

COMPARISON OF THE LEARNING STYLES OF STUDENTS WITH AUTISM
VERSUS TYPICAL ELEMENTARY-SCHOOL STUDENTS

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Developing successful educational opportunities for students with autism has long been a challenge for educators. Although medical research is making great strides in the treatment and etiology of autism, as more and more students with autism are learning alongside their peers in the general education classroom the struggle to find effective teaching methods increases. This challenge may well be due to the fact that students with autism have unusual intellectual and academic skills profiles making it difficult for teachers to accurately assess students and align curriculum. Educators must develop proficiency in carefully evaluating profiles of ability for children with autism as their unique strengths and weaknesses may not always be supported within the general education classroom. Once teachers have a rich understanding of how their students learn best, instructional plans can be developed which allow for their unique preferences.

All learners have a preferred learning style. Educators must become more proficient in assessing learning styles as they strive to differentiate instruction based on their students' needs. This paradigm neither classifies learners based on ability nor disabilities but, rather, on their individual preferences and therefore bodes well for students with unique skill sets such as those seen in students with autism.

Based on the knowledge that individual instructional preferences exist and can be measured reliably, this study examined whether or not the presence of autism influences those preferences. A sample of 52 students whose academic performance is at an

elementary level and who have a diagnosis of Autism Spectrum Disorder (ASD) self reported their preferred learning styles using the Elementary Learning Style Assessment (ELSA). Results were analyzed and compared with ELSA scores of typical students to determine differences or similarities in the preferred learning styles of the two groups.

The data analyzed in this study revealed that students with autism have commonalities in learning-style preferences. Twenty four elements had significance at the .025 level in how they preferred to learn. Additionally, this study examined the commonalities or differences in students with autism and their typical peers. In four of the 25 learning-style elements, students with autism's learning-style preferences differed significantly from their typical peers. Findings are presented and discussed in Chapters 4 and 5.

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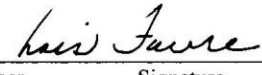
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Doctor of Education Dissertation

COMPARISON OF THE LEARNING STYLES OF STUDENTS WITH AUTISM
VERSUS TYPICAL ELEMENTARY-SCHOOL STUDENTS

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Finally, I owe who I am in large part to my family and friends. Always encouraging and so obviously proud of my accomplishments, they have taught me the power of learning and teaching. I love them for their selfless support of my efforts and for being who they are and sharing that with me.

DEDICATION

This research is dedicated to the children I teach. They have taught me to respect them for who they are and to always strive to work harder on their behalf. I especially feel inspired and humbled by children with autism. Their unique world views and honest perspectives allow them to see beyond casual social niceties and they have changed my life in many ways. If this body of work can help them to be more successful in their efforts to learn and grow, then my efforts are meaningful.

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CHAPTER ONE: INTRODUCTION AND IDENTIFICATION OF THE TOPIC

The Center for Disease Control estimates that the incidence of autism may exceed 1 in 110 people in the United States, and is the second most common, serious developmental disability after mental retardation (Center for Disease Control, 2010). Changes in diagnostic criteria and an increasing awareness of the expressions of autism may partially account for this increase. The Autism Summit Conference (United States Department of Health and Human Services & the United States Department of Education, 2003) declared autism a national epidemic causing a fiscal crisis which exceeds \$60-90 billion per year with a projection of \$34 billion in additional costs in future years. The conference identified research and education as the two critical areas of investigation.

Autism is a conglomerate of symptoms appearing along a continuum that can be present in areas such as communication, social relatedness, sensory integration, stereotypy, and narrow overly focused interests. This broad palette of strengths and weaknesses melds to form a unique profile. Autism's pervasive and encompassing impact on social, emotional, and academic development continues to challenge parents and professionals alike in their quest for effective treatment methods (Cohen & Volkmar, 1997).

The Combating Autism Act of 2006 mandated the reestablishment of the Interagency Autism Coordinating Committee (IACC) that includes representation from such agencies as the Center for Disease Control, Office of Disabilities, and Department of Education, as well as parent and individual advocates. The task set before the IACC is to develop a strategic plan with a vision toward focus, coordination, and acceleration of high-quality research and scientific discovery in partnership with stakeholders to answer

urgent questions and needs of individuals with Autism Spectrum Disorder and their families (Insel, 2009). The inclusion of the Department of Education in this mandate is not a casual nod, as responsible and effective education for students with autism has long been a challenge for educators.

In discussions relative to how people learn, Cronbach (1957) stated that, as early as 1900, researchers such as Thorndike and Woodworth facilitated a mind-set shift from measuring the average mind to measuring the effect of environmental change upon success with a task (Hall, 2003). This consideration of environment, although maverick at the turn of the century, has long been a tool in aiding teachers in the creation of effective classrooms (Anderson, 1996). In creating classroom where students with autism learn alongside typical peers, teachers require tools to carefully consider the comprehensive profile that defines the learning style of students with this disorder.

As recently as 1997, doctors admitted to insufficient knowledge about how children with autism view their world and suggested the need for more studies to understand the multidimensional challenges of school-aged children with autism in the hope that such studies would drive better decision making (Cohen & Volkmar, 1997). Wolery (2000) encouraged the treatment community to develop specific teaching strategies that include an understanding of just how various elements of the environment influence learning and performance in students with autism.

Rationale for this Study

As schools become more inclusive, teachers need to search for new ways to deliver instruction that will facilitate meaningful learning for all students. A classroom is a micro-society designed to facilitate learning in a routine manner while simultaneously

attempting to maintain order and meet curriculum benchmarks as well as the social and emotional needs of each and every child. The needs of a child with autism are sometimes so diverse and individual that they can be difficult to recognize and meet in this group setting. Inclusion can be extremely difficult if educators responsible for overseeing the process for a child diagnosed with autism are not properly apprised of their students' specific learning preferences (Friedlander, 2008).

As students diagnosed with autism come to school with a unique matrix of strengths and weaknesses, it is important for educators to fully understand how these students perceive, integrate, and understand information. While educators can be bombarded with methods and materials, little evidence exists on just how successfully they meet students' needs. This often struggling population must receive instruction, which includes researched-based practices that support every level of need (Lembke & Stormont, 2005). The assessment of this subset of students' preferred learning styles will improve teacher understanding of learning preferences and enable them to plan instruction and environments accordingly, thus helping educators to facilitate increased achievement.

Related Literature to Support Rationale

Understanding the differences in the way students learn is crucial to their success in school. Young student's early school experiences have a profound impact on their view of school and their perception of themselves as learners (Tomlinson & Eidson, 2003). Elementary-level teachers must gain a rich understanding of their students in order to present materials in such a way as to promote student engagement and foster a love of learning. Students who have autism spectrum disorder present additional

challenges for elementary classroom teachers. The complex nature of their diagnosis and wide breadth of possible symptoms make autism spectrum disorder impossible to address with a one-size-fits-all approach (Harris & Handleman, 1997). A reliable and valid tool for determining learning-style preferences and the perspectives gained from this screening might develop more formidable and appropriate instruction for this special-needs sub-set.

Many teachers often feel overwhelmed by the variables in their classrooms (Peck, 1995). An inclusive classroom certainly could consist of students from different ethnic, socio-economic, racial, medical, and cognitive profiles. The specific challenges of including students with autism in a classroom can be difficult to meet. Teachers have an awareness of the importance of investigating student's learning styles and developing strategies based on these preferences. It has been well documented that instruction based on learning-style preferences raises achievement and improves both attitudes and behaviors (Dunn & DeBello, 1999).

The knowledge and understanding of each student's preferred learning style is a valuable resource that no teacher should be without, especially when they are designing instruction for these particularly complex and often at-risk students. Studies have supported the existence of some common learning-style characteristics among students with common diagnoses. Grebb (1999) studied students diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) and found a significant difference ($p < .001$) among clusters of preferences for children with ADHD that do not necessarily align with the preferences of typical students or with teachers' preconceived notions of the issues present within the disorder .

For example, students with ADHD expressed being significantly more motivated by parental encouragement than did students in the general population. Interestingly, students with ADHD did not show a significant difference in elements typically associated with ADHD such as the need to move more than typical students or having access to preferential seating (Brand, Dunn, & Greb, 2002). Educators need to examine the learning styles of all students, especially students who require special attention and who are likely to fail when taught traditionally. We should not lose sight of each child's individuality regardless of diagnosis and should strive to find the best methods of instruction for each.

Researchers who have studied the effect of teaching on individual learning styles of students who were diagnosed with learning disabilities have determined that when instruction matched individual learning-style preferences, student achievement was significantly better. Most special education students are global processors with tactual- and kinesthetic-perceptual strengths and most teachers teach analytically by either talking, which requires auditory skills for learning, or by having their students read, which requires visual-print skills (Dunn & Dunn 2008; Garger 1990; Kyriacou & Dunn, 1994).

After a period of only one year, data collected in a study conducted in Buffalo, New York, evidenced, that high-school students qualifying for special education who then were taught using learning-styles based instruction, subsequently achieved significantly higher test scores than their counterparts who had received traditional special education intervention. After two years, many of these students in the learning-

style experimental group showed achievement almost on par with their non-classified peers (Brunner & Majewski, 1990; Dunn & DeBello, 1999).

When educators understand that students have individual needs and preferred learning styles they can create learning environments that ensure maximum success. The Good High Schools Project (Brigham, Morocco, Clay, & Zigmond, 2006) was created to study school-wide practices employed at the high school level in making a conscious effort to create inclusive environments for all students. These schools designed educational opportunities within a common view of engaging the whole school in the education of those students with disabilities within the context of educating all students. Course work was created or modified with an eye toward connecting and motivating students through innovative structure, planning, and choice. The consideration of student's preferred learning styles lead to creating better choice opportunities. By establishing an atmosphere of uniqueness for all students, these schools were able to successfully address the needs of their special needs population while providing more targeted learning opportunities for all students.

Statement of the Problem

The recent shift toward more inclusive schools has general educators scurrying to understand just how the educational environments they provide for students can meet the needs of their pupils with autism (Mastergeorge, 2007). A teacher who is trained in a wide variety of approaches will have a greater knowledge base from which to make difficult program decisions and will offer better support to the child as well as the educational team (Scheuermann, Webber, Boutot, & Goodwin, 2003). A wide continuum of program options should be available to provide clarification concerning what is needed

to answer the many questions regarding integrated education. Considerations in programming should include variables such as cognitive abilities, behavioral and sensory issues, and social awareness (Harris & Handleman, 1997). The learning styles of students with autism generally have been described by the medical community; however, researchers previously have not investigated a comprehensive self-assessment model as it may relate to this particular diagnosis.

Educational interventions for students with autism are usually highly specialized and are delivered by a team of professionals who address the students' social, behavioral, developmental, and academic needs (Autism Speaks, 2008). These interventions tend to be based on research about the characteristics of autism and what we know as experienced educators about the individual child. However, at present, there are no studies that specifically pair this knowledge base with the knowledge of students' preferred learning style. There is a possibility that we are imposing limitations on the potential of students who have a diagnosis of autism spectrum disorder by making the assumption that they all learn in the same way. The learning-style researchers have found that students who are considered to be high-risk have benefited significantly from instruction that was matched to their particular style of learning (Dunn, Beaudry, & Klavas 1989; Dunn & De Bello, 1999; Dunn, Dening, & Lovelace, 2001; Dunn & Dunn, 2008; Dunn & Griggs, 2007; Kyriacou & Dunn, 1994). While not focusing specifically on students with autism, several existing studies show that the use of instructional strategies that considered the learning styles of both typical students and those with special needs improved school achievement as well as school behaviors (Brand, Dunn, & Greb, 2002; Dunn, 1983; Fine, 2003; Lovelace, 2005). As educators continue to search

for more effective teaching strategies for students with autism to address their academic, social, and behavioral achievements, a consideration of students' preferred learning styles is essential.

Benefits of This Research

The purpose of this study was to describe the learning styles of students with autism and to determine if evidence existed that these students have significantly different learning-style profiles than typical students. The understanding of these learning preferences might enable teachers to develop richer programs for students who are diagnosed with autism and to employ instructional methods that best meet these pupils' needs. More positive outcomes have been seen in students who know they have autism and who understand what that means (Freeman, 1997). Students with autism should feel increasingly more comfortable in their general education classrooms when their emotional, sociological, psychological, physiological, and environmental needs are met. That, in turn, could lead to better school experiences.

To date researchers have not specifically investigated the learning styles of students with autism. The results of this study offer valuable insight into the learning styles of these students. This knowledge enables teachers to create classrooms which are welcoming and enriching. With more data to support student learning preferences the inclusion process can be specifically tailored to meet student needs and support success in the classroom when used for instructional planning and teacher training.

