ABSTRACT

EFFECTS OF KURZWEIL 3000 AS PART OF A READING PROGRAM ON THE READING FLUENCY AND COMPREHENSION OF FOUR ELEMENTARY-AGED STUDENTS WITH ADHD

by Cleighton J. Weiland

The purpose of this study was to ascertain the effectiveness of using the Kurzweil 3000 software as part of a reading program to improve oral reading fluency and comprehension of third and fourth grade students demonstrating attention and reading difficulties. Two third and two fourth grade students participated in using Kurzweil 3000 while reading expository and narrative text. Short duration tests of proficiency in areas of oral reading fluency were used to monitor progress using an A-B accountability design. Generalization measures were assessed including maze passages, comprehension questions, formal observations and a prosody scale as pretest/posttest indicators. In addition, a measure of attention was used to determine each subject’s executive function skills. Students involved in the study significantly increased their reading speed and experienced various levels of success in improving their ability to comprehend text.
EFFECTS OF KURZWEIL 3000 AS PART OF A READING PROGRAM ON THE
READING FLUENCY AND COMPREHENSION OF FOUR ELEMENTARY-AGED
STUDENTS WITH ADHD

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CHAPTER I

Introduction

School psychology is in a state of reorganization and evolution. New roles are emerging for today’s school psychology practitioners where tests of cognitive and academic ability are being replaced with Response to Intervention procedures. Functional assessment, opportunities for group and individual counseling, systems level consultation, and community outreach are gaining acceptance as essential roles for school psychologists in today’s schools (Ysseldyke, Dawson, Lehr, Reschly, Reynolds, and Telzrow, 1997).

Integral to the function of a school psychologist is the development of a strong research base in order to assist schools in review of potential practices and interventions. A school psychologist’s knowledge of scientific inquiry is essential to insuring the fidelity and efficacy of current and future practices as well as student outcomes (Hatzichristou, 1998). With the No Child Left Behind Act’s emphasis on technology and evidence based practices, independent validation of potentially efficacious technological interventions has become progressively more imperative in schools ("NCLB Dominates at FETC," 2003).

As schools grapple with new legislation, everyday matters such as the development of individual interventions continue to draw attention and resources. Designations which co-occur, such as attention deficit/hyperactivity disorder (ADHD) and reading disabilities are becoming increasingly prevalent. Much of the literature suggests that children with both ADHD and a reading disability diagnoses are at an increased risk for poor educational outcomes (Clark, C., Prior, M., & Kinsella, G., 2002; Mayfield et. al., 2005; Barry, Lyman & Klinger, 2002). However, again few studies have analyzed the potential benefit of using technology as a tool for increasing the educational achievement of children with coexistent diagnoses of ADHD and a reading disability (Kleiman, Humphrey, and Lindsay, 1981; Ford, Poe, & Cox, 1993).

The purpose of this study it to document any potential effects that using the Kurzweil 3000 in a structured reading program may have on the reading fluency and comprehension of third and fourth grade students who have attention problems and a reading disability. For school personnel to make an informed decision regarding the
utilization of Kurzweil 3000 software, data must be provided to reflect its possible usefulness and value. In particular, schools need to examine if the use of the Kurzweil 3000 in a structured reading program will aid children with a pronounced reading disability in decoding and comprehension of narrative and instructional text. Due to the paucity of research that has sufficiently explored or examined technology’s affects on children with ADHD or children with reading problems at the primary level, attention towards this line of research has become increasingly important.

The following review of the literature explores varying aspects of elementary age children with ADHD and associated reading fluency and comprehension issues. ADHD and its domains are defined and Executive Function Process and Sluggish Cognitive Tempo theories are discussed. In addition, typical academic problems associated with ADHD and research regarding the use of technology as an intervention for children with ADHD is investigated. Reading domains are defined and various typical reading interventions are considered. Finally, the use of technology, reading, and Kurzweil 3000 software are explored in light of children with ADHD and reading fluency and comprehension difficulties.
CHAPTER II
Review of the Literature

Defining ADHD

Attention-Deficit/Hyperactivity Disorder (ADHD) is the most widespread developmental disorder in the United States, affecting an estimated 3–5% of school-aged children (American Psychiatric Association, 1994). The relative prevalence of ADHD has risen progressively, with approximations of at least one student in every classroom having been identified as having this designation (DuPaul & Stoner, 1994). Although there has been much debate regarding the issue of diagnoses, the DSM-IV provides a clear definition of characteristics associated with the disorder. ADHD is typically diagnosed in childhood, although it is a lasting disorder that continues on into adulthood for many people. ADHD symptoms must persist for at least six months to meet diagnostic criteria and tend to cluster in two diagnostic subtypes, inattention and hyperactivity/impulsivity. The inattention subtype includes symptoms such as an inability to maintain sustained attention to tasks or play activities, trouble listening when spoken to, difficulty in organization, and a reluctance to engage in academic tasks. The hyperactivity/impulsivity subtype includes characteristics such as fidgeting, trouble remaining seated when expected to, talking excessively, and channeling high amounts of energy into inappropriate activities. These subtypes may occur in isolation from one another or occur simultaneously as a combined type, with a child exhibiting symptoms from both subtype criteria. In addition, a child with ADHD characteristically exhibits problems in self-regulatory behavior, blurting out answers at inappropriate times, have trouble waiting for his or her turn, and may often interrupt or intrude on others (DSM-IV).

Theories Related to ADHD

Recently, there have been several studies that have attempted to further the understanding of ADHD in regards to the Executive Functioning process of the brain. Executive Functioning (EF) is the cognitive ability necessary for complex goal-directed behavior and adaptation to a range of environmental changes and demands (Loring, 1999). Currently there are several definitions of EF in the literature with emphases placed on different components and factors of these neuropsychological processes. Denckla
(1996) stresses control processes such as the ability to adjust, plan, respond, and make modifications to performance as the core component of EF. Pennington, Bennetto, McAleer, & Roberts (1996) focused on working memory, that is, the mind’s ability to temporary store and manipulate information necessary for complex cognitive tasks such as language comprehension, learning, and reasoning. Welsh & Pennington (1988) underlined self-control and strategic planning as core functions of EF. Barkley (1997) proposed that there are four executive neuropsychological deficits in children with ADHD including working memory, self-regulation of affect, motivation and arousal, internalization of speech, and reconstitution. Self-regulation of affect refers to emotional self-control, specifically in regards to goal obtainment. Internalization of speech is a term that describes one’s ability to reflect, reason, and govern behavior. Finally, Barkley defines reconstitution as the ability to synthesize and analyze one’s own behavior and fluently and creatively direct one’s behavior in order to obtain goals. All of these characteristics of the EF are consistent with the symptoms found in ADHD as defined by the DSM-IV. In general however, EF includes: planning and organizing; maintaining an appropriate problem solving set to achieve a future goal; inhibiting an inappropriate response or deferring a response to a more appropriate time; representing a task mentally (i.e., in working memory); cognitive flexibility, which is the ability to spontaneously restructure one’s knowledge in response to changing situational demands; and deduction based on limited information (e.g.; Denckla, 1994; Loring, 1999; Pennington & Ozonoff, 1996).

Other research suggests that children with ADHD inattentive type have characteristics that can be described as having a Sluggish Cognitive Tempo (SCT). Data to support this perspective has been gathered from teacher behavioral questionnaires, results from visual search tasks, performance on the Wechsler Intelligence Scale for Children Revised Coding subtest, as well as some emerging research. Hartman, Willcutt, Rhee, and Pennington (2004), obtained parent and teacher ratings of 8-18 year old twins on five potential SCT items. These items included “sluggish/slow to respond, seems to be in a fog, drowsy or sleepy, easily confused, and daydreams/stares into space.” A confirmatory analysis of the data indicated that a three-factor model which included
Inattention, Hyperactivity/Impulsivity, and SCT yielded greater descriptive and diagnostic power, than the current DSM-IV model.

In a study of SCT and reading, Weiler, Bernstein, Bellinger & Waber (2002), examined the reading abilities of children with ADHD inattentive subtype in relation to visual search tasks and auditory processing. Children with both ADHD inattentive subtype and reading disabilities made more classification errors and had longer response time that children who had only ADHD or a reading disability. The findings of the study suggested children who have both ADHD and a reading disability are at a greater risk for reading difficulties than children with ADHD or a reading disability alone, perhaps due to diminished visual and auditory processing speeds.

