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EXAMINING COMPRESSED SPEECH LISTENING MEASURE WITH COLLEGE STUDENTS WHO ARE VISUALLY IMPAIRED OR BLIND

by

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ABSTRACT

Examining Compressed Speech Listening Measure With College Students Who Are Visually Impaired or Blind

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Psychological assessments are a way of gaining some understanding of an individual in order to help make informed decisions (Sattler, 2001). These assessments offer potentially important and valuable information that can assist individuals with impaired vision in learning additional skills, improving deficient abilities, and in providing diagnostic information for future research. In addition, psychological assessments are frequently used to diagnosis a variety of psychological and learning disorders. Assessing individuals with impaired vision presents a variety of challenges from those encountered with the general population.

The current study provided an investigation into the relationship of the results of the compressed speech listening test (CSLT). The CSLT suggests that "making sense" from a compressed speech sound may access a function comparable to that used in

traditional vision-based tests of simultaneous processing. The CSLT is utilized for those who are visually impaired or blind (VI/B) and those who are sighted with an eventual goal to determine whether one possible use for the CSLT could be for assessing simultaneous processing in the sighted and VI/B.

The purpose of this study was to see if there was (1) a relationship between CSLT and Gestalt closure, (2) a difference in performance between sighted and VI/ participants on CSLT, and, (3) within the VI/B participants was there a difference in performance between those who require the use of a screen reader and those whose visual limitation were accommodated with large print?

The results showed a statistically significant positive correlation between CSLT raw score correct and Gestalt Closure test in the sighted participants. There was a statistically significant difference in the CSLT test scores for the sighted participants and the VI/B participants. There was not a statistically significant difference in CSLT of the VI/B participants between those who require JAWS and those who were helped with large print.

Additional analysis' with the CSLT included efficiency (ratio of accuracy and response time) scores and mean response time scores. In regard to CSLT efficiency scores, it was evident that there was a statistically significant difference between VI/B participants who utilized JAWS screen reader and those who utilized large print.

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CHAPTER 1

INTRODUCTION

According to the CDC (2002), 2.76% of the U.S. population over 40 years of age was visually impaired. Further, 2.5% of the population of children in the U.S. was found to be visually impaired (CDC, 2002). Nathan et al. (2004) reported that expectations are present for the rate of blindness and visual impairments to increase over the next 15-20 years. It was found that those expectations were significantly impacted by the aging of the U.S. population (Nathan et al., 2004).

Assessing individuals with impaired vision presents a variety of challenges from those encountered with the general population. Psychological intelligence tests, which are heavily weighted with visual content, only offer adaptations that are not as beneficial to assessing cognitive ability for the visually impaired or blind (VI/B) population of adults and children (Reid, 1995, 1997). The few tests that are specifically designed for VI/B are either outdated, not available any more, not widely used, require additional training, or have longer administration times impacting both the practitioner and the participant (Jones & Marks, 2008; Reid, 1997).

The standard testing instruments are not sufficient to meet the assessment needs for students and adults with visual disabilities (Jones & Marks, 2008). Very few instruments have been produced specifically for use with this population. There is an evident need for neuropsychological evaluations that offer multifaceted information from

such measures as simultaneous processing for persons who are visually impaired or blind, but they are not available. The nature of the issue relates to simultaneous processing ability assessments and adults and children who are visually impaired or blind (VI/B) and that many current psychological ability tests, which are heavily weighted with visual content, only offer adaptations that are not as beneficial with this population (Reid, 1995, 1997).

Psychological assessments are a way of gaining some understanding of an individual in order to help make informed decisions (Sattler, 2001). These assessments offer potentially important and valuable information that can assist individuals with impaired vision in learning additional skills, improving deficient abilities, and in providing diagnostic information for future research (Jones & Marks, 2008).

The purpose of this study is to investigate the construct validity of whether the CSLT correlates with simultaneous processing, as well as, investigates the concurrent validity of the CSLT with the K-SNAP, an established measure of simultaneous processing for individuals who are VI/B. The study examines whether the Compressed Speech Listening Test (CSLT) can substitute for the Gestalt Closure (simultaneous processing measures) with the sighted participants, whether there are significant differences in performance on the scale by the VI/B and sighted participants, and whether there are significant differences in performance within the VI/B dependent on the extent of visual impairment.

The CSLT was previously identified as the CogListening Scale (Jones, 2000). For this study, the CogListening Scale is identified as the Compressed Speech Listening Test (CSLT) in order to specifically describe the task of this test. This study will provide

an investigation into the relationship of the results of the CSLT for those who are visually impaired or blind and those who are sighted with an eventual goal to determine whether the CSLT may be a viable alternative for assessing simultaneous processing.

Background of the Study

The nature of the issue relates to simultaneous processing ability assessments and individuals who are visually impaired or blind (VI/B). Many current psychological ability tests are heavily weighted with visual content and offer adaptations that are not beneficial with this population (Reid, 1995, 1997). In this study visual impairment is defined as the reporting by the participant of corrected visual acuity that requires large print computer software adaptation, and legally blind is defined by the participant who requires the use of the screen reader program.

In examining the few tests that are specifically designed for VI/B it is evident that such tests are either outdated, not available any more, not widely used, require additional training, or have longer administration times impacting both the practitioner and the participant (Jones & Marks, 2008; Reid, 1997) with one exception, the Comprehensive Vocational Evaluation System (CVES). However, the CVES is not utilized in this study because of the lengthy administration time, special training required that limits accessible use, and it does not provide results in the form of cognitive processing scores.

This study will determine whether the CSLT is a valid measure of simultaneous processing by investigating the degree to which the Compressed Speech Listening Test (CSLT) results in similar scores as a standardized and recognized test for simultaneous processing and neuropsychological impairment. The test is Gestalt Closure in the

Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) (Kaufman and Kaufman, 1994) this test will be discussed in more detail following an introduction to the Luria model (Luria, 1980, 1973).

Neuropsychological tests based on Luria's model (Luria, 1980, 1973) such as the Cognitive Assessment System (CAS) (Naglieri & Das, 1997) and K-SNAP (Kaufman and Kaufman, 2004) present evidence of possible benefits and insight, which offers understanding of brain processes for sighted individuals. These tests measure four functions referred to by Luria as Planning, Attention, Successive processing, and Simultaneous processing, which help expose specific brain function weaknesses that serve as a foundation for designing specific interventions for individual needs (Fiorello, Hale, & Snyder, 2006). Unfortunately, what is seen is that there are very few of these types of tests for the VI/B, especially tests measuring simultaneous processing, in an appropriate format suitable for use with individuals who are visually impaired or blind.

One set of test instruments that explores use of Luria's concepts for persons with and without visual impairment (Jones & Marks, 2008) includes a potential simultaneous processing scale using compressed speech. These test instruments offer content that is not visually loaded and can be used as a screening tool to help in the decision process in regards to questions of need for additional extended assessment instruments or questions with occipital lobe weaknesses (Gestalt functions). It is possible that this type of test instrument may offer valuable information, which is offered through other Luria test instruments that are considered viable for sighted individuals such as with the CAS and K-SNAP. Additional research data is needed with the simultaneous processing scale in

regard to individuals who are visually impaired and blind in order to better examine this instrument for appropriate viability for this population.

One way to accomplish that goal is to determine whether the CSLT scores relate to the K-SNAP Gestalt Closure measure. The Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) includes a test measuring simultaneous processing (Kaufman & Kaufman, 1994). The test, however, is significantly weighted with visual content. As a result, it is not suited for use with VI/B individuals.

Purpose of the Study

The purpose of this study is to examine construct validity of whether the CSLT correlates with simultaneous processing and investigates the concurrent validity of the CSLT with an established measure of simultaneous processing for individuals who are VI/B. This study investigates the extent to which the CSLT is a valid psychometric measure of simultaneous processing for the VI/B college population. This includes correlation in specific cognitive ability subtest scores in sighted college students taking the Compressed Speech Listening Test (CSLT) and the K-SNAP Gestalt Closure simultaneous processing subtest, a standardized measure of cognitive functioning and neuropsychological impairment.

Statement of the Problem

Individuals are assessed for a number of reasons such as identifying those who are at-risk for delays in behavioral, cognitive, academic, vocational, or for delays in social/emotional relations (Bradley-Johnson, 1986). Additional reasons for assessment

also include documenting progress in special programs, identifying instructional needs, and to provide information for research (Bradley-Johnson, 1986). Currently, there are no validated methodologies that utilize a simultaneous processing measure for conducting those assessments on the VI/B.

Assessing individuals with impaired vision presents a variety of challenges from those encountered with the general population. For example, some oral tests can be most readily adapted for those with impaired vision, while performance tests are least likely to be applicable (Anastasi & Urbina, 1997). Individuals with visual disabilities may also perform poorly on tasks that require judgment of spatial relationships, demonstrate frustration at prolonged reading tasks, and perform poorly in accurate hand-eye coordination in tasks such as writing (Erin & Koenig, 1997).

Significance of the Problem

Educational significance and impact is evident through the use of neuropsychological based intelligence tests with constructs from Luria's model such as the CAS (Naglieri & Das, 1997) because college students' needs in the classroom can be better met from knowledge gained from neuropsychological instruments. Research evidence indicates that measuring simultaneous processing can be beneficial to grade school students as well as college students. In examining research conducted on grade school children it is possible to infer such success could also include college students. McCallum and Meritt (1983) examined simultaneous processing among college students and they found that their research was consistent with previous research with young children. This indicates, according to McCallum and Meritt (1983), that simultaneous

processing styles are employed by college students as well as younger students. Therefore, simultaneous processing research on college students will be examined and discussed, as well as, simultaneous processing research based on Luria's model with younger students with the expectation that research with younger students showing success with simultaneous processing analysis may also be applied to college students.

For example, research analyzing individuals having difficulty in such areas as reading, written expression, phonological processes, arithmetic, and Attention Deficit Hyperactivity Disorder (ADHD) (Haddad et al., 2003; Johnson, Bardos, & Tayebi, 2003; Joseph, McCachran, & Naglieri, 2003; Lidz & Greenberg, 1997; Naglieri & Goldstein, 2006, respectively) all have shown significant progress in one's educational environment through insight gained from Lurian based test instruments.

Simultaneous processing has been found to be a significant predictor of academic performance indicators in university students, including predicting academic success for early interventions and offers an evident measurable relationship to GPA. An evident strength is also evident in that simultaneous processing can offer significant help in weaknesses in other cognitive areas such as in sequential processing.

The educational value of examining relationships between preferred methods of information processing such as simultaneous processing, and specific academic skills such as reading and writing (Dingman, Mroczka, and Brady, 1995; Merritt and McCallum, 1983; Gunnison, Kaufman, and Kaufman, 1982; and Harris and Wachs, 1986), is great because research studies indicate that deficiencies in some cognitive processing methods can be strengthened and that instructional materials are much more

effective when matched with students' cognitive strengths (Brailsford, Snart, & Das, 1984; Das, Kerby, & Jarmin, 1979; and Pask & Scott, 1972).

The importance of concentrating on the CSLT and possibly measuring simultaneous processing auditorily, in particular, is evident because this idea is novel and new in the current research community. According to Dehn (2006), many assume that simultaneous processing is primarily a visual-spatial ability, which is evident in that all of the most utilized assessment batteries measuring simultaneous processing do so through visual-spatial techniques, and this current research challenges that concept.

This is because this type of instrument has been shown to better modify an individual's interventions for their specific challenges that they are struggling with academically (Fiorello et al., 2006). Researchers are seeing more and more of how increasingly important interpreting ability scores as cognitive processing are, using measures such as Planning, Attention, Successive processing, and Simultaneous processing. Again, it is unfortunate that instruments, which are based on Luria's model are not available for individuals who are visually impaired or blind.

Nature of the Study

First, sighted college students will take the K-SNAP tests and then those same individuals will take the CSLT. The results of the CSLT will be compared to those of the K-SNAP Gestalt Closure test (simultaneous processing) for sighted subjects. In this way, the viability of the CSLT to act as a means to measure simultaneous processing will be examined. Second, a sample of VI/B college students will take the CSLT to compare their performance on the CSLT to that of sighted participants.

With the above data, a statistical analysis will be performed in order to determine the degree of correlation in the scores of sighted individuals taking the CSLT and the K-SNAP Gestalt Closure measure. Performance of the sighted participants on the CSLT will be compared with performance of the VI/B participants using analysis of covariance. An analysis of covariance is utilized in this study to compare performance of the two groups on the CSLT after removing a possible effect of crystallized ability. The Slosson Intelligence Test-Revised (SIT-R3) (Slosson, 2005) will be used as a covariate. The SIT-R3 is a valid and reliable measure of crystallized ability and provides valid information about one's cognitive ability (Slosson, 2005).

An additional analysis was conducted to determine whether there were statistically significant differences within the VI/B participants on the CSLT when a screen reader is required. Reliability data for the CSLT will be gathered for both the sighted and VI/B participants.

Research Questions

The following research questions will guide the proposed study:

- Is there a significant relationship between scores obtained on a measure of simultaneous processing, Gestalt Closure, and scores on the Compressed Speech Listening Test?
- Is there a significant difference between scores obtained on the Compressed Speech Listening Test among sighted participants and the visually impaired/blind participants?

- Within the visually impaired/blind participants is there a significant difference between the performance of persons whose extent of visual limitation requires the use of a screen reader and VI whose visual limitation can be accommodated with large print?

Hypotheses

It is hypothesized in question one that there is not a statistically significant relationship between Gestalt Closure and the CSLT. It is hypothesized in question two that there is not a statistically significant difference between the CSLT test for the sighted participants and the VI/B participants. It is hypothesized in question three that there is not a statistically significant difference in CSLT performance within the VI/B participants between those who do and do not need a screen reader.

Definition of Terms

In order to provide a consistent framework around which a discussion of the recurring themes of the study can be addressed, the following definitions are clarified:

Visual Impairment: According to Hupp (2004), visual impairment has been defined as the reporting of corrected visual acuity scores of between 20/70 and 20/200. That definition for the visually impaired will be used in this study.

Legally Blind: The classification of legally blind is reserved for individuals who have a corrected visual acuity of 20/200 or less (Hupp, 2004). The classification stated by Hupp (2004) will also be used as a baseline definition for the purposes of this study.

Assumptions

This study makes a number of assumptions. First, it is assumed that the self-reported disabling visual conditions of the VI/B participants are accurate. This is verified through each university Disability Resource Center (DRC) as services for college students who are VI/B are only provided after documented for such disability is evident. Second, the administration of the cognitive ability measures is assumed to be consistent and not present any biases. The SIT-R3 is designed to be administered to both sighted as well as visually impaired and blind populations with norms to include all populations. The Sit-R3 is a test of verbal crystallized intelligence that does not rely heavily on visually loaded test items nor is this test dependent on test items that must be "seen" in order to be interpreted within its general scoring (Slosson, 2005).

Limitations and Delimitations

The results of this study are to be limited in their application to populations of similar makeup of the sample population and should not be generalized to other groups. Although the sampling method was the most appropriate for the study, sampling bias may exist due to the choice of sampling method, convenience sampling.

Implications in School Psychology

One role of the school psychologist is to identify pre-K through postsecondary students' difficulties and weaknesses and to assist teachers and parents in helping these students improve within their educational environment including academic and behavioral assistance within the classroom setting. This is more evident today than ever

before with more schools calling on school psychologists to utilize the response to intervention (RTI) model in the school setting.

According to NASP one of the roles of the school psychologist is to assist with the RTI process in order to offer a more specific assessment and offer intervention efforts with individual students (NASP, 2006). NASP goes on to state that the school psychologist can assist school systems in identifying systemic patterns of student need such as identify appropriate evidence-based intervention strategies and assist with persistent challenges among all students in areas such as basic phonics skills and other academic deficits (NASP, 2006). Fiorello et al., (2006) states that RTI assistance must be combined with a cognitive instrument such as instruments supporting Luria's assessment theory in order to better identify students with learning disabilities and offer specific intervention for the student with difficulties and severe challenges, including pre-K through postsecondary level students.

Assessing simultaneous processing ability with sighted and VI/B students can assist school psychologists as they help to determine specific patterns of weaknesses and offer individual intervention strategies that assist struggling students to become more successful within their educational environment. Many college campuses have a school psychology clinic that works closely with such departments as the disability resources center in assessing college students needs for assistance with such areas of challenge as ADHD, reading, writing, and mathematics difficulties. According to Haddad et al., (2003), evidence indicates, as well as, supports previous research, that Planning, Attention, Simultaneous, and Successive cognitive profiles are relevant to instruction. School psychologists, utilizing Luria based ability measures, can contribute valuable

insight in helping parents, teachers, and students better understand students' specific weaknesses as well as offer specific specialized interventions addressing student needs in the classroom.

Summary

This chapter provided an overview of the proposed study involving the assessment of simultaneous processing ability in both the college population of visually impaired or blind individuals and sighted college participants. The background of the problem was covered as was the nature of the study and its significance. Research questions were outlined and the assumptions detailed. Chapter 2 will provide a more extensive review of the literature and Chapter 3 will describe the methodology in significantly more depth.

