

COMPLEMENTARY THERAPY ASSESSMENT VISION THERAPY FOR LEARNING DISABILITIES

SUMMARY

INTRODUCTION TO THE TOPIC

Learning disabilities are a common problem in the pediatric population. Dyslexia, defined as a specific reading disability, affects 80% of individuals with learning disabilities, and 5 to 17% of the general population. Some individuals with learning disabilities also have difficulty in areas such as memory or mathematical calculations. Because of the complex multifactorial nature of learning disabilities, including dyslexia, there are no simple remedies. Remedial educational approaches are arduous for both the parent and child. Parents often seek alternative or adjunct interventions for learning disabilities for their child, including vision therapy.

DESCRIPTION OF VISION THERAPY

Vision therapy, also referred to as visual training or vision training, is a method attempting to correct or improve presumed ocular disorders, visual processing, and perceptual disorders. Vision therapy can be broadly divided into two categories. In the first category, classic orthoptic techniques are used to correct accommodative (focusing) and convergence dysfunctions as well as heterophorias (latent misaligned eyes) and refractive errors (need for glasses) that might be responsible for asthenopic symptoms (eye fatigue and discomfort often aggravated by close work). In the second category, often referred to as behavioral vision therapy, eye movement and hand-eye coordination training techniques are used to improve visual processing skills, learning efficiency, and visual-motor integration. Behavioral vision therapy is based on the premise that differences in children's visual perceptual motor abilities exist and that these perceptual motor abilities influence cognitive and adaptive skills such as reading, writing, and motor activities used in activities of daily living. Behavioral vision therapy has been recommended to improve visual skills and processing in the belief that this will improve learning disabilities, including speech and language disorders, and nonverbal learning disorders. Colored overlays or lenses are sometimes used as part of vision therapy to alter contrast.

CONCLUSIONS

To date, there appears to be no consistent scientific evidence that supports behavioral vision therapy, orthoptic vision therapy, or colored overlays and lenses as effective treatments for learning disabilities. It seems intuitive that oculomotor abilities and visual perception play a role in learning skills such as reading and writing. However, several studies in the literature demonstrate that eye movements and visual perception are not critical factors in the reading impairment found in dyslexia, but that brain processing of language plays a greater role. Furthermore, the vast majority of individuals with known ocular motility and eye movement defects appear to read and comprehend normally. Many individuals born with severely misaligned eyes excel in reading and academics.

Regarding the benefits of treatment, no well-performed randomized controlled trials were found in the literature. In this complex field, controlled studies are difficult to conduct, because there are so many variables involved, and possibly confounding factors. There is no standard definition for what techniques comprise vision therapy. Children included in the studies have been diagnosed with learning disabilities using different criteria, or may have been misdiagnosed, or may have additional conditions that may confound the findings. Furthermore, during a course of vision therapy, children are simultaneously receiving continued and even enhanced instruction in a standard or remedial educational setting, as well as undergoing natural maturational changes. Behavioral vision therapy studies that were found in the peer-reviewed literature reported findings that are inconsistent. A team approach utilizing multidisciplinary educational specialists to assess the effectiveness of vision therapy in scientifically valid studies seems indicated.

RISKS

The costs of vision therapy often are not covered by health insurance and can be substantial. These direct costs are in addition to the cost of lost wages, time, and productivity for working parents who must take time off work to bring a child in for repeated treatments. A program of vision training may provide false hopes and expectations to educators, patients, and families alike, while delaying institution of appropriate treatment plans. No other risks from vision therapy activities have been attributed. Time required for the vision therapy activities at home may impinge upon time available for academic studies, recreation, and family activities.

REPORT

INTRODUCTION TO THE TOPIC

Learning disabilities are a common problem in the pediatric population. Some individuals with learning disabilities also have difficulty in areas such as memory or mathematical calculations. Because of the complex multifactorial nature of learning disabilities, there are no simple remedies. Remedial educational approaches are arduous for both the parent and child. Parents often seek alternative or adjunct interventions for learning disabilities for their child, including vision therapy.