*Academic Achievement of Children with ADHD*

Many studies have begun to look at the academic achievement of children with ADHD. Barry, Lyman & Klinger (2002) explored academic underachievement of children with ADHD given the discrepancy in their measured cognitive abilities as opposed to their in-class performance. Specifically, children with ADHD combined or inattentive types were examined in regards to their predicted intellectual ability, and their performance on mathematics, reading, and writing tasks. The results of the study indicated that children with ADHD who have more severe symptoms perform at a decreased level as compared to non-ADHD children or children with a lower rates of ADHD behaviors.

Clark, Prior, and Kinsella (2002) examined ADHD children’s word recognition ability, which is the ability to identify the pronunciation and meaning of a word encountered in text. They confirmed that word recognition scores were demonstrated to be significantly lower in children with ADHD, with measured verbal ability being a prime predictor of reading ability. Of note in this study is that children with ADHD were measured in tandem with children who had Oppositional Defiance Order and Conduct Disorder. Out of the three experimental groups, children with ADHD scored lower on word recognition scores, which lends credence to the argument that there is not only a behavioral component to ADHD, but often a specific need for academic intervention (Clark, C., Prior, M., & Kinsella, G., 2002).
Mayfield et al., (2005) set out to examine the effects of behavioral and emotional problems for children with ADHD. Children with ADHD and who were poor readers rated themselves as having high levels of internalized behaviors such as depression, anxiety, and somatic complaints as compared to their peers who demonstrated more average levels of reading. Parent reports indicated a greater concern for inattention, somatic complaints, and delinquent behaviors from children with ADHD who were poor readers. As this research highlights, the academic issues surrounding ADHD are pervasive and often begin with deficient reading skills.

**Emergent Reading Development Skills**

Several prerequisite pre-literacy skills must be present for reading development to occur, including rapid naming, phonological awareness, phonemic awareness, and some degree of long-term memory (i.e., an accumulated fund of knowledge one possesses). Rapid naming is the capacity to name visually presented items, including numbers, colors, objects, and letters (Nelson, Brenner, Gonzales, 2003). Phonological awareness is the ability to perceive sound and utilize the structure of language. Phonological processing refers to a basic understanding of printed text and letter strings, their storage, and the understanding that the syllables and words that are spoken are made up of small segments of sound called phonemes. The development of speech sound identification or phonological processing, serves as a foundation to later reading development. Children usually begin development of phonological processing in infancy and continue to acquire greater sophistication of speech sound identification within the first year of life (Shaywitz, 1998). In general, poor readers have an underdeveloped set of phonological skills (Good & Jefferson, 1998) and have extreme deficits in morphological, syntactic, and semantic domains (Ben-Dror, Bentin, and Frost 1995). Morphology refers to the structure and form of words in language, including inflection, derivation, and the formation of compounds. Syntax is the grammatical arrangement of words in sentences and semantics relates to linguistic meaning.

Children who typically have reading deficits have great difficulty with the acquisition of phonemic awareness, which is the process of purposefully deconstructing words into their component speech sounds. Phonemic awareness is an ontogenetic process, which occurs as a child develops competency in reading. A child with reading
difficulties may experience a lower sophistication of phonemic awareness, which curtails and inhibits orthographic representations, (i.e., correct knowledge of word spelling), from being charted onto spoken language (Tijms, 2004).

Reading occurs when a child has developed sufficient decoding skills. Decoding is the ability to decipher printed words into meaningful spoken language. More specifically, decoding refers to the skill at which one is able to recognize and sound individual phonemes in a printed or written word and then blend those phonemes to form the sound of the word. (Adams, 1990; NRP, 2000; National Research Council, 1998; Simmons & Kame'enui, 1998). Reading comprehension is the primary outcome of decoding proficiency and can be examined as the process and utility by which a child identifies letters, recognizes their phonemic properties, and combines these units of sound into words that have a lucid and coherent meaning.

Comprehension is rooted in orthography, which is the method of representing the sounds of a language by written or printed symbols to the meaning or the interpretation of a word, otherwise called semantics. However, true reading comprehension goes beyond reading fluency. Comprehension is the identification of words as well as the literal and implicit meaning of the particular sentence or passage. Decoding and comprehension are thus two aspects of reading that are interrelated and allied, but are distinctly separate conceptual processes (Snyder, Caccamise, & Wise, 2005; Davis 2004).

Reading fluency is commonly described as the speed and accuracy in which a child can decode a segment of text. According to researchers who study reading fluency, fluency develops with prolonged engagement with a diverse selection of literature and text. Reading that is slow and arduous takes a considerable amount of cognitive processing capacity and leaves little room for comprehension or the processing of the text (Reynolds, 2000). The general method of measuring reading fluency is by recording the number of correct words a child can read through in a minute (Deno et al., 2001).

A growing number of studies are examining the role of prosody in assessing proficiency in reading. Prosody is a linguistic term that can be characterized as the degree of expression a reader uses while reading. Elements of prosody include the proper use of stress or emphasis, pitch variations, intonation, and pausing while reading text (Dowhower, 1987; Schreiber, 1987). Because prosody is not graphically represented in
text, the reader must supply this expression through the use of morphemic, syntactic, semantic, and pragmatic cues. Proper use of prosody may signify the reader’s ability to recognize and signal questions, exclamations, surprise, and other meanings present in text (Osborn, J., Lehr, F., & Hiebert, E, 2003).

Research has repeatedly indicated that practice and repetition of text improves fluency in word identification and decoding skills (Snow et al., 1998). Yet this exposure is less likely to occur once a child has been identified as a slow reader (Allington, 1984; Biemiller, 1977-1978). In the initial reading acquisition process, children with reading difficulties are more likely to experience a reciprocal disadvantage in regards to their educational development (Stanovich, 1986, 1993; Chall, Jacobs, & Baldwin, 1990). Variables such as deficient decoding skills, lack of practice, difficult reading materials, in addition to the slow word recognition processes drain cognitive resources that could be utilized in comprehension (LaBerge & Samuels, 1974; Perfetti, 1985; Stanovich, 1980). As a result, negative practice experiences create an unconstructive experiential knowledge schema for children with deficient reading skills. A child caught in this reciprocal process develops a smaller crystallized knowledge base (i.e., an accumulated fund of knowledge gathered over time) because of low exposure, even when differences in cognitive capacity are accounted for (Stanovich & Cunningham, 1992).

Theories of Reading Development

Many reading theories have been developed in order to accurately describe the process and development of reading. These theories attempt to answer questions regarding how one learns to read, why the process may vary with different individuals, and what teaching methods are most effective. Some of the more prolific names in reading theory include Philip Gough and Wesley Hoover, Kenneth Goodman, and David Rumelhart.

Phillip Gough and Wesley Hoover (1990) described a theory called the simple view of reading, a theory that purported that both language comprehension and decoding are necessary for reading comprehension success. This view asserts that weaknesses in either reading comprehension or reading decoding will result in weak reading comprehension. Crucial to the reading success, a reader must master several related domains, including, language comprehension, linguistic knowledge, phonology, syntax,
semantics, and background knowledge. This background knowledge is composed of various domains such as lexical or word knowledge, phonemic awareness, alphabetic principle, letter knowledge, and other related concepts about print.

Philip Gough’s and Wesley Hoover’s writings are related to a larger body of work called the bottom-up reading model, an approach that emphasizes a unilateral course of development in which the reader acquires a series of literacy skills in learning to read and process text. This unilateral series of skills is hierarchical and seen as a part-to-whole process in which specific phonics-related skills are cultivated and learned, eventually leading to proficiency in reading. In the beginning stages, little emphasis is placed on a reader’s crystallized knowledge base, the contextual information contained within text, or other higher-order processing strategies that aid in reading comprehension (McCormick, T. 1988; Dechant, 1991; Singer & Ruddell, 1985). Rather, this model of reading initially focuses on learning habitual responses to specific graphic shapes (Fries, 1962). These habitual responses are necessary to develop into a competent reader and include: identifying letter features; linking these features to recognize letters; recognizing that letters are composed of sounds, learning to blend and segment letter sounds, combining letters to recognize spelling patterns; linking spelling patterns to recognize words; and finally proceeding to sentence, paragraph and text-level processing (McCormick, T. 1988; Dechant, 1991; Singer & Ruddell, 1985).