CHAPTER 2

REVIEW OF LITERATURE

This chapter will begin with a general overview of the importance of neuropsychological testing, especially in regard to simultaneous processing and a general overview of the Lurian model of neuropsychological function and descriptive studies relating the Lurian model to academic achievement. Then a discussion of ability measurement and cognitive processing is reviewed, followed by a discussion regarding assessment issues with individuals who have visual disabilities. Next, a practitioner quandary is discussed in regard to appropriate test instruments that can be utilized for the VI/B, followed by a discussion on simultaneous processing. Then neuropsychological assessment instruments are discussed, followed by a discussion in regard to the Compressed Speech Listening Test (CSLT). Finally, a discussion is offered on the Slosson Intelligence Test –Revised 3, followed by a summary of the chapter deliberation.

Importance of Neuropsychological Testing

Many widely used psychological tests were constructed before the emergence of much of the currently available information relating altered behavior to brain dysfunction (American Academy of Neurology, 1996). Diseases, injury, and severe dysfunction in the brain commonly produce changes in behavior including impairment of cognitive abilities (American Academy of Neurology, 1996).

According to the American Academy of Neurology (1996), knowledge of the presence and characteristics of such changes can aid in the diagnosis; management; and longitudinal care, including assistance in academic learning environments, of patients with neurologic illness. The importance of neuropsychology assessments are significant because these measures get at the underlining challenges of difficult problems. The importance of neuropsychological assessments is also evident in regard to routine medical tests from the medical field in that they are less able to detect or measure subtle deficits that impact one's memory, language, or executive functioning, which are important in academic and vocational recommendations (American Academy of Neurology, 1996).

Neuropsychology assessments utilizing simultaneous processing measures in particular, are significantly important and key in assisting college students in regard to academic success. Simultaneous processing can help assess problem-solving skills that involve several processes at once, can help identify a strength or weakness in recognizing the main idea of a passage, in mapping, assisting in assessing one's ability to solve unfamiliar problems simultaneously, help measure one's ability to process chunks of information that are received all at once, and low scores in simultaneous processing have correlated with an inability to indicate clear relationships between sentences and paragraphs. According to Dehn (2006), simultaneous processing can yield important information, especially when evaluating students for possible LD or ADHD.

More research attention needs to be focused on the relationship between neuropsychological test performance and academic success, especially those returning to school as a college student. According to the American Academy of Neurology (1996),

there has been limited attention between neuropsychological test performance and functional capacity in activities of occupational competence, daily living, and in returning to school.

Conceptual Framework for the Study

The conceptual framework of this study is in the model of neuropsychological function proposed by Alexander Luria. Luria's work, which includes simultaneous processing, has had significant worldwide influence on neuropsychological theorizing and practice, even since his death in 1977 (Solso, 1985; Solso and Hoffman, 1991). Luria's more theoretical Russian method has also served as a significant counterpoint to North American psychometric approach to neuropsychology (Glozman and Tupper, 1995).

In the history of neuropsychological testing, the use of such instruments was originally suggested only when brain damage was suspected. However, the current neuropsychological perspective is increasingly being recommended as a multiple ability alternative to the traditional IQ-based interpretation of performance on intelligence tests (Brinkman, Decker, & Dean, 2005).

Neuropsychological tests based on Luria's model (Luria, 1980, 1973) include such assessments as the Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) (Kaufman and Kaufman, 1994); Cognitive Assessment System (CAS) (Naglieri & Das, 1997); and the Kaufman Adolescent and Adult Intelligence Test (KAIT) (Kaufman and Kaufman, 1993). The KAIT, which is an alternative intelligence test, is considered to be more loosely based on the theories of Luria's model (Tupper, 1999) and

will not be discussed in detail in this study. In regard to the CAS assessment measure and Luria specifically, this test is designed to measure PASS theory, which is a processing-based theory of intelligence that is based on cognitive processes defined by Luria. Such neuropsychological tests which are based on Luria's model present evidence of multiple benefits and much insight, which offers significant understanding of brain processes for sighted individuals.

An additional neuropsychological test based on Luria's model is the Kaufman Assessment Battery for Children-Second Edition (KABC-II), (Kaufman and Kaufman, 2004). The KABC-II, which is designed for children ages three to eighteen, is based on Luria's model, and has a long history of successful research with specific emphasizes on the simultaneous dimensions of mental processing (Tupper, 1999). K-ABC-II research will be discussed with the expectation that research analysis with younger students showing success with simultaneous processing may also be applied to college students.

According to McCallum and Meritt (1983) simultaneous processing styles are employed by college students as well as younger students. Therefore, some simultaneous processing research based on Luria's model with younger students will be examined as well with the expectation that research with younger students showing success with simultaneous processing analysis may also be applied to college students (McCallum and Meritt, 1983).

Luria perceived the brain's basic utility to be represented by three main units (Blocks), or functional systems and proposes that these three brain regions are most useful in understanding cognitive processes (Sparrow & Davis, 2000). These procedures work together to produce behavior and provide attention and include: (a) a unit in the

brain stem and midbrain configuration that relates to arousal; (b) a unit that encompasses the temporal, parietal, and occipital lobes that relate to sensory input; and (c) the frontal cortex which relates to planning and organization (Hale & Fiorello, 2004; Naglieri & Rojahn, 2001; Sparrow & Davis, 2000). These neuropsychological or neurobehavioral models of cognition can be used to evaluate cognition, sensorimotor functions, and linguistics (Lezak, 1995, cited by Sparrow & Davis, 2000). In examining, simultaneous processing, which is one of Luria's four functions (*attention*, *sequential processing*, *simultaneous processing*, and *planning*), it is shown that the simultaneous function includes the ability for combining distinct stimuli for holistic problem solving (Hale & Fiorello, 2004; Jones, 2000; Naglieri & Das, 1990; Naglieri & Rojahn, 2001; Sparrow & Davis, 2000).

Lurian constructs (Hale & Fiorello, 2004) provide a conceptual understanding of the basis of brain-behavior relations. Luria's objective as a neuropsychologist was to map out the brain's systems and functions held responsible for complex behavioral processes, especially the high-level processes related with the intake and integration of data and with problem-solving abilities through assessment of the four processing functions (Kaufman & Kaufman, 2004). For example, in regard to planning ability, Luria's notion is that this concerns evaluation of hypothesis, decision-making, and flexibility, as well as "represents the highest levels of development of the mammalian brain" Golden, 1981, p. 285, cited by Sparrow & Davis, 2000).

Several present-day test instruments use the Luria model principle functions including the Kaufman Assessment Battery for Children-Second Edition (KABC-II) (Kaufman & Kaufman, 2004), the Cognitive Assessment System (CAS) (Naglieri & Das,

1997), and the Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) (Kaufman & Kaufman, 1994).

Cognitive Processing and Academic Achievement

A. R. Luria has provided researchers with a conceptual understanding of how the posterior-anterior, left-right brain axes, and the four lobes (the occipital, temporal, parietal, and frontal lobe) work together to produce complex behavior (Hale & Fiorello, 2004). According to Hale & Fiorello (2004), Luria's *The Working Brain* (1973) still serves as influential work in neuropsychology today. Luria's ideas provide a conceptual understanding of the basics of brain-behavior relationships.

Several different cognitive processing theories, which include Cattell-Horn-Carroll (CHC) theory and the planning, attention, simultaneous, and successive (PASS) model theory and others either offer constructs from Luria's perspective or are based on Luria's theories (Hale & Fiorello, 2004). This study refers to these theories only in the context that they are based off of or offer constructs from Luria's perspective in order to better understand Luria's importance in regard to measuring cognitive processing abilities, such as simultaneous processing, and linking them to academic achievement.

The following analysis first examines the correlation between cognitive processing ability measures, in regard to Luria's influence, and achievement. Next, culture-fair assessments are reviewed. Measuring and interpreting cognitive processing, including simultaneous processing, is then discussed. Next, the educational value of investigating such relationships of academic success and preferred approaches of information processing, such as simultaneous processing, is examined. Next, an

examination of other intelligence tests compared with those constructed on Luria's basic neuropsychological functions for predictors of academic skills are discussed. Then, effective interventions utilizing instruments measuring simultaneous processing that offer neuropsychological functions such as those identified by Luria are examined with pre-K through postsecondary students in the following order (a) Attention Deficit Hyperactivity Disorder (ADHD); (b) written expression; (c) reading and reading comprehension; (d) mathematics; (e) cultural issues; and (f) learning disabilities. Finally, an examination of aptitude-treatment interactions (ATIs) research is analyzed.

Naglieri and Bornstein (2003) conducted an extensive review of individually administered tests of achievement and intelligence examining the correlation between cognitive ability and achievement reported in various test manuals and published journal articles including the Cognitive Assessment System (CAS), the Kaufman Assessment Battery for Children-Second Edition (K-ABC II), and the Woodcock Johnson-III Tests of Achievement (WJ-III:ACH).

Research evidence indicates that measuring and interpreting cognitive processing, such as simultaneous processing, has been found to be remarkably consistent across many differing groups including age, IQ scores, socioeconomic status, culture, and educational attainment (Wachs & Harris, 1986; Snart, O'Grady, & DAS, 1982). Research also indicates that simultaneous processing shows significant correlations with various measures of school achievement (Ashman, 1979, 1982; Cummins, 1979; Cummins & Mulcahy, 1979).

Naglieri & Bornstein, (2003) examined IQ and achievement test composite scores as well as IQ and achievement subtests and then divided them into small and large

samples ($n < 200$ and $n > 200$). They found that instruments ranked at the top, for the large studies, included the ability/achievement composite correlations for the K-ABC, which was evident at .74 followed by the CAS and WJ-III, which both were at .70. Results for the large-scale ability and achievement subtests studies demonstrated that the CAS had the highest correlations with achievement tests even though they do not contain achievement-like subtests found in other ability instruments.

Educational significance and impact is evident through the use of such neuropsychological based intelligence tests with constructs from Luria's model such as the CAS (Naglieri & Das, 1997), the K-SNAP, and the KABC-II (Kaufman & Kaufman, 2004), which puts forward a Lurian interpretation, and offers evidence that students' needs in the classroom are being better met from knowledge gained from neuropsychological instruments. Researchers are increasingly seeing the importance of interpreting ability scores as cognitive processing.

For example, research indicates significant positive academic progress when measuring and interpreting cognitive processing and assisting pre-K through postsecondary students having difficulty in such areas as reading, written expression, phonological processes, arithmetic, Attention Deficit Hyperactivity Disorder (ADHD), as well as college correlation with math and academic grades (Gunnison, Kaufman, & Kaufman, 1982; Haddad et al., 2003; Harris & Wachs, 1986; Johnson, Bardos, & Tayebi, 2003; Joseph, McCachran, & Naglieri, 2003; Lidz & Greenberg, 1997; Naglieri & Goldstein, 2006; Wachs & Harris, 1986, respectively).

Research indicates measuring and interpreting cognitive processing, including simultaneous processing, are valid predictors of academic potential and offers culture-fair

assessments with certain college populations. It is also evident that measuring simultaneous processing offers valid knowledge about strengths and weaknesses of one's processing levels, which then assists college students academically who have learning disabilities in graduate and professional schools (Digman, Mroczka, & Brady, 1995; and Ganschow, Coyne, Parks, & Stanley, 1999, respectively).

The educational value of investigating relationships between preferred approaches of information processing is important because research studies indicate that deficiencies in some cognitive processing approaches, such as simultaneous processing, can be strengthened and that instructional materials are far more effective when matched with students' cognitive strengths (Brailsford, Snart, & Das, 1984; Das, Kirby, & Jarman, 1979; Harris & Wachs, 1986; Pask & Scott, 1972).

The research evidence, in regard to academic progress, has shown that students make significant academic progress in their educational environment through assistance from insight gained from Lurian based test instruments. This is because these instruments have been shown to better modify a student's interventions for their specific challenges that they are struggling with in school (Fiorello et al., 2006).

In examining correlations of other intelligence tests compared with those constructed on Luria's basic neuropsychological functions for predictors of academic skills, studies have shown support for those instruments that have constructs from Luria's model. For example, Naglieri, De Lauder, Goldstein, & Schwebech's (2006) research examined the Wechsler Intelligence Scale for Children-Third Edition (WISC-III) and the Cognitive Assessment System (CAS) to investigate which correlates higher with achievement. Their study examined 119 students (87 males and 32 females) using both

intelligence tests with the Woodcock-Johnson Tests of Achievement. Results indicate that the CAS/WJ-III correlations were consistently higher than those found for the WISC-III/WJ-III. The author's state that CAS full scale accounted for more distinct variance and was a stronger predictor of WJ-III Academic Skills Cluster than the WISC-III Full Scale IQ which is not constructed from Luria's primary four function model.

Effective interventions utilizing instruments that offer neuropsychological functions such as those identified by Luria including Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) and Cognitive Assessment System (CAS) have been shown effective with such issues as (a) Attention Deficit Hyperactivity Disorder (ADHD) (Naglieri & Goldstein, 2006; Van Luit, Kroesbergen, & Naglieri, 2005); (b) written expression (Harris & Wachs, 1986; Johnson, Bardos, & Tayebi, 2003); (c) reading comprehension (Haddad et al., 2003); (d) cultural issues (Digman, Mroczka, & Brady, 1995); (e) reading and mathematics academic achievement (Wachs & Harris, 1986; Lidz & Greenberg, 1997); and (f) learning disabilities in graduate and professional schools (Ganschow, Coyne, Parks, & Stanely, 1999).

Simultaneous Processing and ADHD

A major area impacting a student's education is in regard to Attention Deficit Hyperactivity Disorder, which significantly affects students learning and achievement. The essential features of ADHD are currently described as a "persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequently displayed and more severe than is typically observed in individuals at a comparable level of development" (American Psychiatric association, 2000, p. 85, cited by Naglieri & Goldstein, 2006). In an investigation conducted by Naglieri & Goldstein (2006) the authors propose that an

"assessment of cognitive processing *such as the CAS* should be considered to play an essential role in the DSM-IV assessment and diagnosis of ADHD-C and ADHD-I so that students who are identified possess cognitive characteristics consistent with the subtypes of the disorder," (Naglieri & Goldstein, 2006, p. 5).

Research conducted by Van Luit et al (2005) examined the effectiveness of Luria's basic model utilizing the CAS for Dutch students with and without ADHD. The authors used CAS scores of 51 Dutch students without ADHD and compared them to 20 Dutch students with ADHD, and they compared these scores to American standardized samples of students with and without ADHD. Results showed that students with ADHD in both countries demonstrated comparatively low scores on the Planning and Attention scales of the CAS, but average scores on the Simultaneous scales. The authors suggest that their findings, which correlate with other similar research suggests that the CAS has sensitivity to the cognitive processing difficulties seen in some students with ADHD (Van Luit et al., 2005).

Simultaneous Processing and Written Expression

Written expression is another area that can significantly impact a student's educational success. A study conducted by Harris & Wachs (1986) examines written expression with a group of 70 undergraduate college students, which included 34 males and 36 females with an average age of 20.25 years. They hypothesized that simultaneous processing relates to a students writing ability to maintain an overview of large portions of a piece of discourse and therefore see relationships between parts of the discourse. Each student was seen individually and was asked to write two essays. Results indicated

that low scores in simultaneous processing correlated with an inability to indicate clear relationships between sentences and paragraphs (Harris & Wachs, 1986).

Harris and Wachs (1986) state that inherent in the approach of Luria, Vygotsky, and others is the idea that cognitive competence can be improved because cognitive competencies are thought not as innate capacities, but as skills. Therefore, states Harris and Wachs (1986) students with low abilities in either simultaneous or successive processing, or both can learn to improve such skills.

A study conducted by Johnson, Bardos, and Tayebi, (2003) examines written expression with junior high students ages 11-15 years with (n = 48) and without (n = 48) written expression disabilities. There were a total of 96 students in their study. The Cognitive Assessment System (CAS) and the writing subtests of the Weschler Individual Achievement Test (WIAT; 1992) were utilized in the study. A discriminant analysis was employed to identify the CAS composites and subtests that contributed to group differentiation. The most significant contributor among the four composite scores was the Planning composite. The authors state that subsequent efficiency of classification analysis offered strong support for the validity of the obtained discriminant functions in that the four CAS composite scale scores successfully identified 83% of the participants as members of their respective groups (Johnson et al., 2003).

Simultaneous Processing and Reading

In an examination of reading difficulties it is evident that difficulty with reading acquisition is the most common difficulty with reading referral for educational assessments, with an estimated 5% of students identified as having reading disabilities (Ramus, 2001; Schrank & Flanagan, 2003, cited by Fiorello, Hale, & Snyder, 2006)

because they do not show sufficient response to classroom instruction (Fiorello et al., 2006). In analyzing Luria's four basic model theory, the neuropsychological approach to reading according to Fiorello, et al., (2006) is that this approach begins with the cognitive processes that underlie reading performance rather than concentrating on visible input or output demands.

