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## Short-Term Memory Capacity and Recall of Students with and without Intellectual Giftedness: An Empirical Inquiry

Angela Foil Ellison  
*University of Southern Mississippi*

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SHORT-TERM MEMORY CAPACITY AND RECALL OF STUDENTS WITH AND  
WITHOUT INTELLECTUAL GIFTEDNESS: AN EMPIRICAL INQUIRY

by

Angela Mae Foil Ellison

A Dissertation  
Submitted to the Graduate School,  
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and the Department of Curriculum, Instruction, and Special Education  
at The University of Southern Mississippi  
in Partial Fulfillment of the Requirements  
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December 2017

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WITHOUT INTELLECTUAL GIFTEDNESS: AN EMPIRICAL INQUIRY

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Approved by:

---

Dr. Gregory W. Smith, Committee Chair  
Assistant Professor, Curriculum, Instruction, and Special Education

---

Dr. Sharon E. Rouse, Committee Member  
Associate Professor, Curriculum, Instruction, and Special Education

---

Dr. Steven R. Chesnut, Committee Member  
Assistant Professor, Educational Research and Administration

---

Dr. Hollie G. Filce, Committee Member  
Associate Professor, Curriculum, Instruction, and Special Education

---

Dr. Mary Ariail  
Chair, Department of Curriculum, Instruction, and Special Education

---

Dr. Karen S. Coats  
Dean of the Graduate School

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## ABSTRACT

### SHORT-TERM MEMORY CAPACITY AND RECALL OF STUDENTS WITH AND WITHOUT INTELLECTUAL GIFTEDNESS: AN EMPIRICAL INQUIRY

by Angela Mae Foil Ellison

December 2017

The goal of this research is to examine the differences of short-term memory capacity between intellectually gifted, general education, and students receiving special education services. Using foundations in memory and recall research by Atkinson and Shiffrin and Baddeley and Hitch, data was collected by replication of a previous serial position effect research design. Participants were children in grades four through six located in the southern portion of the United States. An ANOVA analysis found a statistical significance between students receiving special education and general education and gifted students. A failure to reject of the null hypothesis supported that short-term memory capacity of gifted students are not different from general education students.

## ACKNOWLEDGMENTS

I would like to acknowledge the Department of Curriculum, Instruction, and Special Education has been more than supportive during my processes of obtaining my Doctorate of Philosophy in Education. One professor who has been matchless in my success is Dr. Gregory Smith. After three changes in committee members and two changes in the role of chair and lead professor, Dr. Smith, unselfishly took the role of Chair of my Dissertation Committee. Without his encouragement and optimism, confidence and assertiveness, I truly believe that I would not have completed this degree. I am forever indebted to Dr. Smith for his help.

Another professor who has been very supportive of my career and degree completion is Dr. Sharon Rouse. Dr. Rouse was the only faculty member who was on my original dissertation committee. She was also my faculty mentor. Her knowledge and support is something that I have and will always find invaluable.

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Although others have played imperative roles in helping me achieving my goals, the above four professors went far and beyond their required duties and accepted the invitation to become a part of my dissertation committee. I look forward to completing more projects together in the future. Thank you.

## DEDICATION

To my husband, children, and family, I dedicate this work.

Brian, my husband is my rock and has supported me throughout this process with distracting the children and finding supper, ignoring the needed house chores and times of short-temperedness when deadlines were looming. He has given me encouragement when I thought I would never finish and shared my excitement and pride when I reached my goals. I love him dearly.

To my children, I thank you for your patience in the many times I said, “Later,” or “In a minute,” when I was pushing toward this goal. I am excited to have more time now to play and go on adventures.

To my mom, I want to thank you for the many times you babysat and entertained my children as I read through mounds of research and input and analyzed seemingly unending articles and data.

To the rest of my family, including my in-laws, I will always remember the times that you encouraged me and told me how proud you were of me.

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LIST OF ABBREVIATIONS

<i>USM</i>	The University of Southern Mississippi
<i>WCU</i>	William Carey University

## CHAPTER I – INTRODUCTION OF THE STUDY

### Introduction

Misunderstandings of giftedness have been commonplace in a variety of settings from academics to legislation. A report published during the 1920x and 1930s by the National Association for Gifted Children (n.d.) identified the need for specialized education for students classified as gifted. With an increased desire for nurturing gifted minds during the 1950s great Race for Space, the value of focusing on the gifted mind increased followed by federal legislation during the 1970s (NAGC, n.d.). High cognitive abilities correlate to increased memory. Ackerman, Beier, and Boyle (as mentioned in Vock and Holling, 2007), found an intimate relationship between measures of intellectual giftedness and temporary memory storage. Some variance in studies indicated it is possible that no difference is observable between general intelligence and memory and intellectually gifted and memory; others support the dependence of concept of high cognitive abilities on the size of memory (Oberauer et al., 2003).

The definition of giftedness is comprised of a synthesis of historical concepts. An individual can be considered gifted by not only a calculated score on an intelligence quotient test (IQ) but also by one's gifted behavior (Renzulli, 1978). Four definitions most often considered in the current work on gifted include intelligence, giftedness, gifted individuals, and talent development (DeLandtsher, 2011). Clark (2012) states that intelligence is a combination of one's affective, cognitive, intuitive, and physical functioning. Intelligence is positively or negatively influenced by genetic predispositions and environmental conditions. Giftedness, founded in biological concepts, indicates an advanced level of cognitive functioning including affective, physical, intuitive, academic

aptitude, creativity, leadership ability, internal and external insight and skills, visual and performing arts, or a combination of those listed. Gifted individuals refer to those who perform or show potential to perform at heightened levels of intelligence. Due to acceleration and advancement, to show growth, gifted individuals require services and activities beyond traditional classroom instruction. Talent development indicates a specific curriculum to meet the individual needs of the gifted learner. Specialized curriculum for gifted is needed to stimulate and enhance the abilities of gifted learners (Clark, 2012).

#### Presentation of Cognitive Functioning in Intellectual Gifted

When considering intellectual giftedness, the level of cognitive functioning is presumed to increase when compared to other students. Increased temporary memory, attention, and reaction times were found in intellectually gifted, contributing to heightened mastery of reasoning tasks. Bornstein and Sigman (as mentioned in Vaivre-Douret) stated that intellectually gifted show acceleration, especially in their response time of habitual tasks (2011). Limited amounts of research found an increase in processing speed due to gifted having higher vocabulary, memory, cognitive mobility, and advanced reasoning strategies (Delaubier, 2002). Vaivre-Douret's study found intellectually gifted have, among other characteristics, amplified processing speeds due to a surge in visual-motor coordination and nerve input transmission speeds, leading to elevated sensory and motor reactions. In 2003, Neubauer (as mentioned in Vaivre-Douret ) believed the ability to target specific areas of the brain to store information contributed to accelerated rates of performance, depending on the task. Intellectually gifted children possess the ability to assign specific areas of the brain to particular memory tasks,

enabling them to engage a larger area of the brain for memory recall tasks when compared to the average learner (Vaire-Douret, 2011). A study by Vock and Holling (2008) found that working memory correlated with advanced cognitive abilities, especially in for children of elementary age.

Research by Coyle and Read (1998) focused on memory capacity and gifted processed four memory strategies: clustering at recall, rehearsal, sorting, and category naming. The researchers presented the participants with lists of words to recall. The child was presented words written on index cards and allowed to use one or a combination of the aforementioned memory strategies. The rehearsing memory strategy was defined as when the child spoke the words aloud. Category naming was when the child generalized the words into categories. The clustering memory strategy was used only when the child used adult-defined categories to recall words list. The memory strategy called sorting is the actual movement of the word cards into groups. The findings indicated that gifted children displayed high levels of recall and the traits of gifted are supported by theories that state that highly gifted adapt easily to complex thinking activities-(Coyle & Read, 1998).