In reaction to the bottom-up model, a top-down model that does not involve the decoding of written language to spoken language or processing letters and words was proposed by Kenneth Goodman. Goodman viewed reading as the process of the reader bringing meaning to text. Comprehension rather than decoding is the primary basis for reading and follows a whole-to-part type process (Goodman, 1973). Goodman model emphasized: reading comprehension occurs even if a reader does not recognize every word from a selection of text; a proficient reader uses meaning and grammatical cues to identify words as opposed to understanding phonemes, syntax, and other linguistic components; reading requires the use of comprehension strategies rather than the mastery of a series of word-recognition skills; and that the quantity and quality of information gained through reading is of primary importance (Goodman, 1973; Vacca, Vacca & Gove, 2003)
Goodman also introduced the concept of miscue analysis in order to help describe and understand the reading process (Goodman, 1973). Miscue analysis is a diagnostic tool used to help researchers and teachers gain insight into how a reader approaches text. The purpose of the miscue analysis is to describe observed responses in the reading process that do not match expected responses. He states that a reader’s departure from text is not necessarily a negative aspect of the reading process but rather windows for understanding the reading process (Goodman, 1973).

David Rumelhart proposed an interactive theory, stressing that reading is a combination of perceptual and cognitive processes (Rumelhart, 1973). His theory purported that a reader uses sensory, syntactic, and pragmatic information as well as selective use of information from all sources of meaning including graphemic, phonemic, morphemic, syntactic, and semantics cues to construct meaning from text. Rumelhart’s theory emphasized an interaction between the reader's background knowledge and the text itself, without discounting components of the bottom-up approach (Rumelhart, 1973).

Although there has been much debate as to the efficacy of various reading models, modern teaching methods are typically eclectic in nature. A proficient reader engages with text using various sources of information and phonetic reading skills to produce meaning. These skills consist of sensory, syntactic, semantic, and pragmatic information gleaned from the text in addition to using a complex of comprehension strategies. These particular comprehension strategies assist readers in making sense of how prior knowledge can be applied to information presented in the text, as well as how to use the context of text to assist in the recognition of words and meaning (Singer & Ruddell, 1985).

**Assisted Reading Intervention Strategies**

Various interventions exist in regards to reading instruction for children, of which a number are described here. Particular attention was given to reading interventions that have been reviewed, documented and replicated by empirical research. Although by no means an exhaustive list of techniques and procedures, these studies serve as a foundation to reading interventions in this discussion of the literature.
**The Impress Method**

Heckelman (1969) utilized a process of reading instruction called the Impress Method (IM) for improving vocabulary, reading comprehension, reading rate and accuracy. IM is a reading process in which the teacher and the child read in concert with one another. The teacher sits behind the student reader, directing his or her reading into the ear of the student and instructs the student to slide their finger over each word read. In this way, the child’s visual, oral, and tactile senses are engaged in the reading process. Students instructed via IM are thus exposed only to accurate and correct reading patterns. Heckelman’s original study included a group of 24 students that were three years behind their peers in reading development, but had at least an average performance IQ of 90 on the Wechsler Intelligence Scale for Children. Heckelman employed the IM in fifteen-minute sessions for a total instructional period of seven and a quarter hours over a period of thirty school days. The mean gain in reading comprehension was 1.9 grade levels with varied levels of improvement ranging from 0 to 5.9 grade levels.

Hollinsworth (1970; 1978) attempted to replicate Heckeman’s findings in two studies examining the IM. In his first study, Hollinsworth’s (1970) attempted to document significant effects of the IM on vocabulary, reading comprehension, reading rate and accuracy. Two randomly selected groups of typically developing fourth grade children with no documented reading disabilities were constructed. An alternate form of the IM was employed, utilizing an EFI Multi-Channel Wireless Language System (EFI) in order to prevent teacher voice fatigue and promote economy of time. Essentially, the EFI served as a substitute for the teacher, allowing the child to listen to their own voice as well as a tape recording of the story. Thirty sessions were conducted in which the children in the treatment group read a different story for each 12-15 minute session using the EFI technology. The stories were one grade level below students’ ability for the first portion of the treatment, at grade level for the next phase, and one grade level above for the final phase. No significant results were reported for this study in respect to vocabulary, reading comprehension, reading rate and accuracy.

In another attempt at documenting the usefulness of IM using the EFI technology, Hollinsworth (1978), conducted a second study operating under similar conditions with some noteworthy alternations. Hollinsworth recruited fifth and sixth grade students in
addition to fourth grade students, one remedial student, and expanded the sessions from 30 to 62 for a total of 15 ½ hours of reading time. All other conditions were the same as the original study. The experimental group made a statistically significant mean growth of one year during the semester, as compared to the control group mean score of only 0.4 years of growth, indicating that perhaps the amount of time engaged in IM is important for reading development.

Assisted Reading and Repeated Reading Methods

Rasinski (1990) examined whether Repeated Reading (RR) in conjunction with listening to a fluent reading of the text would generate an effect in general reading skills and automaticity necessary for reading comprehension. Third grade students of equal reading ability were placed in three experimental conditions; reading groups, paired with a student of their own ability level, or independent reading. Each student was categorized as either having a high, average, or low reading ability. Two equivalent passages of one hundred words at the fourth grade reading level were used to insure the passages would be challenging to the students in the three conditions. In the first cycle of the study the children either participated in RR or listening and following along with the teacher as one of the reading passages was reread over a period of four days. The second cycle was the same, with an alternate text being read. Gains in reading speed and accuracy were statistically significant with an overall gain in reading fluency. There was no difference in reading gains between the repeated readings and listening-while-reading conditions.

Rasinski cited drawbacks to the RR method, including observations regarding student fatigue, loss of interest and motivation, and reported that RR may prove to be more labor intensive for teachers providing assistance for initial student reading of text.

Mefferd and Pettegrew (1997) further studied the application of RR on an intermediate-level special education classroom for developmentally handicapped fourth and fifth grade students. Three students with varying ethnic and socioeconomic backgrounds functioning at a beginning reading level participated in RR over a five-month period, where twenty “Curious George” books were read several times during a five-day period. During each five-day phase the students observed the teacher reading with fluency and expression while the teacher moved her finger from word to word across the page. The children each selected five words from the readings that they
wished to learn. Choral reading of the material was conducted during the five-day period and was eventually phased out to independent reading by the end of the week. During the independent readings the teacher encouraged the use of prediction, self-monitoring and self-correction behaviors. Each child scored significantly higher in basic sight vocabulary, word identification, self-confidence and autonomy. The children also demonstrated a reduction in omissions and were more willing to take risks in using spelling cues to attempt words. Various increases in word identification and comprehension scores as well as an increase in fluency and utilization of syntactic cueing were observed.

Dowhower (1987) conducted in a study exploring the effects of RR and assisted reading procedures on the reading comprehension of second grade children. Subjects were selected regardless of reading proficiency, yet stratified groups were formed depending upon reading skill level. Reading problems were defined as a reading rate of less than 50 words per minute on grade appropriate text. Two experimental groups were randomly selected to participate in either assisted or unassisted RR groups. Six basal reading books at the beginning second grade level were rewritten in order to obtain a second grade readability level. In the RR condition, children worked independently reviewing previously read reading passages. In the assisted reading condition, children read along with a tape-recorded passage until they felt comfortable practicing the passage on their own. Students in both the assisted and unassisted RR groups showed gains in word identification accuracy as indicated by a pre and posttest measures. Both the RR and assisted group showed a statistically significant gain in reading comprehension as measured by reading rate and accuracy.

Effects of Technology on Children With ADHD

Few studies have been conducted examining the effectiveness of using Computer Assistive Instruction (CAI) for children with ADHD to improve academic outcomes. However, existing studies have indicated possible connections between CAI and its effectiveness in the classroom. Ford, Poe, and Cox (1993) attempted to examine several different CAI formats on a sample of 21 children identified with ADHD. Two of the four conditions included reading drill and practice and a reading tutorial. Each CAI package included two formats for comparison: game and non-game, playing against computer and
playing with a partner, animated and non-animated graphics, and unlimited time or beat the clock competition. Non-attending behavior of each child was operationally defined as fidgeting, responding impulsively, out of seat, talking to neighbor, and making inappropriate noises. Attention of the children increased significantly on software with a game format, without animated graphics, and with unlimited time to respond.

Kleiman, Humphrey, and Lindsay (1981) used a computer program specifically designed for children with ADHD. The experimental group used the computer program to solve math problems whereas the control group used only paper and pencil to solve equivalent problems. Dependent measures for the study included accuracy, number of problems attempted, and rate of problem-solving using the computer software as opposed to the paper and pencil format. Children using the computer program completed twice as many math problems as compared to the children using paper and pencil only. A greater amount of time was spent working on each problem as compared to the paper and pencil group, without a decrease in speed or accuracy in problem solving. However, no statistical test was used in order to determine the significance or the level of effect and therefore there was no clear understanding as to the relationship between children with ADHD and CAI.

