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Does phonological processing, a specific subtype of dyslexia, impact performance on intelligence tests?

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DOES PHONOLOGICAL PROCESSING, A SPECIFIC SUBTYPE OF DYSLEXIA, IMPACT PERFORMANCE ON INTELLIGENCE TESTS?

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ABSTRACT

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The purpose of this study was to examine the impact of a specific subtype of dyslexia, namely phonological processing, on performance and the results of ability on IQ testing. Twenty-two records from a learning center in southern New Jersey were used for data in this study. The sample consisted of 12 male and 10 female children's charts. These children were tested at the learning center in 2005. The age range of the sample is six to eleven years-old. There is no identification of any kind in this study. The information used from the charts included: full scale IQ scores from the Weschler Intelligence Test for Children- Fourth Edition and 3 subtest scores from The Comprehensive Test of Phonological Processing. The 3 subtest scores used were: Elision, Rapid Color Naming, and Rapid Object Naming. A correlation was done between the all 3 subtests of the CTOPP and the full scale score of the WISC-IV. Results showed a significant correlation at the 0.05 level between the Elision subtest of the CTOPP and the full scale score of the WISC-IV. This study concluded that there is a correlation between poor phonological processing scores and performance on IQ tests.

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Chapter 1

Need

According to the United States Department of Education statistics, 2.5 million out of 58 million schoolchildren are receiving special education services in their schools (Shaywitz, 2003). It is inferred that about 2 million of these children are receiving special education services for a reading disability. Large-scale surveys that directly measure reading proficiency indicate that reading disabilities may be much more prevalent (Shaywitz, 2003). Most of these children seem to have the intellectual and sensory equipment necessary for reading, yet cannot, Shaywitz writes (2003). Shaywitz (2003) explains that there is a gap between poor and good readers. "Poor readers never catch up to their classmates who are good readers." Poor readers will experience and continue to experience reading problems unless they are given a scientifically based, proven intervention (Shaywitz, 2003).

The deficit seems only to involve reading letters and words, this is known as dyslexia. Dyslexia is a localized language problem, not a visual problem. Many believe that dyslexia is seeing letters and words backwards, though it really has nothing to do with sight. It is a difficulty with naming the letters, for instance, calling the letter *b* a *d*.

The localized area of weakness in the language system has to do with phonological processing. This process takes place in the functional part of the brain where sounds of language are put together to form words and where words are broken down into their element of sounds (Shaywitz, 2003).

Research showed that thirty percent of the population will have difficulty with phonemic awareness. Phonemic awareness is the "building block" of reading. Young children illustrate their phonemic awareness abilities through rhyming tasks, segmenting multi-syllable words, and segmenting words. For example, recognizing the word *cupcake* has two parts, *cup* and *cake*. Segmenting words is also an integral part of phonemic awareness, *cat* is made up of three sounds, /k/-/a/-/t/.

Phonemic awareness is the phonological processing piece of reading. Deficits in phonological processing are specific to dyslexia. Dyslexia is diagnosed when an individual has poor literacy skills but has adequate intelligence and opportunity to learn (Snowling, 2000). Dyslexia affects decoding, comprehension, spelling, and writing. Decoding is the term given to the ability to look at a word, put the sounds together, and read it. Comprehension is essentially, understanding what was read. Dyslexia is a challenging, widespread disability.

Deficits in decoding, comprehension, and spelling must impede an individual's ability on intelligence tests. Dyslexia must be taken into consideration during review of IQ testing scores.

Purpose

The purpose of this study was to examine the impact of a specific subtype of dyslexia, namely phonological processing, on performance and the results of ability on IQ testing. There is a relationship between *The Comprehensive Test of Phonological Processing* (CTOPP) scores and *The Wechsler Intelligence Scale for Children- Fourth Edition* (WISC-IV) full scale performance.

The variables in this study were the CTOPP scores and WISC-IV full scale scores.