When analyzing theories of memory, the origin began with William James' theory of the brain having primary and secondary memory areas. Primary memory allocated for the temporary stores of memory, and secondary memory denoted for information that is stored permanently (Vianna et al., 2000). Theories of memory have been researched and changed as more information about the brain has developed, leading to other memory theories such as The Short-term Memory Model (Atkinson & Shiffrin, 1968) and The Working-Memory Model (Baddeley & Hitch, 1974).

Short-Term Memory Model and Working-Memory Model both address primary memory through the concept of temporary memory storage: (a) Short-term Memory Model (Atkinson & Shiffrin, 1968) refers to temporary memory as short-term memory; and (b) The Working-Memory Model (Baddeley & Hitch, 1974) refers to temporary memory as working memory. Atkinson and Shiffrin's Short-term Memory Model (1968) explained that information processing begins when engaged by one of the senses. Once practiced, short-term memory is transferred to long-term memory (Cowan, 2008). Baddeley and Hitch (1974) developed the Working Memory Model based on the previous Atkinson and Shiffrin (1968) model. They believed that working memory is needed to organize and complete an action. Working memory is not isolated from long-term memory. The central executive component functions more like a connecting piece, using visuo-spatial and phonological connections to relay information between the long-term memory and working memory. Academia's interchangeable use of the two words, short-term memory and working memory, demonstrates the closeness in relationship of these two memory models (Baddeley, 2012).

#### Definition of Key Terms

1. Giftedness refers to persons who have characteristics of high achievement in areas of creativeness, artistic, leadership, academic, or intellect (US Department of Education, 2002).
2. Intelligence quotient test (IQ) is a test given to determine the intelligence of an individual as compared to a normed population (Kazdin, 2000).

3. Gifted individuals are students who score at 120 on an IQ test or at 90 percentile or above on a nationally normed test (Mississippi Department of Education, 2013).
4. Talent development refers to the development of gifted talent: intellectual, academic, artistic, or creative (MDE, 2013).
5. Cognitive functioning pertains to the development of intellectual growth (Clark, 2012).
6. Intuitive functioning relates to the processing of information by relying on impressions and possible meanings, basing decisions on patterns (Clark, 2012)
7. Physical functioning is defined as the physical development of a person (Clark, 2012).
8. Genetic predispositions are the predetermined outcome of an individual due to genetic makeup (National Institutes of Health, 2017).
9. Academic aptitude is the projected academic performance of a person (Nugent, 2013).
10. Short-term memory (STM) refers to the store of memory that is initiated by a sensory perception and maintains approximately 8 items of information for a range of 0-18 seconds (Atkinson & Shiffrin, 1968).
11. Working memory (WM) defines the store of memory adapted from concept of short-term memory that is needed to organize and complete particular tasks (Baddeley & Hitch, 1974).
12. Long-term memory (LTM) defines the store of memory that contains unlimited information that can be recalled when needed or triggered by a



connect sensory perception (Atkinson & Shiffrin, 1968; Baddeley and Hitch, 1974).

13. Serial Position Effect was coined by Hermann Ebbinghaus (1913), serial position effect refers to the memory recall of words in a presented list.

### Summary

Not all gifted individuals exhibit the same combination of gifted characteristics (Clark, 2012; Renzulli, 1978). However, the list of gifted characteristics include: (a) having an increased memory and advanced comprehension, (b) being a quick learner and a problem solver, and (c) having some areas of self-teaching, intense feelings and emotional reactions, abstract analysis, heightened sensitivities, and intense concentration for example (Webb, Gore, Amend, & DeVries; 2007). This study will attempt to report a comparison of the memory capacity of a sample population of general education students, students who receive special services, and students identified as intellectually gifted. Recognizing the cognitive analysis of students identified as intellectually gifted is essential not only to the learning environment but should also be considered when creating or selecting the appropriate instrument when testing for intellectual giftedness and other areas of cognitive ability. Knowing the memory capacity of each student population also helps determine the appropriate level and combination of instructional delivery and practice needed for all learners to be successful.

The aim of this project is to extend the findings of previous research on attention and memory of gifted. A secondary purpose of this study is to potentially identify areas and characteristics of memory that could be beneficial for instructional delivery. Ultimately, this project aims to answer the questions: What are the differences between

the short-term memory capacity of intellectually gifted students and general education students? and What are the differences between the short-term memory capacity of intellectually gifted students and students receiving special education services?

## CHAPTER II – REVIEW OF RELATED LITERATURE

Today's educational settings often overlook gifted learners due to high-stakes testing. Teachers come to the classroom with preconceived ideas of a gifted learner's memory and level of performance. According to VanTassel-Baska and Stambaugh (2005) when teaching, teachers focus less on the needs of intellectually gifted students, believing these students need less guidance and instruction than other learners.

Although differentiation attempts are made, general education classrooms frequently fall short of providing an appropriate education for gifted students. Other general education classroom characteristics that contribute to this is lack of subject matter knowledge that can increase the often already advanced knowledge the gifted student brings to the classroom and problems with classroom management (VanTassel-Baska & Stambaugh, 2005). A preconceived notion about gifted learners found by Endepohls-Ulpe and Ruf (2005) included the idea that high cognitive functioning, self-motivation, and high achievement. Many teachers viewed the gifted learner as having an established advantage over the regular learner. However, research by Nicely, Small, and Furman (2001) showed that when asked about their understanding of giftedness, 85% of teachers stated they had none to some understanding.

Mendoza (2006) found that although gifted children have been known to learn at a far faster pace than the average learner, No Child Left Behind (NCLB) of 2001 increased the idea of equality of all learners, creating a common teaching strategy for all learners. Teacher interviews reported by Mendoza (2006) indicated that the classroom teacher, however, did recognize the effects of lack of motivation on the gifted child.

Signed into law by President George Bush, the implementation of the No Child Left Behind Act in 2001 (NCLB) developed some hurdles for the instruction of the gifted child in the regular education classroom. The foundation of NCLB focused on accountability, research-based education, flexibility, and parent options (US Department of Education, 2001). Mendoza states that teachers received pressure to focus on the lower scoring students more than the gifted students, who were scoring at the top. Differentiating in the regular classroom for the gifted student increased in difficulty. Therefore, instruction concentrated on the below average to average learner. Some teacher critics argued that the lower performing students and those that could improve the test scores received more focus. Since gifted students often scored at the top of performance tests, most differentiation ignored gifted students' needs (Mendoza, 2006). NCLB has left many gifted children to depend upon their own resources to meet their learning needs in the regular education classroom (Inan, Bayindir, & Demir, 2009). Nicely, Small, and Furman (2001) found that curriculum coordinators and principals overwhelmingly were against gifted learners leaving the regular classroom to be given gifted services. Grey (pg. 1, 2004) stated, "Three million gifted and talented students are currently our nation's most underserved and underfunded human resource."

Memory differences within a classroom affect the instruction and student assessment outcomes. VanTassel-Baska and Stambaugh (2005) discussed the difficulties providing differentiation for gifted learners in the regular academic setting. Some issues include the need for advanced and accelerated learning opportunities, negativity and philosophical barriers about giftedness by regular education teachers, and knowledge of the kind of differentiation needed for the gifted learner. The study also found a lack of

understanding by the academic teachers of how to provide services and the lack of mandated requirements as challenges for providing services and addressing the advanced learning requirements of intellectually gifted students.