DESCRIPTION OF VISION THERAPY

Vision therapy, also referred to as visual training or vision training, is a method attempting to correct or improve ocular, visual processing, and perceptual disorders.¹ The American Optometric Association defines vision therapy as “a sequence of activities individually prescribed and monitored by the doctor to develop efficient visual skills and processing.”²

Vision therapy is based on the premise that differences in children’s visual perceptual motor abilities exist and influence skills such as reading, writing, and motor activities used in activities of daily living. Vision therapy aims to improve a child’s motor awareness, motor planning and motor sequencing on the premise that this will improve learning disabilities, including speech and language disorders, and nonverbal learning disorders. In order to understand this premise, it is important to know that vision therapy practitioners identify three interrelated domains of visual function, all of which they believe must be evaluated fully to identify learning-related vision problems.²

- Visual pathway integrity, including eye health, visual acuity, and refractive status.
- Visual skills, including accommodation status (eye focusing), binocular vision (eye teaming), and eye movements (eye tracking).

- Visual information processing including identification, discrimination, spatial awareness, and integration with other senses.²

Different treatment areas within vision therapy are orthoptic vision therapy, behavioral vision therapy, and the use of colored lenses and overlays. While these three treatment areas are defined, this assessment will discuss the evidence supporting behavioral vision therapy and colored lenses and overlays.

Orthoptic Vision Therapy

Asthenopia (eye fatigue and discomfort often aggravated by close work) is believed by some to be related to reading inefficiency. The aim of the orthoptic aspect of vision therapy is to improve vergence amplitudes (measure of the ability to bring the eyes into alignment) in cases of convergence insufficiency (eye muscle problem causing outward deviation of the eyes when looking at a near object that can cause eye fatigue or double vision) by teaching diplopia (double vision) awareness. Other asthenopic symptoms due to heterophorias (latent misaligned eyes) or accommodative dysfunction (focusing problems) are addressed using a variety of refractive lens powers, prisms, bifocals and haploscopic (simultaneously presents separate visual targets to each eye) devices. In general, children have normal accommodative and vergence amplitudes. It is important to distinguish the role of the orthoptist in pediatric eye care from these types of orthoptic vision therapy that are being used to treat learning disabilities. An orthoptist is a professional trained in the diagnosis and treatment of strabismus and amblyopia and often works in a pediatric ophthalmology practice.

Behavioral Vision Therapy

Behavioral vision therapy involves eye exercises, eye-hand coordination tasks, and exercises designed to improve the patient’s motor memory activity. Vision therapy requires a number of office visits depending upon the severity of the problem diagnosed by the vision therapy provider. The typical length

of the program ranges from several weeks to several months and usually includes activities to perform at home.

Colored Lenses and Overlays

Vision therapy may include the use of colored overlays or filters, and glasses for mild refractive errors with or without prisms. Colored overlay filters are said to reduce pattern glare, which is a hypersensitivity to repetitive patterns, including lines of print on a page.^{4,5}

DEFINITION OF THE PROBLEM

Dyslexia, one type of learning disorder, is reported to be present in 5% to 17% of children in the United States and is believed to be an inherited disorder of phonologic awareness.⁶⁻⁸ A phoneme is the smallest perceptible portion of speech. It is now thought that the fundamental difficulty in individuals with dyslexia is being aware that the letters in a printed word correspond to the sounds (phonemes) heard in the spoken word and subsequently being unable to decode the printed word.⁶⁻⁸ Dyslexia affects girls and boys equally. Other learning disorders that may feature reading difficulties are distinguished from dyslexia by the presence of the disorder in both phonologic and semantic-syntactic aspects of language.⁸ Nonverbal learning disability is the least studied learning disorder and occurs in about 10% of the individuals diagnosed as having a learning disability.⁹ The main deficits of these disorders include visual-spatial perception, visual memory, psychomotor coordination, complex tactile-perceptual skills, reasoning, concept formation, mathematical abilities, and psychological/behavioral difficulties.

It is important to recognize that children often have visual complaints from normal visual phenomena. Wright and Boger review many normal, common physiologic visual experiences such as blurred or double vision.¹⁰ A child's description of these experiences can be misinterpreted by the patient, parent, or practitioner as abnormal, and lead them to believe that the complaints are the basis of a reported learning or reading problem. Experiences that

children complain of include blurring or "swimming together" of print while reading due to normal relaxation of accommodation or convergence, and from physiologic diplopia. It is important to note that pathologic conditions such as high refractive errors, heterotropias (misaligned eyes), and true convergence insufficiency can cause these complaints and these conditions should be diagnosed and treated. Children with abnormalities identified at routine vision screening examinations as described in national standards^{11,12} should be referred for comprehensive eye examination.