Theory/Background

The Wechsler Intelligence Scale for Children- Fourth Edition (WISC-IV) assesses a child's current cognitive abilities in both verbal and nonverbal areas. The Verbal Comprehension subtests assess the child's ability to process verbal material and to use language to reason and express ideas. The Perceptual Reasoning subtests assess nonverbal reasoning, visual-spatial perception, and ability to process visual material. Auditory recall and attention are assessed by Working Memory subtests and visual-motor integration and efficiency of visual processing are measured by Processing Speed subtests (Educational Assessment Associates, 2005).

The WISC-IV is used as part of the process of diagnosing a learning disability. A learning disability in part is defined as a significant problem in reading or arithmetic (D'Angiulli, Seigel, 2003). A staggering percentage of learning disabilities are actually reading based disabilities. Of these reading disabilities, the most common is dyslexia. Dyslexia as mentioned is a deficit where the individual has difficulty naming letters with sounds and reading words.

Dyslexia involves difficulties with phonological processing, which includes knowing the relationship between sound and symbol (letters). Difficulty with phonological processing is one core deficit in dyslexia (D'Angiulli, Siegel, 2003). Word reading is based on orthographic and phonologic processing (Miller-Shaul, Breznitz, 2004). Miller-Shaul and Breznitz (2004) clarify orthographic and phonological

processing. Phonological processing occurs auditorally and through speech. Orthographic processing occurs through visual patterns of words or parts of words. Efficient processing within and between these systems promotes the ability to read, spell, comprehend, and write.

Researchers have found that phonological representations are qualitatively inferior among dyslexic readers (Miller-Shaul, Breznitz, 2004). All dyslexic students are disadvantaged on tasks that place heavy demands on phonological assembly and segmentation processes (2004).

Phonological processing relies heavily on auditory processing. To read pseudo words, a reader must decode each letter into its corresponding sound (2004). Dyslexic readers have a problem with categorical representation of individual phonemes and with identification of phonemes when they are represented rapidly (2004). The phoneme is defined as the smallest unit of speech that distinguishes one word from another (Shaywitz, 2003).

Shaywitz (2003) illustrates how phonemes are less well developed in children with dyslexia. She explains that a phoneme is analogous to a child's wooden letter block whose face is so worn that the letter is no longer visible. As a consequence, such children when speaking may have a hard time selecting the appropriate phoneme and may instead retrieve a phoneme that is similar in sound. For example, one may retrieve the word *lotion* for the word *ocean*. Shaywitz (2003) further explains that a dyslexic might order the phonemes incorrectly, one might say *emeny* when he/she actually means to say *enemy.*

The Comprehensive Test of Phonological Processing (CTOPP) assesses phonological processing. There are two versions of the CTOPP because it encompasses such a span of age ranges and abilities (Pro-Ed, 2005). The first version is developed for 5 and 6 year olds, typically kindergarteners and first graders. The second version is developed for those 7 through 24 years of age, second grade through college. Both versions are individually administered, taking about 30 minutes to complete the core subtests (Pro-Ed, 2005).

"The CTOPP has four principle uses: (a) to identify individuals who are significantly below their peers in important phonological abilities, (b) to determine strengths and weaknesses among developed phonological processes, (c) to document an individual's progress in phonological processing as a consequence of special intervention programs, and (d) to serve as a measurement device in research studies investigating phonological processing (Pro-Ed, 2005)."

"The test contains the following subtests: Elision, Blending Words, Sound Matching, Memory for Digits, Non-word Repetition, Rapid Color Naming, Rapid Digit Naming, Rapid Letter Naming, Rapid Object Naming, Blending Non-words, Phoneme Reversal, Segmenting Words, and Segmenting Non-words (Pro-Ed, 2005)."

The CTOPP is a much more comprehensive assessment for phonological processing than the WISC-IV. This study hypothesizes that low scores on the CTOPP will inhibit performance on the WISC-IV.

Definitions

Phonological processing is a system that operates by an auditory, speech-based route, whereas, orthographic processing provides information regarding the visual patterns of words or parts of words (Miller-Shaul, Breznitz, 2004). Auditory processing is the ability to hear information and correctly process the meaning. Auditory processing is key in phonological processing. Decoding is essentially reading; identifying symbols with their sound and then blending the sounds together into a word.