Clarefield and Stoner (2005) examined the use of CAI for three kindergarten and first grade students diagnosed with ADHD and considered at-risk for reading difficulties. An internet-based reading program, Headsprout Reading Basics was used as a CAI tool to supplement instruction for each student. Each lesson is comprised of exercises intended to build phonological awareness through interactive activities focused on early literacy skills. Specific components of the program included animated characters, immediate feedback for each task, and humorous movies interspersed between each lesson. Partial interval time sampling procedures were administered bi-weekly through the use of Headsprout in order to assess changes in on-task behavior. In addition, first grade oral reading fluency probes were used to assess each child’s reading growth. Results indicated significant increases in both on-task behavior and oral reading fluency for each subject involved in the study.

Assisted Reading Software
Some research has indicated that computer software in designing interventions for children with reading deficits. Grant (2004) posits that the use of electronic books may be able to assist reading in students with learning difficulties and help in comprehension of expository text when new terms and factual information is presented. Electronic books are a computerized version of a book, the size of a paperback or legal notepad with back lighted screens that allow a user to read, save, highlight, bookmark, and annotate text. Other studies have indicated that assisted reading software may be used to help increase reading proficiency in children. Assisted reading software is a tool that presents text on a computer screen while simultaneously reading and highlighting the words for the user.

**Scaffolding and Assisted Reading Software Technology**

A framework in which to consider Assisted Reading Software technology can be viewed through the theoretical perspective of socio-constructivist Lev Vygotsky. Vygotsky determined knowledge to be socially constructed by the individual before it can become internalized. In this perspective psychological and physical tools bring knowledge and language from existing on an external plane to the internal plane of the child (Vygotsky, 1979). However, a simple provision of these mediating tools does not insure that learning will occur (Reid-Griffin & Carter, 2004). Vygotsky posits that only through a “zone of proximal development” can an individual truly begin this process of internalization. The zone of proximal development occurs when the upper limit of what a child can perform independently intersects with the upper limit of what she or he can perform with the assistance of a skilled helper. This assistance can come in various forms including provision of cues, cognitive strategies, practice opportunities and explanations (Vygotsky, 1979). Bruner was the first to use the word “scaffolding” to describe this process of assistance and stated that a balance must be struck between providing assistance and withholding help (Bruner, 1974). An excess of assistance will lead to little learning whereas not enough assistance often provokes frustration (Reid-Griffin & Carter, 2004). Opportunities for improvement in reading using scaffolding procedures are potentially available to children via use of technology such as Assisted Reading Software.

**Assisted Reading Software Research**
Montali and Lewandowski (1996) investigated the potential benefits of text to speech technology for average and less skilled readers. They hypothesized that a bimodal presentation of text would increase the amount of exposure to text and strengthen sound-symbol associations. Fifteen eighth and ninth grade students with below average reading skills participated in the study. All students scored in the average IQ range using the Wechsler Intelligence Scale for Children – Revised and between the 45th and 60th percentile of the reading portion of the Iowa Test of Basic Skills. The Reading Comprehension and Decoding subtest of the Kaufman Test of Educational Achievement were administered as additional measures of reading achievement. Nine reading passages from grades 6, 8, and 9 as calculated by the Fry Readability Graph. Text was presented to each respective reader via three conditions: visual, auditory, and a bimodal presentation. In the visual presentation, the student read the passage as it appeared on the screen. In the auditory condition, the text was read via a prerecorded voice via a computer speaker. In the bimodal presentation text was highlighted word by word on a computer screen and the prerecorded voice read the passage in tandem with the student. After each condition, the student was presented with ten reading comprehension questions. Three sessions of thirty to forty minutes were conducted. Montali and Lewandowski reported that struggling readers performed as well as average readers when text was presented in the bimodal fashion such as assisted reading software affords.

Disseldorp and Chambers (2002) studied the effects of assisted reading software on thirty-four ninth grade students. The subjects were readers with a range of abilities and varying levels of academic performance. In the first stage of the study, the subjects read text without assistance in order to obtain baseline levels of reading comprehension. The subjects then read text without assisted reading software and answered comprehension questions regarding what they had read. Finally, in the third stage, the subjects read text with assisted reading software and were again asked to answer comprehension questions from the text. The result indicated an overall statistically significant improvement in comprehension, with poorer readers benefiting more than proficient readers. Disseldorp and Chambers indicated that the aural and printed presentation of the assisted reading software elevated the reading comprehension
performance of students with low reading abilities and decreased the performance of more proficient readers.

However, not all studies have replicated significant results with technology similar to assisted reading software. Leong (1995) examined the effect of assisted reading software on reading comprehension using reading comprehension questions and passage retell, a method of assessing reading comprehension via verbal summaries of a passage. The study included 64, 68, and 60 students in grades 4, 5, and 6, respectively. Before the study commenced, each student was administered a battery of reading tests, categorizing the students based on their reading skills. In this way, a main effect for grade and reading ability could be documented. Expository passages, estimated to be at approximately the 6th grade level according to the Writers Work Bench were used. In two sessions that were several weeks apart, the students participated in reading on-line text while simultaneously listening to the same text being read. There were significant differences in reading scores across ages and ability levels, but no significant reading effects were found in the text to speech conditions.

Hecker et. al., (2002) performed an exploratory study to investigate the effects of the Kurzweil 3000 on college students with an ADHD diagnosis. Included in the study were 12 male and 8 female subjects, 19 of which scored in the average to superior range of the Wechsler Adult Intelligence Scale - III Verbal and Full Scale indices. Thirteen of the subjects were regularly taking physician prescribed anti-stimulant medications in order to alleviate ADHD symptoms. In addition, 25% of the subjects were classified for the purposes of this study as having a reading disability as indicated by a combination of either their scores on the Gray Oral Reading Test-3 or by formal pre-existing documentation. A single group experimental design was used in which baseline data was gathered and then Kurzweil 3000 treatment was implemented. Several dependent variables were evaluated including reading speed and comprehension, distractibility and fatigue while reading. Variables were measured using self-assessment, independent reading logs, questionnaires and results of the Nelson-Denny test which measures reading rate and comprehension. Statistical analysis indicated that were able to maintain greater attention levels and reduced fatigue and stress while reading, and increased reading speed. However, reading comprehension scores improved for some students but
decreased with others. Hecker et. al., (2002) stated that the failure to achieve significant results for comprehension may be attributed to intervening variables associated with the method of evaluating reading comprehension data.

**Purpose**

The purpose of this study is to document potential effects that using the Kurzweil 3000 as an assistive reading accommodation may have on the reading fluency and comprehension of elementary school children who have ADHD and a reading disability.

Technology used to facilitate assistive reading methods such as stories on cassette tape and EFI listening devices have frequently been used to improve children’s reading in schools (Hollinsworth, 1970; 1978; Rasinski, 1990). The Kurzweil 3000 is also currently being used in numerous schools as a tool to facilitate supplemental instruction in reading. However, little research has been done in which the Kurzweil 3000’s effects as part of a reading program are scientifically examined. Due to a lack of studies that have sufficiently explored or examined the Kurzweil 3000’s affects on children with ADHD or children with reading problems at the primary level, attention towards this line of research has become increasingly important.

Questions that need to be explored include:

1. Will the use of Kurzweil 3000 software as part of a reading program improve oral reading fluency growth rates in elementary children?
2. Will use of Kurzweil 3000 software as part of a reading program lead to improved oral reading fluency in third and fourth grade students on standardized school administered curriculum-based measures?
3. Will prolonged exposure and use of Kurzweil 3000 software as part of a reading program improve reading comprehension in elementary children?
4. Will on-task behavior increase during classroom reading time after use of use of the Kurzweil Kurzweil 3000 software as part of a reading program?
5. Will children with attention and reading difficulties exhibit a change in reading prosody after using Kurzweil 3000 software as part of a reading program?
6. Will there be an increase in the executive functioning processes in the child after use of Kurzweil 3000 software as part of a reading program?
CHAPTER III
Methodology

Subjects and Recruitment

Subjects included two third graders (Abby and Louis) and two fourth graders (Ben and Dennis), each a student from a local public elementary school. Students were selected through a referral list provided in a collaborative arrangement by the building level principal, the reading specialist, and respective classroom teachers. The subjects were then selected based on meeting criteria in both areas of attention and reading.

Criteria for Subject Selection-ADHD

ADHD is a medical diagnosis, and as a result access to diagnostic information through schools is protected through The Family Educational Rights and Privacy Act (FERPA). However, special attention was given in assuring that each student had attentional difficulties: First, each subject was nominated by their teacher and the building level principal as having a history of behaviors that were consistent with ADHD as defined by the DSM-IV. Secondly, each subject’s guardian or parent confirmed in writing that an ADHD diagnosis with an inattention subtype had been made by either a physician or an otherwise qualified medical professional.