FDA STATUS AND LEGAL STATUS

There are no legal or FDA controls or restraints on orthoptic or behavioral vision therapy.

The College of Optometrists in Vision Development (COVD) Board of Directors certifies optometrists in vision therapy. To become a Fellow (FCOVD), the applicant must pass a written and oral examination.

SUMMARY OF EVIDENCE

Search Methods and Study Selection

MEDLINE[®] was searched for the years 1968 to December 2000 for English language articles on vision disorders, learning disorders, dyslexia, visual perception, rehabilitation, language therapy, occupational therapy, and physical therapy. More than 450 citations were retrieved; about 100 of these articles were obtained and reviewed as being of relevance to the assessment. The reference lists of the pertinent articles were consulted and yielded additional articles not indexed in MEDLINE.

Statistical Issues and Study Design

The primary methodological concern found in most studies of children and adults with learning disabilities is that the types of learning disorders being investigated are not defined consistently. The treatments that are described as vision therapy differ in each study

as well as the length of time they are given, making aggregation of results meaningless. The outcome of interest in many studies is not well defined. In many studies, the experimental groups were not screened for conditions such as attention deficit/hyperactivity disorder, nonverbal learning disabilities or high functioning autism, which are potential confounders or confounding variables. In some studies, it is not clear if the experimental group has continued with other remediation programs during the course of the experimental intervention. Many studies do not adequately describe the control group; other studies do not have a control group. An age-matched control group is important in any study but particularly for studies of learning disability because children doing well in school also may have abnormalities. Many studies do not discuss masking of therapists and observers to minimize bias. The majority of the studies are in small numbers of subjects. Any of these issues affect the interpretation and applicability of the results. These methodological concerns are in studies with both negative and positive findings.

Specification of Level of Evidence

No well-performed randomized controlled trials (Level I evidence) were found in the literature regarding the benefits of treatment. The evidence that currently exists in the peer-reviewed literature is graded as Level II to Level III, with most studies graded as Level III. Level II consists of evidence obtained from well-designed controlled trials without randomization; well-designed cohort or case-control analytic studies, preferably from more than one center; and, multiple time series with or without the intervention. Level III evidence consists of evidence obtained from descriptive studies, case reports, and reports of expert committees or organizations.

Evidence about Treatment Rationale

The rationale for behavioral vision therapy is based on the premise that differences in children's visual perceptual motor abilities exist and influence the learning of skills such

as reading, writing, and other motor activities used everyday. It is important to note that children may experience problems in both motor coordination and visual perception, but this correlation does not mean that the visual perceptual problems underlie the clumsiness and that the remediation of perceptual deficits will automatically improve coordination.¹³

Chase reviewed the literature on the neurobiological basis for learning disabilities, specifically developmental dyslexia and language-learning impairments.¹⁴ He discusses stages of neural maturation: proliferation, migration and differentiation. Disruption of any stage of this sequential process can result in faulty auditory and visual processing. Some patients with dyslexia are slower to process information in the magnocellular (M) transient pathway of their visual system (that part of the visual system responsible for peripheral visual field and movement), but it is unknown whether these impairments affect reading development.^{14,15}

In 1987, Beauchamp and Kosmorsky reviewed the history of dyslexia and its relationship to neuropathology and eye movement research.¹⁶ Based on an extensive review of the interdisciplinary literature, they concluded that eye movements are secondary to brain processing dysfunction and are not the controlling factor in dyslexia or learning disabilities.

In a study comparing normal and learning disabled children, Polatajko found no significant differences between the groups in measures of visual-ocular control (refixation saccades, smooth ocular pursuit, optokinetic nystagmus, spontaneous nystagmus, and gaze nystagmus).¹⁷ Another study compared reading strategies in children with severe perceptual-visual problems to fully sighted children matched on age and verbal ability. The two groups did not differ in performance of the tasks in the study. This does not support the role of visual perception anomalies in dyslexia.¹⁸ Another study that compared dyslexic children with age-, gender-, and IQ performance-matched controls led the authors to conclude that it is unlikely that visual

characteristics are the major causative factors in specific reading difficulty.¹⁹

Hoyt, discussing the function of eye movements in dyslexics, cites several studies to show that eye movements are not the primary cause of reading impairment.²⁰ Comprehension failure is responsible for slow reading and reduced and re-fixation saccades.²⁰

Swank describes the efficiency of phonetic tutoring as an efficient method of treating a dyslexic child.⁶ She emphasizes that “decoding or word recognition is one part of reading; however, the ability to comprehend what is read is a higher level skill.”⁶ The result of a deficit in phonologic processing is a lack of automaticity in using phonologic codes. Comprehension is mediated by both hemispheres of the brain. Nonverbal disorders are a result of dysfunction in the right hemisphere.