Definition of Key Terms

The following terms are relevant to this research:

1. *Learning Style* is defined as the way in which students begin to concentrate on, process, internalize, and remember new and difficult academic information (Dunn & Dunn 1992).
2. *Autism (Autism Spectrum Disorder) (ASD)* is defined by its medical diagnosis according to the DSM IV. This diagnosis is complex and outside the realm of this investigation. However, a brief overview of the criteria used in diagnosis might prove helpful. For a diagnosis of autism, six criteria must be present, including criteria relating to social abnormalities, impaired communication, and range of interests and activities. The *splinter skills* apparent in children with autism make traditional cognitive assessments difficult to administer, sometimes resulting in an unusually-wide range in sub-test scores (Volkmar, Klin, & Cohen, 1997).
3. *Elementary Learning Styles Assessment (ELSA)* is an on-line self-reporting assessment that asks a series of questions to identify each student's learning preferences. It examines preferences in 25 areas such as lighting, temperature, noise level, peer interaction, and teacher or self directed learning (Dunn, Rundle, & Burke, 2007).
4. *General Education Classroom* is defined as one taught by a teacher qualified to serve nondisabled students (*Regulations of the Commissioner of Education, Part 200*).
5. *Typical Peers* are non-disabled classmates who make up general education classrooms (*Regulations of the Commissioner of Education, Part 200*).
6. *Sensory Integration* is defined as the ability to organize sensory information for use. This ability can be either mildly to significantly heightened or mildly to

significantly impaired requiring careful consideration for successful inclusion in the classroom setting (Ayers, 1979; Grandin, 1995).

Methodology

This research investigated the learning-style preferences of 52 students with autism and 60 typical students. Students with autism were recommended by their teachers to participate in this research and the data from scores of typical students were taken from a national database. Students completed an online test which is a valid and reliable assessment of a student's preferred learning style. Upon completion of the test student data were assessed by two statistical analyses, either the Chi-square Goodness of Fit test or a Chi-square Crosstabulation. Data were then analyzed to determine level of significant differences in expected frequencies for students with autism (Chi-square Goodness of Fit Test) and expected frequencies in both students with autism and typical elementary level students (Chi-square Crosstabulations). Results, implications and further research are discussed in Chapters 4 and 5.

Research Questions and Hypotheses

This research investigated the relationships between autism and learning style by addressing the following questions:

Research question one. Are there common learning-style preferences among students who are diagnosed with autism?

Non-directional hypothesis. There are common learning-style preferences among students diagnosed with autism.

Research question two. Are there differences between the preferred learning styles of students with autism and typical students?

Non-directional hypothesis. There are significant differences between the learning-style preferences of students with autism and the learning-styles preferences of their typical peers.

Subjects

The participants in this study attended a non-sectarian day school for children aged 3-16 who have developmental disabilities. It is located in the suburbs of a major United States city and admits children without regard to race, religion, nationality, or handicap who exhibit the following characteristics: autistic spectrum disorder, PDD NOS (Pervasive Developmental Disorder, not otherwise specified), schizophrenia, Asperger's syndrome, delayed and/or inappropriate speech and language development, perceptual difficulties not related to specific sensory deficits, delayed motor development, inappropriate affect, and association disorders. All students lived at home and commuted to school from several school districts in two neighboring northeast states. Tuition and transportation fees were paid by sending districts who had determined they have no appropriate placement for these students, but must underwrite the opportunity for a free and appropriate education as per special education law.

The 52 participants in this study were a sample of convenience that suited the purposes of this study and were chosen from the approximately 160 students who attended the school. Some considerations for inclusion in this study were the ability to independently use a computer, reading ability, understanding of directions, and capacity to attend to task. Insight into level of student ability was gained from discussions with staff. All students whose parents granted permission for participation in the study were tested.

The learning-style preferences of this group were compared to the learning-style preferences of 52 students randomly chosen from a national data base of elementary school students who do not have a known diagnosis of autism. These students made up general elementary classrooms and are considered typical peers. The comparison group consisted of students from similar academic levels, socioeconomic status, gender, and diverse cultural composition.

Instrumentation

Elementary student's preferred learning styles were assessed using the Elementary Learning Style Assessment (ELSA) (Dunn, Rundle, & Burke, 2007). This is a comprehensive diagnostic instrument that considers at least 20 different variables in each individual's environment, emotional, sociological, physiological, and cognitive processing traits. Students were tested individually on a computer. They were given a choice of reading one of two stories, one with a pirate theme or one with a clown theme. After reading a passage of the story students were asked to answer 25 multiple-choice questions, including representative picture images that measure the patterns through which learning occurs. Questions were developed at the 2.0 Flesh-Kincaid Grade Level for reading. Each question was presented three times throughout the evaluation to assure response consistency. Then results were used to create a one-page computerized, graphic summary of each student's learning-style preference as well as a full narrative report suggesting approaches for capitalizing on identified strengths (see Appendix A).

Description of Research Design

This research is an investigation that measured the characteristics of a sample on prespecified variables and compared the findings among autistic children with their typical counterparts. There was no experimentation or manipulation of subjects; merely an investigation of an existing phenomenon. The sample consisted of students with autism spectrum disorder and the pre-specified variables were the 25 learning-style variables identified by the ELSA. Responses of students with autism were compared to the responses of typical elementary-school students who have not evidenced a known diagnosis of autism. To answer Research Question One, a Chi-square Goodness of Fit test was used to examine differences in categorical data (learning-style preferences) for students with autism. A Chi-square test is an appropriate nonparametric statistical test to determine if significant differences exist beyond the .05 level between observed and expected frequencies (Hinkle, Wiersma, & Jurs, 2003). To address Research Question Two a Chi-square Crosstabulation examined each of the 25 learning-style variables for each of the two groups, students with autism and typical students.

Data Collection Procedures and Timeline

The sample of 52 students diagnosed with autism spectrum disorder participated in their current specialized school instruction during the school year 2008-2009. An informational meeting was held for teachers and school staff in early spring 2009 to explain learning styles and the proposed study. Copies of a sample of the Elementary Learning Styles Assessment Student Report as well as a graphic interpretation of the Dunn and Dunn learning-style model were explained and given to the staff. Telephone contact numbers and an e-mail address were supplied to the teachers in case they wanted

further information. Letters requesting parent consent and explaining this study were sent to parents in March 2009, along with a cover letter written by the school director encouraging parental support. A follow-up staff meeting was conducted after approximately one half of the students had been tested to keep staff informed of the testing progress. A total of 52 students were individually given the ELSA using a school computer connected to the internet on five different occasions between April and June 2009.

The Statistical Package for the Social Sciences (SPSS, Inc. 2006) was utilized to analyze test data. The results were used to respond to research questions one and two.

Conclusion

This study focused on the need for investigation into the learning-style preferences of students with autism. Data obtained from this study might enable teachers to gain a better understanding of these students and in turn use this understanding to create more comfortable and successful learning environments for their students. Chapter Two will contain a review of the literature relevant to learning theory, an overview of the diagnosis of autism, a review of research studies on various instruction methods for students with autism, a discussion of learning style theory, and a review of research studies on the learning styles of the special needs population.

CHAPTER TWO: REVIEW OF THE LITERATURE

This research examined the similarities and differences in the learning styles of students diagnosed with autism spectrum disorder. Although a wealth of information has been published about this population, there is no evidence of research done specifically on the learning-style preferences of elementary level students who have been diagnosed with autism. In order to synthesize this information a review of related literature will be presented under the following headings: (a) theoretical background relevant to learning theory; (b) the diagnosis, treatment, and overview of instructional strategies for students with autism spectrum disorder; and (c) review of the research of students' learning-style preferences. This review will inform and validate this study.

Theoretical Background

Behaviorism Theory

The influential psychologist, B.F. Skinner, theorized that psychiatry is the study of behavior and behavior is the function of genetic endowment and environment (Skinner, 1974). Changes in behavior are a direct result of an individual's response to stimuli in their environment. In his writing, *Beyond Freedom and Dignity* (1971), Skinner proposes we appreciate the vast influence our surroundings have on us and understand that we are its products. He explains that everyday stimuli and rewards have created who we are and that we have learned to *be* based on them. The intertwining of our inner selves and our reaction to our environment helps in the prediction and control of human behavior and its interpretation of daily life.

Skinner was very concerned with how individuals come to know themselves. He suggested that being aware of certain feelings gives us a special kind of readiness to act

upon stimuli. This knowledge is readily available as we grow and learn as the past provides us with a large fund of knowledge about our previous reactions to similar stimuli. This aspect of Skinner's theory serves as a foundation for this investigation into learning styles. It helps to underscore the importance of student knowledge of and their ability to define their preferred learning styles. Aligned is the use of operant conditioning used in the teaching of students with autism when employing the Applied Behavior Analysis approach. Skinner's construct plays a key role in understanding how learning occurs when using these methods.

Operant conditioning is based on reinforcement. If behavior is followed by a consequence and the nature of the consequence modifies the tendency to repeat the behavior in the future, then one has been conditioned and learning has occurred. Reinforcement can be anything which strengthens the chance that desired behavior will reoccur. Conversely, Skinner demonstrated that a behavior no longer followed by reinforcement decreases the probability that that behavior will occur in the future. In teaching more complex sets of behavior, Skinner employed *shaping* which is a method of reinforcing successive approximations (Skinner, 1953). This gradual coming to points of learning using rewards along the way can be seen as analogous to scaffolded or tiered teaching.

A widely respected instructional intervention used for students with autism and discussed later in this chapter is Applied Behavior Analysis. Educators using this intervention model employ the basic assumptions of Skinner's view. Therapists decide what they want the student to learn, provide reinforcement based on student preference and reward evidence of desired behaviors. Preferred rewards are chosen upon careful

analysis and consideration of student preferences. A behavioral analysis acknowledges the importance of physiological research. How a student behaves is directly related to who he is at the moment he behaves, as a result of the accumulation of experiences gathered from previous exposures to his environment (Skinner, 1974). A student's, as well as his teacher's, awareness of the effects of the many aspects of his environment help to create the positive canvas for learning.

Developmental and Social Learning Theory

Vygotsky developed theories of learning which focus on the social aspects of learning communities. He saw the complex task of learning as an unevenness in the development of different functions; the intertwining of external as well as internal influences and adaptive processes. It is the duty of the educator to determine or reveal this internal or subterranean developmental network. Drawing on the experiences from interactions with others, preferably more capable and learned others, and relating them through one's own store of knowledge enables learning (Vygotsky, 1986). The recent drive for inclusive education models designed for children with autism are built upon this very premise of learning from more capable peers. Difficulties with social interaction, judgment and connection impact every facet of school life and can be difficult for adults to teach to children (Volkmar, Klin, & Cohen, 1997).

Vygotsky points out that two children can be developmentally aligned and yet the subsequent course of their learning can be different. Based on standardized evaluation of their developmental level one cannot make the assumption that they have had the same experiences or perceptions that caused them to come to that level (Vygotsky, 1978).

Learning-style theorists believe the key to effective learning is based upon the perception

piece and are interested in knowing which path is preferred by the learner, pinpointing how information was learned rather than what information was learned. An investigation into the development of the internal relationship between the intellectual process awakened by learning and the environment of space and experience lead educators to a deeper understanding of student learning (Dunn & Dunn, 1992).

Vygotsky describes his developmental approach to psychology as built upon three concepts: higher mental functions, cultural development, and mastering one's own behavior. He likened this development to the structure of the earth's core, layered upon itself with each layer remaining intact while the next emerges. He further enriches this analogy by acknowledging that the composition of each layer is dependent upon experience and environment, as within the earth's layers lay the remains of eras past. This cumulative pattern of development further supports the importance of learning style awareness in that it allows for differences in the composition of development (Vygotsky, 1986). A visual learner has created their unique layers via what they see, an auditory learner's world is dependent on what they hear. These unique perspectives have an acute bearing on the depth and breadth of ones knowledge.

Vygotsky is widely known for defining the *zone of proximal development*. He explains this as the distance between one's actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978). His acknowledgement of the many factors which come together in the creation of this zone underscore the importance of authentic investigation into learning style preferences. Understanding this distance furnishes educators with a lens

through which the internal course of development and learning can be viewed and understood.

Overview of Autism Spectrum Disorder

Introduction to Autism. Learning is dependent upon the organization of information in such a way as to be meaningful and useful to the learner's thinking. Students of all ability levels must learn how to learn (Bruner, 1960). Learning is not reserved for only the best student under pre-prescribed conditions, but is dependent upon helping all students achieve their optimum intellectual potential.