Assumptions

It is assumed in this study that the CTOPP and WISC-IV were given in the same manner to each individual: Specifically in a quiet room, with ample time (unless tests are timed), with no assistance from the psychologist administering the test. It is also assumed that all individuals in this study were diagnosed dyslexic.

Limitations

The limitations in this study include: limited sample size as well as a population restricted to southern New Jersey. The learning center in which the CTOPP and WISC-IV were given is located in southern New Jersey, therefore, limiting the population to that specific location. It would be interesting to broaden this study into a longitudinal study to see if and how scores change due to maturity and intervention with a systematic, scientifically proven program. Maturity brings compensatory strategies to the dyslexic individual and may therefore change scores. A scientifically proven intervention program could also change scores due to improvement with phonological processing.

Summary

There will be an extensive review of research in Chapter 2. Chapter 3 will contain the methods section of the study and Chapter 4 will explain the results. Chapter 5 will summarize and discuss the study.

Chapter 2

Introduction

Chapter 2 consists of extensive literature review on the topics of general learning disabilities, dyslexia, social impacts of dyslexia, phonological processing, and cognitive profiles of children with dyslexia.

Literature review is organized in the following manner: Learning Disabilities, Dyslexia, Social Impact of Dyslexia, Phonological Processing and Speech Components of Dyslexia, and finally Cognitive Profiles which include testing and reading disabilities.

Learning Disabilities

According to Frederick Weintraub (2005), 5.75% of all students in the United States are classified as Learning Disabled (LD) and receive special education services. Empirical evidence supports that children classified as LD, whether it be in math or reading, share common characteristics. Sandrine Censabella and Marie-Pacale Noel (2205) conducted a study to determine these common characteristics. They found that LD students have lower working memory capacities than control children. Censabella and Noel (2005) also found slower speed of information processing with all LD children as compared to control groups. Many similar studies have been conducted hypothesizing that LD children have low working memory capacities and slow information processing skills. This is a proven fact.

Pamela M. Stacker (2006) discussed the importance of early intervention in schools for children with LD. She stated the importance of individualized attention for those children with LD. Stacker has witnessed improvements when LD students are designated time each day for special education services outside of the regular education classroom.

Building on Pamela Stacker's discussion on early intervention for students with LD, Kejell A. Salvesen and Johan O. Undeheim (1994) conducted a study on teacher rating scales. The purpose of the study was to determine whether or not teachers are able to pick out at risk students. They found that on average teachers were quite accurate in identifying low achievement readers, however were less accurate in identifying dyslexia.

Dyslexia

Lyytinen, et al. (2004) researched the genetic component of dyslexia. The research proved that a family background of at least one parent and a close relative with serious reading problems will result in the child being at risk for dyslexia. There is a heritability of about 50% (2004).

Even though so much research has been conducted, dyslexia is still a baffling disability. Many researchers set out to determine exactly how dyslexia manifests itself, yet is still unknown. Daigneault and Braun (2002) suggest that at birth there is a localized neural network dedicated to "reading acquisition." If there is something wrong with this network in the brain, the individual will have dyslexia.

"In all languages studied so far, a group of children around 5%, experiences severe reading problems (dyslexia) despite normal intelligence, good educational opportunities, and no obvious sensory or neurological damage (Ziegler & Goswami,

2005)." Zeigler and Goswami argue that although the manifestation of dyslexia differs by language, the underlying causes of dyslexia are universal and stem from impaired development of the phonological system (2005). Their research concludes that individuals with dyslexia show the same phonological problems in all word languages studied to date, displaying difficulties in tasks like syllable deletion, syllable reversal, non-word repetition, and rapid naming (2005). There is an imbalance between phonological and semantic skills in dyslexia (Bishop & Snowling, 2004).