According to Fiorello, et al., (2006) important factors in one processing theory, the CHC processing-based theory, which utilizes Luria's perspectives for such areas as reading, can be applied to determine strengths and weaknesses for academic progress. Important factors in the area of reading achievement are (a) auditory processing (Ga)/phonological processing; (b) sensory memory and working memory; (c) long-term memory storage and retrieval and crystallized abilities. CHC constructs such as processing speed/rapid automatic naming can also be assessed as simultaneous processing using Lurian type intelligence instruments.

In analyzing long-term memory storage and retrieval and crystallized abilities for academic success such as in reading achievement, Fiorello, et al., (2006) states that critical reading competency processes include associative memory, meaningful memory, and ideational memory. These items are related to Rapid Automatized Naming (ideational fluency) and basic reading and reading competency skills (lexical/semantic knowledge and language development Glr/Gc). Although Gc is frequently related to temporal lobe functions, the frontal executive-working memory system is in charge of Glr, with encoding being a left frontal task along with the hippocampus, and retrieval a right frontal task (Tulving, Kapur, Craik, Moscovitch, & Houle, 1994, cited by Fiorello, et al., 2006). Determining whether encoding, storage, or retrieval problems in long-term

memory based on reading comprehension deficits would be significantly beneficial for designing targeted interventions (Fiorello et al., 2006). Luria's simultaneous processing (block 2) design of coding and storing information involves integrating such incoming sensory information. In regard to analyzing long-term memory storage and retrieval and crystallized abilities, Luria provided researchers with a conceptual understanding of how the posterior-anterior, left-right brain axes, and the four lobes (the occipital, temporal, parietal, and frontal lobe) work together to produce such complex cognitive processing for areas such as reading (Hale & Fiorello, 2004).

Luria's perspective, states Naglieri & Rojahn (2001) is that there are three types of cognitive processes responsible for mental activity linked to three functional units of the brain. These processes work together to produce behavior and provide attention (unit 1), simultaneous and successive processing (unit 2), and planning (unit 3) (Naglieri & Rojahn, 2001).

In examining processing speed/rapid automatic naming for such academic areas as reading, Fiorello et al. (2006) states that processing speed is associated to the rate of processing or automaticity with simple cognitive tasks. From a neuropsychological perspective (with Lurian principles), it is important to consider automaticity of word recognition and retrieval difficulties, expressive speech and language characteristics, and slow psychomotor pace during testing (Hale & Fiorello, 2004).

Students with reading disabilities are seen to have difficulty with inhibition, selective and sustained attention, flexibility, set maintenance, and phonemic production (Kelly, Best, & Kirk, 1989, cited by Fiorello et al., 2006), indicating that dysfunctional frontal-basal ganglia-thalamus—cerebellar circuits may account for difficulties in

processing speed, working memory, sequencing, temporal relationships, as well as performance monitoring in some students with reading disabilities (Fiorello et al., 2006).

Simultaneous Processing and Reading Comprehension

It is evident that reading comprehension is seen as an important skill for success in school. A study conducted by Haddad et al. (2003) examined planning facilitation and reading comprehension in regard to instructional relevance to Luria's model of four functions. The authors state that their study was to assess whether instructional design to facilitate Planning would have differential benefit on reading comprehension conditional on the specific planning, attention, simultaneous, and successive cognitive characteristics of each participant. Participants included 45 fourth-grade general education students, which were divided into groups that did not differ in any way by either CAS full scale standard score, gender, chronological age, or pretest reading comprehension scores.

A cognitive strategy instructional intervention was administered after each participant's CAS administration and a pretest reading comprehension instructional level was assessed, subjects completed a reading comprehension posttest at their own instructional levels after the intervention. Results indicated that participants with a Planning weakness (n = 13) benefited substantially (effect size of 1.52) from instruction intended to facilitate planning. Participants that had no weakness (n = 21; effect size of .52) or a Successive weakness (n = 11; effect size of .06) did not benefit as much. The authors, (Haddad et al., 2003), state that evidence indicates, as well as, supports previous research, that Planning, Attention, Simultaneous, and Successive cognitive profiles are relevant to instruction.

Simultaneous Processing and Mathematics

Research by Wachs and Harris (1986) examining simultaneous processing and math sores reveal that scores on a simultaneous processing measure, correlated significantly with Scholastic Aptitude Test (SAT) Math scores. Seventy undergraduate participants were tested individually on a battery of tests designed to assess both simultaneous and successive processing. The participants included 34 males and 36 females with an average age of 20.1 years and a mean educational attainment of two completed semesters of university work. The authors state that their research supports the relevance of the Luria model as seen in the significant correlations of simultaneous processing with SAT Math scores.

In researching additional reading and mathematic achievement the Cognitive Assessment System (CAS), Lidz & Greenberg (1997) found statistically significant associations regarding reading and mathematics and the CAS method in their study. Participants included 75 rural first grade regular education students. The CAS looked at planning, attention, and simultaneous and successive forms of processing with these students. A pretest, intervention, and posttest were administered in the study. The interventions addressed weaknesses seen from CAS testing and results illustrated statistically significant relationships among all four processes and achievement (Lidz & Greenberg, 1997).

Simultaneous Processing and Cultural Issues

A study conducted by Dingman, Mroczka, & Brady (1995) examined culture of American Indian college population and simultaneous processing. Many difficulties inherent in assessing students with instruments normed from another culture make it

difficult in predicting academic success for such populations (Dingman. et al., 1995). A significant covariate of performance was evident in their study when they examined three tests of simultaneous processing (Form Completion, Orientation, and Localization). Dingman. et al., (1995) state that their analysis suggest that these and other tests that measure simultaneous processing may be valid predictors of academic potential for the American Indian population. The authors state that this is significant because college admission, trying to predict future success, is often contingent upon standardized test scores, which do not include measuring such strengths seen with other cultures as simultaneous processing. High teacher expectations are also linked to high achievement test scores, low teacher expectations may directly influence the number of American Indian college students who set college as their goal. According to Dingman. et al., (1995) only 9.3% of American Indians, Eskimos, and Aleuts hold a bachelor's degree compared to 20.3% of all persons 25 years and older.

The authors' (Dingman. et al., 1995) analysis indicated that in examining the number of quarters of continued college enrollment and college grade point average and performance on 8 tests did not approach statistical significance; however, three simultaneous processing measures in the battery were significant in relation to the number of college quarters an American Indian student was enrolled in college. The authors state that their results revealed that tests of simultaneous processing are positively correlated with the number of quarters of college enrollment for American Indian students, which is significant data since research is evident that American Indian college students have the highest drop out rate with 50% of this population currently enrolled in school that may not graduate.

Simultaneous Processing and Learning Disabilities

Ganschow et al., (1999) examined learning disabilities in graduate and professional schools in a 10-year follow-up study. Their research revealed that in examining a group of successful medical students identified as having a learning disability. Research evidence indicated that successful medical and law students with a learning disability, in such studies as Accardo, Haake, and Whitman (1989), Walters and Croen (1993), and Runyan and Smith (1991), cited by Ganschow et al., (1999), were successful because they shared common strength in simultaneous processing and well-developed reasoning abilities.

It is evident that there is significant importance in regard to ability measurement with reference to cognitive processing dimensions, which is also noted in reference to potential usefulness in the diagnosis of learning disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association [APA], 1994). The DSM-IV states:

> A smaller discrepancy between achievement and IQ is sometimes used especially in cases where an individual's performance on an IQ test may have been compromised by an associated disorder in cognitive processing (46).

It is evident that it is increasingly important to consider interpreting scores in terms of cognitive processing instead of interpreting overall ability scores.

There are significant amounts of evidence currently that indicate success linking assessments results to interventions, such as the research discussed with the students evident planning weakness who benefited substantially from instruction intended to facilitate planning (Haddad et al., 2003). According to Hale & Fiorello (2004), linking

assessment information to intervention is one of the main tasks of school assessment teams.

Researchers examining aptitude-treatment interactions (ATIs) or the diagnostic–prescriptive model have attempted to identify relationships between specific assessment results and interventions. Early ATI studies, according to Hale & Fiorello, found limited support for ATI; however, according to Hale & Fiorello, most ATI research developed when investigators had poor assessment instruments and limited knowledge of brain functions, and that early ATI research failures have been attributed to an assortment of reasons. Many cognitive constructs were inadequately defined or inadequately measured (Ysseldyke & Salvia, 1974) and often participants were simply divided at the median to define "high" and "low" groups. Treatments were inadequately defined or implemented without integrity confirmation (Reynolds, 1988). Since the early studies, research on ATI has continued to be inconsistent. For instance, research from psycholinguistic training, which identifies student' weaknesses and offers individualized instruction has lead to significant improvement in students' language ability (Kavale & Forness, 1999, cited in Hale & Fiorello, 2004). Occupational therapists, speech and language pathologists, and physical therapists, often use single-subject design to conduct ATIs (Hale & Fiorello, 2004). Another ATI study found that a mediated learning program was best for preschool special education students with language impairments. Recently, performance on the CAS Planning, Attention, and Simultaneous and Successive Processing scales has been linked to intervention with the PASS Remedial Program (PREP). (Hale & Fiorello, 2004). Studies using PREP have shown improvement not only in simultaneous and

successive processing scores, but also in reading and mathematics scores (Das & Kirby, 1994).

According to Hale & Fiorello (2004), there have been various requests for ATI research that investigates the multivariate nature of cognitive constructs, and that address the technical issues related with treatment development and integrity (Braden & Kratochwill, 1997; Deno, 1990, and Reynolds, 1988). When deficit remediation teaching is explicitly connected to academics, either during initial training or through a training transfer process, progress in academic performance has been demonstrated (Hale & Fiorello).

Researchers state that Lurian based models that measure underlining issues that are composed of neuropsychological interpretation of test data, verification of initial hypothesis, methods for ensuring ecological validity, and continual monitoring of intervention effectiveness, meets the ATI standards, providing a successful method for individualized service delivery to all students (Hale & Fiorello, 2004). Neuropsychological tests based on Luria are extremely important for successful identification of underlining relationships that do offer positive results between specific assessments and interventions.

The Visually Impaired And Blind Population (VI/B)

Psychological intelligence tests, which are heavily weighted with visual content, only offer adaptations that are not as beneficial to assessing cognitive ability for the visually impaired or blind (VI/B) population (Reid, 1995, 1997). The few tests that are specifically designed for VI/B are either outdated, not available any more, not widely

used, require additional training, or have longer administration times impacting both the practitioner and the participant (Jones & Marks, 2008; Reid, 1997). The importance of assessing simultaneous processing ability with the visually impaired and blind is significantly as important as with the sighted population. However, in some aspects, measuring simultaneous processing ability may be more important in regard to the visually impaired and blind because of comorbid conditions. Fried and Wallace (1992) state that comorbidity refers to multiple chronic illness or diseases that people experience.

Research indicates that visual impairment is a significant risk factor for additional comorbid medical conditions (Crews & Campbell, 2001). Crews and Campbell (2001) state that for rehabilitation professionals, the difficulties with persons who have visual impairment become so complex that knowing where to begin an intervention can be extremely difficult and appropriate assessments therefore are that much more valuable with this population.

Research with the visually impaired indicates that it can be extremely important to measure such abilities as simultaneous processing so that interventions can address their needs. Julka (2006) states that visually impaired children can integrate critical features better and recall more details when trained through audio mode. When interventions specifically address a visually impaired students strengths and weaknesses and they are given longer time to integrate and code information from sense modalities other than vision, their accuracy improves to that of the level of the sighted population in terms of the units of knowledge they can retrieve from the knowledge acquired during the

teaching phase (Julka 2006). Intelligence, states Julka (2006), seems to affect the visually impaired not only in acquiring knowledge but in retrieving knowledge as well.

Assessing individuals with impaired vision presents a variety of challenges from those encountered with the general population. For example, some oral tests can be more readily adapted for those with impaired vision, but performance tests are least likely to be applicable for appropriate assessment of strengths and weaknesses (Anastasi & Urbina, 1997). Individuals with visual disabilities may also perform poorly on tasks that require judgment of spatial relationships, demonstrate frustration at prolonged reading tasks, and perform poorly in accurate hand-eye coordination, in tasks such as writing (Erin & Koenig, 1997).

Turner & Erchul (1987) state that there are significant challenges to consider when assessing visually impaired students, which include variables effecting vision, effects of visual challenges on psychological development, and proper adaptation and valid use of tests. Various problems also include outdated material and unavailability of manuals and kits, lengthy administration time, and scant research data supporting the tests (Barraga & Erin, 2001; Miller & Skillman, 2003; Turner & Erchul, 1987).

Hill-Briggs, Dial, Morere, & Joyce (2007) state that individuals with physical and sensory disabilities comprise of groups requiring specialized standards of practice for assessment. Numerous issues, according to Hill-Briggs et al., confront the practitioner when assessing an individual with significant visual impairment or blindness such as (a) impact of heterogeneity of the population on test norming; (b) impact of visual functioning, age at onset; and (c) limitations in test adaptation and development.

In examining adaptations to instruments, a few studies have shown a positive correlation between scores on verbal measures and future academic success (Barraga & Erin, 2001; Smedler & Torestad, 1996), but caution is recommended when using such tests with individuals who are visually impaired. In investigating the use of verbal measures, Miletic (1995) suggests that weak performance is evident on verbal tasks in typical cognitive tests because of an inability of individuals who are visually impaired to obtain information from their environment, particularly in areas dealing with similarities and comprehension (Wyver & Markham, 1999), which is needed to solve the task and not to a deficit in the cognitive processes involved with the task.

Research indicates that using only adaptations of a cognitive assessment battery may not be suitable. For example, relying solely on a test of verbal comprehension skills may provide informative data such as in vocational assessment, but is considered less comprehensive than that afforded sighted individuals (Reid, 1995, 1997). Additionally, when using elements of assessment batteries for use with persons who are visually impaired, practitioner satisfaction ratings are considerably lower. For instance, practitioners using various Wechsler tests rated their satisfaction within the 64% to 70% satisfied range when adapting the test for use with persons who are visually impaired (Miller & Skillman, 2003).

Measuring and screening supplementary areas in addition to verbal comprehension can add extremely valuable information as well (Trief, 1998). For instance, gathering information about one's simultaneous processing abilities may increase knowledge and understanding that offers more depth and breadth to an

individual's deficits and would be an important step toward better understanding an individual's capabilities in a more holistic manner.

In analyzing what instruments are available that could be used to assess the ability to reason nonverbally in the visually impaired, it is evident that in the tests that have been adapted, many are not available now, are out of date, not widely used, or are not found reliable and valid (Hill-Briggs et al., 2007; Reid, 1997).

For example, the study conducted by Reid (1997) examines a tactile adaptation for the Kohs Block Design Test, called the Ohwaki-Kohs Tactile Block Design Intelligence Test. This instrument is a nonverbal intelligence test that was originally designed for individuals with hearing and language impairments to measure performance. Ohwaki et al. (1960: cited by Dauterman, Shapiro, & Suinn, 1967) were the first to adapt this instrument. Brand, Pieterse, & Frost (1986) endeavored to establish the reliability and validity of the test. Brand et al. (1986) attempted to establish reliability and validity by blindfolding 58% of the participants in their study and compare results with blind participants, but a bimodal distribution of scores did not result; rather, a goodness to fit demonstrated that the Ohwaki-Kohs scores were normally distributed (Reid, 1997). This example is one reason why blindfolded participants were not utilized in the current study.

The Stanford Ohwaki-Kohs Tactile Block Design Intelligence Test was studied when Suinn and Dauterman (1966; cited by Dauterman et al., 1967) standardized the Ohwaki-Kohs test. There was little agreement among psychologists of its utility and reports indicate that it is no longer marketed (Reid, 1997).

The Ravens Standard Progressive Matrices and the Tactile Progressive Matrices were adapted by Rich (cited by Reid, 1997) for people who are blind. Reid stated that

Rich reproduced selected items from the Color Progressive Matrices in balsa wood and sandpaper to use with students with a visual impairment. He later created a version for adults called the Tactual Progressive matrices (Rich and Anderson, 1965, cited by Scholl & Schnur, 1976). Hill-Briggs et al., (2007) state that the Raven Progressive Matrices have had limited contribution to neuropsychological assessments of individuals with visual-impairment or blindness for a variety of reasons. According to Reid, this test has since ceased to be available because of issues such as high production costs.

A pilot study was conducted on the TONI for adaptation for persons with visual impairment (Duncan, Weidel, Prickett, Vernon, & Hollingsworth-Hodges, 1989). Duncan et al. described the test as a nonverbal assessment measuring problem-solving ability. The TONI requires participants to complete a range of various tasks such as classification and progression based on abstract graphical designs. Duncan et al. copied the test to thermaform plastic, producing durable, "embossed" lines to represent the designs. The tactile scores and the Wechsler scores did not correlate significantly ($r = .371, p > .05, N = 9$). The result, along with the excessive complexity of certain items, and the lengthy administration time required, Duncan et al., concluded that the Tactile TONI could not be recommended as a performance test for the visually impaired and the blind.