Leo Kanner (1943) posed a clinical description of "autistic disturbances of affective contact". His work was based on the theory of Gessell who demonstrated that normally developing young children exhibit a marked interest in social interaction. Kanner observed a group of children who were lacking this developmental marker of internalizing the social world and using it to build a self. In an attempt to create a universal and explicit definition of autism, Rutter (1978) suggested autism as a diagnostic term used to describe a complex group of features which includes four essential features:

- Onset by age 2 ½;
- Impaired and distinctive social development;
- Impaired and distinctive communication; and
- Unusual behaviors which might include resistance to change, idiosyncratic responses to the environment, stereotypies, etc.

Edward Ritvo (1978) in his work for the National Society for Autistic Children elaborated on this definition by including the following concepts: (a) rates and sequence of development; (b) responses to sensory stimulus; (c) speech, language cognition, and

non-verbal communication; and (d) capacity to relate appropriately to people, events, and objects.

These definitions helped to frame the definition of autism which appeared in the DSM-III, third edition, 1980 (Volkmar, Klin, & Cohen, 1997). As their understanding deepened, researchers, using their clinical experiences and observations, identified subcategories within these definitions. The development of these subcategories is recognition of the spectrum nature of this disorder and can be distinguished by categories such as: age of onset, etiology, level of ability, and current clinical picture (Wing, 1997). Included in these subcategories are Asperger's Syndrome, Autism Spectrum Disorder (ASD), Pervasive Developmental Disorder (PDD) and Pervasive Developmental Disorder- Not Otherwise Specified (PDD-NOS).

Assessment of Students with Autism. Assessment in autism comes with many complexities and challenges as the diagnosis covers a broad range of developmental abilities which span the entire IQ spectrum as well as varying degrees of symptom severity, communication skills, and self-sufficiency (Volkmar, 1996). Careful consideration must be given to the strengths and limitations of students with autism in an effort to choose appropriate and reliable assessments.

The nature and level of intelligence of students diagnosed with autism is somewhat of an enigma. Standard IQ tests such as the Wechsler Intelligence Scale for Children have long been the gold standard for determining both level of intelligence in children as well as the nature of their specific strengths and weaknesses. Dawson, Soulieres, Gersbacher, and Mottron (2007) carefully considered the items on this test in relation to the particular known strengths and weaknesses of 38 children between the

ages of 7 and 16 diagnosed with autism, and 24 typical children who did not have a diagnosis of autism. They found that several test items ask the examinee to rely heavily upon social and practical understanding such as, “What is the thing to do if you find an envelope in the street that is sealed, addressed and has a new stamp on it?” This type of question measures crystallized intelligence, or what you have learned. Oral answers were then scored by the examiner for their quality. They found the students with autism to score in the 26th percentile for Full Scale IQ which placed them in the range of low average intelligence.

In contrast, these students were also administered the Raven’s Progressive Matrices which is a test comprised of 60 items divided into 5 sets of increasing difficulty. The items are a matrix of geometrical designs with one cell of the matrix left blank, presented with six or eight alternatives for the matrix’s completion. There is minimal verbal direction or personal interaction in this test. The Raven’s Progressive Matrices is a test of reasoning and problem solving which require examinees to perform fluid-intelligence tasks or tasks which measure the ability to learn and to process information. Students with autism scored at the 56th percentile on the Raven’s Progressive Matrices Test. In addition, one third of the students with autism scored above the 90th percentile on the Raven’s, while no one with autism scored in the “High Intelligence” range on the Wechsler Intelligence Scale. The researchers also compared a similar group of typical children and they did not share the discrepancy in test scores. They concluded that the intelligence of students with autism may be underestimated and that they tend to show real strengths and weaknesses in functioning. This study further highlights the unique nature of intelligence and performance in students with autism (Dawson, et.al, 2007).

Students whose diagnosis falls with the autism spectrum are unique thinkers and learners regardless of their specific diagnosis. Research in autism supports a multidimensional profile; however, students so diagnosed are often assigned to diagnostic categories to facilitate ease of programming and services. The variability of subtypes in this particular condition can differ in many domains such as etiology, clinical presentation, and cognitive, social, and language development (Loveland & Tunali-Kotoski, 1997).

Klin, Volkmar and Sparrow (1992), using adaptive behavior scales to study social behavior in 29 young developmentally disabled children matched for chronological age, mental age, and IQ with 29 young children with autism, showed that students with autism have less developed social and interpersonal skills. School, a highly social structure, often proves to be difficult for children with autism. In the early years, play tends to be parallel rather than interactive with students generally choosing inanimate objects over interactive play with peers. School-aged children with autism usually have difficulties in large social settings such as the lunch room and can be found walking alone on the perimeters of playgrounds as they have little understanding of the subtle social rules of recess games. School programs often include social skills training. The quality and type of this training is critical to progress. Opportunities for social interaction do not guarantee useful social skills development experiences unless the child's individual needs are specifically being addressed (Geller, 2009).

Communication deficits in autism can be characterized by limited use of joint attention, unusual intonations and voice qualities (prosody), linguistic functions (pragmatics), question seeking, commenting, informing, and expressive gestures (Tager-

Flusberg, 1997). A highly verbal classroom filled with children's chatter and teacher directions can be overwhelming for the student with autism who may have language processing difficulties. An in-depth analysis of strengths and weaknesses in the above areas could aid educators in developing individualized experiences that encourage achievement.

Assessment is a fundamental component in the planning and programming for students with autism. Their complex learning profile and the fact that no one approach or intervention has been conclusively proven to be more effective than another make it essential for teachers to study each student's unique learning pattern (Tsatsanis, 2004). Treatment approaches will prove more successful when core strengths and weaknesses are identified and instruction and material reflect that knowledge. Learning about the learner from the learner is a strategy instructional teams can use to understand how some students with autism view their world. This knowledge will enable teachers to engineer safe and comfortable classrooms for these students with unique learning characteristics (Kluth, 2003).

O'Riordan and Passetti (2006) studied a phenomenon they call a disturbed processing of incoming stimuli in autism. Their study included two groups of 12 children each with a mean age of 8.7 years. The participants in the first group had a diagnosis of high functioning autism, the second group were typically developing children with no known diagnosis of autism. The groups were pairwise matched using chronological age and cognitive ability as measured by the Raven's Standard Progressive Matrices. Subjects participated in two experiments, one where they received auditory stimulus presented through headphones and they were asked to discriminate tone, the second

where they were presented with four different grades of wet or dry sandpaper and were asked to detect differences in texture. Two comparable groups participated in a third experiment each consisting of 13 subjects with a mean chronological age of 10 years. This experiment presented participants with eight different stimulant presentations of pressure being applied to their forearms. Results of the first (auditory) experiment showed that children with autism are superior to matched controls at discriminating between auditory stimuli. The second experiment (tactile) showed no significant difference between the individuals with autism and without autism in the ability to discriminate between tactile stimuli. The third experiment (degree of tactile pressure awareness) showed no significant difference between the two groups in the detection of the various degrees of tactile pressure exerted.

Their research suggests that although it tends to be a widely held belief that there is an enhanced visual discrimination among students with autism, this acuity also may extend to other sensory modalities, such as the processing of auditory information and allows for discussion which deviates from the traditional belief that students with autism tend to be visual learners. This trend did not always extend to the tactile modality. Although indicating an emphasis on the use of visually cued instruction, Quill (1997) noted the importance of identifying the precise abilities of and learning potential for each child with autism as their diverse abilities were noted.

A diagnosis of autism usually places increased demands on both teachers and learners. A team approach where each member brings their unique perspective and deep knowledge of autism and where careful consideration is given to each student on an

individualized level provides students with a program that maximizes team effectiveness and increases student achievement (Autism Speaks, 2008).

Treatment Approaches for Students with Autism

There are many treatment approaches proposed for students with autism. The only programs that continue to promote student growth and achievement are those which are structured and geared to the student's developmental level of functioning and are determined by individual and ongoing assessments (Freeman, 1997). In making an effort to determine best practices for students with autism the National Research Council Committee on Educational Intervention for Children with Autism (2001) advised that individualized supports and services should focus on the child's strengths and weaknesses to determine the most appropriate intensity and level of instruction needed to best meet the child's individual goals. Additionally, the deliberate design of educational environments and the incorporation of preferred methods and materials will capitalize on student interests, increasing engagement in the learning process (Hurth et al. 1999).

After reviewing 22 evidence-based comprehensive treatment studies for children with autism ranging in age from 18 to 72 months conducted between 1998 and 2005, Rogers and Vismara (2008) further posed that "it is clear that the field is still very early in the process of determining (a) what kinds of interventions are most efficacious in early autism, (b) what variables moderate and mediate treatment gains and improve outcomes following intervention, and (c) the degree of both short-term and long-term improvements that can reasonably be expected" (p. 8).

In a metaanalysis of research examining theoretical approaches to curriculum development for students with autism, Olley (1999) points out that developing a clear

understanding of cognition among students with autism remains a mystery for professionals in many domains. While there are several approaches to program development with varying emphasis on specific curricular elements, no single curriculum has emerged as significantly successful for teaching children with autism, nor have many of these approaches undergone strident empirical evaluation. A curriculum that does exist is generally composed of methods for teaching individualized skills in well-controlled environments.

It can be hypothesized that the very nature of autism and the diversity of abilities and deficits make curriculum decisions across the spectrum difficult to address while simultaneously underscoring the need for a better understanding than we currently have for the assessment of learning style among students with autism. Teaching to the learning style of a student with autism can make an impact on how well he attends to and processes information. It is important for educators to assess and understand the learning styles of students with autism early on in their school career in order to adequately create a classroom environment that will afford the greatest student success (Edelson, 2007). A focus on specialized knowledge and reflective teaching is essential, especially for students with autism (Jordan & Powell, 1995). Teacher training programs must provide teachers who are involved with teaching students with autism a “tool box” full of many best practices in areas such as knowledge of the disorder, parent involvement, theoretical underpinnings of instructional approaches, adaptive behaviors and transitions, competencies in areas of language and communication, behavior, and environmental awareness (Scheurermann, Webber, Boutot, & Goodwin, 2003).

The diversity of the symptoms that make up this spectrum disorder is considerable, there being no *one-size-fits-all* profile of a student with autism (Loveland & Tunali-Kotoski, 1997). Furthermore, researching, planning and creating the most effective program for each child can become a Herculean task. There are many approaches to determining the most effective interventions for students with autism. Since a diagnosis of autism influences various domains, the input of all professionals is sought. This team-based endeavor considers the evidence base for intervention (the why), the legal mandates by which service is determined (the what) and the capacity of the staff and other team members to implement the intervention with fidelity (the how) (Tincani, 2007).

Service-delivery teams must have in-depth knowledge of the wide range of educational practices available and make program decisions based on the unique needs of each individual student. Although some schools have adopted one particular approach over another it is widely agreed that there is no one-size-fits-all approach to teaching students who have autism but rather programs must be judged on their ability to serve the personal needs of their students while capitalizing on their strengths and weaknesses (Autism Speaks, 2002; Freeman, 1997; Iovannone, Dunlap, Huber, & Kincaid, 2003; Mastergeorge, 2007; National Research Council, 2001; Wolery, 2000).

Instructional Strategies for Students with Autism

As a field we need to investigate further strategies and examine data that guide us in choosing specific interventions for specific students (Iovannone et al., 2003). Regardless of the many paths investigated and the one ultimately chosen, a clear understanding of just how their students learn best will facilitate more informed and

better decision making and ultimately increased achievement and reduced behavior concerns.

Although there are many programs that claim to benefit students with autism this research chose to review the literature related to three of the most commonly and successfully used methods, Applied Behavior Analysis (ABA), Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH), and an eclectic approach.

Applied Behavior Analysis

Applied Behavior Analysis (ABA) refers to a systematic approach used to teach students with autism. Its fundamental principle is that behavior-analytic methods and research findings must be used to make measurable changes in behavior (Autism Speaks, 2008). There is empirical demonstration of measurable changes in behavior related to systematic and controlled manipulations in the environment (McIntyre, Gresham, DiGennaro, & Reed, 2007). In this analysis antecedent behaviors are investigated, responses adjusted, and positive reinforcement used to shape desired behaviors.

ABA techniques can be extended and used to teach specific skills. The treatment is based on the isolation of step- by-step systematic teaching using small measurable units, prompts, and meaningful reinforcers (Skinner, 1974). A study by Lovaas (1987) documented that intervention using the ABA methods substantially improved functioning in a group of nineteen pre-school aged children with autism. Nine of the nineteen children who had intensive ABA for 2 years showed average scores in cognitive and language testing by age 6 or 7 and completed first grade without specialized instruction. There have been many studies of early intensive ABA treatment (Eikeseth, Smith, Jahr,

& Eldevik, 2002; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Sallows & Graupner, 2005; Zachor, Ben-Itzhak, Rabinovich & Lahat, 2007) that strove to extend or replicate the work of Lovaas using various levels of intensity of treatment, settings, clinicians, and assessments.

