National Education Association publication, "What Research Says to the Classroom Teacher about Listening." Mr. Taylor has published numerous articles for American Education Research Association journals and contributed to the publication of over 300 books and instructional programs in the area of reading.

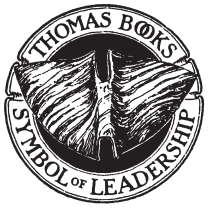
EYE MOVEMENTS AND THE FUNDAMENTAL READING PROCESS

How to Evaluate Silent Reading Efficiency

By

STANFORD E. TAYLOR, M.A.

Taylor Associates/Communications



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This book is dedicated to the memory of my father, Earl A. Taylor, whose pioneering work in the area of eye-movement recording and explanation of the Fundamental Reading Process skills inspired my work over the years in these areas and to my son, Stanford Mark Taylor, who continues the legacy in reading technology to develop fluency in silent reading

FOREWORD

Stanford Taylor is one of our nation's leading experts on the role of the eye in reading and the technologies that are available to record and evaluate eye movements during reading. He is correct in his observation that there is a general lack of knowledge about the Fundamental Reading Process and how eye movements influence the efficiency of silent reading. This book will help to overcome this knowledge deficiency by providing essential information to those in higher education who prepare students for the teaching profession, to teachers in the classroom who help students learn to read, to reading clinics, and to behavioral optometrists who work with students who are experiencing unusual visual problems during reading. Within the pages of this book one can find information on such topics as the Fundamental Reading Process, the history of eye-movement recording, and how to interpret the data that can be derived from eye-movement devices such as the Visagraph.

Stanford Taylor's credentials testify as to why he is considered to be a leading scholar in the field of reading for more than half a century. He has been the founder of several organizations that developed cutting-edge reading instructional programs, and these organizations brought these programs to thousands of schools where they are used to introduce students to reading and to help them become more highly skilled readers. To add to Stanford Taylor's versatility as a creative scholar he has also invented and developed instruments to record the movements of the eye while reading and has had patents awarded for these inventions. To add to his accomplishments, he has a wide list of publications that explain how the eye functions during silent reading.

Stan and I have collaborated on many papers and projects in the past to call attention to the need for more awareness about the nature of fluency in silent reading and the role that automaticity in word recognition plays as a prerequisite for fluency. This book will add to this information base.

In summary, this book by Stanford Taylor is essential reading for all who

want to understand the role of the eye in silent reading and want to increase their instructional capability as teachers and reading remediation specialists.

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PREFACE

There has long been an absence in the annals of reading development in terms of the most basic reading skills, which this author terms the Fundamental Reading Process, as well as a lack of appreciation of what can be easily measured through eye-movement recording during silent reading.

With the relative ease of use of today's eye-movement recording techniques and the core curriculum's demand for explicit and accurate measurements of the reading process, it is essential that eye-movement recording be utilized by all schools as a quick and easy means of selecting students who need silent reading fluency development. In addition these same recordings can indicate the need for possible referrals to a vision specialist when visual/functional impediments are extreme.

The purpose of this book is multi-faceted; it is primarily dedicated to exploring the nature of the Fundamental Reading Process and to discussing the manner in which proficiency in these basic skills can be evaluated through eye-movement recording. Here is a brief overview of the contents of this book:

- Understanding the nature of the Fundamental Reading Process
- History of eye-movement recording
- Exploring eye-movement recording through the use of the Visagraph Eye-Movement Recording system
  - Selecting the reading test level
  - Interpreting the Reading Report
    - Fixations
    - Regressions
    - Average span of recognition
    - Average duration of fixation
    - Reading rate
    - Grade level efficiency
    - Cross-correlation
  - Reading simulation
  - Graphs

  - Interpreting the Visual/Functional Report
- Uses of eye movements in terms of reading appraisal
- Field use of the Visagraph Eye Movement Recording system (schools, clinics, optometrists)
- Visagraph/EyeLink comparison in terms of eye-movement data
- 2012 Visagraph Norm Study Report

Reading and tutoring centers will naturally be interested in both the diagnostic eye-movement recording techniques as well as the web-based practice techniques available through computer technology. The ability for clients to use this silent reading development technology at home, beyond usual clinic hours, is certainly an advantage in terms of reading remediation.

Reading researchers might also be intrigued by the comprehensive description of the silent reading process, as well as the effect on the oral reading process with the development of proficiency in silent reading. Especially helpful should be the information revealed through eye-movement recordings about the many subliminal factors involved in the process of reading, as well as the changes produced by today's web-based computer techniques to modify the basic visual/functional, perceptual, and information-processing skills that comprise the silent reading process.

In addition higher education curriculum directors may be interested in this book as recommended reading for graduate courses that cover what occurs during silent reading and what outcomes are possible with current reading practice programs using web-based computer technology. Such programs might also be of interest for their use with incoming freshmen who need to improve their silent reading proficiency to deal with the more extensive and higher-level content they will encounter in their post-secondary education.

Classroom teachers may be particularly interested in the chapters that describe what has and can be been done in classrooms and labs to improve silent reading proficiency.

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and Learning, Bothell, Washington; and to Theodore S. Kadet, OD, FCOVD, Developmental Vision Associates, PLLC/dba Hope Clinic, Bellevue, Washington.

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EYE MOVEMENTS AND THE FUNDAMENTAL READING PROCESS

Chapter 1

EYE MOVEMENTS AND THE FUNDAMENTAL READING PROCESS

The Fundamental Reading Process is comprised of the most basic functions of reading, silent or oral. The purpose of this chapter is to acquaint the reader with these skill areas.