Social Impacts of Dyslexia

Elly Singer (2005) wrote that along with the reading and spelling problems in dyslexia, psychosocial problems occur as well. These problems include inattentiveness, low motivation, dropping out of school, fear of failure, depression, anxiety, loneliness, low self-esteem, and poor peer relations. Singer considered that dyslexic individual's social functioning is affected due to a lack of competence in communication and deficient social problem solving. Singer continued to discuss peer bullying. Children with dyslexia and other learning disabilities are at greater risk of being bullied by their peers (2005). David Hollar (2005) furthers this discussion proposing that research suggests that youth with disabilities experience higher incidence rates of alcohol and other drug use than their peers. This makes great sense, dealing with dyslexia and social issues together could become extremely draining. If these children do not have strong support systems, it can be understood that they may turn to substances.

Phonological Processing

Reading is a complex task: To read even a simple sentence demands a number of skills ranging from recognizing each individual word to understanding the meaning of the text (Nation, 1999). An individual word must be broken down even further. Each sound is known as a phoneme, which is the smallest unit of speech. Thirteen studies reviewed for this section each concluded that phonological processing is an absolute necessity in reading. Blombert, et al. (2004) accept the assumption that the core problem in dyslexia is best described as a phonological deficit. Blombert, et al. postulate that the cause of the phonological deficit involves auditory and speech perception. Richardson, et al. (2004) concur with the hypothesis that auditory tasks requiring amplitude envelope rise time processing explained significant variance in phonological processing. According to Richardson, et al. the "phonological core deficit" theory argues that dyslexic children find it difficult to represent mentally the sound patterns of the words in their language in a detailed and specific way. Their study confirmed that auditory processing deficits strongly predict phonological skills.

In addition to phonological processing deficits, retention of verbal material in working memory, rapid naming, and object naming also play a role in dyslexia. Blomert, et al. (2004) writes that people with dyslexia are shown to be subtly impaired in the former during task analysis. Faust, et al. (2003) also concludes that children with severe reading problems, like dyslexia, show more difficulty and longer reaction times on the *Rapid Automitized Naming* (RAN) tasks. The RAN is a rapid naming assessment which relies on working memory. Objects measure naming speed by assessing the number of

seconds required to name a series of six familiar objects presented in random order (Speece & Ritchey, 2005). It is evident in most research that rapid naming tasks take longer to complete along with phonological processing deficits in children with dyslexia.

Puolakanaho, et al. (2004) describe phonological awareness and its importance in emergent readers. Phonological awareness is the ability to blend words orally, create compound words, syllables, onset-rimes, and phonemes (Speece & Ritchey, 2005). The purpose of the study was to compare phonological awareness between two groups of children, one with familial risk for dyslexia and a control group. It was proven that it is extremely pertinent to assess emerging phonological awareness skills in association with risk for dyslexia.

Speece and Ritchey examine the link between phonological awareness and RAN tasks in the development of reading fluency in their 2005 study. Fluency of course is another area of weakness that comes with dyslexia since it is defined as the ability to quickly and accurately identify words in text. The purpose of this study was to examine the development of reading fluency during early stages of reading. Speece and Ritchey used the *Comprehensive Test of Phonological Processing* (CTOPP) to assess RAN. The CTOPP was explained in chapter 1 of this research and will be further discussed in chapter 3. The CTOPP was also administered to assess students' phonological awareness. The results in this study show that it is important for early readers to develop fluency, therefore, it is also important for them to develop strong phonological awareness and RAN skills. Alphen, et al. (2004) also conducted a study of emergent language and reading skills. The study concluded that phonemic awareness and early language development must be assessed as soon as possible to identify dyslexia.

Sofie, et al. (2002) also used the CTOPP to assess phonological processing in their study. It too was found to be an important tool in identifying at risk readers.

Mann & Foy (2003) conducted a study in terms of phonemic awareness as well. Their findings were more of the same, phonemic awareness instruction and assessment must begin early during pre-school years in order to detect and possibly begin an intervention for dyslexia.

It has also been briefly mentioned that spoken language is also an influence in early reading. Ramos-Sanchez & Cuadrado-Gordillo (2004) found in their comparative study of dyslexic and normal readers, that dyslexic children had poorly developed language skills. These skills included immediate verbal memory, speed in naming objects, and auditive-phonological processing. Again, it was found that phonemic awareness had a strong causal relationship with reading and writing (Ramos-Sanchez & Cuadrado-Gordillo, 2004).