Howard et al. (2005) compared three different treatment methods, ABA, Autism Education Programming, and Generic Programming treating 61 pre-school aged children with autism over a period of 14 months and found the group who received ABA treatment outperformed comparable children in standardized tests of cognitive, language, adaptive skills, motor skills, and learning rates. Zachor et al. (2007) compared 39 pre-school aged children with autism using two early intervention treatment methods, ABA and an Eclectic Development Approach, focusing on changes in the severity of their symptoms. While both groups showed improvement, the improvement in the group receiving ABA treatment was more apparent than that of the group receiving Eclectic Development treatment pointing out that while early intervention significantly improves symptoms of autism, determining the type of intervention is crucial.

Sallows and Graupner (2005) compared two intervention models using cognitive, language, adaptive, social, and academic measures in 23 pre-school aged children with autism over a four year period in part as an attempt to replicate the studies of Lovaas (1987). The group was divided into two groups, one receiving intervention from trained clinicians, and the other from parents who were trained. Comparison of pre-treatment and post-treatment scores showed a significant improvement ($p < .01$) in full scale IQ scores, Receptive Language scores, and Social and Communication scales regardless of

implementers, with 48% achieving average post-treatment IQ scores and at age seven succeeding in a regular general education classroom.

Eikeseth, Smith, Jahr, and Eldevik (2002) compared an ABA method and a Combination method which included TEACCH, Sensory Integration and Discrete Trial Training in 22 four to seven-year-old students with autism over a one year period. Their findings showed that the ABA group performed significantly better on standardized measures of cognitive, language and adaptive functioning. On average the ABA group gained 17 points in IQ, 13 points in language comprehension, 23 points in expressive language and 11 points in adaptive behavior while the eclectic group obtained average changes of +4 points in IQ, -1 point in language comprehension, -2 points in expressive language and 0 points for adaptive behavior in a 1-year follow-up evaluation. This study provides evidence that some four- to seven-year-old children with autism may make substantial gains with intensive behavioral intervention.

Applied behavior analysis is usually a very intense, comprehensive undertaking involving many hours per week of individualized therapy. Best results have been seen in pre-school aged children who are enlisted in a program carried out with a great deal of integrity. The issue of adequate treatment integrity is well documented in the literature, (DiGennaro, Martens, & Kleinmann, 2005; DiGennaro, Martens, & McIntyre, 2005; Wilder, Atwell, & Wine, 2006) and suggests that teachers fail to implement interventions with fidelity for a variety of reasons.

Although behaviorally-based interventions dominate the research literature with hundreds of studies showing the effectiveness of improving individual skills in the areas of sensory, academic, self-help and behavior, children being educated in the public

school generally are being taught by teachers and therapists who tend to work from a developmental rather than behavioral perspective (Green, 2001; Maurice, Green, & Foxx, 2001; Rogers & Vismara, 2008). Good teaching demands an integration of developmental and behavioral practices (Dawson et al. 2010).

Table 1

Behavior Treatment Model Studies for Students with Autism

Author	Title	Sample	Treatment	Findings
Howard, J.S., Sparkman, C. R., Cohen, H. G., Green, G., & Stanislaw, H. (2005)	A comparison of intensive behavior analytic and eclectic treatments for young children with autism	61 preschool aged students diagnosed with autism or pervasive developmental disorder- not otherwise specified (PDD-NOS).	1.)Intensive Behavior Analytic Treatment (IBT) 2.)Autism educational Programming (AP) 3.) Generic educational programming (GP)	No statistically significant difference between the mean scores of children in the AP and GP groups, however, students in the IBT group had higher mean scores in all domains than the other two groups combined.

Sallows, G. O., Graupner, T. D. (2005)	Intensive behavioral treatment for children with autism : Four-year outcome and predictors	23 pre-school students with autism between the ages of 24 and 42 months	1.) Clinician directed Intensive behavioral approach as described by Lovaas(1973)but without the use of adversity 2.) Parent directed Lovaas approach	Lovaas' behavioral treatment program could be refined, implemented and would yield comparable results.
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Table 1 (Continued)

Behavior Treatment Model Studies for Students with Autism

Author	Title	Sample	Treatment	Findings
Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2002)	Intensive behavior treatment at school for 4- 7 year-old children with autism: A 1 year comparison controlled study	22 four- seven-year- old students diagnosed with autism who attended both public and private school	1.)Behavior analytic intervention 2.) Combination of methods including discrete trial training, TEACCH –based procedures, and sensory integration therapy	Students receiving behavior analytic treatment performed significantly better on standardized measures of cognitive, language and adaptive functioning.
Zachor, D.A, Ben-Itzhak, E.,Rabinovich,	Change in autism core symptoms	39 Preschool- aged students with autism	1.)Eclectic developmental approach	The ABA group improved more than the ED

A., Lahat, E.	with	2.)Applied	group. Changes
(2007)	intervention	Behavioral	in core autism
		Analysis	symptoms were
			more apparent
			with intervention
			based on ABA

Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH)

The TEACCH program was defined by Eric Schloper and his colleagues at Division TEACCH of the University of North Carolina at Chapel Hill as a global approach to teaching students with autism. Its aim is to minimize the features of the disorder by using structured and continuous intervention and environmental adaptations (Schloper, 1994). It seeks to make reality as clear as possible for students with autism by utilizing their strengths to clarify the where, how, when, and how long and strives for more independence in handling their own time and space (Panerai, Ferrante, & Zingale, 2002). A widely accepted developmental approach, the TEACCH program assesses the individual child’s developmental skills within the framework of the characteristics associated with autism and a curriculum is designed for each child. Teaching is directed to a student’s strengths and to emerging skills in which a student is likely to be successful. The intent of the program is to create a sense of routine, organization, and

predictability with the educational environment having clearly demarcated work areas where students' work on carefully graded tasks from start to completion (Tutt, Powell, & Thornton, 2006). While principles focus on presumed strengths in the functioning of students with autism, seemingly intuitively appropriate, empirical evidence for the efficiency of the TEACCH method has not yet been accomplished using research methods that control for internal and external validity (Gresham, Beebe-Frankenberger, & Mac Millan, 1999).

Hume and Odom (2007) studied the benefits of establishing work systems as an element of structured teaching as developed by TEACCH. They created work environments for three young adults with autism. The study employed an Applied Behavior Analysis withdrawal of treatment design. Individual work systems resulted in a higher level of on-task behavior and task completion and/or participation in all subjects.

Ozonoff and Cathcart (1998) studied 22 two to six-year olds, dividing them into two even groups, one whose parent's added home-based intervention modeled on the TEACCH program to already existing intervention and one that did not. Students in the experimental (TEACCH) group made developmental gains of 9.6 months over a four-month period with a significant ($p < .01$) gain in total cognition and developmental skills. Results suggest that home intervention based on the TEACCH model improves cognitive and developmental skills in children with autism.

Researchers in Italy (Panerai, Ferrant, & Zingale, 2002) compared two groups of eight children with a mean chronological age of nine years and having a diagnosis of autism with severe intellectual disability using the TEACCH method and an integration program. The experimental group (TEACCH) was divided into small homogeneous

groups while the control group attended regular classes with support. The staff teaching the experimental group was schooled in the TEACCH method including creating clear and predictable work space, addressing individualized communication needs (i.e. objects, pictures, drawings, written word, etc.) following of precise routines (i.e., working from left to right, rewards for completed tasks, etc.), the use of specifically designed materials and a clear understanding of the *when* factor such as posting schedules and other aids which help to reduce student anxiety. The authors found significant differences in the areas of personal domain ($p < .05$), total daily living skills ($p < .02$), play and leisure skills ($p < .05$) and total score ($p < .02$) as measured by the Psycho-Educational Profile-Revised and the Vineland Adaptive Behavior Scale. The analysis of the differences between the experimental group and the control group results indicates that the TEACCH program is a more effective treatment than the treatment applied to the control group.

Teachers who work with students who have autism are at a high risk for teacher burnout. Often special educators have had generic training and lack experience in innovative techniques specific to autism. They feel they have not been given the tools necessary to develop a feeling of competency or an in-depth understanding of this complex disorder (Cherniss, 1995). An educational plan, which endeavors to incorporate both stringent assessment as well as an understanding of the philosophy behind some of the widely used treatment approaches for autism, can serve to elevate feelings of incompetence and emotional exhaustion. Jennett, Harris, and Mesibov (2003) studied variables that may be related to burnout in teachers of students with autism. They examined commitment to an underlying philosophy of teaching approach and

professional self efficacy. Their study included 64 students with autism; 34 receiving ABA (Applied Behavior Analysis) treatment and 30 receiving TEACCH (Treatment and Education of Autistic and Related Communication-Related Handicapped Children) treatment. Teachers completed questionnaires developed by the authors. Teachers who identified themselves as having an ABA teaching philosophy had significantly higher ABA scores ($p < .001$) than the teachers who identified with the TEACCH philosophy and conversely. There were no significant differences found between the groups in the area of self efficacy which was rated high for both groups, nor were there significant differences found in the areas of emotional exhaustion, depersonalization, or personal accomplishment for either group. The study concluded that the more one understands and adheres to a theoretical orientation, the more effective one feels as a teacher and, in turn, reports less teacher burnout despite the challenges of teaching students with autism.

An important area for further research is to evaluate TEACCH using studies with strong experimental designs. The evaluation of TEACCH (see Table 2) is surprisingly limited given its widespread influence in practice (National Research Council, 2001).

Table 2

TEACCH Treatment Model Studies for Students with Autism

Author	Subject/Sample	Treatment	Findings
Hume, K , & Odom, S. (2007)	Three young adults with autism	Supply TEACCH style workspace	Increased on task behavior and or participation
Ozonoff, S., & Cathcart, K. (1998)	22 two-six year olds	Addition of home TEACCH intervention to already existing program	TEACCH group made developmental gains of 9.6 months over 4 months in total cognitive and developmental skills

Panerai, S,	16 autistic	1 group was	Significant differences in
Ferante, L., &	students with	integrated with	TEACCH group in personal
Zingale, M.	severe	support,1 group	domain, daily living skills, and
(2002)	intellectual	homogeneous	play and leisure skills
	disability	TEACCH	
		group	

Eclectic Approach

Intervention approaches for students with autism should be individualized to match a child’s current developmental level and his or her profile of learning strengths and weaknesses (Prizant & Rubin, 1999; Simpson, et al., 2005). No one intervention should be considered superior in the treatment of autism given the great heterogeneity in children. Rather, an eclectic approach which gleans various interventions from many different approaches may in fact make the most impact on the greatest number of children. While many studies have compared the effectiveness of various programs to an eclectic approach (Eikeseth et al., 2002; Eldevik, Eikeseth, Jahr, & Smith, 2006; Howard et al., 2005; Zachor et al., 2007) there is no consistency across studies enabling definition or replication of an eclectic approach. One study may include speech and language

intervention but exclude sensory-integration therapy while another may use some ABA methods and incorporate an art or music therapy component. The broad pallet of available intervention make it impossible to compare programs or to clearly define the components of an eclectic approach other than to acknowledge the inclusion of multiple interventions within one prescribed treatment program.

When discussing interventions and treatments for children with autism, Simpson, et al. (2005) delineates using five broad categories: (a) interpersonal relationship interventions and treatments; (b) skill-based interventions and treatments; (c) cognitive interventions and treatments; (d) physiological/biological/neurological interventions and treatments; and (e) a category labeled “other”.

Interpersonal relationship interventions and treatment includes activities which strengthen the connection between students with autism and those around them. They focus on relation-based attachments and are evident in such interventions as Play-Oriented strategies, Gentle Teaching, Floor Time, and Animal therapy programs (Simpson et al., 2005). Skill-based interventions might include Incidental Teaching, Picture Exchange Communication System, Structured Teaching (TEACCH), Applied Behavior Analysis (ABA) , and Discrete Trial Training; interventions which are based on developing a hierarchy of skills.

Cognitive interventions and treatments might include Social Stories, Power Cards, Learning Experiences (LEAP) and other interventions which focus on self-monitoring of actions and decisions, shifting the locus of control from teacher or therapist to student ((National Research Council, 2001)

Physiological, biological, or neurological interventions and treatments are designed to alter the neurological functioning believed to be at the core of autism spectrum disorders. Such interventions might include pharmacology, Sensory Integration (SI), Auditory Integration Training, and vitamin therapy.