The D48 is another nonverbal test for the visually impaired. Domino (1968) compared the performance of persons who are blind on the D48, a tactile test, with performance on the Weschler verbal scales. The D48 (Gough & Domino, 1963) utilized tactile dominoes, which many people with visual impairment are already familiar. The test included a set of problems each being a principal of succession defined by a series of

dominoes. A correlation of .58 ($p = <.01$, $N= 30$) between the scores of the two tests were obtained. Unfortunately, Reid (1997) states, although the D48 test offered a promising correlation with the Wechsler verbal scales, the test was exceptionally difficult and stressful for most participants, and Domino himself, recognized the limited practical applicability of the test due to its high level of difficulty.

The Haptic Intelligence Scale for Adult Blind (Shurrager & Shurrager, 1964, cited by Reid, 1997) was designed to work with participants who were totally blind, partially sighted, and fully sighted. The participants who were partially and fully sighted were blindfolded for the study. All three groups were tested and the subjects with total blindness achieved the highest scores. The results are treated cautiously because of the blindfold addition and results in the study. Bauman (1975) states that the only norms available were for participants with no vision, and other limitations as well including a lengthy administration time, high production costs, and limited normative data for participants below the age of 16. As a complete kit (Reid, 1997) the HIS is particularly heavy and cumbersome and some test materials appear quite childlike and lacking face validity.

Hill-Briggs et al. (2007) examined a variety of perceptual-motor tests that can and have been used to assess persons with visual-impairment or blindness and they concluded that very little success has been achieved in non-verbal cognitive or memory assessments with this population. For example, the use of the Tactual Performance Test (TPT), the Finger Oscillaiton (FO), and the Grip Strength (GS) subtests from the Halstead-Reitan Battery (HRB) were all found to offer little success in a cognitive or memory assessment.

The Vocational Intelligence Scale for Adult Blind (VISAB) (Jones and Tears, 1964, cited by Reid, 1997) was reported to be another tactile test designed to test nonverbal cognitive ability. In this test the participant had to determine tactilely which of four geometric patterns was least like the others. Scholl & Schnur (1976) state that a correlation of .63 was reported between scores on the VISAB and the Wechsler verbal scales. Reid (1997) states that this test has been recommended for adults with residual vision, but that the VISAB is no longer marketed.

Two adaptations, discussed by Jones & Marks (2008), which offer evidence as potential intelligence instruments for persons with visual impairment include the work of Reid (2001, 2002) in tactile adaptation of the Kohls Block Design Test and the Slosson Intelligence Test-Revised with the supplementary manual for use with the visually impaired or blind. (Larson & Slosson, 2000).

Reid (2001) reports on research of a tactile adaptation of the Kohs Block Design Test, called the AKBDT, and the creation of a new scoring system. This test corresponds to Royer's 1977, cited by Reid, 2001) analyzed block design performance in two conditions: "cued," an alteration in which each stimulus design is superimposed with a grid demarcating the edges of the blocks composing the design, and the "uncued," which is the standard block design (Reid, 2001). Reid offers insight to the standardized instruction devised and provides input on expected time completions, but no discussion of validity and no correlations to other intelligence tests, such as the Wechsler verbal scales, were offered.

In examining current cognitive instruments specifically designed for individuals with vision impairment some disconcerting findings are evident. For instance, Miller &

Skillman (2003) replicated an earlier study by Bauman & Kropf (1979) in which they asked assessment professionals, who worked with individuals with vision impairments, what instruments they used and how satisfied they were with the results. Satisfaction scores were compiled for verbal, nonverbal, and overall applications. They found the highest satisfaction ratings overall for two scales in particular, which included the Oregon Project for Visually Impaired and Blind Preschool Children (Brown, Simmons, & Methvin, 1986) and the Cognitive Test for the Blind (Dial et al., 1990), with satisfaction reported at 100% and 95%, respectively, however, these instruments were not widely used. Miller and Skillman's analysis was that little change had been made since the 1979 survey, suggesting that there remains a need for new test instruments, and that the development of viable tests remains a challenge and an ethical obligation (Jones & Marks, 2008).

The McCarron-Dial Comprehensive Vocational Evaluation System (CVES) is one exception, which has demonstrated effectiveness with the population of the visually disabled. The CVES, according to Hill-Briggs et al., (2007) measures three primary neuropsychological factors: verbal-spatial cognitive abilities (VSC); perceptual-motor functions (PM); and emotional-coping concerns (EC). Research has shown the effectiveness of this instrument in identifying neuropsychological deficits associated with learning disabilities (Rabeck, 1995) and sequelae associated with diabetic retinopathy (McGee-Hall, 1995). The CVES is a comprehensive instrument and quite valuable for assessing individuals who are VI/B, but a quick screener to possibly assess whether a more comprehensive evaluation is needed or to give a quick synopsis of one's difficulties is not readily available for the VI/B.

Undoubtedly, the standard testing instruments are not sufficient to meet the assessment needs for students and adults with visual disabilities (Jones & Marks, 2008). Very few instruments have been produced specifically for use with this population.

According to Jones & Marks (2008) the practitioner's quandary in deciding on an appropriate test instrument is even further weakened in regard to neuropsychological appraisal. Price, Mount, & Coles (1987, cited by Jones and Marks, 2008), about twenty years ago, recommended that assessment with a neuropsychological perspective could be beneficial in working with persons who have visual limitations. The authors note that in addition to the value in planning rehabilitation activities that many visually impaired people have a secondary premorbid condition, sometimes related with a head trauma that resulted in loss of vision. Hill-Briggs et al. (2007) concur that a large percentage of individuals present with multiple etiologies with vision loss.

Simultaneous Processing

Neuropsychological tests based on Luria's model are valuable as has been evident. Measuring simultaneous processing, which is associated with Luria's second functioning unit (Block 2) for receiving, analyzing, and storing information (Hale & Fiorello 2004), is an important part of such tests. Simultaneous processing, according to Flanagan & Harrison (2005) is a mental activity by which the individual integrates separate stimuli into groups or into a whole and so simultaneous processing measures have strong spatial aspects for this reason. Simultaneous processing, according to Kaufman (2004) demands a gestalt like, frequently spatial integration of stimuli that is needed to solve the problems with maximum efficiency. The input has to be synthesized

simultaneously, such that the separate stimuli are integrated into a group or conceptualized as a whole via the senses (Kaufman, 2004). Simultaneous processing can be used to solve tasks with verbal content, as long as the cognitive demand of the task requires integration of information (Flanagan & Harrison, 2005).

Simultaneous processing, according to Flanagan & Harrison (2005) underlies the comprehension and use of grammatical statements, because they demand comprehension of inflections, prepositions, and word relationships, so that the person can obtain meaning based on the whole idea. Simultaneous processing is measured with tasks that necessitate integration of parts into a single whole and understanding of grammatical and logical relationships (Flanagan & Harrison). The literature of Luria suggests that damage to the occipito-parietal regions result in a hindrance of simultaneous processing. Anderson and Traivs (1983) give descriptions for simultaneous processing, they state that, "Simultaneous processing of information requires the organization of input into groups so that the relationships of parts to the whole can be grasped and manipulated" (p. 92).

Literature already mentioned has described how simultaneous processing can be identified in specific tasks involving spatial (simultaneous) concepts. The functioning of simultaneous processes can be difficult to detect in less specific realms, such as language, however, Litz (1991) wrote:

> Especially in language, it can become quite confusing to determine whether successive or simultaneous processing is taking place, and it seems that these can overlap, depending upon the structure of the language (i.e., spatial or temporal). It also seems that individuals differ with regard to strategic preference for type of processing, so that the same input may be processed simultaneously or

successively, depending upon the individual. Furthermore, as Vygotsky (1978, p. 33) points out, what we perceive may be simultaneously integrated, but when we talk about it we are often restricted to successive nature of speech. (p. 139)

Morris and Mather (2007) offer several intervention-based suggestions for the improvement of simultaneous processing for students with learning or behavioral problems. The authors propose PREP (Process-Based Reading Enhancement Program) to assist in the remediation of processing deficiencies. They describe the process:

> During twice weekly sessions for about 16 weeks, learners are trained in global processes in a manner that encourages internalization, along with subsequent generalization and transfer. Students become aware of the underlying cognitive processes through guided discussion of what they are doing during and following the tasks. The tasks include procedures such as rehearsal, categorization, monitoring of performance, and prediction. The program consists of four simultaneous processing modules, with scripted instructions for each task. (p. 279).

Morris and Mather (2007) offer suggestions other than PREP for the improvement of simultaneous processing. These methods include the following:

> …providing learners with practice in forming verbal and nonverbal relationships by having them link items of information into a surveyable array…matching and categorizing items, having the student supply missing details in a story, teaching the student how to summarize a written passage, and having the student create and use maps. (pp. 279-280).

Neuropsychological Assessment Instruments

Several present-day test instruments use the Luria model principal functions such as the simultaneous processing function, including the Kaufman Assessment Battery for Children-Second Edition (KABC-II) (Kaufman & Kaufman, 2004), the Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) (Kaufman & Kaufman, 1994), and the Cognitive Assessment System (CAS) (Naglieri & Das, 1997).

Another neuropsychological instrument for consideration is the Woodcock-Johnson Tests of Cognitive Ability (WJ-III: Cog). Although not considered a primary neuropsychological assessment instrument, the WJ-III:Cog is designed specifically to access the full range of cognitive abilities from the CHC theory, which in many ways is compatible with current neuropsychological theories on cognitive functioning (Hale and Fiorello, 2004).

The WJ-III: Cog includes auditory measures such as the "Sound Blending Test," which requires a participant to synthesize speech sounds to form a word, and the "Auditory Attention Test," which focuses on measuring attention auditorily (Riverside Publishing, 2009). According to Evans, Floyd, McGrew, and Leforgee (2001), the Sound Blending and Auditory Attention tests help in analyzing one's ability to attend to, perceive, and analyze patterns of sound and speech. Sattler (2001) states that the Sound Blending test measures the ability to synthesize sounds. The auditory tests in the WJ-III: Cog have apparently not been investigated as measures of simultaneous processing. No connections are made with simultaneous processing in its manual or in specific books that analyze cognitive instruments such as Sattler's (2001) cognitive applications publication.

Many of the neuropsychological test instruments are significantly weighed down with visual content and not available in a design appropriate for use with adults and students with a visual impairment or who are blind (Jones & Marks, 2008), or such instruments do not attempt to measure simultaneous processing auditorily. Again, it is unfortunate that such instruments which are based on Luria's model are not available for individuals who are visually impaired or blind.

Detailed descriptions of the KABC-II tests, according to Kaufman & Kaufman (2004), show that these measures require acute visual ability. For instance, *Conceptual Thinking* (a nonverbal measure of reasoning in which the child demonstrates classification ability) requires the individual to view a set of four or five pictures and identify the one picture that does not belong with the others. Some of the items use abstract visual stimuli and others use meaningful visual stimuli.

The K-ABC-II *Face Recognition* subtest (measures short-term visual memory and visual processing) requires the individual to attend closely to photographs of one or two faces that are exposed for five seconds and then selects the correct face or faces, seen in a different pose, from a group photograph. *Pattern Reasoning* (a nonverbal measure of reasoning) requires the individual, who sees a row of images with one image missing, to select an image that can be placed in the gap to complete the pattern.

K-ABC-II *Rover* subtest (measures simultaneous or visual processing that demands decision making to identify the shortest route to a goal) requires the individual to move a toy dog to a bone on a checkerboard-like grid that contains obstacles such as rocks and weeds, and tries to find the "quickest" path—the one that takes the fewest moves. *Triangles* (measures visual-construction ability and understanding of spatial

relations) require the individual to assemble several identical foam triangles (yellow on one side, blue on the other) to match a picture of an abstract design. *Block Counting* (measures the ability to visualize objects in three dimensions) requires one to count the exact number of blocks from pictures of stacks of blocks, which are configured so one or more blocks is partially or completely hidden from sight.

The K-ABC-II *Gestalt Closure* subtest (measures simultaneous or visual processing in which the individual synthesizes disconnected visual stimuli into a single meaningful image) requires the individual to mentally "fill in the gaps" in partially completed "inkblot" drawing and describes the object or action depicted in the drawing (Kaufman & Kaufman, 2004). The KABC-II simultaneous processing measures do require acute visual ability and therefore are not appropriate with assessing simultaneous processing skills with the population of the VI/B.

Kaufman's (Kaufman & Kaufman, 1994) Short Neuropsychological Assessment Procedure (K-SNAP) also uses an application of Luria's conceptualizations. The K-SNAP is designed to briefly assess all three functional units of the brain (Tupper, 1999). The K-SNAP is comprised of several different subtests which include the Mental Status, Number Recall, Gestalt Closure and the Four-Letter Words. The K-SNAP takes approximately 30 minutes to complete all of the different subtests (Kaufman & Kaufman, 1994).

The K-SNAP measures adolescent and adult cognitive functioning at three distinct levels of complexity. The K-SNAP offers an impairment Index which provides an objective look at a person's level of impairment (specific criteria were selected to correspond to specific clinical and neurological disorders) (Pearson, 2009).

Most tasks on the K-SNAP are administered in easel format and part of one subtest requires paper and pencil. The K-SNAP Mental Status stimuli are auditory and/or visual and response is verbal. Gestalt Closure stimuli are visual and the response is verbal. Number Recall stimuli are auditory and the response is verbal. Four-Letter Words stimuli are visual and the response is verbal or motor (Pearson, 2009). The K-SNAP allows teaching to ensure all examinees understand the nature of the task and includes various input/output formats to minimize unfairness to people with lateralized brain damage.

The K-SNAP can be interpreted in the context of several intellectual and neuropsychological assessment theories –including the PASS model (Pearson, 2009). The Planning, Attention, Simultaneous, Successive (PASS) cognitive-processing theory is built on the neuropsychological work of Luria (Naglieri & Johannes, 2001). In examining the K-SNAP to the PASS model it is evident that each of the K-SNAP subtests tap Planning, Attention, Simultaneous processing and Successive processing.

For instance, the K-SNAP Gestalt Closure subtest, a perceptual task, is a measure of Simultaneous Processing and the Number Recall subtest, a verbal task, is a measure of Sequential/Successive processing (Donders, 1998). The K-SNAP Mental Status subtest, an attention-orientation skill, is a measure of Attention, and the Four-Letter Words subtest is a measure of planning ability.

According to Henry (2001), Forward Digit Span, similar to the K-SNAP Number Recall test, measures more than just –sequential/successive processing ability. Research evidence indicates that working/short-term auditory memory can be measured by utilizing Forward Digit Span/Number Recall subtests. The author (Henry, 2001) showed

that the listening measure and forward digit span in her research correlated significantly. Henry's research also indicated that reversed digit span did not significantly correlate at all with either the listening test or forward digit span. It is evident through such research as Henry's (2001) study that Digit Span Forward/Number Recall subtests and assessments measuring listening skills can correlate significantly, which indicates that both are measuring more than sequential/successive processing skills, they are also measuring working/short-term auditory memory (Henry, 2001).

The Cognitive Assessment System (CAS) (Naglieri & Das, 1997), a neuropsychological cognitive instrument as well, is based on Luria's model and measures simultaneous processing through such subtests as *nonverbal matrices*(ages 5 to 17*)*, *verbal-spatial relations* (ages 5 to 17), and *figure memory* (ages 5 to 17).

Detailed descriptions of the CAS subtests, according to Naglieri & Das (1997) also show that the CAS subtests require acute visual ability. For instance, *nonverbal matrices* (shapes and geometric elements which are interrelated through spatial or logical organization (Flanagan & Harrison, 2005) requires the individual to select one of five/six picture designs that best completes the matrix by comprehending the relationships among the parts of the item. *Verbal-spatial relations* (measures comprehension of grammatical and logical spatial relationships) requires the individual to choose, from six drawings, the picture that correctly answers the question read to them. *Figure memory* requires the individual to identify a geometric figure that is embedded within a more complex picture design.

It appears that most if not all instruments measuring simultaneous processing do so by utilizing the visual senses. Luria's simultaneous processing (block 2) design of

coding and storing information states that it does so by integrating incoming sensory information. Research utilizing an individual's other sensory inputs for measuring simultaneous processing, such as tactile or auditory senses, has been suggested as successful measures with the VI/B. For instance, Keller (1997) suggests that the Visual-Motor Gestalt Test can be adapted by replacing the printed card identification marks (A, 1-9) with large print or Braille substitutes. According to research by Jones (2000), their data is consistent with the hypothesis that compressed-speech is able to provide a viable alternative to visual stimuli for assessment of the simultaneous processing function. Simultaneous processing can be used to solve tasks with verbal content, as long as the cognitive demand of the task requires integration of information (Flanagan & Harrison, 2005). There appears to be little or no reason why one can't focus on auditory stimuli for incoming information in a gestalt manner in order to better measure simultaneous processing skills with the VI/B.

An obvious quandary is at hand because there is an evident need for neuropsychological evaluations that offer multifaceted information from such measures as simultaneous processing for persons who are visually impaired or blind, but they are not available.