With all the knowledge acquired by researchers about the importance of phonemic processing, Nathlie A. Badian (2005) decided to take a study one step further. The purpose of the study was to determine the importance of visual-orthographic deficits in dyslexia. The results showed that visual-orthographic deficits are equally important as phonological processing in reading.

There is overwhelming empirical evidence to support that phonological processing is a key element in reading. The CTOPP is an accurate way to test phonological processing and is a good determent for dyslexia.

Cognitive Profiles

Bell, et al. (2003) conducted a research study to determine the most plausible factor structure of the basic cognitive processing subtests underlying dyslexia. The participants in the study were 105 students from an elementary/middle school in a mixed rural-suburban county in the southeast. Fifty boys and 55 girls ages 67-159 months were included. The *Test of Dyslexia* (TOD) was developed to provide a comprehensive, valid assessment of the cognitive variables currently believed to underlie dyslexia.

Correlational and factor analyses were used to examine the interrelationships among the cognitive variables presumed to underlie reading: Phonological Awareness, Auditory Synthesis, Word Memory, Memory for Letters, Rapid Naming, and Visual Discrimination (2003). There were moderate to high correlations between the processing abilities and Rapid Naming overall had the strongest correlations with the other subtests. The relationships between the cognitive and achievement variables also had high and significant correlations. Bell, et al. found that processing was the strongest predictor of dyslexia, which is consistent with current research (2003).

Willcutt, et al. (2001) conducted a study to contrast the performance of individuals with reading disability, attention-deficit/hyperactivity disorder (ADHD), both, and neither reading disability or ADHD. The participants in this study were between 8 and 16 years old and were twins. Only one twin had to have low achievement test scores or be referred by tutor, teacher, or psychologist for both to be invited into the study. The reading, IQ, and phonological awareness measures were administered. All examiners were unaware of the diagnostic status of the child and the results of the testing conducted at other sites.

As expected, Willcutt, et al. found the mean number of ADHD symptoms was higher for the ADHD and reading disabled + ADHD groups than the RD and comparison groups, and the reading disabled and reading disabled + ADHD groups had lower means on the reading measures than the ADHD and comparison groups. The mean Verbal and Performance IQ scores of the three clinical groups also fell significantly below the mean of the comparison group. The results indicate that individuals with reading disabilities have a large deficit in phonemic awareness compared to those without reading disabilities (Willcutt, et al., 2001). This study proves once again that phonological processing represents the core deficit in reading disabilities.

Fletch, et al. (1994) examined the validity of distinguishing children with reading disabilities according to discrepancy and low achievement definitions. The study included 199 children, 7.5-9.5 years old. Four assessments of expected reading achievement and two assessments of actual reading achievement were obtained. The children were broken up into five groups by their plot scores on the WISC-R Full Scale IQ and Woodcock-Johnson decoding tests. A MANOVA was used to combine and separate groups. The results of this study do not provide strong support for the validity of distinguishing children who meet discrepancy and low achievement definitions of reading disability (Fletch, et al., 1994). The results grouped reading disabled children with cognitive profiles together, meaning their symptoms were very similar.

Scarborough & Parker (2003) assessed reading achievement, IQ, and behavior problems in second and eighth grade for a longitudinal sample of 57 children. Tests and interviews were individually administered in the children's homes during a single two-to three-hour session at each age. Correlations between grade 2 and grade 8 indicated

considerable stability of individual differences in word id, decoding, reading comprehension, and IQ. Differences in mean IQ were also seen for the groups with reading disabilities, bur the magnitudes of these differences were similar in grade 2 and grade 8. Both verbal and performance IQ were lower for the reading disabled group (Scarborough & Parker, 2003). The reading disabled group was no farther behind in grade 8 than they were in grade 2 however, they were still behind.