Lastly, the category labeled “other” includes such interventions as art and music therapy, herbal, mineral and other supplements, and dietary changes, which do not fall into any of the previous categories and are approaches that stem from various disciplines. Simpson acknowledges that all possible options for students with autism are not represented even with this broad categorizing and reiterates the cautionary plea of other experts that there is not one single treatment method that should be exclusively prescribed to meet the varied needs of all children with autism (Atwood, 1998; Cohen & Volkmar, 1997; National Research Council, 2001).

In developing an eclectic program for students with autism, educators might consider any one or a combination of various interventions (National Research Council, 2001). While many are not supported by scientifically-based data, they are mentioned here since there is, in some cases, evidence of efficacy and, thus should not be categorically dismissed as without merit. Once again experts remind us of the limited rigorous research studying interventions and treatments for children with autism.

Learning Style

Learning-Style Theory

One of the major considerations for classroom achievement today is the learning style of individual students. Most teachers know what to teach, but do not realize that they can not possibly know how to teach it without first identifying how their children

learn (Dunn, 1999). Teachers must strive to understand each student's preferences in an attempt to deliver instruction in a multitude of ways to maximize each student's learning. Identical instruction delivered to a classroom of children may be effective for some and ineffective for others. The Dunn and Dunn learning-style model, in comparison to other learning-style theories, lends a comprehensive eye toward various environmental conditions and instructional methods. The model focuses on identifying individual preferences for specific environments, strategies, and resources and the extent to which each approach either fosters or inhibits academic achievement (Dunn, Denig, & Lovelace, 2001).

Several theorists observed student learning style from different perspectives. Joseph Hill (1976) developed his Cognitive Style Mapping theory based on how individuals interpret symbols. He theorized that students interpret symbols based on their cultural and experiential differences and that their family and peers help shape the meaning they assign to symbols.

Kolb (1976) created his Learning Style Inventory, dividing learning types into four groups. The first type was Converger, where strengths were active experimentation and abstract conceptualization. The second was Diverger where learning is best achieved through concrete experiences and reflective practice. The third, Assimilator whose strength is in creating theoretical models, and the fourth, the Accomodator, who learns best in experimental, hands-on environments.

Letteri (1980) created the Cognitive Style Profile where he identified three types of learners. The Type 1 learner was an analytical processor. This type of learner was detail oriented and mindful of order and sequence. A Type 3 learner was a global

processor, someone who was able to see the whole picture and paid little attention to detail or sequence. Type 2 learners were a combination of both Type 1 and Type 3 and did not succeed academically. The basis of Letteri's theory was that teachers had to change the way students learned or they would not meet with academic success.

Drs. Rita and Kenneth Dunn developed their learning-style theory based on classroom environment and a student's reaction to it relative to their learning. The Dunn and Dunn model includes an investigation of 20 elements embedded in five strands: (1) environmental (sound, light, temperature, and furniture/seating design), (2) emotional (motivation, persistence, responsibility, and need for either externally imposed structure or a need to do things their own way), (3) sociological (learning alone, in a pair, in a small group, as part of a team, or with either an authoritative or collegial adult, and wanting variety as opposed to patterns and routines), (4) physiological (perceptual strengths, time-of-day energy levels, and need for intake and/or mobility while learning) and (5) psychological (global/analytical, and impulsive/reflective) (Dunn & Dunn, 1992) (see Appendix B).

A quantitative synthesis of experimental research was conducted by Lovelace (2005) wherein she examined the Dunns' widely recognized body of work. Compared with other learning-style approaches, the Dunn and Dunn learning-style model includes greater comprehensiveness, is more extensively researched and demonstrates higher levels of consistent effectiveness (Given, 1998). Student's learning styles are based on their reaction to various stimuli, biologically inherited traits, and previously established behavioral patterns. In identifying 20 elements including each individual's environmental, emotional, sociological, physiological, and cognitive-processing

preferences, the instruments based on the Dunn and Dunn learning-style model measure the degree to which these elements impact each student.

Lovelace's meta-analysis of research conducted using the Dunn and Dunn model over a period of 20 years concluded that matching students' learning-style preferences with specifically designed complementary instruction statistically improved academic achievement as well as students' attitudes toward learning. Her study reviewed 76 research investigations. Studies were included in this review if, (a) they were experimental or quasi-experimental in nature; (b) the investigation reported on one of the four instruments based on the Dunn and Dunn learning-styles model; (c) the investigation addressed one or more of the 20 elements of the environmental, emotional, sociological, and physiological strands; and (d) the study had enough statistical information to estimate effect size.

The analysis of 7,196 participants provided 168 individual effect sizes. The mean effect-size values calculated and interpreted through this meta-analysis provided evidence for increased achievement and improved attitudes when responsive instruction was available for diagnosed learning-style preferences (Lovelace, 2005). This research supports what effective teachers have always known: students learn best when they are engaged, comfortable in their environment, and experiencing and receiving information through their most preferred modalities.

The Dunn and Dunn learning-style model is based on the theory that everyone can learn, but differently. The focus of the Dunn and Dunn model is the self-examination of these 20 elements that must be considered to optimize learning (Dunn & Dunn, 1992). The assessment of learning style allows for the examination of preferences for specific

instructional environments, strategies and resources, and the extent to which each impacts academic achievement (Dunn, Denig, & Lovelace, 2001).

Dunn and Dunn Model and Special Education Populations

The Dunns' research extends to the special education population for which they determined that, when instruction was tailored to individual learning-style strengths, significant achievement increases were manifested on standardized test scores among students officially classified as special education. Brunner and Majewski (1990) used a learning-styles approach based on the Dunn and Dunn model, making adaptations to curriculum, environment, and classroom practice, with high school students in New York State who were identified as mildly handicapped. Before these interventions 25% of these students passed the necessary local examinations and State Competency tests to receive diplomas. During the program's first year the number increased to 66% and the second year 91% of the students were successful. The third year results remained constant at a 90% passing rate, with a greater number of identified students whose instruction was based on their learning style passing the State Competency exams than their typical peers.

Similar data were revealed by Fine (2002) in his study of high-school level special education students. Fine analyzed the effects of specific learning-style instruction on science achievement, attitudes, and behavior toward instruction in 436 students in grade nine through eleven, of which 228 were classified as emotionally disturbed or learning disabled according to their Individual Educational Plan. Instructional units were divided into seven phases of eight days each. Following a repeated measure design, Units One and Seven were taught traditionally whereas Units Two through Six each

incrementally added one additional learning-style strategy at a time. Statistically higher achievement and attitudes favoring learning-style instruction were evidenced ($p < .001$). Student test scores significantly improved with each incremental implementation and students' behavior significantly improved ($p < .001$) with each addition of learning-style instruction.

Braio, Beasley, Dunn, Quinn, and Buchanan (2001) also studied the effects of using incrementally introduced learning-style strategies. Their study examined the reading instruction of 81 special education and 35 low-achieving general education urban fourth, fifth and sixth graders. The researchers trained seven teachers in incorporating learning-style strategies into instruction. They also received instruction on how to : assess learning styles, explain learning style to students and use specific literature designed to heighten student awareness of learning style, to administer and interpret the Learning Styles Inventory, and administer the Semantic Differential Scale to determine attitude changes toward instruction, to redesign classrooms to accommodate preferences, create instructional resources to accommodate students perceptual strengths, to plan activities, to develop word lists, to create pre-and post-tests, and to record scores for five instructional phases in the same uniform manner (Braio, et al. 2001).

During a 10-week period structural analysis units on compound words, plurals, prefixes, suffixes and contractions were divided into 5 two-week phases. An additional learning style element was introduced at each treatment phase. Based on learning-style prescriptions from the Learning Styles Inventory (Dunn, Dunn, & Price 1996) students were divided into three groups, environmental preferences (EMP), multiple preferences (MULT), and those students who expressed no preference (Braio, et al. 2001).

At the beginning of every phase, teachers were given a structural analysis packet including a list of compound words, plurals, prefixes, suffixes or contractions to be taught in their respective instructional units. Students were pretested at the beginning of each phase and received a posttest at the end of a two week instructional period. Phase One did not use a unique instructional approach, Phase Two required teachers to redesign the physical aspects of their classrooms to provide for individual student preference for sound, light, design and mobility. Phase Three introduced tactual and kinesthetic instructional resources , Phase Four matched all perceptual preferences (auditory, visual, tactual, kinesthetic) and continued to accommodate environmental and mobility preferences. Phase Five removed learning-style accommodations in an attempt to assess whether any decrement in performance or attitude occurred (Braio, et al. 2001).

The results showed no statistically-significant change in achievement across experimental phases for the group who declared no preference. However, statistically significant changes across phases was detected for both the EMP ($p < .0001$) and the MULT groups ($p < .0001$). Furthermore, scores showed significant ($p < .0134$) change in attitude across the phases of the study. These findings support those of previous researchers who reported that teaching special education and regular education low-achieving students through their learning-style preferences resulted in improved academic achievement and attitudes towards learning (Braio, et al. 2001).

Brand (1999) examined the learning-style preferences of 101 third- through sixth-graders medically diagnosed with Attention Deficit Disorders (ADD) using the Learning Style Inventory (Dunn, Dunn, & Price, 1996). The study identified three elements that

evidenced significance at the $p < .05$ level (need for low light, lack of persistence, and being a morning learner). One element, being strongly parent motivated, was significant at the $p < .01$ level. These findings indicate common learning-style preferences among children with ADD. Additionally, a discriminant analysis related to grade level was significant ($p < .001$) indicating that learning-style characteristics of third and fourth graders differed from those of fifth and sixth graders.

Greb (1999) examined the learning-style preferences of 138 fifth through twelfth graders medically diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). This research focused on the identification of learning-style strengths as well as common group preferences as determined by the Learning Styles Inventory. In comparing scores for the 20 learning-style elements, eight significant differences were found. The most significant finding ($p < .001$) supported the view that students with ADHD preferred learning in the kinesthetic approach. There were two elements, tactual and parent motivated where differences were found at the $p < .01$ level, and two additional elements, visual and time-of-day preferences where significant differences were found at the $p < .05$ level. Additionally, learning-style differences between pre-high school students in grades 5-8 ($n = 86$) and high-school students in grades 9-12 ($n = 52$) were significant beyond the $p < .05$ level for the following learning preferences: (a) tactile, $p = < .01$; (b) kinesthetic, $p = < .05$; and (c) parent motivated, $p = < .05$. Often underachieving students have different learning styles than their typical peers at different stages of development and instruction must be individualized to meet their needs and increase their level of achievement (Dunn, Thies, & Honigsfeld, 2001).

Learning Style Differences and Gender

Researchers investigating gender differences in learning-style preferences concluded that males tend to be more kinesthetic and tactual, in need of mobility, and prefer an informal design when concentrating (Greb, 1999; Mitchell, 2000). Dunn and Griggs (1995) determined that males have a relatively low auditory preference compared to females.

Brand, Dunn, and Greb (2002) analyzed data from 230 boys and girls in grades 3 through 6 who were medically diagnosed with ADHD. They determined that boys with ADHD were more persistent ($p = <.02$) than girls with ADHD, and that girls were more auditory ($p = <.02$).

Greb (1999) found that male students in grades five through twelve with ADHD reported significantly higher kinesthetic mean scores (57.40) on the Learning Styles Inventory than females students (49.88) of the same grade level with ADHD and found no other significant differences between male and female learning preferences for the other learning preferences tested.

Studies that investigate differences in learning-style preferences based on gender may be of particular interest to researchers in autism as the ratio of males to females who are diagnosed with autism is 4:1 (Ehlers & Gilberg, 1993).

Based on the research done by Brunner and Majewski (1990), Brand (1999), Greb (1999), Brand, Dunn, & Grebb (2002), and Fine (2002), who found differences in the learning styles of special education students (see Table 3), one must investigate the possible outcome of research on the learning styles of students with autism.

Table 3

Learning Style Studies of Students with Special Needs

Researchers	Sample	Subject Examined	Findings
Brunner and Majewski (1990)	Mildly handicapped students; grades 9-12	Achievement on standardized local and state competency tests	Before intervention 25% passed. After 1 year 66% passed. After 2 years 91% passed
Fine (2001)	436 Nine-Eleventh graders, 228 with special needs	Science achievement, incremental implementation of learning style instruction	Achievement and behavior improved with each increment.
DeBraio, Beasley, Dunn, Quinn and Buchannan (2001)	81 special education students and 35 Low achieving typical students in	Reading achievement, incremental implementation of learning style instruction	Improved achievement for both groups

grades four-
six

Table 3 (Continued)

Learning Style Studies of Students with Special Needs

Researchers	Sample	Subject Examined	Findings
Brand (1999)	101 Students with ADHD in grades 3- 6.	Comparing students with ADHD and typical students and across grade levels.	Common learning style in students with ADHD. Differences found across grades

Grebb (1999)	138	Comparing learning styles of students with ADHD to typical peers and between gender and grade levels	Common learning style in students with ADHD. Differences found across gender and grades.
		Students with ADHD in grades 5-12	

Conclusion

While there is little or no research specific to the learning styles of students with autism, this chapter discussed a number of related topics and supplied a theoretical and empirical foundation for the study of learning styles in the special needs population. The benefit of a clear understanding of all students learning styles and its effect on level of achievement has been well studied and documented. This chapter also discussed diagnostic considerations and the unique nature of learning in students with autism.