Criteria for Subject Selection-Reading Disability

In addition to an ADHD diagnosis, subjects were selected based the presence of a documented reading disability. School personnel had previously assessed each subject in accordance with state and school law. Standard measures of assessment were used in documenting the existence of a reading disability, including: Criterion referenced test batteries, curriculum-based measures, teacher interviews, reviews of school records and academic work, and structured and unstructured interviews of appropriate school staff.

Materials

Assistive Reading Software

The assisted reading software used in this study was the Kurzweil 3000 (Kurzweil Educational Systems, 2002). This software was provided by the manufacturer for the duration of the study and was loaded onto laptop computers in the school. Kurzweil 3000 was selected because the product was explicitly designed to improve reading speed and comprehension. Essentially, the product reads and highlights electronic text that can be
accessed directly from the Internet, Word and PDF documents, or scanned documents using an electronic scanner. The synthesized voice is of high quality and has human like characteristics. Reading speed can be made to vary based on a student’s ability and preference level. A student can use a number of reference tools such as a recursive dictionary option that defines a word that a student might trouble delineating, a list of synonyms, and spell check. The software also provides a highlighting tool that can be used to select a word and have the word pronounced and broken up into syllables.

**Baseline and Treatment Reading Passages**

Reading passages were developed from the Ginn Reading Series (Clymer, Indrisano, Johnson, Peason, & Venezky, 1987) in accordance with guidelines suggested by Shinn (1989). The reading passages contained less than 150 words each and were created using the extended version of the Fry "Readability Graph" (Fry, 1977). Fry readability levels are determined by analyzing the number of words and sentences per 100 words.

**DIBELS Reading Measures**

The curriculum-based measurement instrument the Dynamic Indicator of Basic Early Literacy Skills 6th Edition (DIBELS), was employed as a secondary measure of each child’s reading ability at the time of the study. Specifically, the DIBELS Oral Reading Fluency (DORF) subtest was used as a summative growth analysis tool. The DORF is an evidenced based standardized component of the DIBELS battery with precise administration procedures that gauge reading fluency and accuracy using a grade appropriate text for elementary students. The DORF is designed to calculate a child’s reading performance as well as growth in reading levels throughout the duration of the school year. Three reading passages less than 250 words each were provided for the subjects during the DORF assessment.

**Maze and Question Passages**

Fuchs and Fuchs (1992) have determined maze passages to be a basic measure of reading comprehension. Adhering to guidelines provided by the Fuchs, maze passages were created from passages found in the Ginn Reading Series (Clymer, Indrisano, Johnson, Peason, & Venezky, 1987). In the maze reading procedure the first and last sentence remain intact whereas every seventh word in each remaining sentence has been
deleted and replaced with a blank. The reader must select between the correct word and two distracter words to complete each phrase in the reading passage. The two distracter words are either semantically or syntactically incorrect.

Question passages were also created from the Ginn Reading Series as well (Clymer, Indrisano, Johnson, Peason, & Venezky, 1987). Intersentential, inferential, and literal question types were created in order to observe each student’s ability to comprehend various elements of the text. Intersentential questions are designed to access a student’s ability to understand and integrate across-sentence information (McKenna & Layton, 1990). Inferential questions require the reader to combine prior knowledge with information in the passage in order to deduce the correct response. Finally, literal questions require the reader to locate or recall a specific piece of information from an exact part of the text (Davey & McBride, 1986).

**Behavior Observation System**

On-task and off-task behavior of each subject was measured during classroom reading times via the Behavior Observation System (BOS) protocol (Jones, Wickstrom, & Friman, 1997). The BOS is a momentary time sampling observation procedure, which allows an analysis of information to be gathered about a child’s behavior within a short duration of time. The BOS is used in tandem with a prerecorded ten-second-interval cassette tape, an audiocassette recorder, and an earpiece. During observations, the 10-second auditory prompt provides the observer with a cue to record predefined behaviors.

**Prosody Rubric**

A prosody rubric adapted from the National Center for Educational Statistics was used in order to assess prosody levels for each subject (see Appendix B). The rubric is composed of four levels with four components that reflect various degrees of proficiency in prosody. The scale was developed to assess a reader’s awareness of meaningful phrase groups, knowledge of syntax, and skill in expressive interpretation.

**Delis-Kaplan Executive Function System**

Assessment of each subject’s EF skills was completed using the Sorting Task subtest of the Delis-Kaplan Executive Function System (D-KEFS). The D-KEFS is a test battery designed to assess cognitive abilities associated with the EF such as basic reasoning and concept formation skills. Concept formation skills refer to an individual’s
ability to integrate a series of features in order to form a class of ideas or objects. The test instrument was designed as a series of measures that can be administered independent of one another.

Data included in the D-KEFS Technical Manual provide significant evidence as to the instrument’s reliability and validity. The D-KEFS was standardized on a sample of 1750 subjects matching the demographic characteristics of the 2000 U.S. Census figures, with the relevant stratified standardization occurring for individuals between 8 to 15 years old. Internal reliability of the D-KEFS ranges from .57 to .81, overall, with the Sorting Task exhibiting lower rates of reliability because of the interdependence of the component items. Test-retest reliability is generally robust, although variable depending upon age and subtest. Part-whole correlations exist across subtests in the D-KEFS, such as the Sorting Task, indicating subtest validity. However, concurrent validity is low with other neurocognitive tests including the California Verbal Learning Test-Second Edition and the Wisconsin Card Sorting Test.

Scores from the Sorting Task are organized into Composite Scaled Description Scores and Contrast Scaled Scores and are converted into age-correlated scaled scores with a mean of 10 and a standard deviation of 3. Composite Scaled Description Scores are indicative of a subject’s reasoning and concept formation skills. The Contrast Scaled Score is a measure designed to determine if adequate concept-formation skills are preset for a subject, in addition to teasing out an inability to channel this knowledge into behavior when required to do so. According to the D-KEFS Examiner’s Manual, the most likely explanation for lower scores on the CSDS are inaccurate and deficient concept formation skills, resulting in a high number of incorrect responses. Lower scores on the CSS indicator are likely for examinees who: possess a vulnerably to distractibility and cannot concentrate on the sorts generated by the test administrator; focus on only one of the sorting rules employed by the test administrator and persevere in incorrect responses; or have deficiencies in initiation and concept formation skills.

Procedures

Parents of the subjects were approached by the school district and asked to allow their child to participate in a study exploring the efficacy of Kurzweil 3000 as part of a structured reading program. Parents were informed that the study’s purpose was to
investigate how using the Kurzweil 3000 in conjunction with a structured reading program might affect their student’s reading and attentional difficulties. Signed parental consent was obtained for each student who participated in the study (See Appendix C) as well as information regarding each subject’s ADHD diagnosis.

*Generalization Measures*

Before treatment commenced, a number of generalization measures were administered to determine how use of Kurzweil 3000 as a supplemental tool might impact associated areas related to reading and attention. These measures were conducted prior to treatment and baseline data collection procedures, and once again after treatment was completed. Assessment methods that contribute directly to instructional design such as maze, comprehension questions, and time on-task, are best practice in school psychology for documenting a child’s response to intervention and are consistent with the language contained within special education law (Reschly, Tilly & Grimes, 1999; Shinn, 1998, Jones & Wickstrom, 2002). Maze procedures were utilized per recommendations provided in Ardoin et. al. (2004), in which maze passages are considered to provide supplemental information for outcomes associated with curriculum-based measurements such as DORF. Reading comprehension questions were devised in line with criteria set forth by Dewitz & Dewitz (2002) for assessing and documenting reading comprehension. Research has indicated academic learning time and the amount of time in which a child is actively and productively engaged in learning directly influences academic outcomes (Gettner & Seibert, 2002; Gettner & Stoiber, 1999). Data regarding on-task behavior was gathered using a model similar to the one reported in Clarefield and Stoner (2005).

The DORF curriculum-based measurement instrument, was employed as a pretest and posttest appraisal of each subject’s current reading ability as compared to his or her peers. Students were allowed exactly one minute in which to read each passage. The DORF reading passages were scored using the following standardized procedures: Errors were scored as omissions, substitutions, and hesitations for three seconds or longer on a word. Self-corrections to a word were scored as correct. The final oral reading fluency score was calculated by selecting the median correct words per minute (CWPM) for all three passages (Shaw & Shaw, 2002). The school reading specialists collected these data
during the fall, winter, and spring norming cycles. These data were only collected for the third grade subjects, as fourth grade student DORF data was not available.