Helland & Asbjornsen (2004) investigated digit span performance in dyslexia. All participants had schooling from Norway. There were 37 dyslexic subjects ages 10-16 and the control group consisted of 20 students ages 11-13. The dyslexia group was split into 4 subgroups by scores on receptive language test and math abilities. All participants took the Digit Span test from the WISC-R (2004). The entire dyslexia group had a weak correlation between verbal IQ and Digit Span. As predicted, sub-grouping by language comprehension and math skills revealed different digit span profiles in the three dyslexia subgroups compared to controls (2004). "In sum, this study showed distinct patterns of verbal working memory functions in subgroups of dyslexic children based on language comprehension and math skills."

The role of phonological processing deficits in poor readers of non-alphabetic languages such as Chinese is not well documented, however this chapter will review two. Penney, et al. (2005) examined good and poor readers of Chinese. They were tested using and auditory processing task, a phoneme perception task, and several measures of phonological awareness and orthographic processing. Thirty-nine primary students participated form schools in Hong Kong, 15 females and 23 males, gender of one participant was not recorded (2005). Children completed four tests: Stop-RT (auditory),

phoneme perception, a morphological awareness task, and five subtests of the HKT-SpLD (2005). ANOVA revealed a significant group difference for the Stop-RT assessment; the good readers did significantly better than the poor readers. The same was found when a two-way-repeated measures ANOVA was used on the phoneme perception task, good readers responded faster than poor readers. One-way ANOVAs revealed that the good readers performed significantly stronger in Chinese word reading, rapid naming, rime and onset detection (2005).

Ho, et al. (2002) found similar data when conducting their study to examine the cognitive profile and multiple-deficit hypothesis in Chinese dyslexia. Thirty Chinese dyslexic children in Hong Kong were compared with 30 average readers of the same chronological age and 30 average readers of the same reading level in a number of rapid naming, visual, phonological, and orthographic tasks (2002). The multiple-deficit hypothesis is essentially stating that there is also a visual processing factor in addition to phonological processing deficits, naming speed deficits, and orthographic deficits (2002). An ANOVA was carried out for each take and post hoc comparisons with Tukey's test showed that for most of the tasks (all visual, orthographic, rapid naming, onset detection, and word repetition), the dyslexic group performed significantly lower than the chronological age control group but similarly to the reading level control group (2002). Interestingly, the only task that the dyslexic group performed significantly better than the reading level control group was sound discrimination, suggesting that Chinese dyslexic students do not appear to have a serious problem in discriminating syllables (2002).

Dyslexia involves difficulties with phonological processing, which includes knowing the relationship between letters and sounds and over the years a consensus has

emerged that one core deficit in dyslexia deals with phonological processing (D'Angiulli & Siegel, 2003). D'Angiulli & Siegel conducted a study in 2003 involving 364 children, ages 7 to 16, who had volunteered to be in a study of language and memory processes in children with and without learning disabilities. There were three groups, reading disabilities (RD), arithmetic disabilities (AD), and TA (2003). Children were assigned according to the scores that they attained on the WRAT or WRAT-R. ANOVAs were used to computate statistics. RD children had significantly lower scores than their peers on tests that required expressive language skills, especially phonological processing. "These results show that if the definition of RD as a deficit impairing a phonological processing module is adopted, then a specific reading disability can be identified by standardized word recognition and pseudo-word reading tests (2003)".

Summary

There is overwhelming evidence that supports phonological processing as a core deficit in dyslexia. Two of the most suggestive studies to support this are the studies on Chinese dyslexic and poor readers, since it was always thought that phonological processing only pertained to alphabetic languages. Interestingly, Chinese students had the same phonological difficulties as the rest of the dyslexic and poor readers in the world. Also, the empirical evidence supports that reading disabled students do not perform as well as control children on cognitive assessments. This is problematic when they must take a version of the WISC and other cognitive assessments. Studies have also shown that the WISC-III is not always the best predictor of reading disabilities. It is important to also assess the individual's phonological processing, which can be done

successfully with the CTOPP. The studies reviewed have validated the importance of phonological processing in reading.