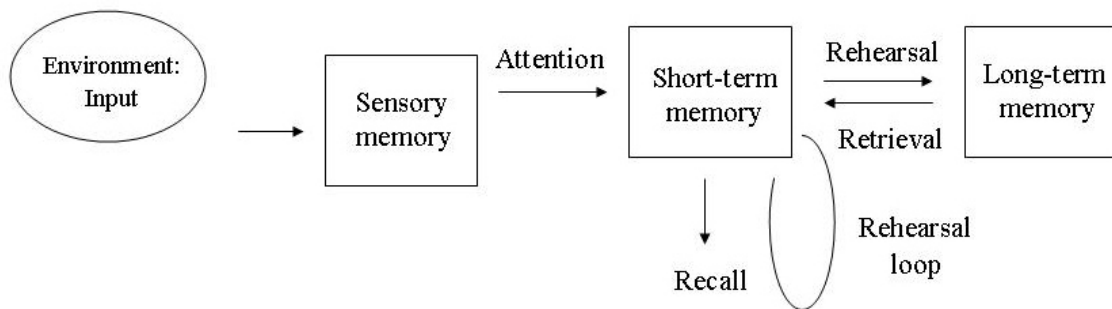
### Theoretical Framework Of Memory Development

To fully understand the theories related to short-term memory (STM), working memory (WM), and long-term memory (LTM), the original concepts of primary and secondary memory must be explored. In 1890, William James (as mentioned in Cowan 2008) developed the theory that two areas divide memory: primary and secondary. Primary memory stated that memory is used to connect to current, present information; and secondary memory explained that knowledge developed over a lifetime of events (Cowan, 2008). Based on this concept, Atkinson and Shiffrin (1968) developed the short-term memory model. For this model, STM fostered the idea that primary memory and can be viewed as the amount of information that can be saved and accessed over during a brief amount of time (Cowan, 2008).

From the Short-term Memory Model (Atkinson and Shiffrin, 1968), Baddeley and Hitch (1974) developed the Working Memory Model. Baddeley and Hitch claimed that the idea of primary memory (Cowan, 2008) and the Atkinson and Hitch model lacked the inclusion of consciousness. In the Working Memory Model, WM defined the part of memory needed to organize and complete an action. The central executive component, the main component of the Working Memory Model, functioned more like a connecting piece, using visuo-spatial and phonological connections to link information between the long-term memory and working memory.

*Short-term Memory Defined and Short-term Memory Model.*

Short-term memory (STM) refers to the retention of information for a very brief time. Information enters the STM store through detection by the sensory organs. Key areas of short-term memory include (1) limited capacity, (2) limited duration, and (3) encoding. Limited capacity refers to retaining approximately seven facts at a time; limited duration refers to information easily lost due to amounts of time or distraction, and encoding refers to translating observations of language into sounds. According to Atkinson and Shiffrin (1968), STM and LTM function as two separate memory stores. To transfer from STM to LTM, rehearsal of the information is required. The information lost is referred to as decay, and the information remembered transfers to LTM.



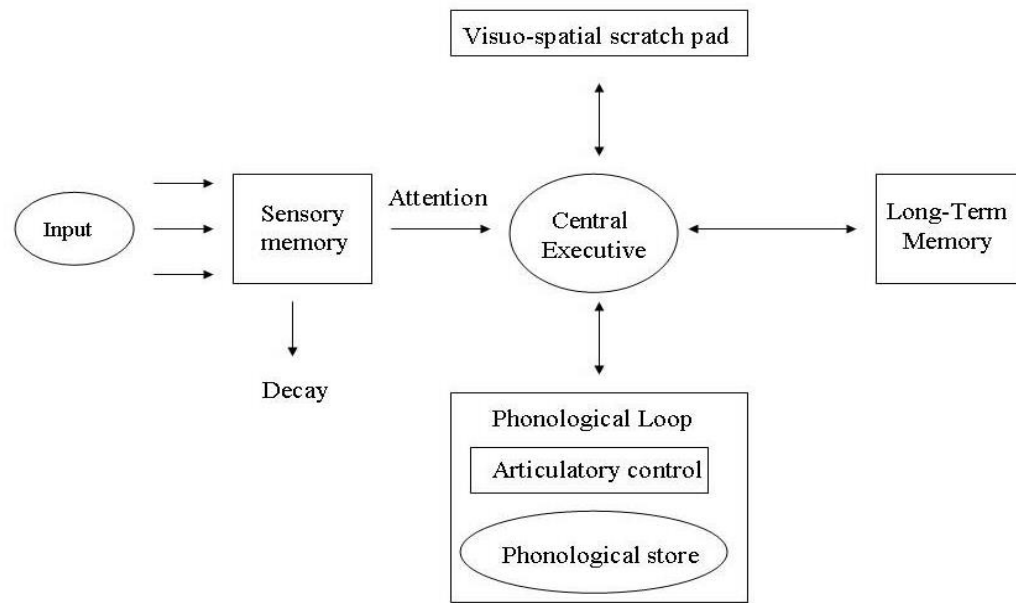
*Figure 1.* The Short-term Memory Model (Atkinson & Shiffrin, 1968).

*Working Memory Defined and The Working Memory Model.*

Working memory (WM) is a term used by psychologist to describe the power to keep concepts in mind and mentally use information across small periods of time. When information stored in working memory fades, it is forever gone. Working memory varies with each person and increases with age. In the classroom, working memory affects learning and retention. In education, working memory presents a workspace to maintain data while mentally employed in other related activities. Children utilize working

memory when a complicated task uses newly introduced material. Task completion can suffer from poor working memory, thus delaying the child's learning success (Gathercole & Alloway, 2007). Working memory has become synonymous with performances that are task-related or require instant results while utilizing various facets of temporary memory.

Alan Baddeley and Graham Hitch (1974) developed a model (Figure 1) to provide a different concept to previous short-term memory (STM) evaluation. Juxtaposing the Multi-Store Model, Baddeley and Hitch proposed that instead of working in a linear organization, STM is called working memory and was composed of a single store that keeps all information. Within this store, different areas are reserved for specific information. The central executive regulates the functioning of two subsystems: the visuo-spatial sketch pad and the phonological loop. The visuo-spatial sketchpad stores and processes data in a spatial or visual form. The Phonological Loop processes data that is written or spoken and consists of two parts: the Phonological Store, which maintains spoken words for up to two seconds; and the Articulatory Control Process, which produces verbal communication.



*Figure 2.* The Working Memory Model Components (Baddeley & Hitch, 1974).

Working memory is woven together by sensory perception, attention, and memory. Components of WM model (Figure 2) included central executive, input, sensory memory, visuo-spatial scratch pad, phonological loop, and long-term memory.

Considered the most important part of the model, the central-executive was responsible for controlling attention to focus memory on the task at hand. The phonological loop and the visuo-spatial scratch pad were considered passive storage subsystems controlling a speech-based system and a visual and spatial system. In 2000, Baddeley added an area called the episodic buffer that linked working memory to long-term memory and provided an area where information from subsystems created a combined experience (Henry, 2011).