Test instruments intended specifically for interpretation of neuropsychological processing functions, such as the Cognitive Assessment System (Naglieri & Das, 1997), designed to assess neurocognitive functioning and simultaneous processing across administrations (Bleiberg et al., 2000; Kabat et al., 2001), and are considered to be similar in compatibility and in sharing many commonalities such as with the Lurian neuropsychological approach (Hale & Fiorello, 2004) all have shown significant insight

to brain functioning ability of an individual. Much research has demonstrated effectiveness with sighted students to guide instructional interventions in arithmetic, reading, writing, phonological processing, and with attention/hyperactivity disorder (Haddad et al., 2003; Johnson et al., 2003; Joseph et al., 2003; Lidz & Greenberg, 1997; Naglieri & Goldstein, 2006; Van Luit et al., 2005). This model could be significant for students, as well as, adults with impaired vision or blindness. At this time, it is not possible to test simultaneous processing for those who are VI/B with the available instruments.

The Compressed Speech Listening Test (CSLT), referred to in previous studies as CogListening Scale (Jones, 2000), was developed for use with the visually impaired or blind. The CogListening Scale is identified in this study as the Compressed Speech Listening Test (CSLT) in order to explain its function utilizing an acronym. There is no current or planned commercial objective for the CSLT (Jones & Marks, 2008). Instead the intent is to make available a measure of simultaneous processing as an open source tool for professionals who provide services in education and rehabilitation to the VI/B population.

The CSLT is being analyzed in this study in order to help fill the simultaneous processing assessment gap for the VI/B because this measure utilizes one's auditory senses through compressed-speech for measuring simultaneous processing. The CSLT rests on the notion that "making sense" from a compressed-speech sound may tap a function comparable to that used in traditional vision-based tests of simultaneous processing. In a standard gestalt closure measure, an individual is presented with an incomplete figure, often a line drawing, and asked to identify the figure. The hypothesis

is that successful completion of this task involves "filling in the blank sections" and that the same fundamental function may be required to "fill in a missing sound."

Tentative support for the connection between the compressed speech-based measure and the traditional gestalt closure measure is available (Jones, 2000). An exploratory factor analysis using an adapted gestalt closure test found the compressed speech (CogListening) and gestalt closure loading on a single factor, distinct from other cognitive tests.

The significance and importance of measuring simultaneous processing ability is seen throughout the research literature. Kaufman (2004) states that simultaneous processing tasks can provide a good measure of problem solving, spatial relations, and conceptual ability (an enormously important aspect of neuropsychological functioning). Kaufman (2004) goes on to state that such measures can assess real-life skill ability that is directly relevant to intelligent and appropriate functioning in interpersonal situations. Simultaneous processing tasks are seen to be quite useful in neuropsychological analysis of the differential functioning of the two cerebral hemispheres (Kaufman, 2004).

The Compressed Speech Listening Test (CSLT)

There has been an enormous advancement of technology over recent years and it appears that more could be offered for the visually impaired in the way of incorporating advanced technology in one's cognitive assessment and screening processes. That's not to say that technology in the area of the visually impaired is static, only that more could be offered to continue to assist the visually impaired for further benefit.

The importance of concentrating on the CSLT and possibly measuring simultaneous processing auditorily, especially through the ease of use of computers in particular, is evident because this idea is novel and new in the current research community. According to Dehn (2006), many concur that simultaneous processing is primarily a visual-spatial ability, which is evident in that all of the most utilized assessment batteries measuring simultaneous processing do so through visual-spatial techniques, and this current research challenges that concept.

Vincent, Dumont, Bouchard, & Lesperance (1997) incorporated computers into assessment for the visually impaired. The authors state that an Assessment of Computer Task Performance was developed to evaluate the performance, both in terms of speed and accuracy, of children ages 4 to 12 years with low vision when using sequences of actions that result in a computer command. This instrument measures the performance of an individual's computer task skills with students with low vision. The study's test-retest reliability, construct validity, and internal consistency were assessed. Results showed that four standardized tasks in the test have a high degree of reliability, and one showed a moderate degree and that the three longest tasks were evident to be the most stable.

Additional technology items for the visually impaired and blind have been found to be beneficial as well, such as a bank note reader, magnifiers, and an accessible virtual adventure game (Trief, 2007).

Definitely, careful consideration is recommended when designing computer programs, especially for utilization with individuals who are visually impaired or blind. The procedures in a computer program designed for cognitive assessment for individuals who are visually impaired or blind should be user friendly in that the use of navigating

and assessing the program should be kept as simple as possible, such as in assessing and navigating through the program like the ease of use of menus and the buttons being pushed. These items should be made easy so that subjects can focus more on the requirement of the task and less on the process of navigation and such and when applicable offering some assistance in navigation to and between tests could be offered as needed as well (Jones, 1980).

Integrating current technology in order to better assist those who are screened and/or assessed can be very beneficial for people, especially for those individuals with visual impairments or who are blind. Research suggests that individuals who are visually impaired or blind would enjoy utilizing computers for such tasks and the real challenge will be to keep the process and navigation as easy as possible in the computer program.

The particular interest in this study is the possible usefulness of the Compressed Speech Listening Test with the VI/B. The CSLT has also been suggested for possible online utilization as well (Jones & Marks, 2008). This instrument has its historical roots in research funded by Title-IV-C on assessments for children and adolescence with visual disabilities (Jones, 1980) as well as in a database of instruments distributed as the Tester's WorkBench (TWB), a battery of computer-based assessment instruments developed by the Office of Military Performance Assessment Technology and also disseminated as the Automated Neuropsychological Assessment Battery (ANAM).

The Compressed Speech Listening Test utilizes "sound" stimuli and with each stimulus a straightforward declarative sentence is comprised of an actor, an action, a setting, and a target. The person performing the action is a women, man, girl or boy.

The action is a constant "to get." The setting is an office, storeroom, kitchen, or garage. The target object is a paper, pencil, plate or a package.

Participants listen to the stimulus sentence (e.g. The women was in the office to get a paper), then after pressing a key on the keyboard, the participant responds to three questions for each stimulus sentence, identifying the actor, the setting, and the target. The questions are in multiple-choice format and all responses utilize the keyboard.

The first study (Jones, 2000) used eight stimuli at graded levels of compression for a total of 24 test items. A follow-up study (Jones, 2001b) reduced the number of stimuli to six for a total of 18 test items.

Test questions are preceded by sample questions to familiarize the individual with the response task and to demonstrate the compressed-speech sound. While exposure does increase the accurateness of perception of synthetic speech, a lengthy practice period does not appear to be needed (Voor & Miller, 1965).

Compressed speech, which according to Arons (1992), is also referred to as accelerated, time-scale modified, rate converted, sped up, or time-compressed speech, and is evident that this technique can be utilized successfully in a variety of applications including teaching, human-computer interfacing, and aids to individuals with disabilities.

Humans, according to Davis, Hervais-Adelman, Taylor, Johnsrude, and McGettigan (2005), are capable of understanding speech in a variety of settings that dramatically affect the sounds that reach their ears. Individuals exposed to such techniques as compressed speech, states Vemuri, Decamp, Bender, and Schmandt (2004) are capable of successfully comprehending tasks with more speed and accuracy. Persons who are VI/B, states Bischoff (1979), have shown that they can efficiently use listening

to learn academic material and that compressed speech can be utilized without a serious disruption of communication or understanding.

Bancroft and Bendinelli's (1982) examined three experimental listening modes with the VI/B, which included normal speech mode, accelerated mode (acceleration of 270 wpm), and the compressed mode (Compressed to 60 percent normal). The acceleration tape rate was 30 percent faster than normal. Results found a consistent and statistically significant trend utilizing compressed speech over both normal and accelerated speech mode. The difference between the normal and the accelerated conditions was statistically significant (p=.01), as well as, the mean difference between the normal and compressed modes (p=.001), and the difference between the compressed treatments and the accelerated (p=.01) (Bancroft and Bendinelli's, 1982).

Sentences for the CSLT were created using a speech synthesizer compressing speech based on Microsoft® Agent. The time-warp similarity tool in the Goldwave© sound editing program was utilized to compress the speech sounds. The similarity function in this sound editor utilizes correlation to overlap or add small, similar sections of the sound. This technique protects the pitch while reducing (or increasing depending on the need) the presentation time.

The rates of compression for the stimulus sentences range from 1.25 to 4.0. In effect, the last sentence was given at a rate four times faster than usual speech, with pitch held at a constant.

Slosson Intelligence Test-Revised 3 (SIT-R3)

The Slosson Intelligence Test basic uses include situations where a quick estimate of general verbal cognitive ability is desired for screening purposes, tentative diagnosis of cognitive ability, and confirmation of other test results (Slosson, 2005). The SIT-R3 is an individual screening intelligence test that can be administered to persons with and without visual disability. This instrument can be administered to children and adults with age ranges from 4 years old through adulthood. The test requires that questions be read to the participant with basal and ceiling requirements. Administration time varies between 10 to 20 minutes, including scoring time. The SIT-R3 offers a supplementary manual for administration with the visually disabled and has minimal performance items and embossed materials allowing ease of testing of the visually impaired and blind.

A brief history overview of the Slosson indicates that this intelligence test is on its third revision, and was first created in 1963. The domains that the test items were developed for are similar to those of verbal subtests of the Wechsler intelligence scales and the Stanford-Binet Intelligence Scale (Blackwell and Madere, 2005). Reliability for the SIT-R3 was assessed through internal consistency, retest, and split-half procedures. The Slosson Intelligence Test basic uses include situations where a quick estimate of general verbal cognitive ability is desired for screening purposes, tentative diagnosis of cognitive ability, and confirmation of other test results (Slosson, 2005). The test norms of this instrument show that the SIT-R3 correlated .827 with the WISC-R, Verbal IQ, and the Calibrated Norms reflect a high of .828 correlation between the SIT-R3 and the Wechsler Intelligence Scales for Children-Third Edition (WISC-III) Full Scale Intelligence Quotient (Slosson, 2005). Dyer (1999) states that the SIT-R provides a

reliable measure of verbal cognitive ability and that correlations are evident between the SIT-R and Wechsler Adult Intelligence Scales in range from .83 to .91. The Slosson is getting more attention and is seen as a reliable instrument for general verbal cognitive ability (Blackwell and Madere, 2005).

The Slosson Intelligence Test is being utilized in this study because emphasis is on the VI/B population and it is an instrument that can be utilized with the VI/B population as well as the more recent addition has special stimuli to use with children. The use of the Slosson Intelligence Test is to equate general ability with the simultaneous processing test.

Summary

Individuals are assessed for a number of reasons such as identifying those who are at-risk for delays in behavioral, cognitive, academic, vocational, or for delays in social/emotional relations (Bradley-Johnson, 1986; Jones & Marks, 2008). Additional reasons for assessment also include documenting progress in special programs, identifying instructional needs, and to provide information for research (Bradley-Johnson). Currently, no such validated methodologies exist for assessing simultaneous processing on the visually impaired or blind. Some assessments for cognitive measurement and neuropsychological impairment can be modified to be applied to VI/B, but the accuracy of such evaluations are relatively unknown.

It is possible that such computer generated auditory instruments can offer additional information for cognitive evaluation, and may offer insight for classroom interventions that other neuropsychological assessments based on Luria's model have

shown such as the Cognitive Assessment System (CAS) (Naglieri & Das, 1997). It is the hypothesis that such research data will show evidence that the CSLT instrument is beneficial in regard to individuals who are visually impaired or blind and that additional research could make this computer test instrument more viable with this population.

Evidence clearly suggests that (a) standard test instruments are not sufficient to meet the needs of visually impaired or blind students and adults; (b) that the Luria model does offer much insight in intelligence evaluations and can offer successful interventions to assist with measuring such issues as a long-term memory, short-term memory, reading disability, arithmetic problems, written expression disability, and issues with ADHD; (c) that interventions can be offered with more insight to individual specific challenges when used in tandem with neuropsychological instruments measuring simultaneous processing that offer constructs based on the Lurian model; and that (d) it is possible that technology items such as computer simultaneous processing test instrument can play an important role in neuropsychological assessment for the VI/B population, especially in utilization as a screening tool assessing simultaneous processing in order to help in the decision process answering questions of need of additional extended assessments.

The first chapter provided the introduction for the study, highlighted by the purpose and problem of the study. This chapter provided a review of the literature relevant to the research topic. The next chapter, Chapter 3, will provide the research methods used and the justification for doing so.

CHAPTER 3

INTRODUCTION

Neuropsychological tests based on Luria's model are valuable and measuring simultaneous processing offers much insight and is an important part of the assessment. Kaufman (2004) states that such measures can assess real-life skill ability that is directly relevant to intelligent and appropriate functioning in interpersonal situations. Simultaneous processing tasks are seen to be quite useful in neuropsychological analysis of the differential functioning of the two cerebral hemispheres.

There are few ability tests that are specifically designed for VI/B population. Psychological intelligence tests are heavily weighted with visual content and often offer altered versions that are not beneficial for assessing cognitive ability for the visually impaired or blind (VI/B) population (Reid, 1995, 1997). There are significant challenges to consider when assessing visually impaired students and adults, which include variables affecting vision, effects of visual challenges on psychological development, and proper adaptation and valid use of tests (Turner & Erchul, 1987). Adapting tests which are designed for the sighted population to assess the VI/B is often just not appropriate.

Luria's simultaneous processing (block 2) design of coding and storing information involves integrating incoming sensory information. Research utilizing an individual's sensory inputs other than vision for measuring simultaneous processing,

such as auditory senses, has been suggested (Jones, 2001b) as an alternative for use with the VI/B. It appears that most instruments measuring simultaneous processing do so by utilizing the visual senses, which is not acceptable for the VI/B population. There is no published instrument available that appropriately measures simultaneous processing for the VI/B. Instruments are needed that measure simultaneous processing in more appropriate ways than just utilizing visual content.

The purpose of this study was to investigate whether the Compressed Speech Listening Test (CSLT) could substitute for the Gestalt Closure (simultaneous processing measures) with sighted participants, whether there were significant differences in performance on the scale by the VI/B and sighted participants, and whether there were significant differences in performance within the VI/B dependent on the extent of visual impairment.

The hypothesized chain was that if there was a statistically significant relationship between CSLT and Gestalt Closure in the sighted participants, and there was not a statistically significant difference in performance between the sighted and VI/B participants on the CSLT, then the CSLT may be a viable option for measuring simultaneous processing in the VI/B.

Research Questions

The following primary research questions will guide the proposed study:

- Is there a significant relationship between scores obtained on a measure of simultaneous processing, Gestalt Closure, and scores on the Compressed Speech Listening Test?

- Is there a significant difference between scores obtained on the Compressed Speech Listening Test among sighted and visually impaired/blind participants?
- Within visually impaired/blind participants is there a significant difference between the performance of persons whose extent of visual limitation requires the use of a screen reader and those whose visual limitation can be accommodated with large print?

Hypotheses

It is hypothesized in question one that there is a statistically significant positive correlation between scores on the Gestalt Closure and the CSLT tests in the sighted participants. It is hypothesized in question two that there is not a statistically significant difference between the CSLT test scores for the sighted participants and the VI/B participants. It is hypothesized in question three that there is not a statistically significant difference between the CSLT tests scores for VI/B participants with no useable vision who require use of a computer screen reader and those who do not.

Participants

Two discrete samples were required, one was part of an on going subject pool study in the department of educational psychology and the other sample was a separate group of college participants who were visually impaired/blind (VI/B). The students who were in the on going subject pool were the sighted group (n = 88), which was compared to the VI/B participants (n = 26) in the new sample. Participants who were in the on-

going subject pool were upper division students meeting an undergraduate course requirement in order to participate in the research study. Participants who were in the VI/B sample include college students from the University of Nevada, Las Vegas, as well as, three main campuses from the College of Southern Nevada. No participants were omitted, all participants were used for which data were provided in the areas being analyzed.

Participants who are visually impairment or blind have been classified as a low-incidence disability compared to students with other disabling conditions (Crews & Whittington, 2000). Researchers, government agencies, colleges, and assistive organizations combine participants who are visually impaired and blind into one group when working with this population because it is such a low-incidence disability (DVBI, 2009). In order to increase the opportunity of gaining the largest sample size possible within the college population both visually impaired and blind participants were grouped together in this study.

Blindfolding participants in a study is another way of increasing sample size; however, this increases additional variables that may negatively influence research outcomes. Blindfolded participants were not utilized in this study in order to reduce variables that may negatively impact the study. For example, Shurrager's & Shurrager's (1964) research blindfolded fully sighted participants and compared results with totally blind participants and it was evident that the participants who were totally blind received the highest scores. A recommendation was offered in that the results of that study be treated cautiously because subjects were working in an artificial environment, using

unfamiliar working methods, and had a strong visual cognitive mapping system that may have influenced their results.