Reading comprehension was assessed for each subject using a maze reading passage as well as a passage with subsequent comprehension questions. Standard instructions were administered in which students completed the maze passage untimed. In addition, reading comprehension was measured by questioning in which a reading passage was presented followed by intersentential, inferential, and factual questions, wherein the subject reviewed the story for answers.

On-task and off-task behavior of each subject was measured using the Behavior Observation System (BOS) protocol. Observations were conducted during twelve-minute class wide silent reading times. Behavior was coded dependent upon whether a student was on or off-task. On-task behavior was defined as those times when the subject was actively attending to reading (e.g., book open and eyes directed at the page). Off-task behavior was defined as those times the subject was not engaged in reading behavior. Examples of off-task behavior included talking to another student, looking around the room, or flipping through the pages of a book at a very rapid pace. A topographical analysis of verbal and motor off-task behavior was conducted in order to evaluate student behavior during each reading observation session.

A prosody rubric was used in order to assess each subject’s ability to read with stress and emphasis, pitch variations, intonation, and appropriate pausing. Each subject was recorded with an audiocassette recorder during pretest and posttest sessions while reading a grade level narrative passage. An independent rater scored both the pretest and posttest readings using a prosody rubric. The independent rater used a single-blind procedure in which they were uninformed as to which readings were recorded after or before treatment. The independent rater marked items from the rubric on a scale of one to four, which best characterized each reader’s appropriate use of expression used while reading.

A measure of attention was conducted using the Delis-Kaplan Executive Function System (D-KEFS) Sorting Task. The test consists of two conditions: (1) Free Sorting where the subject is asked to sort the cards into two groups, with three cards in each group and (2) Sort Recognition where the test administrator sorts the cards into two
groups with three cards in each group. During the Free Sorting the subject is asked to provide a description of their sort. The subject identifies and describes correct rules for each sort done by the administrator during the Sort Recognition. Assessment occurred for all subjects as a pretest and posttest appraisal of the child’s current level of executive functioning.

Oral Reading Fluency Measure

Oral reading fluency was assessed bi-weekly prior to treatment using three grade level appropriate reading passages for each session. Reading fluency was measured using procedures that mirrored the DIBELS DORF assessment tool. Treatment commenced for each subject using a staggered baseline-across-subjects treatment design.

Treatment

After baseline and generalization measures were collected, subjects were trained in using the Kurzweil 3000. Subjects were instructed in how to use the synthetic speech option and the recursive dictionary, as well as the synonym and pronunciation tools. Subjects were instructed to alter reading speed of the synthetic voice to preference.

During the 30-minute bi-weekly sessions, each subject read narrative and expository reading passages using the Kurzweil 3000 synthetic voice option. Subjects were also allowed to access the recursive dictionary and the synonym and pronunciation tools if necessary. Subjects used a library of high interest reading passages in which they were allowed to choose the stories they read during 42% of the treatment sessions. Stories were randomly selected for the students during the other 58% of the treatment condition. Measures of reading fluency were collected each day using the median score three grade level Fry reading passages in order to establish growth rates. A reading log was used to trace each student’s performance during the treatment phase. Specifically, time spent reading during treatment, the specific story read by the subject, and the date and time of the treatment were recorded.

Reliability

To assess the reliability of the curriculum-based measurement scores for reading fluency, a second examiner independently scored 31 % of the readings during the baseline condition and 34 % during the treatment condition. The reliability of the two
observers was calculated by dividing the lower estimate by the higher estimate, and multiplying by a 100. The mean reliability was 98% (range, 91 to 100%).
Chapter IV
Results

Results were organized to match the original questions derived from the literature review. These questions were designed to explore the effects of using Kurzweil 3000 in a structured reading program on various components related to reading and attention for the third and fourth grade subjects included in this study. These results include analyses of multiple variables, including: oral reading fluency growth rates, oral reading fluency as measured by standardized school administered curriculum-based measures, reading comprehension, on-task behavior during classroom reading times, reading prosody, and executive function.

Question I: Will the use of Kurzweil 3000 software as part of a reading program improve oral reading fluency growth rates in elementary children?

The data were analyzed in terms of growth rates, adjusted effect size, and percentage of non-overlapping data. Growth rates were determined by calculating the average number of words per week each student was able to cumulatively add to their original baseline. Adjusted effect size was calculated in order to document the magnitude of the treatment effect according to a formula derived from the literature (Swanson & Saches-Lee, 2000). The percentage of non-overlapping data was calculated by ascertaining the percentage of treatment scores that fell above the baseline rate (Scruggs et. al., 1987). Figure 1 {1.1, 1.2, 1.3, 1.4} describes the individual results for each respective statistical measure.

Abby’s individual performance indicated general gains in reading fluency. During baseline, Abby’s average oral reading fluency rate was 83 Correct Words Per Minute (CWPM). During the treatment condition, Abby’s average oral reading fluency rate was 99 CWPM. The highest score obtained during the intervention was 86 CWPM during the 4th session of treatment. The growth rate obtained during the intervention was 3.66 CWPM per week. Visual inspection indicated that use of the Kurzweil 3000, as part of a reading program was initially successful. During the treatment phase of progress monitoring the percentage of non-overlapping data (PND) points achieved was 100 %. In addition, the effect size treatment condition was 1.3.
Lewis’s performance also indicated a general trend in reading performance over the course of using the Kurzweil 3000 as part of the structured reading program. During baseline, Lewis’s average oral reading fluency rate was 27 CWPM. During the treatment condition, his average oral reading fluency rate increased to 35 CWPM. The highest score obtained during the intervention was 46 CWPM during the 12th session of treatment. The growth rate obtained during the intervention was 2.4 CWPM per week. Visual inspection indicated that use of the Kurzweil 3000 as part of a reading program was initially successful. During the treatment phase of progress monitoring the percentage of non-overlapping data (PND) points achieved was 77%. In addition, the effect size treatment condition was 2.1.

Denny’s reading performance was highly variable across both baseline and treatment conditions. During baseline, Denny’s average oral reading fluency rate was 104 CWPM. During the treatment condition, his average oral reading fluency rate increased to 120 CWPM. The highest score obtained during the intervention was 162 CWPM during the 11th session of treatment. The growth rate obtained during the intervention was 7.7 CWPM per week. However, due to the variability in Denny’s performance, this summary statistic should be viewed with caution. Visual inspection indicated that use of the Kurzweil 3000 as part of a reading program was initially successful. During the treatment phase of progress monitoring the percentage of non-overlapping data (PND) points achieved was 75%. In addition, the effect size treatment condition was .94.

Ben’s reading performance was also highly variable across both baseline and treatment conditions. During baseline, Ben’s average oral reading fluency rate was 44 CWPM. During the treatment condition, his average oral reading fluency rate increased to 57 CWPM. The highest score obtained during the intervention was 72 CWPM during the 2nd and 6th sessions of treatment. The growth rate obtained during the intervention was 3.53 CWPM per week. Ben’s growth rate performance also should be viewed with caution. Visual inspection indicated that use of the Kurzweil 3000 as part of a reading program was initially successful. During the treatment phase of progress monitoring the percentage of non-overlapping data (PND) points achieved was 100%. In addition, the effect size treatment condition was 1.35.
Question II: Will use of Kurzweil 3000 software as part of a reading program lead to improved oral reading fluency in third and fourth grade students on standardized school administered curriculum-based measures?

Oral reading fluency data for the third grade subjects were collected using DIBELS standardized procedures during the winter and spring benchmark periods in which this study was conducted. Data from the fall period in which DIBELS oral reading fluency data was also collected for further data analysis. Table 2 summarizes the results of this indicator.

During the fall data collection period Abby read 76 CWPM. Oral reading fluency for the winter period indicated that Abby had decreased to 64 CWPM. Data collected during the spring benchmark, which coincided with the end of the treatment period of this study, indicated an increase of 89 CWPM for Abby. This was an overall gain 25 CWPM between the Winter and Spring benchmark.

Lewis read 17 CWPM during the fall DORF data collection period. Oral reading fluency for the winter period indicated that Lewis had improved to 24 CWPM. Data collected during the spring benchmark, which again coincided with the end of the treatment period of this study, indicated increases for Lewis of 35 CWPM. This was an overall gain of 9 CWPM between the Winter and Spring benchmark.

Question III: Will prolonged exposure and use of Kurzweil 3000 software as part of a reading program improve reading comprehension in elementary children?

Individual performance for reading comprehension is summarized in Figure 2 {2.1, 2.2, 2.3, and 2.4}.