*Long-term Memory.*

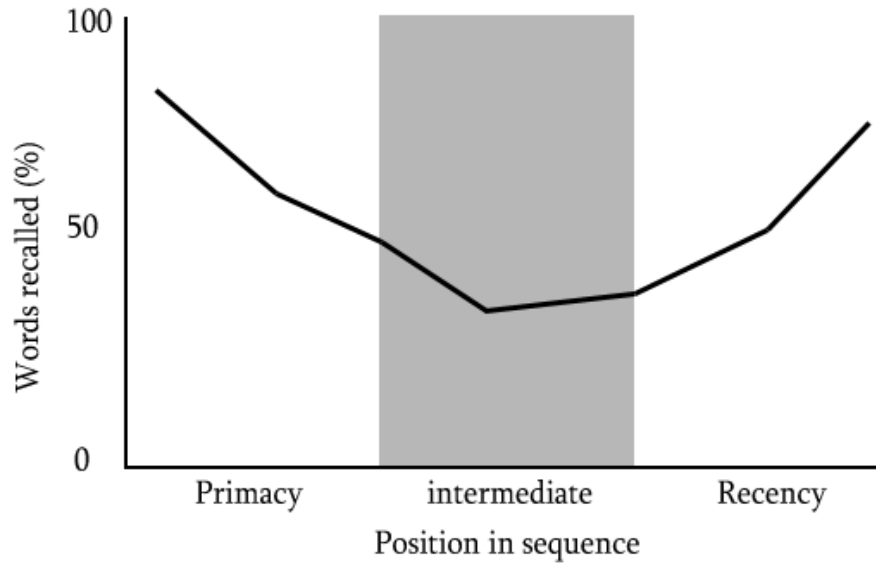
Long-term memory (LTM) stores information for indefinite periods of time and is unlimited (Atkinson & Shiffrin, 1968). Three differences of LTM include (1) procedural



memory, which is often considered unconscious or automatic response for the memory of motor particular tasks requiring motor skills; (2) semantic memory includes the memory of language meanings and general knowledge; and (3) episodic memory that consists of the information of lived events (Tulving, 1972). Shiffrin and Atkinson (1969) describe LTM as an elaborate filing system, which keeps information in relation to specific content. When needed, the information in LTM is recalled depending upon a relevant need.

### *Free Recall and Serial Position Effect*

Free recall is the use of memory to recall given information without use of a memorization technique or tool. Coined by Hermann Ebbinghaus (1913), serial position effect refers to the memory recall of words in a presented list. Studies on memory have shown that participants often remember words located at the beginning (called primacy effect), and the end (called recency effect), of the presented list (Deese and Kaufman, 1957; Murdock, 1962). Serial position curves often show a decrease in the middle (Fig. 3). Different studies found that differences in spacing or rate of words affect the serial position curve (Glanzer & Cunitz, 1966; Murdock 1962). Free recall and serial position effect mostly differ in that free recall considers the number of items remembered important and serial position effect focuses on the number of words and the position of the information retained (Klein, Addis, & Kahana, 2005).



*Figure 3.* Idealized Serial Position Curve (Murdock, 1962).

#### Statement of the Problem

A lack of research about the short-term memory of intellectually gifted students contributed to the need for this study. If a presence of differences between intellectually, general, and other learners is present, it would benefit the educational system to know where the memory strengths and weaknesses of individual learners fall. Not only would the knowledge of such information be personally helpful for the student, but the data would be advantageous to the success of instructional delivery and assessment as well as college and career orientation of the student.

#### Purpose of the Study

The purpose of this study is to examine the short-term memory of intellectually gifted students. Specifically, it seeks to determine if there are differences in the memory of gifted students, general education students, and students receiving special education services.

## Research Questions

Specific research questions to be addressed in this are to:

1. What are the differences between the short-term memory capacities intellectually gifted students and general education students?
2. What are the differences between the short-term memory capacities intellectually gifted student and students receiving special education services?

## Hypotheses

For the purposes of this study, the following hypotheses were tested:

H<sub>1</sub>: There is a statistically significant difference between the short-term memory of intellectually gifted students and general education students.

H<sub>2</sub>: There is a statistically significant difference between the short-term memory of intellectually gifted students and students receiving special education services.

H<sub>0</sub>: There is no statistically significant difference between the short-term memory of intellectually gifted students, general education students, and students receiving special education services.

## Limitations, Delimitations, and Assumptions

1. Internal validity may be affected by poor student performance due to attitude towards testing.
2. Participants were limited to local school districts located in the southwestern Mississippi and were children in grades 4-6. Therefore, results can only be generalized to this population.
3. Predictor variables included additional training in memory techniques.

## Significance of the Study

Teachers and parents require more information concerning the memory development of gifted to help gifted children reach their full potential. Also, providing information to the educational setting may contribute to instructional and assessment design to better challenge the gifted student. A review of the literature found a small amount of prior research concerning working memory and intellectually gifted.

## CHAPTER III - RESEARCH DESIGN AND METHODOLOGY

### Introduction

The following section describes the research design and methodology for this study on the short-term memory of gifted and general education students. To begin, an inspection was done the problem and purposes of the study. A review of the current literature found limited research focused on the short-term memory of gifted children, including research that utilizes the serial position effect process. The purposes of this study are to add to existing literature, aid in the design of instruction used in instruction, and determine a better way to present materials to students that will help develop specific instructional strategies to increase student short-term memory knowledge and further understanding gifted students as a whole. The population and sample were specific to a sampling of students located in the southern region of Mississippi.

Next, the instrument and data collection were examined. Data were collected based via presentation of word trials in a based on serial position effect protocols. The researcher presented slideshows of word groups. The researcher replicated the procedures from a prior study implementing serial position effect by Azizian and Polich (2007).

### Problem and Purpose Overview

General assumptions of gifted cause people to often overlook the educational needs of gifted learners. One such assumption is that gifted learners can learn material with very little help or strategies utilized. Prior research on gifted students mainly focuses on identification of giftedness, academic and intellectual development, and unique characteristics of gifted (VanTassel Baska & Strambaugh, 2005; Cross 2002; VanzTassel Baska, 2012; Olenchak, 1999; Maker & Shiever, 2005). However, research reported does

little to connect the use of information identified as necessary when educating gifted learners, especially the information surrounding short-term memory and serial position effect. A gap in literature remains identifying the possible memory limits and potentials of learners. This gap creates a lack of information connecting memory and specific learners that is needed to craft successful instructional and assessment opportunities. The purpose of this study is to examine the relationship between short-term memory and serial position effect of children with and without intellectual giftedness. The ultimate goal is to ascertain the variance in short-term memory of gifted and general education students. Few studies have been designed to determine if a difference is observed in short-term memory of students with and without intellectual gifts.

#### Research Questions and Hypotheses

Specific research questions to be examined in this are to:

1. What are the differences between the short-term memory capacities intellectually gifted students and general education students?
2. What are the differences between the short-term memory capacities intellectually gifted student and students receiving special education services?

#### Hypotheses

For the purposes of this study, the following hypotheses were tested:

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H<sub>0</sub>: There is no statistically significant difference between the short-term memory of intellectually gifted students, general education students, and students receiving special education services.

### Population and Sample

Data were collected from participants in grades 4-6 in the traditional classroom located in the southeastern region of the United States in two school districts. Classroom teachers completed information for each student (ethnicity, gender, age, reading level, and free-reduced lunch) and indicated if the student received services for disabilities or giftedness. Two districts in southeastern Mississippi participated in the study.

District A has an average total population of 593 in the elementary and middle school grades four through six. The number of participants for District A was 235 (73.7% of total participants). The percentage of District A participants who receive special education services was 31, and the percentage of District A participants labeled as gifted was 36. District B has an approximate population of 226 in the grades 4-6. The number of participants for District B was 84 (26.3% of total participants). The percentage of District B participants who receive special education services was 21, and the percentage of District B participants labeled as gifted was 6. The approximate number of students per class for both sites was 20.

Participants included 154 white students (48.3%), 158 black students (49.5%), and 7 (2.2%) from other races. 53 percent of the participants were female with 47 percent as male. Participant socio-economic status was determined by the participants' qualification for free and reduced lunch due to household income as requested by the food services department at each school; 63.8% of the participants qualified for free and

reduced lunch costs. Student reading levels were found to be 44.7% below grade level readers, 36.3% on-grade-level readers, and 18% above grade level readers. Participants who were identified as gifted comprised 13.2% of the population with 16% of the population identified as students receiving special education services. Additional demographics in Table 1 show the occurrences of each disability among participants who were labeled as receiving special education services.