In another study, Brand et al. (1986) attempted to establish reliability and validity of the Ohwaki-Kohs test. Brand et al. (1986) blindfolded 58% of the participants in their study. A bimodal distribution of scores did not result, rather an analysis of goodness to fit indicated that the scores were normally distributed.

Sampling Plan

For the purpose of the study, a convenience-sampling plan, which is a form of non-probability sampling, was used. The convenience-sampling method has an advantage over a probability sampling method (i.e. random sampling technique) in that the researcher would be able to obtain more participants for the study in a shorter period of time (Cozby, 2001). Similarly, the convenience-sampling plan was appropriate for this study since the students were not randomly selected from the entire population of currently enrolled students and VI/B subjects. For the sighted college students, the participants selected for the study were enrolled in a class that required them to participate in the study. The VI/B subjects, on the other hand, were selected based on whether they voluntarily chose to participate in the current study. Requests were sent out for the VI/B participants through college campuses mail utilized through the Disability Resource Center on each college campus.

Instrumentation

The *Slosson Intelligence Test-Revised 3* (SIT-R3) (Slosson, 2005), a cognitive measure with special adaptations available for use when needed with the VI/B, was used in this study in order to equate the sighted and VI/B samples on crystallized ability.

The Slosson Intelligence Test basic uses include situations where a quick estimate of general verbal cognitive ability is desired for screening purposes, tentative diagnosis of cognitive ability, and confirmation of other test results (Slosson, 2005). The SIT-R3 is an individual screening intelligence test that can be administered to persons with and without visual disability.

This instrument can be administered to children and adults with age ranges from 4 years old through adulthood. The test requires that questions be read to the participant with basal and ceiling requirements. Administration time varies between 10 to 20 minutes, including scoring time. The test norms of this instrument show that the SIT-R3 correlated .827 with the WISC-R, Verbal IQ, and the Calibrated Norms reflect a high of .828 correlation between the SIT-R3 and the Wechsler Intelligence Scales for Children-Third Edition (WISC-III) Full Scale Intelligence Quotient (Slosson, 2005). Dyer (1999) states that the SIT-R provides a reliable measure of verbal cognitive ability and that correlations are evident between the SIT-R and Wechsler Adult Intelligence Scales in range from .83 to .91. The Slosson is getting more attention and is seen as a reliable instrument for general verbal cognitive ability (Blackwell and Madere, 2005).

The SIT-R3 offers a supplementary manual for administration with visually disabled. The Sit-R3 is a test of verbal crystallized intelligence that does not rely heavily

on visually loaded test items nor is this test dependent on test items that must be "seen" in order to be interpreted within its general scoring (Slosson, 2005).

The *Kaufman Short Neuropsychological Assessment Procedure* (K-SNAP, Kaufman & Kaufman, 2004) is comprised of several different subtests. These subtests include the Mental Status (measuring attention-orientation ability), Number Recall (measuring sequential/successive processing ability), Gestalt Closure (measuring simultaneous processing ability), and the Four-Letter Words (measuring planning ability). The K-SNAP takes approximately 30 minutes to complete all of the different subtests. The K-SNAP provides scores for three subtests as well as two composite scores. Also provided by the K-SNAP is a descriptive category for the mental status of the participants. The three subtest scores that are calculated for the K-SNAP are the Gestalt Closure, Number Recall, and Four-Letter Words subtests. The composite scores are then the Recall/Closure and K-SNAP composite scores. For the Gestalt Closure, Number Recall, Four-Letter Words and the Recall/Closure composite score yield scaled scores that have a mean of 10 and a standard deviation of three. The overall K-SNAP composite score then yields a standard score that has a mean of 100 and a standard deviation of 15. For the purpose of this study scores on the K-SNAP Gestalt Closure subtests were analyzed and compared to the corresponding CSLT scores.

The utility of the *Compressed Speech Listening Test* (CSLT) as an alternative to standard Gestalt Closure tests for persons who are VI/B was the primary focus of this study. The study design obtained a correlation of the simultaneous processing ability of the sighted participants on the CSLT and the K-SNAP Gestalt Closure subtest, as well as

a comparison of the simultaneous processing ability of the sighted participants and VI/B participants on the CSLT.

The CSLT is a scale developed for use with the VI/B originally identified as the CogListening test. A new label for the scale, Compressed Speech Listening Test (CSLT), was used in this study in order to explain its function and purpose.

The CSLT uses eight compressed speech sound stimuli, declarative sentences comprised of an actor, an action, a setting, and a target. The person performing the action is a women, man, girl or boy. The action is a constant "to get." The setting is an office, storeroom, kitchen, or garage. The target object is a paper, pencil, plate or a package.

Participants listen to the stimulus sentence (e.g. The women was in the office to get a paper), then after pressing a key on the keyboard, the participant responds to three questions for each stimulus sentence, identifying the actor, the setting, and the target. The questions are in multiple-choice format and all responses utilize the keyboard. The test is preceded by sample questions to familiarize the individual with the response task and to demonstrate the compressed-speech sound.

The first study of the CSLT (Jones, 2000) used eight stimuli at graded levels of compression for a total of 24 test items. Cronbach's coefficient alpha reliability coefficient was .71, with a standard error of measurement of 1.48. A follow-up study (Jones, 2001a) reduced the number of stimuli to six for a total of 18 test items. This study uses the version of the scale with eight stimuli and 24 items. The rates of compression for the stimulus sentences range from 1.25 to 4.0.

Data Collection

Data for the sighted participants were obtained for secondary data analysis from an on-going study of cognitive and personality test characteristics using a subject pool sample of participants. Participants in this study completed the testing in two sessions. One session included completion of a neuropsychological assessment scale and the CSLT with all tests administered on computers in the school psychology clinic/lab. Participants took the computer-based tests after completing a series of group administered personality, ability, and achievement tests, all in the same session. The second test session for the sighted participants was administration of one-on-one examiner/client tests and includes administration of the K-SNAP and the SIT-R3 instruments. Participants arrived at the computer lab and/or the one-on-one testing offices where they were provided information regarding the study. This included a description of the study as well as the purpose of the study. The potential participants were made aware of how long it will take them to complete the entire study as well as any other further information necessary for the study.

For the VI/B participants in the study, the CSLT computer program was loaded onto the researcher's laptop. The Job Access with Speech (JAWS) screen reader program was also loaded on the laptop for use with VI/B participants who have no usable vision. JAWS is used to read instructions and questions before and after the CSLT statements are given. With its internal software speech synthesizer and the computer's sound card, information from the screen was read aloud to the user (Freedom Scientific, 2008). JAWS is produced by the Blind and Low Vision Group at Freedom Scientific of St. Petersburg, Florida. Its purpose is to make personal computers using Microsoft Windows accessible to VI/B users. It accomplishes this by providing the user with access to the

information displayed on the screen via text-to-speech and allows for comprehensive keyboard interaction with the computer (Freedom Scientific, 2008).

A difference in performance may be evident between the screen reader and those whose visual limitation can be accommodated with large print. Possible reasons for such a performance difference may be because the reader, utilizing large print, may be able to visually search out and choose the correct sentence faster than the participant who would have to wait to hear each word read out loud in each sentence.

The loading of the software on a laptop for mobility was done so that the tests were administered at the VI/B participants' convenience. This included going to designated meeting areas on each college campus, usually utilizing rooms located at the Disability Resource Center at each College of Southern Nevada campus, that were agreed upon by both the VI/B participant and the researcher. The University of Nevada, Las Vegas participants were tested in the school psychology clinic/lab facilities on the UNLV campus. Participants mostly chose the campus they were most familiar with but sometimes participants would request the campus closest to their home. By doing this the VI/B did not have to travel very far out of their way or to unfamiliar settings and possibly increased the number of potential participants who chose to partake in the study. Arrangements were made on each college campus through the Disability Resource Center to send out flyers and mailers to each potential VI/B participant enrolled at each college.

First contact was made with the VI/B participants through emailing and through the United States Postal Service. In order to ensure confidentiality, all contact was initiated through the Disability Resource Center (DRC) on each college campus, which included the University of Nevada, Las Vegas campus and the College of Southern

Nevada, which has three main campuses including the Henderson, Cheyenne, and Charleston Campus. No names, addresses, or phone numbers were given to the researcher from any of the DRC personnel. The researcher supplied the flyers to each DRC for envelope stuffing and addressing. Information mailers about the study and request for participants were sent out on three occasions. The first group of mail sent out to participants included 250 flyers, this did not include each of the emails sent to participants that had an email address on file with each DRC. The research study received 9 participants from that group of mailers sent out.

Second contact was three weeks later and included 420 flyers of which 180 of those were mailed to potential participants from the College of Southern Nevada DCR, 40 were mailed and/or emailed from the University of Nevada, Las Vegas, 100 of the flyers were placed at each College of Southern Nevada DRC campus, which included 50 that were put in current student campus mailboxes and 50 that were placed at each of the DRC counters to be seen by everyone who came by the DRC. The research study received 12 participants from the second contact group of mailers sent out.

Third contact was three weeks after second contact and included 150 flyers of which 50 were placed at each College of Southern Nevada DRC. An email was also sent to each participant from each College of Southern Nevada Campus. The researcher also went to a campus convention and talked with visually impaired and blind students and passed out 75 flyers at the College of Southern Nevada, Charleston campus. The convention was designed for students with disabilities for job prospects and community outreach assistance. The research study received 5 participants from the third contact

including the campus convention group of mailers sent/handed out. A total of 26 VI/B participants were obtained for the study.

In order to encourage participants who were VI/B to participant in the study an additional assessment was offered for them called the vocational assessment inventory, which was combined in a short report in order to offer specific knowledge for possible vocational assistance.

The potential participants were made aware that at any point in the study, if they wish to not finish the study, they could discontinue the study without any subsequent consequences. The consent form was read to the VI/B with consent to participate then indicated with press of a computer key, a process approved by the UNLV IRB for consent with computer-based test administration. If the potential participant chose not to consent after hearing the conditions, then they were thanked for considering taking part in the study and no further information was collected from them. All the VI/B participants in this study indicated with press of a computer key consent and participated in the research study.

The raw data from the computerized tests as well as the examiner administered tests were imported into a computer spreadsheet, Microsoft Excel for future analyses. The information that was obtained from the participants was imported where each row in the Microsoft Excel spreadsheet received a unique identification number. This identification number was used in order to specify which responses correspond to the participants in the study. The data will be saved on a separate flash drive and stored in a filing cabinet or will be stored on a personal computer in which only the researcher has access to. By doing this the confidentiality of each participant in the study will be maintained so that no

personal information will be accessible. The data is then kept on file for a period of three years where it will then be destroyed and deleted from the hard drive.

Data Analysis

The data analysis included the subject pool data analysis, VI/B data analysis, as well as, combined analysis. The data analysis that was used in this study was comprised of summary statistics, Pearson product-moment correlation coefficients, reliability analysis (Cronbach's alpha coefficient, analysis of variance, and an analysis of covariance. Each of these analyses were conducted in SPSS Version 17.0® statistical analysis program.

Subject Pool Data Analysis

Assessing what relationship was evident between the scores of sighted subjects taking the K-SNAP Gestalt Closure (K-SNAP GC) Test and the CSLT was the goal of this analysis. The purpose was to investigate whether the CSLT could be utilized as a substitute for the Gestalt Closure as an assessment of simultaneous processing.

A spreadsheet was created via Microsoft excel that included demographic variables for subject pool participants. All raw scores collected on the K-SNAP Gestalt Closure test were included in the spreadsheet. IQ scores from the Slosson Intelligence Test-R 3 were included in the spreadsheet, as well as, all scores for CSLT. The spreadsheet included CSLT accuracy, mean response time, and efficiency/throughput scores (ratio of accuracy and response time) for each of the 24 items. A total score that included the comprised overall accuracy and mean response time were calculated as a function of accuracy and speed. Pearson's product-moment correlation coefficients were

calculated between CSLT efficiency/throughput and K-SNAP GC. Finally, an internal consistency reliability analysis was determined for the CSLT with the sighted participants utilizing Cronbach's alpha.

Visually Impaired / Blind Data Analysis

This data analysis focused on characteristics of the CSLT with the VI/B participants. A spreadsheet was created via Microsoft excel that included demographic variables for VI/B participants. All VI/B participant scores for CSLT as well as IQ scores from the Slosson Intelligence Test-R 3 were included in the spreadsheet. The spreadsheet included CSLT accuracy, mean response time, and efficiency/throughput scores for each item. Total scores were included for overall accuracy, mean response time, and a efficiency/throughput score calculated as a function of accuracy and speed.

Performance of participants who used the screen reader JAWS program with the subject group who used the large print software program to complete the CSLT were compared in this analysis. The analysis of variance procedure was used to compare performance of these two groups on the total accuracy, mean response time, and efficiency/throughput scores. Finally, an internal consistency reliability analysis was determined for the CSLT with the VI/B participants utilizing Cronbach's alpha.

Combined Data Analysis

A statistical analysis of covariance was utilized with the combined data of the VI/B and the sighted subject pool administered the CSLT test and the Slosson Intelligence Test-Revised 3 (SIT-R3) in order to equate the samples on crystallized ability.

The potential cognitive variability produced between sighted and VI/B sampling groups in such areas as visual cognitive mapping and visual storing of information, when examining crystallized ability, may limit the sensitivity of the CSLT test results when comparing sampling groups. In order to minimize this variability a technique known as the analysis of covariance was utilized to reduce the variability of the error term by adjusting the scores statistically (Keppel & Wickens, 2004), and makes the analysis of covariance a more thorough, higher-level, and sophisticated method of analysis of variance.

The analysis of covariance restores, numerically, the balance that could have been attained if both sampling groups were comparable in cognitive crystallized ability. The analysis of covariance produces adjusted means from which the effects of differing levels from the sampling groups are removed (Keppel & Wickens, 2004).

The Slosson Intelligence Test-R3 will serve as the covariate. The Slosson was selected because of its brevity and its demonstrated applicability for use with the VI/B. The covariate is needed because it is expected that the groups will not be similar in measured ability. Because the variables from both sighted and VI/B sampling groups for the CSLT results are expected to be positively correlated, the group with a possibly unintentionally larger value of IQ ability probably would have a slightly larger value in CSLT results, even if there was no effect of the treatment factor. The use of the covariance analysis group regression was used to predict what the means of the two groups taking the CSLT would have been had the two groups been similar on the covariate. The point of making the adjustment, according to Keppel & Wickens (2004) is

not to make the differences smaller or larger but to make them more accurate estimates of the population values.

Summary

The descriptive statistics that were computed for this study included frequency distributions as well as measures of central tendency. For the frequency distributions, the number and percentage of each occurrence was presented for the categorical or dichotomous variables in the study. These include the demographic characteristics of the participants as well as the sighted and VI/B participants. The measures of central tendency included presenting the mean and standard deviation in the study. These variables include the scores received from the subtests on the CSLT, K-SNAP, and the SIT-R3 instruments. The CSLT includes item scores for each of the 24 items measured. The one score that was included from the K-SNAP was the score on the Gestalt Closure test. The Slosson Intelligence Test-R3 score that was utilized in this study included the overall composite IQ score. Pearson product-moment correlation coefficients were used to investigate the relationship between the CSLT and the Gestalt Closure scale. An analysis of covariance was utilized in this study with the Slosson as a covariant in order to equate crystallized ability of the participants. The analysis of covariance was used to adjust for ability as an extraneous variable in the comparisons of performance on the CSLT.

Chapter 3 discussed the research methodology that was employed in the current study, which was that of a non-experimental correlational comparative research design. Also included in Chapter 3 was information on the data collection process as well as

proposed statistical analyses. Also presented in this chapter were the appropriateness of the research design, the proposed hypotheses, and the population information. The following chapter then presents the results for this study where they were examined and assessed.

CHAPTER 4

RESULTS

Psychological assessments offer potentially important and valuable information that can assist individuals with impaired vision in learning additional skills, improving deficient abilities, and in providing diagnostic information for future research. The purpose of this study was to investigate whether the Compressed Speech Listening Test (CSLT) could substitute for the Gestalt Closure (simultaneous processing measure) with sighted college participants, whether there were significant differences in performance on the scale by the VI/B and sighted participants, and whether there were significant differences in performance within the VI/B dependent on the extent of visual impairment.

The CSLT suggests that "making sense" from a compressed speech sound may access a function comparable to that used in traditional vision-based tests of simultaneous processing. The CSLT is a measure that may be beneficial for those who are sighted and visually impaired or blind (VI/B). An eventual goal is to determine whether one possible use for the CSLT could be for assessing simultaneous processing in sighted and VI/B populations. According to Dehn (2006), many concur that simultaneous processing is primarily a visual-spatial ability. This is evident in that all of the most utilized assessment batteries measuring simultaneous processing do so through visual-spatial techniques. The current research investigated a possible alternative measure for simultaneous processing.

The concept is that with today's technology, the use of computers can be utilized in order to make it easier to measure simultaneous processing auditorily, through the use of compressed speech. Also, because such assessments available today measure simultaneous processing through visual stimuli only, these assessments eliminate the availability of measuring simultaneous processing for those who are visually impaired or blind.