Kulp and Schmidt cite a controlled study of fourth graders by Poynter et al,²¹ which showed “that reading skill was related to language skills and that oculomotor ability was not the principal cause of reading disability” but may be a factor in reading disability.²² The abnormal saccadic eye movements of dyslexics may be due to brain processing and attention issues, not a cause of the reading difficulty. A dyslexic individual may re-read a word due to lack of understanding of phonics, but not because the eye movement abnormality causes the comprehension deficit or learning deficiency.

Irlen described the use of colored lenses and overlays as a means of improving reading performance.²³ Aarnisalo and Pehkonen studied the effect of colored lenses on the dark-adaptation thresholds of normal subjects.²⁴ They found that colored filters absorbing wavelengths greater than 530 nm resulted in significantly higher dark-adaptation thresholds. If some individuals with dyslexia do have a rod-processing system deficit, the use of colored filters absorbing wavelengths less than 530 nm might be better than neutral density filters. Such colored filters could

selectively reduce stimulation of the parvocellular (P) sustained visual pathway in relation to the magnocellular (M) transient visual pathway. Parvocellular neurons probably serve color vision and are most active under higher luminance conditions while magnocellular neurons are sensitive to luminance changes in dim illumination.

BENEFITS

Based on past literature reviews and a recent literature search, there is no consistent evidence showing benefits of vision therapy for learning disabilities.

In reviewing the ophthalmologic, optometric and psychological literature in 1984, Metzger and Warner found no proven relationship between reading failure and perceptual ability.²⁵ Keogh and Pelland’s review article, addressing the benefits of vision therapy, concluded that efficacy has not been demonstrated;²⁶ in their review article, Kulp and Schmidt concluded that treatment can be successful.²² Keogh and Pelland conclude that “it is not surprising that the findings from vision therapy studies are inconsistent and do not lead to clear decisions about efficacy, even when the results are aggregated across studies. There is limited evidence from some studies that vision therapy is effective, but with whom and under what conditions is still to be documented.”²⁶ An additional consideration is that children participating in a course of behavioral vision therapy sessions generally enjoy the treatments and succeed at the exercises. This success may give them more confidence in their reading skills, leading to an improvement.

Beauchamp confirmed the confusing nomenclature of learning disabilities and the lack of proven benefit of vision therapy in reading disabled children.²⁷ He cites Keogh²⁶ and Levine²⁸ who question the scientific basis of vision therapy for children with reading problems. Beauchamp, however, fails to compare the other categories of learning differences such as visual dyspraxia (nonverbal learning disability), attention deficit/

hyperactivity disorder and autism spectrum disorders. All of these diagnoses, singly or in combination, affect children who have problems learning in school.

Two larger scale studies were carried out over 20 years ago, one by Heath et al²⁹ and the second by Getz.³⁰ In the Heath study, there was improvement in proprioception, oculomotor control and convergence after vision therapy compared to a control group; but there were no differences in reading gain in either experimental groups. In Getz' study, 60 children were assigned to a control group and another 60 to a vision therapy group for one-half hour per day, 5 days per week for four months. All students were tested at the end of the period but not at the beginning using the California Cooperative Primary reading test; the spelling section of the WRAT (Wide Range Achievement Test, Third Edition), and the reading section of the WRAT. The WRAT tests single word identification, not reading of paragraph material. The vision therapy group outperformed the control group on the two reading measures.