Table 1

*Sample Population's Specific Special Education Identification*

Subgroups	Frequency	Percentage
Specific Learning Disability- Language Arts	16	5.0%
Specific Learning Disability- Math	13	4.1%
Emotional Behavioral Disorder	1	.3%
Attention Deficit Hyper Activity Disorder	27	8.5%
Other Disability	5	1.6%
Speech and Language Disability	13	4.1%

Data Collection and Instrumentation

Permission to conduct this research was sought from the Human Subject Protection Review Committee. The researcher replicated procedures from that of prior research conducted concerning serial position effect (Azizian & Polich, 2007). The replicated research used serial position effect to determine short-term memory capacity of a selected population through the use of a timed slide show of random words. In this study, phonetically spelled words were accepted because the research replicated a study



for recall of the number or percentage of a given word list, not language processing or spelling ability. STM model is being used to study the differences in the population because of processing time related to viewing and writing the remembered words (Baddeley & Hitch, 1974). Also, requiring the correct spelling would require the engagement of LTM for learned decoding skills (Wagner, Torgesen, & Rashotte, 1994).

### Procedures

After permission was gained from IRB, the parents of the sample population at each school received an initial contact letter via their child's teacher explaining the research and asking for permission for their child to participate in a study related to memory. Then, the researcher gave an approved oral presentation to the participants explaining the research and allowing those with parental permission to consent to continue participation in the research. Students in the room without parental permission had the option to complete a teacher or researcher provided activity. The activity was awarded no reward or consequence.

To begin the research, the teacher chose a piece of paper from a basket with the numbers 1, 2, 3, 4, or 5 written on each to determine the version of the slideshow used with the participants in his room. The students were given pre-numbered answer documents. During presentation and response time, the classroom teacher aided the researcher by the completing a provided document, using only the participant number to associate with any demographics. This document insured that the researcher was never in possession of student names with identification numbers, data collected, or demographics.

## Data Collection Instrument

The method for collecting data for this research was a presentation of timed word lists via PowerPoint. Lists of twelve randomly selected, below grade level words containing 2-3 syllables were selected from Kučera and Francis' (1967) Computational Analysis of Present-Day American English, often used in serial position effect research. Presentations were prepared with five different word lists to maintain random selection, with only one list used per presentation. Words were written in Arial 32 point font with white letters on a black background. Even though most serial position effect research is conducted in small groups or even one-on-one, each participant in this study attempted to recall the list of words in a naturalistic classroom setting following single subject research design procedures (figure 4). A single word was presented for the duration of 250 milliseconds (msec) with intervals of 1500 msec with each word presented only once. Participants wrote on provided response sheets. After presentation of the word list, students were given 60 seconds to write, in no particular order, as many words as possible that they recalled from the presentation. Words were accepted if spelled correctly or phonemically to resemble the correct word. However, words recalled that were not on the word list were documented and reported.

*Figure 4.* Design of Word Lists

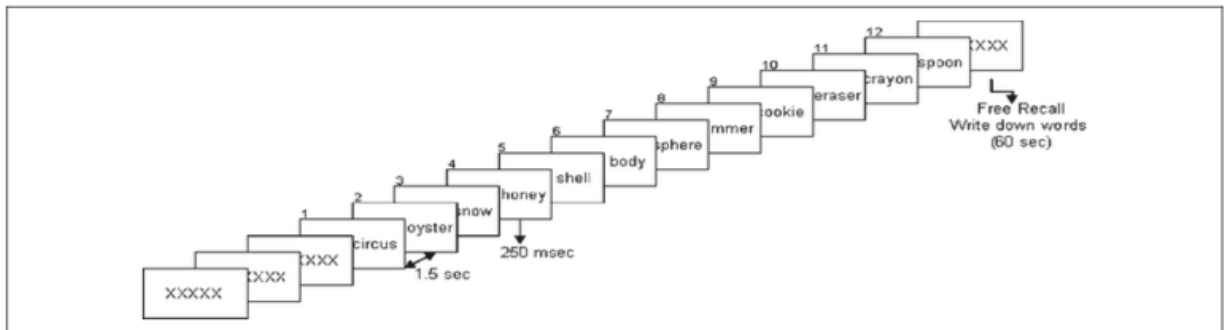


Table 2

*Words Contained in Each List)*

	Word	Word	Word	Word	Word	Word	Word	Word	Word	Word	Word	Word
	1	2	3	4	5	6	7	8	9	10	11	12
List 1	land	fill	bottle	shape	crash	pipe	writer	care	happen	grass	study	fire
List 2	glass	doll	summer	hard	trash	lift	busy	size	ready	pond	heavy	cute
List 3	wrap	hair	center	foot	tent	cliff	motor	race	listen	earn	perfect	front
List 4	catch	life	office	age	ink	knee	student	lock	address	chop	empty	space
List 5	dress	late	giant	drum	half	break	paper	law	number	voice	across	hole

## Data Analysis

The researcher utilized an analysis of variance was applied to analyze all hypotheses to determine if differences occurred between and within the categorical variables: intellectually gifted students, general education students, and students receiving special education services in grade levels (4-6), with follow up post-hoc tests. ANOVA was the selected analysis for testing the variance between means between more than two groups (variation within each group and variation of group means around population mean). An ANOVA was chosen because this research has only one independent variable with three levels: intellectually gifted, general education, and special education (Fields, 2013) An ANOVA highlighted the extent the variance in the data could be attributed to the grouping variables and not the variance (error) within the responses. The ANOVA set alpha of 0.05 was kept, implying type I error ration to be 1/20 (Fields, 2016). A power analysis was used to determine the appropriate sample size for this research study and justify the number of participants sufficient enough to produce comparative data. Effect size was addressed by determining the participant number needed in each sub-population by using the GPower program. By selecting an analysis and F-test to determine use in the calculations, the sample size was determined (Prajapati, Dune, & Armstrong, 2010).

## Summary

The types of data collected were discussed in this section, who was eligible to contribute data, how the data were collected, the procedure used to gather data, and the analytical process of reviewing the data. The absence of literature pertaining to intellectually gifted students and memory via serial position effect was a driving force for

designing and creating this research study.

The details regarding the research study's design elements, data collection, and sample population have been reviewed and include students who have been identified as intellectually gifted, general education students, and students receiving special education services. Participants were from the southern part of Mississippi and given permission to participate in the study from a parent or guardian and with district support.

## CHAPTER IV – RESULTS

### Introduction

The purpose of this study was to conduct a critical analysis of the percentage of recall to determine if one group remembered more than another group in order. Short-term memory was examined; and data were analyzed for differences between gifted students and other student populations, general education and special education, for information that could impact instructional delivery and assessment success. The study was conducted at two schools southern Mississippi and included participants from grades fourth through sixth. The sample population groups studied were general education, gifted education, and special education (see Table 3).

The primary research questions were (1) what are the differences between the short-term memory of intellectually gifted students and general education students? and (2) what are the differences between the short-term memory of intellectually gifted students and students receiving special education services?

To address the research questions, all participants viewed a timed PowerPoint slideshow of twelve randomly selected words containing 2-3 syllables found in Kučera and Francis' (1967) Computational Analysis of Present-Day American English, often used in serial position effect research. Five versions of the slideshow were available for random teacher selection. Of the five, 47 participants were shown version one; 37 were shown version two; 67 were shown version three; 47 were shown version four; 28 were shown version five. This chapter provides the results of the quantitative analysis of the data collected during this research.