Research reviewed here further supported the need for a more in-depth investigation into the learning styles of students with autism.

CHAPTER THREE: METHODOLOGY

This chapter describes the research design and methodology of this study, which was designed to determine the extent of similarity or difference in the learning-style preferences of elementary-level students who have a diagnosis of autism spectrum disorder and the similarities and differences of these preferences to their typical peers. It provides the following information relevant to the research methodology: research questions and hypotheses, description of the subjects and the setting, description of the

instrument, the reliability and validity of that instrument, description of the research design, data collection procedures, and limitations of the study.

Research Questions and Hypotheses

This research investigated the relationship between autism and learning styles by addressing the following questions:

Research question one. Are there common learning-style preferences among students who are diagnosed with autism?

Hypothesis. There are common learning-style preferences among students diagnosed with autism.

Research question two. Are there differences between the preferred learning-style of autistic and typical students?

Hypothesis. There are significant differences between the learning–style preferences of autistic students and typical students.

Description of Setting and Subjects

The 52 participants in this study were a *sample of convenience* that suited the purposes of this study. They were selected from the population of approximately 160 students who attend a private, non-profit, non-sectarian day school for children aged 3-16 who have developmental disabilities. The program, which is located in the suburbs of a major United States city, admits children without regard to race, religion, nationality, or handicap who exhibit the following characteristics: autistic spectrum disorder, PDD NOS

(Pervasive Developmental Disorder, not otherwise specified), schizophrenia, Asperger's syndrome, delayed and/or inappropriate speech and language development, perceptual difficulties not related to specific sensory deficits, delayed motor development, inappropriate affect, and association disorders (*The Forum School* [Brochure]). All students live at home and commute to school from several school districts in two neighboring Northeast states. Tuition and transportation fees are paid by local-sending districts as per special education law (IDEA, 1975). Participants in this study have a medical or educational diagnosis of autism spectrum disorder.

The school's philosophy of educating the whole child is reflected by the variety of activities it offers. Programs that parallel traditional school experiences include an adaptive swimming and physical education program, as well as curriculum-based music and art classes. Students receive support services such as Occupational Therapy, Physical Therapy and Speech Therapy as per their Individual Educational Plans (IEP) developed by sending districts. Extended-year services which include summer classes, therapies and weekly overnight camping experiences are often mandated. Additional available services are sibling and parent support groups as well as weekend respite care. Classes are ungraded and students generally are taught in a group of students with a similar academic level and a ratio of 1 adult to not more than 4 students. Teachers and therapists as well as some teaching assistants, are all state certified and many hold advanced degrees. It is common for a student to have the same teacher for more than one school year. The small class size and high adult-to-student ratio allows teachers and support staff to create individualized and meaningful learning environments for these students with unique needs (A. Amabile, personal communications, March, 2009).

The school's program reflects an eclectic approach to learning based upon each child's particular strengths and weaknesses. Research-based principles such as Applied Behavior Analysis and task/reward based methods are included. Each class might have its own positive reward system based on student performance and tailored to meet individual student need. A major component of the program incorporates social interaction throughout the school day. An extensive hot-lunch program addresses frequent atypical eating patterns seen in children with autism while encouraging independence in making choices and personal responsibility. Students are encouraged to communicate and participate in all curriculum areas according to their level of ability at any given time, building on Vygotsky's Zone of Proximal Development theory. Borrowing from the TEACCH model, classrooms are designed to encourage independence and task completion. Students move through a series of steps to achieve an IEP goal or objective. Whenever possible, typical peer partners are enlisted to help facilitate appropriate social interaction (S. Krapes, personal communication, March 2009).

The learning-style preferences of this group were compared to the learning-style preferences of 60 randomly chosen elementary school students who do not have a known diagnosis of autism. These students make up general elementary classrooms and are considered typical peers. The comparison group consisted of students randomly drawn from a population of 11,015 students who have taken the Elementary Learning Styles Assessment. Of the 11,015 students, 10,937 are six to ten years old, and 8,677 are in grades two through five, which constitutes a sample thought to be closely aligned in age and academic performance with the sample of students with autism. They resided in

various states in the United States including New York, Arkansas, North Carolina, Georgia, Texas, and Ohio and have similar academic levels, socioeconomic status, and cultural composition to the group of students with autism who also were given the Elementary Learning Style Assessment (S. Rundle, personal communication, April, 2009).

Instrumentation

Elementary student's preferred learning styles were assessed using the Elementary Learning Style Assessment (ELSA) (Dunn, Rundle, & Burke, 2007). This is a comprehensive diagnostic instrument that considers 20 different variables in each individual's environment, sociological, and cognitive processing traits as described in the Dunn and Dunn learning-style model. Research conducted by the Dunns and their colleagues (Dunn, 1983; Dunn & DeBello, 1999; Brand, Dunn, & Greb, 2002; Burke & Dunn, 2003; Fine, 2003; Mitchell & Dunn, 2008;) has documented that when students are taught according to their identified learning-style preference, they display statistically-increased academic achievement, improved attitude toward instruction, and better discipline than when they are taught without attention to their preferred style. Extensive experimental research on learning styles verifies that students, prompted correctly, can accurately articulate their learning-style preferences. Not all of these elements are easily identified by teachers as some aspects are not evident to even an experienced eye. However, a properly administered reliable and valid learning-style identification instrument influences children's instructional experiences positively and significantly increases achievement and attitudes (Lovelace, 2005).

A student's learning style is based on a complex set of reactions to outside stimuli, feelings, and previously established behavioral patterns. The ELSA is designed to react to these established patterns through the use of stories, fantasy, holistic writing, imagery, humor, and pictures. Three stories are presented followed by a series of questions that pertain to the student's individual learning style. The assessment measures the pattern through which learning occurs in individual students, summarizing the environmental, emotional, sociological, physiological, and psychological preferences that each student has for learning.

In the environmental realm, the ELSA assesses a student's immediate environment, considering sound, light, temperature, and seating design and suggests a basis for redesigning a classroom to complement many students' needs. Students register different responses to environmental factors such as a preference for background noise or learning in a quiet environment; bright light as opposed to dim light or a preference for a warm or cool environment while learning. A student's sociological preferences are examined through the lens of learning alone, with a partner, as part of a small group, with peers, with an authoritative or collegial adult or in a combination of ways. Physiological factors considered are students' preferred modalities or perceptual preferences such as auditory, visual, tactual and/or kinesthetic perceptual preferences. Food or liquid intake while learning and chronobiological or "time of day" energy levels and mobility needs are also identified as they have been shown to relate to task efficiency. Developmental elements of learning style may include: motivation, the need for more or less structure, conformity vs. nonconformity, and with whom learning is more likely to occur. The

ELSA also includes an assessment of processing style and indicates a student's inclination to process information analytically or globally.

Using computers, students answer 75 multiple-choice questions, including representative picture images, which measure the patterns through which learning occurs. Questions were developed at the 2.0 Flesh-Kincaid Grade Level for reading. Each question is presented three times throughout the evaluation to assure response consistency. Results then are used to create a one-page computerized, graphic summary of each student's learning-style preference as well as a full narrative report suggesting approaches for capitalizing on identified strengths (Dunn, Rundle, & Burke, 2007-2008).

To establish validity and reliability of the instrument, 1,298 second-, third-, fourth-, and fifth-graders from eight schools were tested. The sample was comprised of 663 females and 635 males from various ethnic populations including, but not limited to, Hispanic, African American, Caucasian, Asian, and Caribbean elementary-school students. These students attended private, parochial, and public institutions in urban, suburban, and rural communities in the major geographic regions of the United States.

Reliability was analyzed with respect to stability of test scores over repeated administrations. Students were administered the globally formatted version of the ELSA twice. A test-retest reliability coefficient for each of its elements was computed. Test-retest coefficients ranged from a minimum of .719 (structure) to a maximum of .924 (reflective/impulsive). The mean value of the coefficients was .822. This high test-retest reliability concludes that individuals test results will remain relatively consistent over repeated administrations (Gall, Gall, & Borg, 2007).

Internal-consistency reliability was measured by computing correlation coefficients among items within each element using Cronbach's Alpha, a test widely used for computing test score reliability (Gall, Gall, & Borg, 2007). The internal consistency-reliability coefficients for ELSA ranged from .718 to .905 with a mean of .812 in a sample consisting of 630 male students and 668 female students. This shows a good to high correlation between different items on this test (Gall, Gall, & Borg).

Content validity was established by a five-member jury, which unanimously agreed that the ELSA paralleled the Dunn and Dunn learning-style model, incorporated 20 elements of that model, conformed to the established criteria for the assessment of learning styles, was appropriate for elementary school students, and conformed to established criteria describing a global cognitive style (Dunn, Rundle, & Burke, 2008).

Description of the Research Design

This research is an investigation that measured the characteristics of a sample on prespecified variables and compared the findings among children with autism with their typical counterparts. There was no experimentation or manipulation of subjects; merely an investigation of an existing phenomenon. This type of descriptive study has yielded much valuable knowledge about opinions, attitudes, and practices. This knowledge has helped shape educational policies and initiatives to improve existing conditions (Gall, Gall & Borg, 2007).

The sample for research question one was one of 52 students with autism spectrum disorder and the pre-specified variables were the 25 learning-style variables identified in the Elementary Learning Style Assessment (ELSA). The samples for research question two were 52 students with autism and 60 typical elementary level

students and the same 25 learning-style variables as used in research question one.

Responses of these two groups were compared and analyzed.

Description and Justification of the Analyses

This study is an analysis of the relationship among non-manipulated variables. These variables are presented as items on a personal-preference inventory where subjects self-reported their own preferences. This instrument can be thought of as a standardized interview in which the subject, through introspection, indicates feelings that may be interpreted in terms of what is known about preference patterns (Best & Kahn, 2006). Data were gathered on several variables for each individual in the sample and analyzed. The results may enable the researcher to extend conclusions beyond the sample observed, and perhaps generalize the hypothesis to a greater population of students with autism (Best & Kahn). To answer research question one, a Chi-square Goodness of Fit test was used to examine differences in categorical data (learning-style preferences) for students with autism. A Chi-square test is an appropriate nonparametric statistical test to determine if significant differences exist beyond the .05 level between observed and expected frequencies (Hinkle, Wiersma, & Jurs, 2003). This is an elegant statistic based on the simple idea of comparing the frequencies one observes in certain categories to the frequencies one might expect to find in those categories by chance (Fields, 2005).

To address research question two a Chi-square Two Variable Crosstabulation examined each of the 25 learning-style variables for each of the two groups, students with autism and typical students. A Chi-square Two Variable Crosstabulation is an appropriate nonparametric statistical test to determine if significant differences exist beyond the .05 level in two groups in examining whether or not the presence of autism

contributes to specific learning style preferences (Hinkle, Wiersma, & Jurs, 2003; Huck & Cormier, 1996). The Statistical Package for the Social Sciences (SPSS 15.0, 2005) was utilized to analyze data collected.

Data Collection Procedures and Timeline

The data for this study were collected from the child participants. Letters requesting permission to participate in the study were sent to parents or guardians via student backpacks with a detailed explanation of the Elementary Learning Style Assessment (ELSA) and the purpose of this study, along with a cover letter of support for the study written by the school's director (Gall, Gall, & Borg, 2007). Students returned permission slips to classroom teachers who in turn sent them to the school's central office. Teachers were advised of testing procedures and given an overview of the research being conducted during a general staff meeting. An open discussion also took place with staff at a general staff meeting during the testing period in an effort to encourage greater participation. A comprehensive explanation of test results was offered to both parents and teachers (Dunn, Rundle, & Burke, 2007). Four teachers and three parents contacted the researcher to discuss either test procedure or specific results.

Initially teachers were asked to identify students who they felt would be responsive participants. They were advised that, (a) the ELSA was written at a 2.0 reading level, (b) students should be self-reflective enough to answer questions about how they preferred to learn, and, (c) students should have adequate computer skills to allow them to complete the test.