Chapter 3

Sample

Records were obtained from a learning center in southern NJ. This learning center offers psychological testing and counseling, reading therapy using multi-sensory techniques in public and private schools as well as at the center, and math tutoring. The records are accessible to employees of the learning center. Most clients visit this center for educational testing and reading therapy. The goal of this study was to have data from at least 25 records. Only 22 fit criteria for this study. The criteria for this study included a WISC-IV full scale completed with at least three subtests of the CTOPP completed. The three subtests are elision, rapid color naming, and rapid object naming. There will be no identification of any kind in this study. The age range of children's records used is six years-old to eleven years-old. The records consisted of 12 males' and 10 females' scores. All testing in the records used was completed in 2005.

Measures

WISC-IV full scale scores and three subtests of the CTOPP were taken from the records. The three subtests used from the CTOPP were elision, rapid color naming, and rapid object naming.

The WISC-IV (The Wechsler Intelligence Scale for Children-Fourth Edition) was administered to thousands of children during a five-year period. This five-year period included the pilot, tryout, and standardization phases of development. The Psychological

Corporation as well as outside experts analyzed the results of each phase and determined which should be included in subsequent research. Items were also reviewed for potential bias by a panel of experts and through statistical analysis; those items were either taken out or modified to reduce potential bias.

The refined assessment is clinically sound in both content and utility, with sensitivity to cognitive functions related to learning disabilities, attention disorders, and executive functioning.

The CTOPP (The Comprehensive Test of Phonological Processing) assesses phonological processing. There are two versions of the CTOPP because it encompasses such a span of age ranges and abilities. The first version is developed for 5 and 6 year-olds, typically kindergarteners and first graders. The second version is developed for those 7 through 24 years of age, second grade through college. Both versions are individually administered, taking about 30 minutes to complete the core subtests, which are the Elision, Rapid Color Naming, and Rapid Object Naming. The CTOPP is much more comprehensive assessment for phonological processes as compared to the WISC-IV.

Procedures

Charts of current clients were reviewed, charts containing completed WISC-IV and CTOPP results were used in this study. All records share dyslexia as a diagnosis. Serious mental health issues were excluded.

Hypothesis

The specific subtype of dyslexia, phonological processing, impacts performance on IQ tests. Null: There is no effect on IQ tests.

There is a relationship between the CTOPP subtests scores (The comprehensive Test of Phonological Processing) and the WISC-IV (Wechsler Intelligence Scale for Children-Fourth Edition full scale performance scores. It is hypothesized that low scores on the CTOPP, indicating poor phonological processing skills will in turn impede the individual's ability to score highly on the WISC-IV. The variables in this study are the CTOPP subtest scores from the Elision, Rapid Color Naming, and Rapid Object Naming and the WISC-IV full scale performance score.

Method

A correlational design was used to determine if there is a relationship between low scores on the CTOPP subtests (poor phonological processing skills) and low full scale scores on the WISC-IV. Data entered for the correlation consisted of all 22 full scale WISC-IV scores, Elision scores (CTOPP), Rapid Color Naming scores (CTOPP), and Rapid Object Naming scores (CTOPP). Each record was entered as either 1 for male or 2 for female.

Chapter 4

Introduction

This study focused on the specific subtype of dyslexia, phonological processing, and its impact on intelligence tests. An extensive literature review conducted for this study supports that phonological processing plays a huge part in reading and reading disabilities. The assessment used in this study to determine strength or weakness in phonological processing skills is the *Comprehensive Test of Phonological Processing* or CTOPP. Three subtests from the CTOPP were used: Elision, Rapid Color Naming, and Rapid Object Naming. The Elision subtest assesses the individual's ability to break a word into syllables and phonemes or single sounds. For example, a task may be for the individual to say the word "toothbrush" without saying "tooth." The Rapid Color and Rapid Object naming subtests require the individual to rapidly name colors in a row and objects in a row.

The scores from the three subtests of the CTOPP were correlated with the full scale *The Weschler Intelligence Scale for Children, Fourth Edition* or WISC-IV scores.

Hypothesis

The specific subtype of dyslexia, phonological processing, impacts performance on IQ tests.