#### *Participant Demographics.*

Table 3 displays variables for all participants. Of participants, more than half were female (N=120). Student participating were in fourth (N= 86), fifth (N= 128), or sixth grade (N= 105). Reading levels were also indicated by using STAR Reading (standardized reading assessment) scores with N= 116 on level, N= 143 below level, and N= 48 above level. District A participants have 58.6% identified as free and reduced lunch, while District B had 100% free and reduced lunch. The general education student population was the largest subpopulation with N= 226 of all participants when compared to other subpopulations of gifted and special education being represented with N= 42 and N= 52, respectively. Table 5 displays the specific abilities within the total sample populations.

Table 3

*Participant Demographics*

Variable	District A	District B	Total (n)
<b>Gender</b>			
Female	120	49	169
Male	115	35	150
<b>Grade Level</b>			
Fourth	65	21	86
Fifth	65	63	128
Sixth	105	0	105
Free and Reduced Lunch	119	84	203

ELL	0	3	3
Gifted Education	36	6	42
Special Education	31	21	52

Table 4  
*Participant Reading Levels*

Reading Level			
On Level	91	25	116
Above Level	41	17	58
Below Level	101	42	143

Table 5  
*Specific Categories*

Categories	District A	District B	Total (n)
Special Education	31	21	52
SLD (LA)	12	4	15
SLD (Math)	11	2	13
ADHD	14	13	27
EBD	1	0	1
Speech	12	1	13
Other Health Impairment	2	3	5

*Note: Some students were identified with receiving more than one area of services.*



## Quantitative Data Analysis

The data were inspected for missing data. Missing data were re-evaluated for researcher input error. Three cases were found to be mistakenly keyed as placeholders and counted as participants. These items were removed from the participant numbers. Therefore, the final analysis included all 219 participants.

### *Overall Findings.*

Data indicated that differences found between and within participant groups.

*Research Question 1:* What are the differences between the short-term memory of intellectually gifted students and general education students?

*Research Question 2:* What are the differences between the short-term memory of intellectually gifted students and students receiving special education services?

For analysis of the research questions, data were input into SPSS version 23.0 for iOS, utilizing a univariate ANOVA analysis. This analysis was chosen due to the increased amount of information provided in the results, depending on the selections chosen while constructing the analysis (Howell, 2011).

Statistical significance ( $p < .05$ ) was found in the effect of the overall experiment. More specifically, a statistically significant effect was not found between the general education and gifted education groups ( $p > .05$ ,  $d = -.068$ ). For  $H_1$ , intellectually gifted students recalled .12 more words than general education students.

However, a statistical significance was found between gifted education and special education ( $p < .001$ ,  $d = .721$ ), recalling 1.37 more words than students receiving special education services. In addition to the test hypotheses, a statistically significant difference was found between general education students and students receiving special

education services ( $p < .05$ ,  $d = .668$ ) (Fields, 2016a) (Table 6). This information is also reflected in a means plot of the number of words correctly remembered (Figure 5).

Table 6

*Significance Values Found*

Participant Groups	Comparison Group	$p$ values
General Education	Gifted	1.000
	Special Education	<.001
Gifted	General Education	1.000
	Special Education	.001

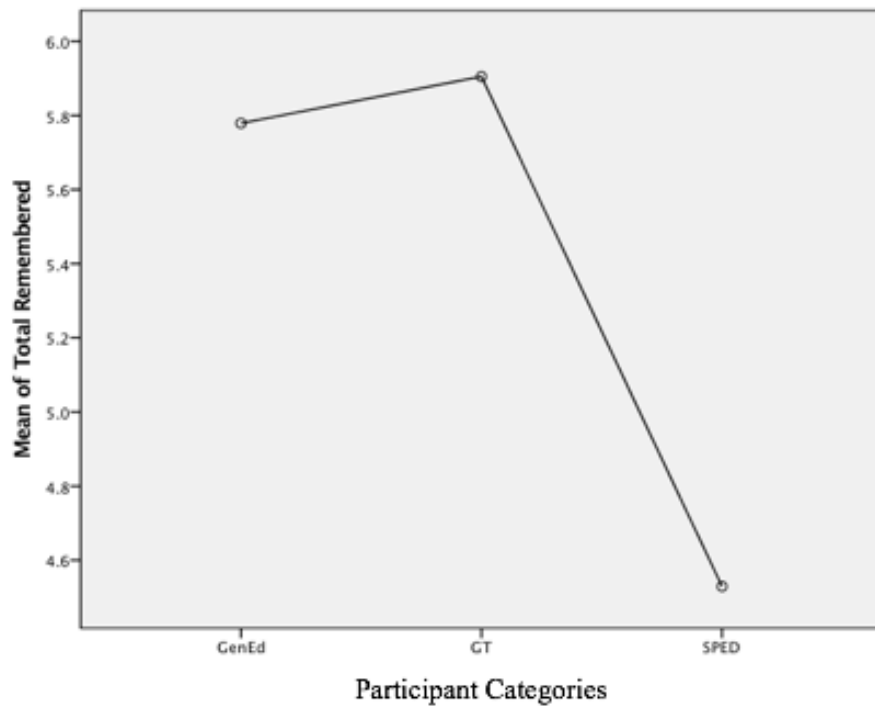


Figure 5. Means of Number of Words Remembered

## CHAPTER V – DISCUSSION

### Introduction

The focus of this chapter is to summarize the hypothesis and results and examine the theoretical and practical implications of the research findings previously presented in this study. The purpose of this study was to evaluate the short-term memory capacity of students identified as intellectually gifted, general education, and student receiving special education services. Other areas covered in this chapter a discussion of the statistical and results of the data analysis.

### Summary of Findings

The hypotheses in this study were tested with a univariate ANOVA. Statistically significant differences were found during data analysis, and a Bonferroni Post Hoc analysis was chosen to determine the specific means that were significantly different. The posed hypotheses were:

H<sub>1</sub>: There is a statistically significant difference between the short-term memory capacity of intellectually gifted students and general education students.

H<sub>2</sub>: There is a statistically significant difference between the short-term memory capacity of intellectually gifted student and students receiving special education services.

For H<sub>1</sub>, a critical analysis of the data showed no statistically significant difference between students identified as general education or students identified as gifted education. This, in turn, requires the research findings to fail to reject the established null hypothesis or alternative hypothesis (H<sub>0</sub>: There is no statistically significant difference between the short-term memory capacity of intellectually gifted students and general education students) because the alpha level set ( $\alpha=.05$ ;  $p>.05$ ) was violated (Johnson &

Christensen, 2008; Fields, 2013).

For H<sub>2</sub>, a critical analysis of the data showed a statistically significant difference between students identified as intellectually gifted and students receiving special education services. This created the opportunity for the research findings to reject the null hypothesis and accept the relevant hypothesis due to the analysis results indicating a significance level less than .05 ( $p < .001$ ) (Johnson & Christensen, 2008; Fields, 2013). In addition to the tested hypotheses, a statistically significant difference was found between general education students and students receiving special education services.

A Bonferroni Post Hoc analysis was used to evaluate the significant differences between each group of means. Bonferroni was chosen due to the amount of means analyzed in the study. Within the Bonferroni, a Pairwise Comparison was conducted to control the familywise error by implementing the significance level to maintain the Type I error rate of all comparisons by keeping the alpha level at .05 (Fields, 2013).

#### *Serial Position Effect Outcomes.*

When analyzing the mean score comparisons, the serial position effect of the findings was different for each group. Students in general education ( $M=5.78$ ,  $SD=1.71$ ) displayed a stronger memory in the primacy area of order, remembering 66.45% of the words; the middle set of words were remembered at 41.47%, and the recency area was remembered 40.23%. The memory decay between word order was 24.98% between primacy and mid and 1.24% between mid and recency, giving the general education category the group with the least amount of loss between the last two groups of words.