In particular, this study's intent was on addressing the following research questions.

1. Is there a significant relationship between scores obtained on a measure of simultaneous processing, Gestalt Closure, and scores on the Compressed Speech Listening Test?
2. Is there a significant difference between scores obtained on the Compressed Speech Listening Test among sighted participants and the visually impaired/blind participants?
3. Within visually impaired/blind participants, is there a significant difference between the performance of persons whose extent of visual limitation requires the use of a screen reader and those whose visual limitation can be accommodated with large print?

Visual impairment was defined as the reporting by the participant of corrected visual acuity requiring large print computer software adaptation. Legally blind was defined as those participants who required the use of the screen reader program.

The following research hypotheses were made in relation to the research questions.

1. There is not a statistically significant correlation between scores on the Gestalt Closure and the Compressed Speech Listening Test in the sighted participants.
2. There is not a statistically significant difference between the Compressed Speech Listening test scores for the sighted participants and the visually impaired/blind participants.
3. There is not a statistically significant difference between the performances of persons whose extent of visual limitation requires the use of a screen reader and those whose visual limitation can be accommodated with large print.

Confirmation of the above hypotheses would suggest that the Compressed Speech Listening Test might be a viable alternative for measuring simultaneous processing.

Demographic Characteristics of the Participant Samples

This study included two separate research samples. The first pool of subjects included a sample of sighted, upper division education majors, college participants who were required to participate in a research project at the University of Nevada, Las Vegas campus. The sighted participants were given multiple tests in order to address another research projects questions and they were also given the tests needed for measurement in this study. The second research sample included only college participants who were visually impaired and blind. These participants included the University of Nevada, Las Vegas, as well as, all three main campuses of the College of Southern Nevada. The visually impaired and blind sample subjects where not required to take these tests; however, an incentive was given for participation.

Sighted participants (n = 88) were 79 percent female (*n* = 70) and 21 percent male (*n* = 18). In terms of age distribution 78 percent were in the age group 18-25 (*n* = 69), 18 percent in the age group 26-35 (*n* = 16), and 3 percent in the age group 36-45 (*n* = 3). In terms of ethnicity, most participants (66 percent) were in the Caucasian ethnic group (*n* = 58), 10 percent were in the African American ethnic group (n = 9), 7 percent belong to college participants that choose two or more ethnic groups (*n* = 6), 6 percent belong to Hispanic ethnic group (*n* = 5), 5 percent belong to Asian ethnic group (*n* = 4), 4 percent belong to college participants that marked other ethnic group (n = 4) and 2 percent belong to Native Hawaiian or Other Pacific Islander ethnic group (n = 2).

Participants who were visually impaired or blind (*n* = 26) were 69 percent female (*n* = 18) and 31 percent male (*n* = 8). In terms of age distribution 46 percent were in the age group 18-25 (*n* = 12), 46 percent in the age group 26-35 (*n* = 12), and 8 percent in the age group 36-45 (*n* = 2). In terms of ethnicity, most participants (81 percent) belong to Caucasian ethnic group (*n* = 21), 11 percent belong to African American ethnic group (*n* = 3), and 8 percent belong to Hispanic ethnic group (*n* = 2).

In regard to the participant demographic characteristics comprising the groups, there was little variability among participants. The majority of participants in both groups tended to be Caucasian females between the ages of 18 and 35. Participants in both groups were college students many of which were in upper division classes. No participants were omitted, all participants were used for which data were provided for analysis.

The Slosson Intelligence Test-Revised 3 (SIT-R3) was also administered to both the sighted and visually impaired and blind participants. The SIT-R3 is designed to be

administered to both sighted as well as visually impaired and blind populations with norms to include all populations. The Sit-R3 is a test of verbal crystallized intelligence that does not rely heavily on visually loaded test items nor is this test dependent on test items that must be "seen" in order to be interpreted within its general scoring (Slosson, 2005). In terms of Slosson cognitive IQ scores, sighted participants (n = 85) mean IQ score was 93 and visually impaired or blind participants (n = 26) mean IQ score was 103.

Table 1
Characteristics of participants, gender, age, ethnicity, SIT-R3 IQ

			Sighted sample		VI/B Sample	
			N	%	*N*	%
Gender	Male		18	21	8	31
	Female		70	79	18	69
Total			88	100	26	100
Age	18-25		69	78	12	46
	26-35		16	18	12	46
	36-45		3	3	2	8
Total			88	100	26	100
Ethnic group	Asian		4	5		
	African American		9	10	3	11
	Native Hawaiian or Pacific Islander		2	2		
	Caucasian		58	66	21	81
	Hispanic		5	6	2	8
	Other		4	4		
	Two or more groups		6	7		
Total			88	100	26	100
SIT-R3			85	97	26	100
	Sighted Mean IQ 93	VI/B Mean IQ 103				
Total			85	97	26	100

Reliability of the Scale

The research questions in this study addressed several aspects of the validity of the Compressed Speech Listening Test (CSLT). A reliability analysis was performed to assess the internal consistency of the CSLT in order to determine if items from the scale were measuring the same trait (Corcoran & Fischer, 2000). Table 2 presents the reliability values.

Cronbach's alpha and split-half reliability coefficients are commonly used to estimate the internal consistency of psychometric instruments. Researchers such as Pallant (2007), Corcoran & Fisher (2002), and Santos (1999) propose that a Cronbach alpha coefficient of .7 is acceptable whereas any value above .8 is ideal. Researchers also indicate that a moderate value of .60 is common and acceptable in an exploratory research study (Avani & Quittner, 2003). Researchers also indicate that a comfortable .60 is acceptable for newly developed scales (Ware, Brook, Ross, Williams, Stewart, & Rogers, et al., 1980). The authors (Ware, et al.) also indicate that for a measure to be useful internal-consistency must meet or exceed .50. Specifically, the authors state in their study that "For a measure to be useful in group comparisons, internal-consistency estimates had to meet or exceed a 0.50 standard" (Ware et al., 1980, p. 9).

Ritsner, Rabinowitz, & Slyuzberg (1995) stated that their research at .56 was in the acceptable range of internal-consistency. Specifically, the authors state that "All Cronbach α values are greater than .56 and many approximately .75, suggesting high internal consistency" (Ritsner, et al., 1995, p. 450).

In order to further investigate the accuracy of the participants' scores the standard error of measurement (SEM) was calculated to determine the range in which the true

scores would fall (Feldt & Qualls, 1998). It is directly related to the reliability of a measure: the higher the reliability, the lower the standard error of measurement. The magnitude of the SEM is influenced by both the absolute size of the reliability coefficient and the standard deviation in the sample from which the coefficient was calculated. In general, the higher the reliability coefficient, the lower the standard error of measurement. In order to best estimate the reliability in this study, both the reliability coefficient and the standard error of measurement will be utilized, recognizing that the precision of a measure may be underestimated by the coefficient when the standard deviation of the measure is low.

Table 2
Reliability Test with 114 participants on the CSLT with 24 Items

Cronbach's Alpha	.663	SEM	2.11
Split-Half	.715	SEM	2.06

*SEM=Standard Error of Measurement; Cronbach's Alpha and split-half on odd/even items.

Hypothesis 1

Hypothesis number one states that there was not a statistically significant correlation between scores on the Gestalt Closure and the CSLT tests in sighted participants. To test for this a Pearson's product moment correlation coefficient was calculated between the variables of the sighted Compressed Speech Listening Test (CSLT) and the Kaufman Short Neuropsychological Assessment Procedure-Gestalt Closure (KSNAP-GC) subtest.

The CSLT significantly correlated with the K-SNAP-Gestalt Closure (r = .283). Results indicated a positive and statistically significant correlation in the expected direction (p=.008). The null hypothesis is rejected.

In addition to the subtest for simultaneous processing (Gestalt Closure), the K-SNAP also includes measures of sequential processing (Number Recall) and problem solving functions/planning (Four-Letter Words) (Kaufman and Kaufman, 1994).

Research results indicate that the two variables, CSLT and K-SNAP Number Recall/Digit Span, (sequential processing) were positively and significantly (p=.000) correlated, (r = .393). Results also indicate that the two variables, CSLT and K-SNAP Four-Letter Words (problem solving/planning), were not statistically significantly (p=.097) correlated (r = .180) Results are displayed in Table 3.

The Pearson's product moment correlation coefficient between CSLT and Number Recall (.3933) was higher than the Pearson's product moment correlation coefficient between CSLT and Gestalt Closure (*.283*). The correlation coefficients were converted to z scores in order to test the significance of the difference between the coefficients using procedures suggested by Blalock (1972). The difference between the correlation coefficients was not statistically significant (p>.05). Results are displayed in Table 4.

Table 3
Correlation of Compressed Speech Listening Test

	N	Pearson's *r*	*p*
K-SNAP Gestalt Closure	86	.283(**)	.008
K-SNAP Number Recall	86	.393(**)	.000
K-SNAP Four-Letter	86	.180	.097

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

Table 4
Significance of the difference between two correlation coefficients (*n* = 86)

	Pearson's *r*	*z*-score Conversion	*p*
K-SNAP Gestalt Closure	.283(**)	.2909	
K-SNAP Number Recall	.393(**)	.4153	
Between Groups			.813

Hypothesis 2

Hypothesis number two states that there was not a statistically significant difference between the CSLT test scores for the sighted and the VI/B participants. To test this hypothesis, a one way analysis of variance (ANOVA) was conducted. The difference in raw score total correct performance on the CSLT between sighted ($M = 20.08$) and VI/B ($M = 18.54$) was statistically significant, $F(112) = 6.519$, $p = .012$, effect size (Cohen's d) = .57.

A statistical analysis of covariance (ANCOVA) was included in order to remove a possible effect in that differences between sighted and VI/B on the CSLT could have been a result of differences in general crystallized ability. The difference in performance

on the CSLT, using adjusted mean scores, between sighted (M = 20.24) and VI/B (M = 18.13) was statistically significant, $F(110) = 12.511$, $p < .000$, effect size (Cohen's d) = .79. Results are displayed in Table 6. The Slosson-R3 (Slosson, 2005) was used as a covariate. There was a statistically significant difference in mean correct response between sighted and VI participants, even when equating for IQ score differences.

Table 5 *Analysis of variance*

ANOVA	Mean	S.D.	*F*	*p*
Sighted CSLT	20.08	2.71		
VI/B CSLT	18.54	2.67		
Between Groups			6.519	.012

Table 6 *Analysis of covariance for* equating IQ *score differences on CSLT between sighted and VI/B*

	Adjusted Mean	*F*	*p*
Sighted CSLT	20.24		
VI/B CSLT	18.13		
Corrected Model*		12.511	.000

The CSLT also provided efficiency/throughput scores (ratio of accuracy and response time). The efficiency/throughput and the mean response time scores between sighted and VI/B participants on the CSLT were examined for additional information. These scores were analyzed for possible variance between CSLT sighted and VI/B participants.

Results indicated that the difference on efficiency/throughput scores between the sighted (M = 24.58) and VI/B (M = 15.42) participants on the CSLT was statistically significant $F(112) = 33.61, p < .000$, effect size (Cohen's d) = 1.18. Results indicate that efficiency scores between sighted (M = 24.58) and VI/B (M = 20.23) participants utilizing large print was not statistically significant $F(95) = 3.561, p = .062$, effect size (Cohen's d) = .63. Results are displayed in Table 7. It was expected that VI/B participants utilizing large print may be a comparable group to sighted participants because they were not hindered by JAWS screen reader. JAWS screen reader slowed down many VI/B participants responses because of the time it took them to listen to all instructions and statements being read auditorily in addition to listening to the CSLT. The only auditory statements that the sighted and VI/B participants utilizing large print heard were from the actual CSLT.

Results indicated that mean response time scores on the CSLT between sighted (M = 2150.62) and VI/B (M = 3913.08) were statistically significant $F(112) = 80.69, p < .000$, effect size (Cohen's d) = 5.07. Results indicate that mean response time scores between sighted (M = 2150.62) and VI/B (M = 2741.00) participants utilizing large print were statistically significant $F(95) = 9.288, p = .003$, effect size (Cohen's d) = .74. Results are displayed in Table 8.

With exception of only one analysis, efficiency/throughput scores using only participants from the VI/B sample who used large print, differences in CSLT performance between the sighted and VI/B samples were statistically significant. The exception could have been an artifact of the small sample size. Hypothesis two is rejected.

Table 7
Analysis of variance efficiency scores

ANOVA	Mean	S.D.	*F*	*p*
Sighted CSLT	24.58	6.50		
VI/B CSLT	15.42	8.79		
Between Groups			33.61	.000
Sighted CSLT	24.58	6.50		
VI/B CSLT-Large Print	20.23	7.39		
Between Groups			3.561	.062

Table 8
Analysis of variance Mean response time

ANOVA	Mean	S. D.	*F*	*p*
Sighted CSLT	2150.62	491.15		
VI/B CSLT	3913.08	1.62		
Between Groups			80.69	.000
Sighted CSLT	2150.62	491.15		
VI/B CSLT-Large Print	2741.00	1007.56		
Between Groups			9.28	.003

Hypothesis 3

Hypothesis number three states that there was not a statistically significant difference, in regard to the CSLT between the performance of persons whose extent of visual limitation required the use of a screen reader and those whose visual limitation

were accommodated with large print. To test this, a one way analysis of variance (ANOVA) was conducted. The difference in raw score total correct mean performance on the CSLT between those who utilized JAWS screen reader (17.94) and those who utilized large print (19.67) was not statistically significant, $F(24) = 2.61$, $p = .119$, effect size (Cohen's d) = .69. Results are displayed in Table 9.

Table 9 *Analysis of variance,* VI/B CSLT – JAWS/Large Print

ANOVA	*N*	Mean	S.D.	*F*	*p*
JAWS Screen Reader	17	17.94	2.75		
Large Print	9	19.67	2.24		
Total	26	18.54	2.67		
Between Groups				2.61	.119

In addition to examining possible variance on the CSLT between raw correct scores on JAWS screen reader and large print with the VI/B participants, two additional areas, efficiency/throughput (ratio of accuracy and response time) and mean response time were also analyzed.

To test both of these additional factors, a one way analysis of variance (ANOVA) between the VI/B participants utilizing JAWS screen reader and those using large print was utilized for both efficiency/throughput mean scores and mean response time scores.

The difference in efficiency/throughput score performance on the CSLT between JAWS screen reader ($M = 12.87$) and large Print ($M = 20.23$) was statistically significant $F(24) = 4.74$, $p = .040$, effect size (Cohen's d) = .92. Results are displayed in Table 10. The difference in mean response time performance on the CSLT between JAWS screen

reader (M = 4474.05) and large Print (M = 2853.48) was statistically significant $F(24)$ = 7.40, p =.012, effect size (Cohen's d) = 2.34. Results are displayed in Table 11.

Table 10 *Analysis of variance efficiency scores*

ANOVA	Mean	S.D.	*F*	*p*
VI/B CSLT JAWS Screen Reader	12.88	8.57		
VI/B CSLT Large Print	20.23	7.39		
Between Groups			4.74	.040

Table 11 *Analysis of variance Mean response time*

ANOVA	Mean	S.D.	*F*	*p*
VI/B CSLT JAWS Screen Reader	4474.05	1.63		
VI/B CSLT Large Print	2853.48	981.13		
Between Groups			7.40	.012

It was evident that JAWS screen reader significantly slowed down VI/B participants response time, which impacted the efficiency/throughput and mean response time scores. In examining efficiency/throughput scores from those participants utilizing large print (M = 20.23) it was evident that those scores were much higher than from those participants utilizing JAWS screen reader (M= 12.88).

In examining the CSLT raw correct score means for VI/B participants who utilized JAWS screen reader (M = 17.94) and those who utilized large print (M = 19.67), it was evident that it was not statistically significant. The results of the analysis for hypothesis three indicated that the null hypothesis of equal means failed to be rejected.

Summary

The purpose of this study was to see if there was (1) a relationship between CSLT and Gestalt closure, (2) a difference in performance between sighted and VI/ participants on CSLT, and, (3) within the VI/ participants was there a difference in performance between those who required the use of a screen reader and those whose visual limitation were accommodated with large print?

Results indicate, with regard to sighted participants, that there was a statistically significant positive correlation between both the CSLT raw score total correct and K-SNAP Gestalt Closure (Simultaneous processing) subtest measure, as well as, the CSLT raw score total correct and K-SNAP Number Recall subtest measure (Sequential/successive processing). There was not a statistically significant positive correlation between sighted participants CSLT raw score total correct and K-SNAP Four-Letter Words (problem solving/planning measure) subtest measure.

In regard to the CSLT raw score total correct between sighted and VI/B participants, a statistically significant difference was evident and the effect size was medium. In regard to mean response time on the CSLT, there was a statistically significant difference and large effect size between sighted and VI/B participants on mean response time scores. In regard to efficiency/throughput scores (ratio of accuracy and time) on the CSLT, there was a statistically significant difference and a large effect size between sighted and VI/B participants on efficiency scores. However, there was not a statistically significant difference in the efficiency scores with a medium effect size between sighted and VI/B participants utilizing large print. In regard to mean response

time, there was a statistically significant difference in mean response time with a medium effect size between sighted and VI/B participants utilizing large print.