During maze pretest procedures, Abby provided the correct response 77 percent of the time. This percentage slightly decreased to 75 percent during posttest data collection. During the questioning pretest procedure, Abby provided the correct response 70 percent of the time. After treatment Abby’s performance improved to 90 percent.

During maze pretest procedures, Lewis provided the correct response as 55 percent of the time. Lewis’s performance on the maze procedure increased to 96 percent during posttest data collection. During the questioning pretest procedure, Lewis provided the correct response 60 percent of the time. After treatment Abby’s performance improved to 80 percent.
During maze pretest procedures, Denny provided the correct response 100 percent of the time, a rate that remained stable during posttest data collection. During the questioning pretest procedure, Denny provided the correct response 100 percent of the time. After treatment Denny’s performance on the questioning procedure fell to 80 percent.

During maze pretest procedures, Ben provided the correct response 57 percent of the time. This percentage increased slightly to 63 percent during posttest data collection. During the questioning pretest procedure, Ben provided the correct response 50 percent of the time, a rate that remained stable during posttest procedures.

Question IV: Will on-task behavior increase during classroom reading time after use of the Kurzweil 3000 software as part of a reading program?

Data regarding on-task behavior during reading is also summarized in Figure 2 (2.1, 2.2, 2.3, and 2.4). On-task behavior measured during the pretest period revealed a group mean of 57 percent (range, 47 to 72). Posttest procedures fell to a mean level of 54 percent (range, 40 to 75).

Question V: Will children with attention and reading difficulties exhibit a change in reading prosody after using the Kurzweil 3000 software as part of a reading program?

Data regarding reading prosody is summarized in table 3. Pretest data indicated a significant range in prosody scores (1-3), however, zero of four subjects exhibited significant gains in reading prosody after using the Kurzweil 3000. Prosody for Lewis and Ben was described as: reading most of the pretest and posttest stories word by word; repeating or missing too many words; not emphasizing important words or phrases; and not reading with expression. Abby read the pretest and posttest stories with 3 to 4 word phrases and repeated and missed only a few words. However her reading was devoid of expression with little emphasis placed on important words and phrases. Denny read most of the pretest and posttest stories in 3 to 4 word phrases and repeated or missed only a few words. He also emphasized important words or phrases and read the stories with some expression.

Question VI: Will there be an increase in the executive functioning processes in the child after use of Kurzweil 3000?
Data regarding executive functioning of each subject during pretest and posttest procedures is summarized in Table 4. Results are described as Composite Scaled Description Scores (CSDS) and Contrast Scaled Score (CSS). Composite Scaled Description Scores are indicative of a subject’s reasoning and concept formation skills. During both the pretest and posttest phases, Abby performed significantly lower than her peers on the CSDS measure, with a slight increase occurring during the posttest procedures. Abby’s score on the CSS measure was a 10 during the pretest and was slightly lower during the posttest. Lewis’s CSDS and CSS scores improved markedly between pretest and posttest procedures. Lewis scored a 5 on the CSDS during pretest and improved to a score of 9 during the posttest. His CSS improved from 5 on the pretest to a 10 on the CSS during posttest measures. Ben improved both his scores on the CSDS and the CSS from pretest to posttest procedures as both his scores were above the mean standardization sample. Finally, Denny’s scores also improved on both the CSDS and CSS measures. The mean group score for CSDS was 5 (range, 1-8) during pretest procedures. The posttest phase revealed increases where all of the subjects with the exception of Abby improved to within one standard deviation of the mean standard score. During the posttest phase the mean group score for CSDS was 8.25 (range, 2-13).

The Contrast Scaled Score is a measure designed to determine if adequate concept-formation skills are preset for a subject, in addition to teasing out an inability to channel this knowledge into behavior when required to do so. During the pretest phase, only Lewis and Denny performed significantly below the mean standard score. The mean group score for CSS was 6.75 (range, 4-10) during pretest procedures. The posttest phase revealed increases for all of the subjects with the exception of Abby. For the posttest, every subject scored within one standard deviation of the mean standard score with the exception of Denny. During the posttest phase the mean group score for CSS was 8.5 (range, 5-11).
Chapter V

Discussion and Conclusion

The purpose of this study was to explore the use of the Kurzweil 3000 as a tool in providing assistive reading instruction to four elementary age children with reading and attention difficulties. During the 30-minute bi-weekly treatment sessions, each subject read grade level narrative and expository reading passages using the Kurzweil 3000 synthetic voice option. General gains in oral reading fluency were observed throughout treatment. In addition, generalization measures indicated varying gains in reading comprehension. On-task behavior, however, decreased for the subjects during posttest data collection procedures. In general, results provide initial support to implementing Kurzweil 3000 as supplemental instruction with students who have reading and attention difficulties.

These results were similar to those found for high school and college age subjects (Disseldorp & Chambers, 2002; Hecker et. al., 2002). Disseldorp and Chambers (2002) found that the simultaneous presentation of text and an assistive synthetic voice benefited reading comprehension for ninth grade students with poor reading skills. Hecker (2002) found that use of the Kurzweil 3000 increased reading speed, but lead to inconsistent gains in reading comprehension for college level students.

Reading fluency growth rate results can be interpreted through data provided in the literature. Deno, Fuchs, Mearton, & Shin (2001) collected normative data on 5 effective treatment studies using reading growth rates for students with learning disabilities. Mean improvement for students, grades 2 through 6, was +1.39 CWPM each week. Growth rate means were further broken down by grade, with “ambitious goals” cited as 1.5 and 1.1 CWPM each week for grades three and four, respectively. Abby, Lewis and Ben exceeded these estimates substantially, indicating strong support for the use of Kurzweil 3000 as a potentially effective intervention for improving reading fluency in third and fourth grade children with reading and attention problems.

The DORF data can be interpreted by examining its imbedded system-wide percentile rankings. These percentile rankings are used to determine the level of risk each student has for potentially poor reading outcomes (Good, Wallin, Simmons, Kameenui, & Kaminski, 2002). Students in the third grade are considered “at-risk” or
“some risk” with ORFs below 67 CWPM, or 92 CWPM respectively. Both Lewis and Abby made substantial gains in reading fluency as calculated by the DIBELS third grade ORF measure. Although Lewis still remains in the “at-risk” descriptor, Abby fell just three words shy of reaching the “low risk” category. Assessment data gathered using the DIBELS measures provide corroborating evidence that use of Kurzweil 3000 in a structured reading program may have contributed to reading fluency gains for both Abby and Lewis. Again, DIBELS data was not available for either Denny or Ben.

Individual performance on maze and questioning procedures was inconsistent; therefore the use of Kurzweil 3000 as an assistive device in a structured reading program for increasing reading comprehension in students with reading and attention difficulties remains unclear. Although many studies have concluded (Deno, Mirkin, & Chiang, 1982; Fuchs, Fuchs, & Maxwell, 1988; Jenkins & Jewell, 1993) reading fluency and comprehension to be highly correlated to each other, a deficit in reading fluency may pose as only one of many barriers prohibiting children from extracting meaning from text. Use of Kurzweil 3000 may be most beneficial when incorporated into a multifaceted approach of evidenced base interventions in addressing reading comprehension difficulties.

On-task behavior during reading time fell substantially for two out of the four subjects involved in the study. Both Abby and Lewis’s on-task behavior fell to a rate of 42%, whereas Ben and Denny increased to a rate of 66%. The rate of on-task behavior can best be interpreted by taking into account grade level norms found in the literature. According to Shapiro (2004), the typical third grade student is expected to be on-task at least 69% of the time. On-task behavior for fourth grade students is expected to be 74%. Therefore, the results of the on-task behavior observations can best be described as conflicting and inconsistent.

There are numerous intervening variables that could account for the precipitous drop in on-task behavior exhibited by two of the subjects after treatment, some of which can be found in the literature. Burns and Dean (2005) examined the on-task behavior of students with ADHD and a learning disability during reading drill tasks. They found that the higher the number of unknown words present in the drill reading task, the higher the percentage of off-task behavior. Burns and Dean’s study highlights the need for teaching
students at their instructional level in order to promote on-task behavior. The posttest formal observations of this current study could have possibly occurred while both Lewis and Abby were reading new and unfamiliar reading material. Another possible explanation for the drop in on-task behavior during reading could exist in the context of the observations, which occurred in the last week of school before summer break. Abby and Lewis may have experienced lower rates of on-task behavior due to potentially distracting end of the year events occurring within the school.