Students who receive special education services ( $M=4.53$ ,  $SD= 2.013$ ) were found to be the only group to have results that support the serial position effect theory. For

primacy words, the students who received special education remembered 63.7% of the beginning words, 34.5% of words in the middle, and 38.25% in the recency area.

Students who were identified as intellectually gifted ( $M= 5.90$ ,  $SD= 1.77$ ) had the least amount of decay in memory in serial position effect from primacy to mid area. Although intellectually gifted showed a smaller number of words remembered in the primacy area when compared to the other groups (57.85%), 40.2% of the words were remembered in the mid area, and 29.8% in the primacy group of words.

The most any one participant remembered was ten words. For a more detailed analysis, Table 7 shows the percentage of the words remembered relative to the order in which they were displayed during the presentation.

Table 7

*Percentage of Words Remembered Relative to Order Presented*

	Word Order											
	1	2	3	4	5	6	7	8	9	10	11	12
Gifted	85.7	78.5	73.8	52.3	52.3	30.9	50.0	23.8	30.9	42.8	38.0	30.9
Special Education	58.8	45.0	27.4	45.0	49.0	41.1	29.4	35.2	37.2	25.4	23.3	25.0
General Education	62.4	69.9	65.9	54.8	39.8	37.6	50.0	28.7	38.0	33.6	44.6	40.7

### Research Implications

One goal of this research was to add to the scholarly research available concerning the differences in memory between students who are gifted, general education, and special education. The literature in chapter two indicated that a possible connection would be found in the data that showed a statistically significant difference in STM capacity between these groups. Although significance was found between gifted

and special education and regular education and special education, none was found between gifted and general education STM capacity.

Findings indicating no significant difference between students who are gifted and general education are important to the understanding of the areas of giftedness. One myth documented that pertains to gifted students is that all gifted children are academically successful. This myth can create a negative learning environment for the intellectually gifted child. According to the 2013 Regulations for the Gifted Education Programs in Mississippi, students can be identified as the following:

1. Intellectually gifted children- children with an exceptionally high degree of intelligence, determined through an identification process that includes an IQ test, grades 2-12
2. Academically gifted children- children who demonstrate an exceptionally high degree of academic ability including test scores and academic grades, grades 9-12
3. Creatively gifted children- children with an exceptionally high ability in visual arts with a high degree of creativity, grades 2-12
4. Creatively gifted children- children who demonstrate an exceptionally high degree of creative and performing arts, grades 2-12 (MDE, 2013).

The National Organization for Gifted Children states that due to boredom and frustration, losing interest or poor study habits, unchallenging classrooms and struggles for social acceptance can cause a gifted learner to underachieve (NAGC, 2014). More specifically, a myth among teachers that has been documented is that students who have high-abilities never face problems or challenges in their educational setting and find achievement stress-free and easy when compared to their peers. While this may be true

for some, not all gifted students find academics enjoyable (Moon, 2009).

While gifted students did show a mean score increase in the number of words remembered, the findings in this research support that the area of increased ability in intellectually gifted children is not always academic or memory related. Current literature states that intellectually gifted children may have increased memory, but they may also show an increase in cognitive displays of intelligence and understanding of behavioral and social norms as well as the need to shift cognitive focus frequently within a small amount of instructional time (Hertberg-Davis, 2009). Sometimes, these frequent shifts in focus can lead to a diagnosis of Attention Deficit Hyper Activity disorder (ADHD). Gifted students with ADHD can have auditory processing and attentional disorders (Gillman et al., 2013). When engaging the auditory loop for STM, intellectually gifted students with ADHD could be affected by a decrease in memory.

Twice exceptionality can also cause a gifted student to perform a task at an observed average mastery level but require the child to need increased amounts of time when processing information. Some areas affected by increased processing needs in gifted twice-exceptional children are phonics, spelling, letter reversals, visual pattern confusion, auditory processing weaknesses, written expression, and word sequencing (VanTassel Baska, 2012). According to Reis and Renzulli (2004), the high abilities of the gifted child can be masked by disabilities making identification and remediation needs of intellectually gifted children difficult. Intellectually gifted children who are not strong in visuo-spatial relationships have a tendency to recall less than children who have strong visuo-spatial relationships (Hindal, 2014).

A statistical difference was found between students identified as intellectually gifted and those identified as special education, as well as between students identified as general education students and students identified as special education. Prior research supports this finding, stating that students with special education rulings consistently score lower than other learners in STM levels, specifically students who have a significant language disability (SLD). The findings of this study support other published research in showing that students with special education rulings remember a significantly less number of words as other learners, i.e., student in general education and identified as intellectually gifted (Johnson, 2014; Carlesimoa, Marottab, & Vicaribc, 1997).

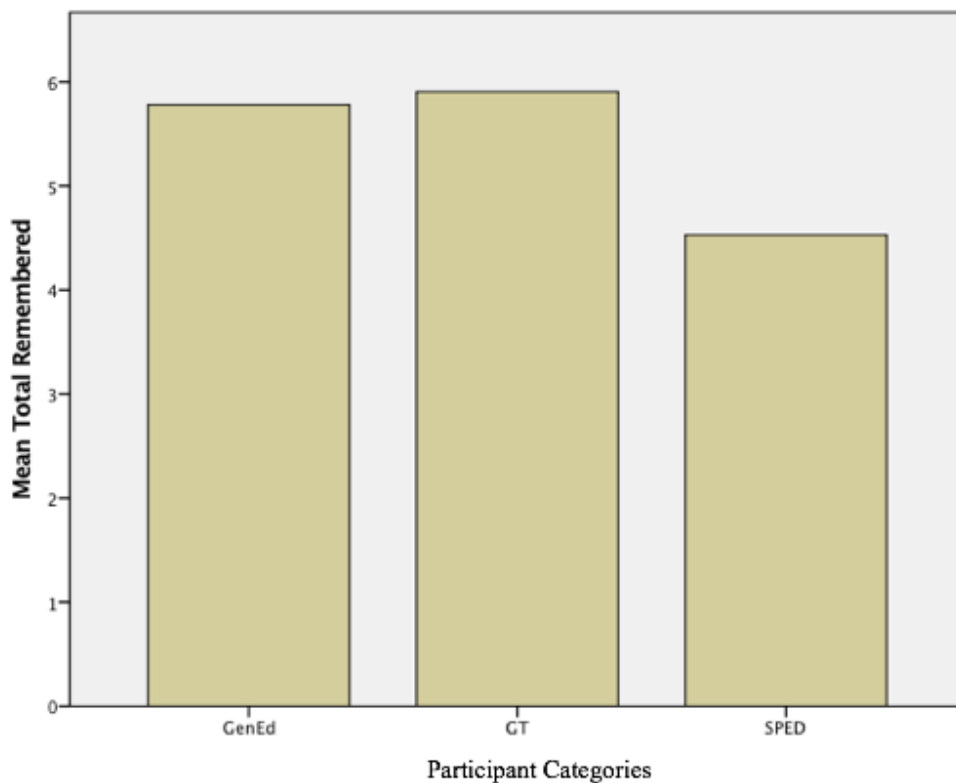
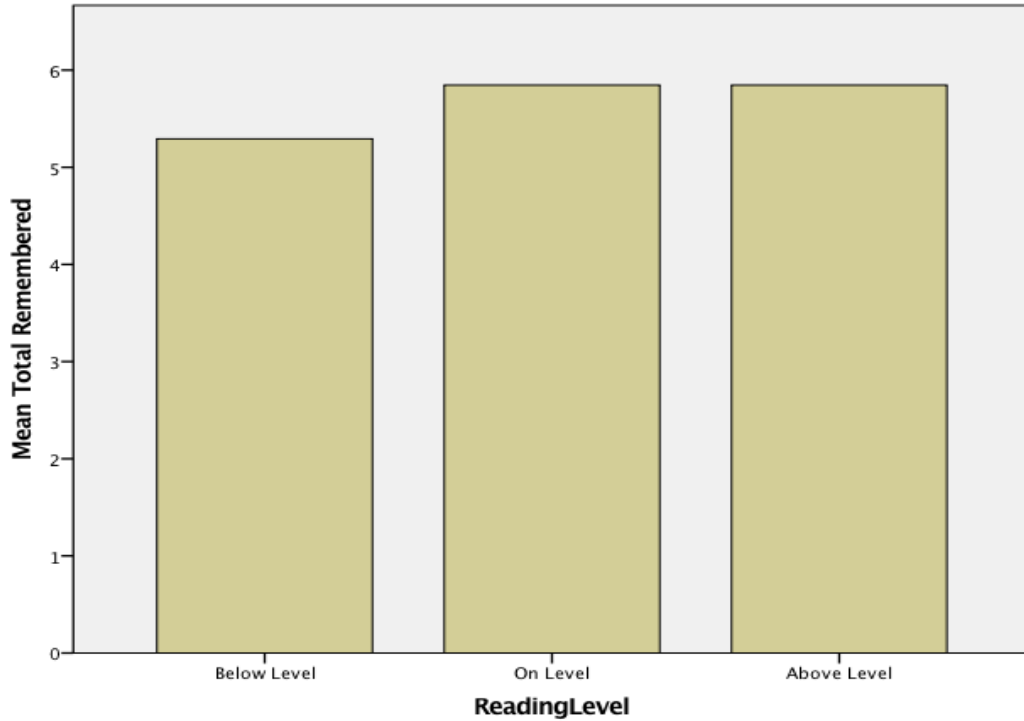