Studies of the Irlen lens or other colored overlays have had inconsistent results.³¹⁻³³ Lightstone states that the color overlay must be child-specific, requiring trial and error.³⁴ Carroll et al performed dark adaptation on 41 dyslexic readers and 23 normal volunteers between the ages of 10 and 20 years.³⁵ Twelve of the disabled readers had poor dark adaptation at peripheral retinal locations consistent with a rod processing system deficit. He states that the study is inconclusive in proving that the scotopic sensitivity syndrome (a specific visual-perceptual dysfunction proposed by Irlen) is due to dark adaptation dysfunction.

Menacker and colleagues conclude in a controlled study of 24 children, aged 8 to 12 years, that reading ability was not improved nor worsened with a variety of colored overlays.³⁶ Also, the subjective color chosen by the children did not correlate with reading performance. Another report tested 41 participants (28 boys and 13 girls) ranging in age from 15 to 17 years to evaluate the

reliability of colored filter testing procedures. Two tests, separated by 2 weeks, using colored filters resulted in poor test-retest reliability leading the researchers to conclude that colored filter testing is not a reliable measurement technique.³⁷

RISKS

The costs of vision therapy are often not covered by health insurance and can be substantial. These direct costs are in addition to the cost of lost wages, time, and productivity for working parents who must take time off work to bring a child in for repeated treatments. A program of vision training may provide false hopes and expectations to educators, patients, and families alike, while delaying institution of appropriate treatment plans. No other risks from vision therapy activities have been attributed. Time required for the vision therapy activities at home may impinge upon time available for academic studies, recreation, and family activities.

QUESTIONS FOR SCIENTIFIC INQUIRY

Further research is necessary to answer the following questions.

1. Are specific components of vision therapy effective for any specific aspect or type of learning disability?
2. What effect do eye movements have on reading speed or efficiency?
3. What integrated multidisciplinary model is best to treat children and adults with learning disabilities?

THE OPHTHALMOLOGIST'S ROLE

A parent may bring a child for a comprehensive eye examination by the ophthalmologist because of concern that vision may be causing learning difficulties. It is important for the ophthalmologist to recognize common visual complaints from healthy normal children, such as physiologic diplopia, and relaxation of accommodation. If no ocular abnormalities are identified, the

ophthalmologist will wish to direct children and parents to the appropriate educational professional as necessary. A comprehensive evaluation by a qualified educational professional, such as a licensed neuropsychologist or school psychologist, is the best option for diagnosing and planning treatment for an individual with learning differences.^{40,41}

Making the correct diagnosis of the specific type of learning disability is of paramount importance before any therapeutic regimen can be prescribed.³⁸⁻⁴¹ The ophthalmologist can further assist the family by recommending parental tutoring of the child at home with a good phonics based reading program. Because reading difficulty affects not only academic performance but also self esteem, confidence, and effort, parents need to be encouraged to focus on these aspects as well. It may be helpful to discuss with parents the likelihood that some treatments recommended by private learning consultants may be judged by health insurers as educational in nature and therefore not reimbursable.

INFORMATION FOR PATIENTS

Learning disabilities, including dyslexia and other forms of reading problems or academic underachievement, require a multidisciplinary approach to diagnosis and treatment. This process should involve educators, psychologists, neuropsychologists, and physicians. Individuals with learning disabilities should receive early, appropriate, and comprehensive educational, psychological, and medical assessment and treatment. Learning disabilities often only become apparent after a child experiences academic difficulty. A certain number of children who experience reading difficulty may also experience a treatable vision disorder. Some visual abnormalities, such as farsightedness, may not be detected during pediatric screening procedures. Therefore, pediatricians evaluating children for reading difficulties should consider referring patients to an ophthalmologist familiar with children's eye problems. However, eye problems are rarely the cause of the learning disability.

CONCLUSIONS

To date, there appears to be no consistent scientific evidence that supports behavioral vision therapy, orthoptic vision therapy, or colored overlays and lenses as effective treatments for learning disabilities. It seems intuitive that oculomotor abilities and visual perception play a role in learning skills such as reading and writing. However, several studies in the literature demonstrate that eye movements and visual perception are not critical factors in the reading impairment found in dyslexia, but that brain processing of language plays a greater role. Furthermore, the vast majority of individuals with known ocular motility and eye movement defects appear to read and comprehend normally. Many individuals born with severely misaligned eyes excel in reading and academics.