As the testing progressed teachers felt they had overlooked some students and requested the researcher supply additional parent permission letters. After observing test

taking procedures they became more comfortable with the testing process, developed a clearer understanding of the value of the data being collected, and were eager to have more of their students participate in this research study. Additional parent permission letters were made available to them and several parents responded, granting permission. As the school year was drawing to a close it was decided that further testing could be completed with students who were to attend the extended year summer school. These students were either new or continuing students of the school which offers an eleven month academic program. Permission request letters were again sent home and returned to classroom teachers. The number of affirmative responses necessitated two additional testing sessions in the month of July 2009 for a total of five test sessions and 52 participants.

Students were taken in groups of two to either the school library or a classroom that was vacant by the researcher where they completed the test on two separate computers simultaneously. All students were able to use the computers independently. Some students required assistance to read the story portions of the test as allowed by test protocol, however, most students could read and complete the test questions independently as they were able to utilize picture clues. All participants came willingly and were enthusiastic about using a computer to complete a task.

The Elementary Learning Style Assessment consists of 75 questions interspersed among three sections. Students first chose to read a story about either pirates or a circus with the chosen theme continuing throughout the next two sections. Once read, they proceeded to the question portion of the test. Here they were asked to answer questions about learning preferences. All responses included a picture image that was

representative of the answer. Each student then clicked on his answer choice and advanced through the 25 questions. Once this task was completed they were presented with part two of the story and again asked to answer 25 similar questions when finished. This procedure was presented once again after they read the third and final part of the story. This provided the researcher with a completed Elementary Learning Style Assessment for each subject with autism in the study.

A random sample of 60 subjects of similar age and academic level was then drawn from the database of typical students who have taken the ELSA. An even distribution of 30 males and 30 females were chosen from students throughout the country. A coded identification number was given to each subject and test data was entered into an SPSS spreadsheet (Gall, Gall, & Borg, 2007).

Timeline

To provide information and to gather data, the following timeline was used:

- In the fall of 2008, initial contact was made with the director of the school and the research study was explained in detail.
- A letter of permission was secured from the director. (See Appendix C)
- An introductory contact was made at the school's general staff meeting in January 2009. The purpose of this meeting was to introduce the researcher, provide teachers with an overview of the study including a discussion of procedures, description of the test being used, and to make previous research studies available to staff. The researcher also educated the staff on learning styles and explained the Dunn and Dunn learning-style model.

- Teachers were asked to recommend students for the study in January 2009.
- Parent/Guardian permission letters were sent home and returned to school in January 2009 and February 2009 accompanied by a letter of support from the school's director. (see Appendix D and E).
- Students returned parental permission slips (see Appendix F).
- Student testing began in March 2009 and continued through May 2009.
- Another staff meeting was addressed in April 2009 to update staff on progress of the study and the encourage teachers to consider recommending additional students.
- Additional student recommendations were made and parent/guardian permission letters were sent home during April 2009.
- Parent/Guardian permission letters were sent to all eligible students who had not received previous letters in May 2009.
- Student testing continued in June and was completed in July 2009.
- Each student was assigned a coded identification number and data for each number were entered into an SPSS spreadsheet
- A comparative randomized sample of typical peers was drawn from the databank of the Elementary Learning Style Assessment (personal communication with Susan Rundle, director, International Learning Style Network, President, Performance Concepts International).
- Data were analyzed and conclusions formulated.

- Student reports were shared with parents and teachers who requested follow-up contact (see Appendix G).

Limitations of the Study

Due to the wide range of abilities and disabilities found under the umbrella diagnosis of autism, inherent limitations to this study do exist. The spectrum of autism may include subtypes differing in etiology, clinical presentation, or developmental course as well as in the level of cognitive, social, or language disability (Cohen & Volkmar, 1997). The students with autism studied here are students who possess language, literacy, attention, computer and self-reflection skills which is present in all students with autism. Furthermore, although they are thought to generally be representative of a subgroup of students with autism, they attend the same school and have had the common educational experience of having been taught using the eclectic approaches of teachers who teach at this school (Gall, Gall, & Borg, 2007).

Although the academic levels of the participants in this study were assessed by teacher reported reading levels, the ungraded nature of the school which they attend make it difficult to draw an absolute comparison to the subjects selected from the ELSA database. However, it is an established fact that there is a broad scope of academic ability within any grade level. Further study may be necessary to determine the depth and implications of the differences in learning style of students with autism (Gall, Gall, & Borg, 2007).

Ethics Statement

Permission to participate in this research was sought from the director of the school and parents of all student participants. To assure confidentiality, each participant

was assigned a coded identification number. All data were stored in a locked filing cabinet in the researcher's home or office and was maintained there until the findings were published; accessible only to other researchers for whom the data will prove useful in further comparative analyses and who are enrolled in Western Connecticut State University's Doctor of Education in Instructional Leadership Program.

CHAPTER FOUR: ANALYSIS OF DATA AND EXPLANATION OF THE FINDINGS

The purpose of this study was to describe the learning styles of students with autism and to determine if evidence existed that students so diagnosed have significantly different learning-style profiles than typical students. The understanding of these learning preferences enables teachers to develop richer programs for students who are

diagnosed with autism and to employ specific instructional methods that best meet students' needs. Two research questions were addressed:

1. Are there common learning-style preferences among students who are diagnosed with autism?
2. Are there differences between the preferred learning-styles of students with autism and typical students?

The results of this research inquiry are presented in this chapter. The data gathered from the measurement tool used in this study are presented, followed by a discussion in Chapter Five of the implications of these findings for educators of students with autism.

Results

Description of Information

The Elementary Learning Style Assessment (ELSA) was the primary tool used to gather data for the analysis section of this research study. The ELSA offers students 75 questions that are used to identify their particular learning-style preferences. The assessment measures the patterns through which learning occurs in individual students, summarizing the environmental, emotional, sociological, physiological, and psychological preference each student has for learning (Dunn, Rundle, & Burke, 2007). This instrument was used to address both research questions.

The total number of students assessed was 112. Of those, 60 were considered typical students for the purpose of this study and the remaining 52 students were students with autism.

The data collected from the ELSA were examined to determine whether learning-style characteristics were consistent within and/or between each group. The program used to compute this analysis was SPSS 15.0 (2006).

Data Screening Process

Data collected from the Elementary Learning Style Assessment were examined to verify the appropriateness of the numbers for each value in the study (Meyers, Gamst, & Guarino, 2006). A Chi-square requires that certain criteria be met. The sample must be randomly drawn from the population, data must be reported in raw frequencies, measured variables must be independent, values on independent and dependent variables must be mutually exclusive and exhaustive, and expected frequencies cannot be too small (Meyers, Gamst, & Guarino, 2006). Upon examination of the data for the Chi-square Goodness of Fit Test and the Chi-square Crosstabulation used to analyze questions one and two respectively, it was noted that one assumption for Chi-square had not been met as expected values of less than five were evident in more than 20% of the cells. "When an expected frequency is less than five, it is best not to calculate Chi-square or alternatively, collapse two or more cells until the expected frequency in the new category is at least five" (Steinberg, 2008, p. 352). This analysis necessitated the collapsing of five levels of participant responses into three levels to achieve an expected frequency of at least five.

A Bonferroni correction was used to avoid a possible Type 1 error. By dividing .05 by the number of research questions, the alpha level was set at .025. There is no formal consensus for when Bonferroni procedures should be used, even among statisticians (Perneger, 1998). In some situations, the Bonferroni correction is substantially conservative. This occurs when the test statistics are highly dependent

(Perneger, 1998; Shaffer, 1995). The decision was made not to be more stringent in this research study in order to avoid eliminating important variables. Narum (2006) noted that in conservation genetics Chi-square tests are commonly reported with a Bonferroni correction for multiple tests. While the Bonferroni correction controls the experiment-wise α , this correction is very conservative and results in greatly diminished power to detect differentiation among pairs of sample collections. Ultimately, Narum concluded that more thorough reporting of statistical significance was most necessary in exploratory studies to allow interpretation of biological significance of genetic differentiation among populations.

Research Question One: Description of the Analysis

This analysis of data refers to research question one: Are there common learning-style preferences among students who are diagnosed with autism? To determine whether there was a significant learning-style preference among students with autism for each of the 20 Dunn and Dunn (1992) learning-style elements as measured by the Elementary Learning Style Assessment, 25 one sample 3x1 Chi-square Goodness of Fit Tests were used. The three cells represent the collapsed version of the criteria used by the Elementary Learning Style Assessment (2007) where students from each of the two groups rated their preferences at five levels (Steinberg, 2008). Although categories on a variable--especially a dependent variable--may be collapsed, they cannot be excluded from a Chi-square analysis. Therefore, this analysis did not arbitrarily exclude some subset of the learning-style preferences from the analysis. The decision to collapse categories was carefully motivated, with consideration for preserving the integrity of the data as it was originally collected and with author permission. The categories which were

collapsed were as follows: “Strong preference” and “Somewhat of a preference” were collapsed and relabeled “Preference” and “Strong non-preference” and “Somewhat of a non-preference” were collapsed and relabeled “Non-preference”. The category “No preference” remained the same.

The Chi-square Goodness of Fit test is an appropriate nonparametric statistical test to determine if significant differences exist beyond the $p > .05$ level between observed and expected frequencies. The expected frequency for all variables was 17.3. The purpose of using this test was to determine whether the proportion of individuals who fall into each category equals a set of hypothesized proportions (Hinkel, Wiersma, & Jurs, 2003).

The analysis of the 3x1 Chi-square is reported for each learning style element as well as in Table 4. The Chi-square formula compares the observed frequencies with theoretical or expected frequencies. The expected frequency is calculated by multiplying the row value by the column value for each response and dividing that number by the total number of participants. This formula allows researchers to see the relationship between the groups with respect to the total sample. R values were calculated for all variables. Calculating the R Value allows researchers to determine which variables are major contributors to the statistical significance. The variables having the highest R Value have the most impact upon the significance (Hinkel, Wiersma, & Jurs, 2003).

Statistical significance ($p < .025$) was achieved in 24 variables (see Table 4). The variable which did not have statistical significance was Design; however this variable will be discussed in a later section.

Table 4

Contingency Table for Learning Style Preference Comparisons of Elementary-School Students Diagnosed with Autism – 3x1 Chi-square

Learning Preference	Frequency of Observed Responses	Chi-square	R Value
Sound		19.19*	
Quiet	21		3.7
No Preference	3		-14.3
Background Noise	28		10.7
Light		26.92*	
Dim	4		-13.3
No Preference	14		-3.3
Bright	34		16.7
Temperature		15.73*	
Warm	30		12.7
No Preference	7		-10.3
Cool	15		-2.3
Motivation		49.19*	
Self-motivated	8		-9.3
No preference	3		-14.3
Motivated by others	41		23.7

* $p > .025$

Table 4 (continued)

Contingency Table for Learning Style Preference Comparisons of Elementary-School Students Diagnosed with Autism – 3x1 Chi-square

Learning Preference	Frequency of Observed Responses	Chi-square	R Value
Responsibility		9.50*	
Less conforming	24		6.7
No preference	7		-10.3
More conforming	21		3.7
Persistence		33.50*	
Multi-tasking	37		19.7
No preference	7		-10.3
Single tasking	8		-9.3
Structure		52.65*	
Less structure	5		-12.3
No preference	5		-12.3
More Structure	42		24.7
Alone		24.15*	
Prefers to learn alone	10		-7.3
No preference	8		-9.3
Prefers to learn with	34		16.7
others			

* $p > .025$

Table 4 (continued)

Contingency Table for Learning Style Preference Comparisons of Elementary-School Students Diagnosed with Autism – 3x1 Chi-square

Learning Preference	Frequency of Observed Responses	Chi-square	R Value
Pairs		24.50*	
Does not prefer to learn in pairs	11		-6.3
No preference	7		-10.3
Prefers to learn in pairs	34		16.7
Peers		37.07*	
Does not learn best with peers	6		-11.3
No preference	8		-9.3
Learns best with peers	38		20.7
Authority		57.73*	
Does not learn best with authority	7		-10.3
No preference	2		-15.3
Learns best with authority	43		25.7
Variety		48.50*	
Does not prefer variety	6		-11.3

No preference	5	-12.3
Prefers variety	41	23.7

* $p > .025$

Table 4 (continued)

Contingency Table for Learning Style Preference Comparisons of Elementary-School Students Diagnosed with Autism – 3x1 Chi-square

Learning Preference	Frequency of Observed Responses	Chi-square	R Value
Auditory		24.92*	
Does not learn best listening	7		-10.3
No preference	2		-15.3
Learns best by listening	43		25.7
Visual		44.57*	
Does not learn best by seeing	5		-12.3
No preference	7		-10.3
Learns best by seeing	40		22.7
Kinesthetic		66.26*	
Does not prefer moving	3		-14.3
No Preference	4		-13.3
Prefers moving	45		27.7
Tactual		48.50*	