There was not a statistically significant difference on the CSLT raw score total correct with a medium effect size between those VI/B participants who required JAWS screen reader and those VI/B participants who were helped with large print. In regard to CSLT efficiency scores, it was evident that there was a statistically significant difference with a large effect size between VI/B participants who utilized JAWS screen reader and those who utilized large print on efficiency/throughput scores. In examining mean response time scores, there was a statistically significant difference with a large effect size between VI/B participants who utilized JAWS screen reader and those who utilized large print on mean response time scores.

CHAPTER 5

DISCUSSION

Psychological assessments are a way of gaining some understanding of an individual in order to help make informed decisions (Sattler, 2001). These assessments offer potentially important and valuable information that can assist individuals with impaired vision in learning additional skills, improving 00 abilities, and in providing diagnostic information for future research (Jones & Marks, 2008). In addition, psychological assessments are frequently used to diagnosis a variety of psychological and learning disorders.

Assessing individuals with impaired vision presents a variety of challenges from those encountered with the general population. For example, while some oral tests can be readily adapted for those with impaired vision, it is difficult to adapt most performance tests (Anastasi & Urbina, 1997). Psychological intelligence tests, which are heavily weighted with visual content, only offer adaptations that are not as beneficial to assessing cognitive ability for the visually impaired or blind (VI/B) population (Reid, 1995, 1997). The few tests that are specifically designed for VI/B are either outdated, not available any more, not widely used, require additional training, or have longer administration times impacting both the practitioner and the participant (Jones & Marks, 2008; Reid, 1997).

The standard testing instruments are not sufficient to meet the assessment needs for students and adults with visual disabilities (Jones & Marks, 2008). There is an evident

need for neuropsychological evaluations that offer multifaceted information from such measures as simultaneous processing for persons who are visually impaired or blind, but they are not available.

The current study provided an investigation of the potential utility of a compressed speech listening test (CSLT) for use with persons who are visually impaired or blind. The CSLT suggests that "making sense" from a compressed speech sound may access a function comparable to that used in traditional vision-based tests of simultaneous processing.

The study sought to determine the degree to which the CSLT resulted in similar scores as a standardized and recognized test for simultaneous processing and neuropsychological impairment, specifically, the Gestalt Closure in the Kaufman Short Neuropsychological Assessment Procedure (K-SNAP) (Kaufman and Kaufman, 1994).

Chapter 5 discusses the results from the analysis of the raw data detailed in chapter 4. First, the research questions are addressed in sequence, followed by a summary and then discussion and implications. Next, the implications of this analysis are presented, followed by the limitations of the study. Then recommendations for future research are offered. Last, implications for school psychology are considered.

Research Questions

Research Question 1: Is there a significant relationship between scores obtained on a measure of simultaneous processing, Gestalt Closure and scores on the Compressed Speech Listening Test?

The data analysis showed that the scores on the Gestalt Closure subtest measure and the CSLT raw score total correct were positively correlated and the correlation was statistically significant.

Two correlations, K-SNAP Four Letter Words (planning measure) subtest and K-SNAP Number Recall (sequential/successive measure) subtest, were each calculated with the CSLT raw score total correct. Results indicate that a statistically significant relationship was not evident between CSLT raw score total correct and K-SNAP-Four letter Words (planning measure). A statistically significant relationship was evident however, between CSLT raw score total correct and the K-SNAP-Number Recall/Digit Span (sequential/successive measure) subtest.

Research Question 2: Is there a significant difference between scores obtained on the Compressed Speech Listening Test among sighted participants and the visually impaired participants?

The data analysis showed that there was a statistically significant difference in scores on the CSLT raw score total correct for the sighted participants in comparison with the VI/B participants. Specifically, sighted participants scored higher on the CSLT than the VI/B participants. Furthermore, an analysis of covariance showed that this difference was not due to differences in crystallized intelligence. Both the sighted and VI/B sample were given a cognitive test (SIT-R3) in order to control for the effects of intelligence that may have exerted an effect on their scores on the CSLT raw score total correct.

Two additional performance indicators were also analyzed that included the CSLT efficiency/throughput and CSLT mean response time. The CSLT efficiency/throughput score was calculated as a ratio of accuracy and response time. A

one way analysis of variance (ANOVA) was calculated for both CSLT efficiency/throughput and CSLT mean response time for possible variance between sighted and VI/B participants. The first analysis examined the CSLT efficiency/throughput scores between sighted and VI/B participants. The second analysis examined the CSLT mean response time between the sighted and VI/B participants.

The results indicated that there was a statistically significant difference in both the CSLT mean efficiency/throughput scores and the CSLT mean response time scores between sighted and VI participants. The sighted participants received the higher CSLT efficiency score as well as the lower CSLT mean response time score. One commonality between both measurements (efficiency/throughput and mean response time) is response time.

With exception of only one analysis, efficiency/throughput scores using only participants from the VI/B sample who used large print, differences in CSLT performance between the sighted and VI/B samples were statistically significant. The exception could have been an artifact of the small sample size.

Research Question 3: Within VI/B participants is there a significant difference between the performance of persons whose extent of visual limitation requires the use of a screen reader and those whose visual limitation can be accommodated with large print?

The data analysis showed that there was not a statistically significant difference in CSLT raw score total correct between visually impaired participants who required the use of a screen reader and those whose visual limitation were accommodated with large print.

In examining VI/B participants performance on the CSLT, two additional areas were analyzed (CSLT efficiency/throughput and CSLT mean response time) for possible variance between VI/B participants utilizing JAWS screen reader (used to read instructions and questions before and after the CSLT statements are given) and those VI/B participants utilizing large print. A one way analysis of variance (ANOVA) was utilized for measurement of both CSLT efficiency/throughput (ratio of accuracy and speed) and CSLT mean response time.

The results indicated that there was a statistically significant difference in both the CSLT efficiency/throughput scores and the CSLT mean response time scores between VI/B participants utilizing JAWS screen reader and VI/B participants utilizing large print. One commonality between both measurements (efficiency/throughput and mean response time) was response time. It was evident during testing that the more severe the visual impairment the more time the VI/B participants took in answering the questions.

Summary

The results demonstrated that there was statistically significant positive correlation with the sighted participants between the CSLT raw score total correct and the K-SNAP Gestalt Closure subtest measure as well as the CSLT raw score total correct and K-SNAP Number Recall subtest measure.

There is a statistically significant difference between the CSLT raw score total correct for the sighted participants and the CSLT raw score total correct for the VI/B participants. There was not a statistically significant difference in CSLT raw scores total

correct in the VI/B participants between those who required JAWS screen reader and those who were helped with large print.

In regard to CSLT efficiency/throughput scores, it was evident in the research that there was a statistically significant difference from CSLT efficiency/throughput scores between the sighted and VI/B participants.

Within the VI/B participant sample, there was a statistically significant difference in the CSLT efficiency/throughput scores between those participants who required JAWS screen reader and those who utilized large print. There was also a statistically significant difference in the mean response time scores between those who utilized JAWS screen reader and those who utilized large print in the VI/B participant sample.

Discussion and Implications

Preliminary research (Jones, 2000; Jones, 2001) with the CSLT, identified in those studies as CogListening, showed results consistent with an hypothesis that compressed speech might provide a viable alternative to visual stimuli for assessment of the simultaneous processing function. The research reports noted a need for additional study and a need to consider further development of the instrument itself. These results of this study did not provide clear support for the CSLT as a measure of simultaneous processing, however, these results did support additional investigation of the possible use of aural stimuli to measure simultaneous processing. The results did confirm a need for further development of the instrument.

Construct validity

The statistically significant correlation between simultaneous processing anchor measure, K-SNAP Gestalt Closure, and the raw score correct responses on the CSLT was supportive of the CSLT as a measure of simultaneous processing. The lack of statistically significant correlation between the anchor planning measure, K-SNAP Four Letter Words, provided additional support. However, the statistically significant relationship between a sequential/successive anchor measure, K-SNAP Number Recall, raises serious question about what is actually being measured by the CSLT.

It may be possible that Number Recall/Digit Span is measuring attention rather than sequential processing. According to researchers, Number Recall/Digit Span may be a possible measure of attention, concentration, sequencing, number facility, and auditory short-term memory (Hale, Hoeppner, & Fiorello, 2002). The correlation between CSLT raw score total correct and K-SNAP-Number Recall (forward digit span) in this study is similar to other studies testing listening skills and forward digit span (Henry, 2001).

Perhaps simultaneous processing is just what other researchers have previously concurred in that what Luria described as simultaneous processing is perhaps just primarily a visual-spatial ability or function (Dehn, 2006).

Another possibility is that there are two forms of simultaneous processing, which include a form of both visual and auditory functioning. Research by Rollins, Schurman, Evans, & Knoph (1975) suggests that processing in the auditory system can only occur successively across time, and that the visual system processing can only occur simultaneously in space.

The correlation between the CSLT and the K-SNAP Number Recall (sequential/successive) was statistically higher than the K-SNAP Gestalt Closure (simultaneous processing). Perhaps this is evidence that the CSLT is a stronger measure of something else such as auditory short-term memory. For instance, according to Henry (2001), Forward Digit Span, similar to the K-SNAP Number Recall test, measures more than just –sequential/successive processing ability. Research evidence indicates that working/short-term auditory memory can be measured by utilizing Forward Digit Span/Number Recall subtests. The author (Henry, 2001) showed that a listening measure and forward digit span in her research correlated statistically significant. Number Recall/Digit Span does seem to be measuring more than just sequential/successive processing (Henry, 2001).

Instrument considerations when testing persons with impaired vision

It was evident during testing that the VI/B participants took significantly more time when answering questions. For instance, a response keystroke of either a 1, 2, 3, or 4 was required to answer each question. VI/B participants more often brought their finger back to the center keyboard between every question, even when questions were asked one after the other between CSLT statements. Sighted participants seemed more often to keep their finger near the number 1, 2, 3, and 4 buttons on the keyboard throughout many of the questions, especially when the questions were asked one after the other between CSLT statements. This appears to have slowed down the response time on the VI/B participants when answering questions. And may have also impacted their answers as more time may have diminished short-term memory recall and in turn impacted the correct answers on the CSLT.

It was evident during testing that the more severe the visual impairment the more time the VI/B participants took in answering the questions. For instance, participants with little or no vision would (a) almost always bring their fingers back to the start position on the keyboard and (b) then bring their fingers up to the end of the first row of numbered keys then move across that row feeling each key until they located the numbered key they wanted to press. This extra time appears to be a possible reason why the VI/B response times were longer and their efficiency/throughput scores were lower. In addition, it is possible that the extra time it took for each answer, once they located the appropriate key to press when compared to the sighted population, may have also impacted the VI/B participant's working/short-term memory in recalling the correct answer (Baddeley, 1975; Tarnow, 2008).

The longer response time on the CSLT by the VI/B participants may have negatively impacted short-term memory recall for correct answers (Baddeley, 1975; Tarnow, 2008). According to Baddeley (1975), immediate memory span is not constant, it is impacted by the length of words and length of time of response. This is even more significant when utilizing auditory short-term memory (Baddeley, 1975). Baddeley states that "the word length effect disappears with visual presentation, but remains when presentation is auditory" (Baddeley, 1975, p. 575).

An additional factor with the VI/B included stopping and asking for redirection. The extra time for redirection may have also impacted VI/B participant answers on the CSLT. For instance, most of the sighted participants got question 16 correct; however, most of the VI/B participants got question 16 wrong. Question 16 was a more difficult statement to understand than previous questions and most VI/B participants would stop at

that question and ask the researcher "What do I do if I don't know the answer." This extra time and the hesitation on such difficult questions may be enough to hinder working/short-term memory from remembering the correct answer once they found the appropriate numbered key to press. More research is needed in examining these areas specifically with a larger sample size in order to more accurately calculate the effect that these issues have on VI/B participants.

Reliability

Although the reliability estimates for the 24 item CSLT were sufficient for research use, in its present form, the CSLT could not be recommended for use in actual practice. Projections from item analysis in this study indicated that an Alpha coefficient of .80 could be attained by adding 28 comparable items.

The effect of adding 28 comparable items to VI/B participants is not certain without more research to examine this effect. It is not certain what effect this would have on the time required for the VI/B participants to take the test and even if such an increase would be considered reasonable for participants who are VI/B. It is possible that the longer length of time would cause significant fatigue and stress on VI/B participants. Participants who are VI/B already need significantly more time in utilizing the keyboard and responding to questions without adding additional comparable items to the CSLT.

Limitations

The primary limitation for the current study was the sample size. Although there was enough power to detect significant relationships, this may have limited the generalizeability of the research findings. In addition, the sample was fairly homogenous

in that the majority of participants were Caucasian females between the ages of 18 and 35. Furthermore, all study participants were college students. Both of these issues have an impact on the generalizeability of the findings.

Additional limitations include the possible effect the researcher may have had on the VI/B participants. During the CSLT test the sighted sample where by themselves in the room taking the CSLT on the computer, whereas, the VI/B participants had the researcher in the room while they where taking the CSLT.

Motivation may also be a possible limitation in the current study. The sighted participants possible interest may have been influenced by the need of meeting the requirements for their course, which required participation in this current research study.

Recommendations for Future Research

The current study was comprised of a fairly homogeneous sample and a small sample size. Future research should be comprised of samples that are more heterogeneous. This may increase the likelihood that significant relationships are present due to the differences in variability that may be present as well as the generalizeability of research findings.

Future research may include more analysis on the potential measurement of the CSLT in measuring simultaneous processing or other areas it may possibly measure such as attention, sequential processing, and auditory short-term memory. An additional study may also be beneficial that explores the CSLT in which the Cognitive Assessment System (CAS) is utilized as the anchor test for Planning, Attention, Simultaneous, and Sequential processing (PASS) instead of the K-SNAP. Also, a study may be beneficial

that explores the CSLT in which the WJ-III: COG instrument is utilized as the anchor with such subtests as Sound Blending and Auditory Attention Test to examine what information may be evident with this instrument.

A replication study with a larger number of sighted and VI/B participants could be valuable for a more in-depth analysis of the CSLT. A sample of sighted participants that doesn't come from a subject pool may offer important analysis as well.

Researchers may want to also look at adaptations of the keyboard (just numbered keys) for both sighted and VI/B populations in order for quick recall and memory tests to further measure simultaneous processing ability in both participant groups with less impact of finger placement on keyboard for VI/B population.

Implications for School Psychology

This research is extremely important to continue to pursue so that measures such as simultaneous processing can be explored and replicated, especially for persons who are visually impaired or blind, in order to better address students needs in classroom settings. One role of the school psychologist is to identify pre-K through postsecondary students' difficulties and weaknesses and to assist teachers and parents in helping these students improve within their educational environment including academic and behavioral assistance within the classroom setting.

According to NASP one of the roles of the school psychologist is to assist school systems in identifying systemic patterns of student need such as identify appropriate evidence-based intervention strategies and assist with persistent challenges among all students in areas such as basic phonics skills and other academic deficits (NASP, 2006).

Fiorello et al., (2006) states that it is valuable and important to have a cognitive measure that supports Luria's assessment theory in order to better identify students with learning disabilities and offer specific intervention for the student with difficulties and severe challenges, including pre-K through postsecondary level students.

Assessing simultaneous processing ability with sighted and VI/B students can assist school psychologists as they help to determine specific patterns of weaknesses and offer individual intervention strategies that assist struggling students to become more successful within their educational environment. Many college campuses have a school psychology clinic that work closely with such departments as the disability resources center in assessing college students needs for assistance with such areas of challenge as ADHD, reading, writing, and mathematics difficulties.

In regard to Aptitude-Treatment Interaction in the schools, although studies are becoming more available, there seems to be a shortage in additional assessment data. According to Mills, Dale, Cole, and Jenkins (1995), more investigation would be beneficial in demonstrating success.

McInerney, McInerney, and Marsh (1997) found that when prior competence was controlled, students' initial aptitudes were seen to interact significantly with teaching methods and that these students scored significantly higher on achievement tests, self concept, and sense of control-mastery than did direct instruction groups. According to Caspi and Bell (2004) their research concluded that ATI research offers invaluable insights and should be considered. Seufert, Schutze, and Brunken (2009) state that it was evident in their research on ATI with multimedia learning that significant effects were

found with respect to comprehension and that the modality effect was evident for less-skilled learners in memory strategy use.

According to Haddad et al., (2003), reading comprehension research, evidence supports previous research, that Planning, Attention, Simultaneous, and Successive cognitive profiles are relevant to instruction. School psychologists, utilizing Luria based ability measures, can contribute valuable insight in helping parents, teachers, and students better understand students' specific weaknesses as well as offer specific specialized interventions addressing student needs in the classroom. It is extremely important that current research continue in this area so that school psychologists can better evaluate and understand students strengths and weaknesses in academic settings in order to better address their needs in the classroom.

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