Results

The Elision subtest of the CTOPP proved to be significant at the 0.05 level when correlated with the WISC-IV, thus supporting the hypothesis. The Rapid Color Naming and Rapid Object Naming showed significance at the 0.01 level when correlated with each other. When correlated with the WISC-IV, neither the Rapid Color or Rapid Object Naming were significant. See table 4.1 below.

Table 4.1: Relationship between WISC-IV and CTOPP subtests

		WISC-IV	ELISION	RCOLOR	ROBJECT	Male/Female
WISC-IV	Pearson Correlation	1	.529*	-.420	-.306	.243
	Sig. (2-tailed)	.	.014	.058	.177	.302
	N	21	21	21	21	20
ELISION	Pearson Correlation	.529*	1	-.250	-.119	-.159
	Sig. (2-tailed)	.014	.	-.275	.609	.504
	N	21	21	21	21	20
RCOLOR	Pearson Correlation	-.420	-.250	1	.779**	.196
	Sig. (2-tailed)	.058	.275	.	.000	.408
	N	21	21	21	21	20
ROBJECT	Pearson Correlation	-.306	-.119	.779**	1	-.107
	Sig. (2-tailed)	.177	.609	.000	.	.654
	N	21	21	21	21	20
Male/Female	Pearson Correlation	.243	-.159	.196	-.107	1
	Sig. (2-tailed)	.302	.504	.408	.654	.
	N	20	20	20	20	20

* Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

The strongest predictor of phonological processing impairment by itself was the Elision subtest.

Chapter 5

Results confirmed according to Speece and Ritchey's (2005) study concluding that using the CTOPP to assesses students' phonological processing, it was evident that phonemic awareness and processing must be assessed as soon as possible to identify dyslexia. Bell, et al. (2003) also found that processing was the strongest predictor of dyslexia. In the Bell, et al. (2003) study, there were significant correlations between cognitive and achievement variables of phonological awareness, word memory, memory of letters, rapid naming, and visual discrimination. The results of this study, the significant correlation between the Elision and the WISC-IV supported Bell, et al.'s (2003) findings.

Scarborough & Parker (2003) assessed reading achievement and IQ in their longitudinal study. The study found both verbal and performance IQ lower for the reading disabled group.

Faust, et al. (2003) explains that children with severe reading problems, like dyslexia, show more difficulty and longer reaction times on Rapid Automitized Naming tasks. This supports why both rapid naming tasks in this study were significant when correlated with each other. Speece & Ritchey (2005) concur that in most research rapid naming tasks take longer to complete along with phonological processing deficits in children with dyslexia. It is fair to assume that had the CTOPP rapid naming subtests been correlated with the WISC-IV Verbal score and Working Memory score alone there may have been a significant correlation.

Summary

An overwhelming amount of empirical evidence was found in support of phonological processing as a core deficit in those individuals diagnosed with dyslexia. It is important to assess for phonological processing when testing a child for learning disabilities. *The Comprehensive Test for Phonological Processing* (CTOPP) is a valid and effective assessment for this particular deficit. Studies were reviewed for this present study in which researchers used the CTOPP. The CTOPP was effective in all studies, including the present, in showing weak phonological processing in those children with dyslexia.

The Weschler Intelligence Test for Children- Fourth Edition (WISC-IV) was the second variable in this study. It was hypothesized that weak phonological processing scores i.e. low scores on the CTOPP subtests would significantly correlate with low scores on the WISC-IV i.e. low full scale scores. This study supported this hypothesis with one subtest of the CTOPP. The Elision subtest had a significant correlation with the WISC-IV full scale score. The rapid naming subtests did not have a significant correlation, however. It makes sense that there would be a significant correlation between the Elision subtest and the WISC-IV full scale scores. Poor phonological processors most likely will be poor verbally, thus impacting their performance on I.Q. tests.

In future research, it would be interesting to see if the rapid naming subtests of the CTOPP would significantly correlate with the verbal scores and working memory scores alone of the WISC-IV as opposed to the full scale score.

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