First, there is a reader's visual/functional capability in terms of visual acuity (ability to see clearly), binocular coordination (ability to use both eyes as a team), oculomotility (ability to easily rotate the eyes and not the head), and accuracy in tracking (directional attack employed during reading). These factors affect the clarity of print, ease, and comfort in reading, the ability to stay on lines of print, and the ability to move accurately and sequentially across each line of words during reading. These visual abilities impact the accuracy in which words are perceived and also affect feelings of ease and comfort during reading.

Reinforcement for the need for well-developed visual/functional skills is found in many references.

According to Taylor (1966):

> Reading requires that the individual give attention to the task with his whole mind and body, while, at the same time, he uses in concert a number of acquired mechanical and interpretive skills. . . .
>
> Reading efficiency is not only dependent upon the ability to see and interpret printed materials, but also upon the ability of the individual to use his two eyes together effectively, make the necessary rapid ocular rotations, and sustain effort during extended periods of near-point application. . . .

According to Taylor and Solan (1956):

Teachers can do a great deal in the classroom to develop and improve the reading and visual efficiency of the pupils. . . . Visual experiences can be made more meaningful with careful guidance. Most individuals can be trained to see more easily, more rapidly, more accurately, and more objectively.

According to Gates (1935):

In reading, however, a definite direction must be habituated to permit accurate perception. That the direction must be from left to right across the line has been recognized. This rule is rather unique in visual perception during reading. That pupils need to be taught and guided in forming the habit of moving the eyes consistently along the line from left to right is now obvious. Children who do not learn to do this in the initial stages of reading are certain to encounter serious difficulty in learning to read. . . . Actually the consistent left-to-right procedure is very unnatural in the sense that it has been rarely, if ever, required in any other perceptual activities engaged in by the child. Hence, the need for careful guidance.

According to Betts (1946):

Reading cannot be brought to full fruition as a learning aid until the mechanics have been controlled. . . . Such mechanics as left-to-right progression, accurate return sweeps, and accurate word recognition skills are fundamental to reading, but they must become automatic.

Storm and Smith (1930) reported that:

. . . the task of the school is plainly that of converting the raw material of the child's short, irregular, regressive movements and long pauses into the refined habits of the good mature reader which are characterized by the eye moving across the page in a series of broad rhythmical movements, pausing for a fraction of a second at regular points along the line to gather up as many words as possible at a glance, proceeding on to the end of the line with no regressive movements, and returning to the beginning of the next line with an accurate return sweep.

Symptoms of a lack of visual/functional competence include the following:

- Bringing the book very close to the eyes during reading
- Tilting the head to favor one eye
- Reporting visual discomfort
- Experiencing headaches from reading
- Losing one's place within the lines of print
- Moving the head instead of moving the eyes in reading
- Being easily distracted

These symptoms are cited by Maples and Hoenes (2009), as related to the College of Vision Development Quality of Life Checklist.

The near point activity of reading is not a natural human act. Humans are basically designed for distance viewing. Unfortunately, most people do not possess the visual competence required for efficient reading. Present estimates are that 30 to 60 percent of students and adults suffer, in varying degrees, from a lack of adequate visual coordination skills, poor ocular motility, and inaccurate visual tracking. The National PTA's (1999) resolution, *Learning Related Vision Problems*, states, "Knowledge regarding the relationship between poorly developed visual skills and poor academic performance is not widely held among students, parents, teachers, administrators, and public health officials." Those students classified as underachievers suffer more dramatically from a lack of such visual competence and would benefit from visual retraining. In-school visual training programs such as those administered by Hellerstein, Danner, Maples, Press, Schneebeck, and Miller (2001) and Hoover and Harris (1997) also document the value of visual training combined with computerized reading fluency development training, and both involve the use of eye-movement recording in pre- and post-testing.

Computerized visual skills practice that employs timed scanning of numbers, letters, and words followed by left-to-right displays of reading selections can improve visual/functional competence resulting in greater ease and comfort in reading, as well as more sequential input of words into short-term memory. An eye-movement study by Schlange, Patel, and Caden (1999), in which computerized fluency training that provided timed and directed left-to-right presentations of print without the support of specific visual/functional training also

developed higher levels of visual/functional efficiency as revealed by pre- and post-measurements of eye-movement behavior.

Next, the aspect of perceptual efficiency, or the ability of a reader to quickly and accurately realize the orthography (letters, letter order, and letter cluster awareness) of words, the degree of automaticity of word recognition, and the ability to retain word images for a reasonable length of time during the realization of syntax directly affects comprehension and rate of reading.

According to LaBerge and Samuels (1973), Logan (1997), and Samuels (2006), if most of the time and mental effort during a fixation are required to decode or recognize a word, or if a student devotes several fixations to recognizing a word, little time or capacity is left for comprehension.

Support for responses to letters and words so that attention during reading can be directed to deriving meaning can be found in many references.

Huey (1908) reported:

> To perceive an entire new word or other combination of strokes requires considerable time, close attention, and is likely to be imperfectly done. . . . [Practice, however,] progressively frees the mind from attention to details, and makes facile the total act, shortens the time, and reduces the extent to which consciousness must concern itself with the process.

According to James (1890):

> How many ideas or things can be attended to at once. . . . Not easily more than one, unless the processes are very habitual. . . . Where, however, the processes are less automatic . . . there must be a rapid oscillation of the mind from one to the next, and no consequent gain in time.
>
> . . . we are able to process only one thing at a time, except when the processes involved have been so well learned that they can be carried out automatically.

According to Norman and Bobrow (1975):

> A considerable amount of conscious effort is often required to perform an unfamiliar task. However, when the task is repeatedly practiced, per-