The results of the prosody assessment indicated that there was not a significant advantage to using Kurzweil 3000 as a tool for improving reading prosody. The literature indicates that prosody is generally improved by providing a struggling reader with a model that reads with expression, providing students with practice opportunities to assist in acquiring prosodic intonations, and appropriate feedback (National Reading Panel, 2000). The results of this study may indicate that a synthesized voice may not be a sufficient model for improving prosodic reading with a struggling reader. In addition, because the treatment design did not employ practice opportunities, it seems likely that practice with feedback would be necessary to expect any significant gains in this area.

The results of the D-KEFS indicate that all the subjects (with the exception of Ben) may have had deficits in their EF ability prior to treatment. The specific skills required to complete the Sorting Test are similar to the definition of EF provided by McAleer and Roberts (1996). Specifically, the subjects were required to temporarily store and manipulate information to complete complex cognitive tasks. The Sorting Test also required the subjects to restructure their responses based on the changing situational demands. Finally, the Sorting Test necessitated the subjects make deductions based on limited information provided by the test administrator in the subtest instructions (e.g.; Denckla, 1994; Loring, 1999; Pennington & Ozonoff, 1996). The use of the Kurzweil 3000 imbedded in a structured reading program may have significantly improved the EF of three of the four subjects as measured by the D-KEFS.

Limitations

There were a number of limitations in this study. First, the results of this study cannot be generalized because the small number of subjects was not representative of a larger population. The effects of Kurzweil 3000 as an assistive reading tool may vary
greatly based upon the nature of a child’s learning disability, intensity of ADHD symptoms, as well as other individual characteristics. Secondly, there was no inter-observer agreement for on-task behavior during the pretest and posttest observations, thus creating the potential for scorer error and the inaccurate assessment of on-task behavior. Third, all components of the study were implemented by one person. The increase in the dependent measures may be partly due to a level of rapport established by the researcher and the subjects. Fourth, data was not available regarding the details of each subject’s ADHD diagnosis. It is possible that one or more of the subjects were inappropriately labeled as having ADHD. Fifth, the school in which the data was collected was undergoing remodeling, therefore there was a variable level of noise and other potential distractions on a day-to-day basis. Finally, on a related note, many of the posttest data was collected during the final week of school prior to summer break. These data may be skewed depending upon the degree of distraction these final school days posed for each subject.

Summary

In this present study, we examined the use of Kurzweil 3000 as a tool in improving reading fluency and associated generalized outcomes in a structured reading program. It must be noted however, that the Kurzweil 3000 was designed to be imbedded with classroom curriculum and associated activities. In this current study, we moved the Kurzweil 3000 program out of the context it was designed for to specifically test its efficacy as a tool in a structured reading program. Therefore, the traditional use of the Kurzweil 3000 and other similar computer programs in schools may provide different reading outcomes than was reported here.

Schools and other learning institutions must carefully weigh and examine the use of technology such as the Kurzweil 3000. Clark (1994) asserts that technology provides no learning benefits, and should be viewed as a means for delivering a particular instructional method. He further states that if two treatments have similar results in achieving a particular learning goal, they must possess similar properties. Consequently, the more economical and less expensive treatment must be selected. Still, many important questions remain in understanding the economy of using Kurzweil 3000 as a means of supplementary instruction. What individual characteristics impact one’s
responsiveness to computers as a tool for intervention? Also, how might a child’s ability
to attend to reading differ when being provided instruction from a human instructor as
compared to using a computer as an assistive device? Finally, how might children
benefit from incorporating other evidenced-based intervention strategies with an assistive
reading tool, such as the Kurzweil 3000?

Technology’s role in reading intervention presently remains unclear due to a
paucity of studies examining the efficacy of such programs. Although many questions
still need to be addressed, optimism exists as initial results have demonstrated the
potential use of technology as a tool for improving reading performance in children.
References


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Appendix A

Tables

Table 1.  
*Mean Difference Between Baseline and Treatment CWPM*

<table>
<thead>
<tr>
<th>Student</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby</td>
<td>83</td>
<td>98</td>
</tr>
<tr>
<td>Lewis</td>
<td>26</td>
<td>32</td>
</tr>
<tr>
<td>Ben</td>
<td>55</td>
<td>61</td>
</tr>
<tr>
<td>Dennis</td>
<td>104</td>
<td>122</td>
</tr>
</tbody>
</table>

Table 2  
*Pretest/Posttest Differences Between Fall, Winter and Spring DIBELS Scores*

<table>
<thead>
<tr>
<th>Student</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby</td>
<td>76</td>
<td>64</td>
<td>89</td>
</tr>
<tr>
<td>Lewis</td>
<td>17</td>
<td>24</td>
<td>35</td>
</tr>
</tbody>
</table>
Table 3

*Pretest/Postest Differences in Prosody while Reading*

<table>
<thead>
<tr>
<th>Student</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Lewis</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ben</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dennis</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4

*Delis Kaplan Executive Function System Score Summary*

<table>
<thead>
<tr>
<th>Student</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CSDS</td>
<td>CSS</td>
</tr>
<tr>
<td>Abby</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Lewis</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Ben</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Denny</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

CSDS refers to the Composite Scaled Description Score and CSS refers to Contrast Scaled Score
Figure 1.1. Reading Growth Rates

Figure 1.1. Abby's Reading Progress

Figure 1.2. Reading Growth Rates

Figure 1.2. Lewis's Reading Progress
Figure 1.3

Figure 1.4
Figure 2 (2.1, 2.2, 2.3, and 2.4). Generalization Measures.

Abby's Generalization Measures

Lewis's Generalization Measures

Figure 2.1

Figure 2.2
Figure 2.3

Figure 2.4
Appendix B

Prosody Assessment Rubric

Prosody Assessment

Level 4
☐ Read most of the story in long, meaningful phrases.
☐ Repeated or missed only a few words.
☐ Emphasized important words or phrases.
☐ Read with expression.

Level 3
☐ Read most of the story in 3- to 4-word phrases.
☐ Repeated or missed only a few words.
☐ Emphasized important words or phrases.
☐ Read some of the story with expression.

Level 2
☐ Read most of the story in short, 2-word phrases.
☐ Repeated or missed too many words.
☐ Did not emphasize important words or phrases.
☐ Did not read with expression.

Level 1
☐ Read most of the story word by word.
☐ Repeated or missed too many words.
☐ Did not emphasize important words or phrases.
☐ Did not read with expression.

Scoring: Mark each item that characterized child reading. Circle prosody level that includes the most characteristics.

Appendix C

Participation and Informed Consent

Dear Parent or Guardian:

As part of my work toward a School Psychology degree at Miami University, I am conducting a study of elementary school students.

The purpose of this study is to gain understanding about how children with reading disabilities and ADHD respond to Kurzweil 3000, a computer program that presents text on a computer screen while simultaneously reading and highlighting the words to the user. As a parent of a child with a reading disability, we would appreciate your child’s participation in this study.

Confidentiality of your child as a participant will be protected throughout the study and potential publication or presentation.

Following your consent, your child may or may not be selected for participation in the study. If your child is selected, a written notification will be sent to you in the mail. A primary need of the study is for children with both a reading disability and an ADHD diagnosis. Voluntary release of ADHD documentation would be required.

Participation of your child in this study remains voluntary. Your child will also be asked for their assent to participate and they may refuse even if you consent. Participants can refrain from participating at any time without penalty or explanation. Please note that your child’s participation is appreciated and will add to the validity of the study.

It is estimated that initial participation will take approximately 45 minutes. Initial participation will involve reading several short reading passages, a brief test that measures attention, and an observation of your child within the classroom. After the initial period, your child would use the Kurzweil 3000 software twice a week over a span of ten weeks and then be evaluated again via reading passages, a test of attention, and a final observation. All portions of the study will be conducted at Amanda Elementary during the regular school day.

If you have any questions or comments concerning this study, you can contact me at (513-461-1424) or my faculty advisor, Dr. Doris Bergen (513 529 6622).

This study was approved by The Institutional Review Board for The Protection of Human Subjects at Miami University. Questions or comments can also be directed to the Office of Advancement of Research and Scholarship at 529-3734 or email: humansubjects@muohio.edu. Office of Advancement of Research and Scholarship 3000hip at 529-3734 or email: humansubjects@muohio.edu.

Thank you for your assistance.
Sincerely,

Cleighton Weiland

Cut at the line, keep the top section and return the bottom section to the Principal Prince.

I agree to allow my child to participate in the study on reading using the Kurzweil 3000 software. I understand that this is voluntary and that my child’s personal information will be kept confidential.

____________________  ____________________
Parent or Legal Guardian  Child’s Name

I agree to provide documentation regarding my child’s ADHD diagnosis in writing.

____________________  ____________________
Parent or Legal Guardian  Child’s Name