Figure 6. Mean Scores of Sample Population



Another finding supported in prior research is that students who are at or above grade level in reading level remembered more words than those who were below grade level in reading. Research completed by Swanson, Zheng, and Jerman (2009) showed that participants with reading problems have problems with STM due to lacking the ability of successfully engage the phonological and executive system. Reading difficulties can present in the form of written and oral language deficits, attention disorders, and information processing problems (Gargiulo, 2004 & Lerner, 2000 as mentioned in National Association of Special Education Teachers, n.d.). Students with reading comprehension deficits have common word recognition errors, which could add to the serial position effect results. These errors include word omission, word substitutions, transposition issues, hesitating at words that they cannot pronounce, and delayed word recognition. The hesitation and delayed recognition could create a time issue during the presentation of the slideshow (Garguilo, 2004).



*Figure 7.* Mean Scores of Specific Reading Levels

Students with a learning disability have difficulty with STM and WM memory, both academic and non-academic. Memory difficulties can also be inconsistent, making it challenging for teachers to identify when children need accommodations or who to may have a reading disability that should be referred for special education screening (Garuilo, 2004). Given that students with a learning disability have more difficulty with STM than LM, students with an unidentified learning disorder may not present a disability immediately (Deiner, 2013). Gifted students who have an unidentified disability may appear to perform at the same rate as their peers, having developed self- techniques (Van Tassel-Baska, 2012).

The Serial Position Effects show memory capacity for different groups of learners. The findings for the Serial Position Effects in this study indicate that students identified as intellectually gifted did not remember as many words in the primacy or recency areas. However, intellectually gifted participants had less loss in the primacy to mid area (17.65%) when compared to students who receive special education services and general education students but greater loss from mid to recency (10.4%).

Students who receive special education services had the greater amount of memory decay between the primacy and mid effect (29.2%) than other groups, but had a small percentage of change between mid and recency (3.75%). The decay in remembered items at the primacy to mid areas validates a need for accommodations to support the students receiving special education services to understand the beginning of the activity, especially from direct instruction, which usually takes place at the beginning of a lesson, to student practice.

Learners not included in a special population generally display an idealized serial position curve with more items remembered at the beginning and at the end of a word lists (Deese & Kaufman, 1957). General education students in this study remembered the most words in the primacy area (66.45%) when compared to the other participant categories and had the least amount of decay from mid to recency area (1.24%) but had only a 4.22% difference between general education students and students receiving special education services. This larger drop from primacy to mid also shows a need for general education students to have more support from the beginning of a lesson to the middle portion of the instructional plan

## Limitations and Implications on Future Research

Limitations of this study include the sample population was derived from two districts in a specific area of the southeastern portion of Mississippi. During the research, intellectually gifted students at one school involved were absent during the data collection due to a field trip. Students with ADHD were tested in a group setting, which may have had an effect on attention. Future research including a larger sample population could contain a more heterogeneous group of participants. Deficits in language abilities and recall are larger for boys in the same grade range as the sample population of this study. Specific problems occurred in self-regulatory processes and verbal processing (Douglas & Benezra, 1990). Research on intellectually gifted children and memory point to increased STM and WM. Future studies regarding the use of memory techniques and training that may be developed by intellectually gifted students could be included. Other future research topics could include the primacy and recency effects of both intellectually gifted and special education, STM difference between the four categories of giftedness (intellectually, academically, creatively, and artistically), and STM and serial position effects use in RTI identification and referrals for remediation.

The research procedure contained possible limitations. Some participants in the first test group wrote the placeholder slides containing "XXXX." Although some participants during the remaining data collection continued to write the "XXXX," the researcher added emphasis when delivering the oral directions for the data collection procedure to the participants.

Finally, for most student participants and their parents, this was the first time they were asked to be involved in research at this level. In the future, a "learning session"

could be created that is not included in the data that could alleviate any concerns and increase participant numbers.

### Summary

Quick student master of content is imperative in today's school environment due to accountability pressures. Although differentiation takes place, teachers may move at a pace that assumes the ability of the student to grasp the material. The students in this research project were identified as general education students, intellectually gifted, or special education and connected to data that represents the memory of these groups. Overall, there is not a large enough difference between the general education and intellectually gifted students for the data to support. However, the difference between students who receive special education services and general education and intellectually gifted education was large enough to report the findings. The mean scores did show there is a small increase in total remembered words for intellectually gifted students. When considering this information, this research contributes to knowledge about memory that is needed to help students in each group perform at their highest level. Including memory techniques as a part of the daily instruction could benefit the entire population of the classroom. One last consideration is that not only is it important for teachers to understand the impact of misunderstanding gifted learners, parents also benefit from knowing the true characteristics of intellectually gifted learners.

## APPENDIX A – IRB Approval Letter



### INSTITUTIONAL REVIEW BOARD

118 College Drive #5147 | Hattiesburg, MS 39406-0001

Phone: 601.266.5997 | Fax: 601.266.4377 | [www.usm.edu/research/institutional.review.board](http://www.usm.edu/research/institutional.review.board)

### NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: CH16102005

PROJECT TITLE: Working Memory and a Reduction of Auditory Distraction

PROJECT TYPE: Change to a Previously Approved Project

RESEARCHER(S): Gregory W. Smith and Angela Ellison

COLLEGE/DIVISION: College of Education and Psychology

DEPARTMENT: CISE

FUNDING AGENCY/SPONSOR: N/A

IRB COMMITTEE ACTION: Exempt Review Approval

PERIOD OF APPROVAL: 11/03/2016 to 11/02/2017

**Lawrence A. Hosman, Ph.D.**

**Institutional Review Board**

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