Regarding the benefits of treatment, no well-performed randomized controlled trials (Level I evidence) were found in the literature. In this complex field, controlled studies are difficult to conduct, because there are so many variables involved, and possibly confounding factors. There is no standard definition for what techniques comprise vision therapy. Children included in the studies have been diagnosed with learning disabilities using different criteria, have been misdiagnosed, or have additional conditions that may confound the findings. Furthermore, during a course of vision therapy, children are simultaneously receiving continued and even enhanced instruction in a standard or remedial educational setting, as well as undergoing natural maturational changes. Behavioral vision therapy studies (Level II and Level III evidence) that were found in the peer-reviewed literature reported findings that are inconsistent. A team approach utilizing multidisciplinary educational specialists to assess the effectiveness of vision therapy in Level I scientific studies seems indicated. Meta-analysis of observational but controlled studies designed as efficiently as possible should be carried out to further determine the validity of any orthoptic or occupational therapy component of vision therapy as it relates to improving reading and learning ability.⁴²

Coordinated multidisciplinary treatment by a team consisting of various medical specialists, educators, tutors, psychologists, and rehabilitation specialists (occupational/physical therapists) gives individuals with learning differences the best means of reaching their optimal educational and learning potential.

DEVELOPMENT OF COMPLEMENTARY THERAPY ASSESSMENTS

Complementary and alternative therapies are a growing part of health care in America. The National Institutes of Health National Center for Complementary and Alternative Medicine has defined complementary and alternative medicine (CAM) as covering “a broad range of healing philosophies (schools of thought), approaches, and therapies that mainstream Western (conventional) medicine does not commonly use, accept, study, understand, or make available. A few of the many CAM practices include the use of acupuncture, herbs, homeopathy, therapeutic massage, and traditional oriental medicine to promote well-being or treat health conditions”.⁴³ Americans spend an estimated \$14 billion a year on alternative treatments. Mainstream medicine is recognizing a need to learn more about alternative therapies and to determine their true value, and most medical schools in the United States offer courses in alternative therapies. The editors of the *Journal of the American Medical Association* announced that publishing research on alternative therapies will be one of its priorities. More scrutiny and scientific objectivity is being applied to determine whether evidence supporting their effectiveness exists.

In the fall of 1998, the Board of Trustees appointed a Task Force on Complementary Therapy to evaluate complementary therapies in eye care and develop an opinion on their safety and effectiveness, based on available scientific evidence, in order to inform ophthalmologists and their patients. A scientifically grounded analysis of the data will help ophthalmologists and patients evaluate the research and thus make more rational decisions on appropriate treatment choices.

The Academy believes that complementary therapies should be evaluated similarly to traditional medicine: evidence of safety, efficacy, and effectiveness should be demonstrated.⁴⁴ Many therapies used in conventional medical practice also have not been as rigorously tested as they should be. Given the large numbers of patients affected and the health care expenditures involved, it is important that data and scientific information be used to base all treatment recommendations. In this way, we can encourage high-quality, rigorous research on complementary therapies.⁴⁵

Ideally, a study of efficacy compares a treatment to a placebo or another treatment, using a double-masked controlled trial and well-defined protocol. Reports should describe enrollment procedures, eligibility criteria, clinical characteristics of the patients, methods for diagnosis, randomization method, definition of treatment, control conditions, and length of treatment. They should also use standardized outcomes and appropriate statistical analyses.

The goal of these assessments is to provide objective information of complementary therapies and provide a scientific basis for physicians to advise their patients, when asked.

To accomplish these goals, the assessments, in general, are intended to do the following:

- Describe the scientific rationale or mechanism for action for the complementary therapy.
- Describe the methods and basis for collecting evidence.
- Describe the relevant evidence.
- Summarize the benefits and risks of the complementary therapy.
- Pose questions for future research inquiry.
- Summarize the evidence on safety and effectiveness.

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ADDITIONAL RESOURCES

American Occupational Therapy Association, Inc. at www.aota.org

International Dyslexia Association at www.interdys.org

International Council on Developmental and Learning Disorders at www.icdl.com.

ICDL Clinical Practice Guidelines. Redefining the Standards of Care for Infants, Children, and Families with Special Needs. Available at <http://icdl.com/ICDLguidelines/toc.htm>.

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National Center for Learning Disabilities at www.nclld.org

National Institute of Child Health and Human Development at www.nichd.nih.gov
NICHD Report of the National Reading Panel. Teaching Children to Read: An Evidence-Based
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