Does not prefer touching	5	-12.3
No preference	6	-11.3
Prefers touching	41	23.7

* $p > .025$

Table 4 (continued)

Contingency Table for Learning Style Preference Comparisons of Elementary-School Students Diagnosed with Autism – 3x1 Chi-square

Learning Preference	Frequency of Observed Responses	Chi-square	R Value
Intake		44.93*	
Prefers intake	8		-9.3
No preference	4		-13.3
Does not prefer intake	40		22.7
Morning		17.23*	
Not preferred	20		2.7
No preference	4		-13.3
Preferred	28		10.7
Late Morning		30.26*	
Not preferred	9		-8.3
No preference	7		-10.3
Preferred	36		18.7
Afternoon		53.11*	
Not preferred	7		-10.3
No preference	3		-14.3
Preferred	42		24.7

* $p > .025$

Table 4 (continued)

Contingency Table for Learning Style Preference Comparisons of Elementary-School Students Diagnosed with Autism – 3x1 Chi-square

Learning Preference	Frequency of Observed Responses	Chi-square	R Value
Evening		16.65*	
Not preferred	18		.7
No preference	5		-12.3
Preferred	29		11.7
Mobility		15.5*	
Not Preferred	23		5.7
No Preference	4		-13.3
Preferred	25		7.7
Reflective/Impulsive		16.65*	
Reflective	18		.7
No preference	5		-12.3
Impulsive	29		11.7
Analytical/Global		10.42*	
Analytical	17		.3
No preference	8		-9.3
Global	27		9.7

* $p < .025$

Sound. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for a learning environment which is quiet or includes sound, $X^2(2, N = 52) = 19.19, p = .000$. A Chi-square analysis revealed the major contributor ($R = -14.3$) to this significance is students with autism revealed they did indeed have specific preferences as only 3 students chose not to prefer either a quiet or sound inclusive environment. The majority of students preferred to learn in an environment which included sound ($n = 28, R = 10.7$), however, many students expressed a preference for a quiet learning environment as well ($n = 21, R = 3.7$).

Light. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for a learning environment of low light or bright light, $X^2(2, N = 52) = 26.92, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be their strong preference for learning in environments which have bright lighting ($n = 34, R = 16.7$). Conversely this left significantly fewer students with autism than expected by chance indicating a strong preference for learning new and difficult material in dim light ($n = 4, R = -13.3$). Fourteen students with autism expressed no preference in the lighting of their learning environments ($R = -3.3$).

Temperature. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for a warm or cool learning environment, $X^2(2, N = 52) = 15.73, p = .000$. A Chi-square analysis revealed the major contributor to this significance

was their strong preference for learning in a warm environment ($n = 30$, $R = 12.7$). Fewer students than expected expressed no preference of room temperature ($n = 7$, $R = -10.3$) while learning. A significant number of students with autism preferred to learn in warm environments.

Motivation. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning in an environment where they were self-motivated or motivated by others, $X^2(2, N = 52) = 49.19, p = .000$. A Chi-square analysis revealed the major contributor to this significance was their preference to be motivated by others ($n = 41$, $R = 23.7$). Fewer students with autism than expected by chance showed a strong preference for being self motivated ($n = 8$, $R = -9.3$), while only a few students expressed no preference ($n = 3$, $R = -14.3$), also a contributing factor to the significant Chi-square value. A significant number of students with autism had a strong preference for being motivated by others.

Responsibility. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for being less or more conforming, $X^2(2, N = 52) = 9.5, p = .009$. A Chi-square analysis revealed the major contributor to this significance was the absence of a preference ($n = 7$, $R = -10.3$) as less students than expected by chance made this selection. More students than expected by chance had a strong preference for conforming ($n = 21$, $R = 3.7$), and more students with autism expressed a preference ($n = 24$, $R = 6.7$) for being non-conforming. Students with autism had a strong preference for conforming or not conforming as only 7 students chose no preference.

Persistence. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for single-task persistence and multi-task persistence, $X^2(2, N = 52) = 35.5, p = .000$). A Chi-square analysis revealed the major contributor to this significance was their preference for multi-task persistence ($n = 37, R = 19.7$). Also contributing to this significance is their greater than expected number of choices for not showing a preference ($n = 7, R = -10.3$). A significant number of students with autism had a strong preference for multi tasking and taking short breaks while completing tasks.

Structure. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for a learning environment with more or less structure, $X^2(2, N = 52) = 52.65, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be students' strong preference for learning in environments which are structured ($n = 42, R = 24.7$). Fewer students than expected by chance expressed a preference for an unstructured environment ($n = 5, R = -12.3$) and fewer students than expected by chance expressed no preference for either a structured or unstructured learning environment ($n = 5, R = 12.3$). The results reveal that students with autism strongly prefer learning in a structured environment.

Alone. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning alone or with others, $X^2(2, N = 52) = 24.15, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be students' strong preference for learning with others ($n = 34, R = 16.7$). Conversely, fewer students

expressed a preference for learning alone ($n = 10$, $R = -7.3$) as well as fewer students than expected expressing no preference ($n = 8$, $R = -9.3$). These results revealed that students with autism indicated a strong preference for learning with others.

Pairs. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning in pairs, $X^2(2, N = 52) = 25.50, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a preference for learning in pairs ($n = 34$, $R = 16.7$). In addition, fewer students than expected by chance did not express a preference for either learning in pairs or not learning in pairs ($n = 7$, $R = -10.3$). These results indicated students with autism prefer to learn in pairs.

Peers. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning with peers, $X^2(2, N = 52) = 37.07, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a strong preference for learning best with peers ($n = 38$, $R = 20.7$). Conversely, this analysis showed students with autism do not prefer to learn without peers ($n = 6$, $R = -11.3$). However, it should be noted that more students chose no preference ($n = 8$, $R = -9.3$) than chose a non-preference for working with peers. These results revealed students with autism indicated a strong preference for learning with peers.

Authority. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning with authority, $X^2(2, N = 52) = 57.73, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a strong

preference for authority ($n = 43$, $R = 25.7$). In addition fewer students with autism than expected indicated they had no preference ($n = 2$, $R = -15.3$) and fewer students indicated a non-preference ($n = 7$, $R = -10.3$). These results revealed students with autism indicated a strong preference for learning with authoritative adults.

Variety. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for variety $X^2(2, N = 52) = 48.50, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a strong preference for material being presented in a variety of different ways ($n = 41$, $R = 23.7$). Additionally, fewer than expected students expressed they did not prefer variety ($n = 6$, $R = -11.3$, and fewer students with autism expressed no preference ($n = 5$, $R = -12.3$). These findings revealed students with autism indicated a strong preference for new and difficult material being presented in a variety of ways, and through a variety of sociological preferences.

Auditory. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 26.0$) of choices by students with autism for two levels of preference for learning by listening $X^2(1, N = 52) = 24.92, p = .000$, as no students with autism indicated no preference. A Chi-square analysis revealed the major contributor to this significance to be a preference to learn best by listening ($n = 43$, $R = 18.0$). Conversely, fewer students than expected ($n = 7$, $R = -18.0$) expressed a preference for not learning best by listening. This indicates that students with autism preferred to learn in an auditory manner.

Visual. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three

levels of preference for learning visually $X^2(2, N = 52) = 44.57, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a preference for materials to be presented in a visual manner ($n = 40, R = 22.7$). Additionally, fewer students expressed they did not learn best when material was presented visually ($n = 5, R = -12.3$) and students with autism than expected did not express a preference ($n = 7, R = -10.3$). These findings reveal students with autism strongly preferred to learn information visually.

Kinesthetic. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning through movement $X^2(2, N = 52) = 66.26, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a preference for learning best by moving ($n = 45, R = 27.7$). Additionally, fewer than expected students expressed a preference for not moving while learning ($n = 3, R = -14.3$) and fewer students did not express a preference ($n = 3, R = -14.3$). Analysis of this element indicates students with autism preferred to learn by moving.

Tactual. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning by touching $X^2(2, N = 52) = 48.50, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a preference for learning best by touching ($n = 41, R = 23.7$). Additionally, fewer students than expected expressed they did not learn best by touching ($n = 5, R = -12.3$) and fewer students did not express a preference ($n = 6, R = -11.3$). These results indicate students with autism expressed a strong preference for learning by touching.

Intake. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for intake or snacking while learning $X^2(2, N = 52) = 44.93$, $p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a preference for intake while learning ($n = 40$, $R = 22.7$). Additionally, fewer students than expected expressed a non-preference for intake while learning ($n = 8$, $R = -9.3$) and fewer students did not express a preference ($n = 4$, $R = -13.3$). These results indicate students with autism expressed a strong preference for eating or drinking while learning.

Morning. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning in the morning $X^2(2, N = 52) = 17.23$, $p = .000$. A Chi-square analysis revealed the major contributor to this significance to be that less students with autism than expected did not express a preference or non-preference for learning in the morning ($n = 4$, $R = -13.3$). However, when they did express a preference, they preferred to learn in the morning ($n = 28$, $R = 10.7$) as opposed to not preferring morning ($n = 20$, $R = 2.7$). These results indicate that students with autism prefer to learn in the morning.

Late Morning. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning in the late morning $X^2(2, N = 52) = 30.26$, $p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a preference to learn in the late morning ($n = 36$, $R = 18.7$). A strong contributor to this analysis is also less students than expected expressed no preference ($n = 7$,

R = -10.3). However, these data indicated that students with autism preferred to learn in the late morning.

Afternoon. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning in the afternoon $X^2(2, N = 52) = 53.11, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be a strong preference for learning in the afternoon ($n = 42, R = 24.7$). Additionally a contributing factor to this significance is fewer students with autism than expected expressed no preference ($n = 3, R = -14.3$). These findings indicated students with autism show a strong preference for learning in the afternoon.

Evening. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for learning in the evening $X^2(2, N = 52) = 16.65, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be both a preference for learning in the evening ($n = 29, R = 11.7$) and a contributor of almost equal significance, no preference ($n = 5, R = -12.3$). A non preference for learning in the evening was not found to be a contributor to this significance ($R = .7$). This analysis revealed students with autism prefer to learn in the evening.

Mobility. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for mobility while learning $X^2(2, N = 52) = 15.50, p = .000$. A Chi-square analysis revealed the major contributor to this significance to be students responding they did not have a preference ($n = 4, R = -13.3$). Student responses to

preferences for more or less mobility were somewhat evenly distributed ($n = 23$, $R = 5.7$) and ($n = 25$, $R = 7.7$) respectively. This analysis indicated students with autism had varied preferences for more or less mobility while learning.

Reflective/Impulsive. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for being reflective or impulsive students $X^2(2, N = 52) = 16.65, p = .000$. A Chi-square analysis revealed contributors to this significance to be the preference of students with autism to be impulsive ($n = 29$, $R = 11.7$) as well as fewer than expected students expressing a preference ($n = 5$, $R = -12.3$). A preference for being reflective did not contribute to this significance ($R = .7$). This analysis revealed students with autism prefer to be impulsive.

Analytical/Global. There was a significant difference beyond the .025 level among the observed and expected frequencies ($n = 17.3$) of choices by students with autism for three levels of preference for being an analytical or global learner. $X^2(2, N = 52) = 10.42, p = .000$. A Chi-square analysis revealed contributing factors to this significance to be the preference of students with autism to be global learners ($n = 27$, $R = 9.7$) as well as fewer than expected students expressing a preference ($n = 8$, $R = -9.3$). A preference for being an analytical learner was not a contributor to this significance ($R = .3$). This analysis reveals students with autism prefer global learning environments.

Table 5

Summary of Findings for Learning-Style Preferences of Elementary Students with Autism

Learning-style element	Findings
Sound	Students with autism preferred to learn in an environment with background noise.
Light	Students with autism preferred to learn in a brightly lit environment
Temperature	Students with autism preferred to learn in a warm environment
Motivation	Students with autism indicated a preference for being motivated by others
Responsibility	Students with autism indicated a preference for conforming or not-conforming
Persistence	Students with autism indicated a preference for multi-tasking and taking short breaks while working

Table 5 (continued)

Summary of Findings for Learning-Style Preferences of Elementary Students with Autism

Learning-style element	Findings
Structure	Students with autism indicated a preference for learning with structure
Alone	Students with autism preferred to learn with others
Pairs	Students with autism preferred to learn in pairs
Peers	Students with autism indicated they learn best with peers
Authority	Students with autism indicated they learn best with authority
Variety	Students with autism a preference for material being presented in a variety of different ways and through a variety of sociological preferences
Auditory	Students with autism indicated they learn best by listening
Visual	Students with autism indicated they learn best by seeing

Table 5 (continued)

Summary of Findings for Learning-Style Preferences of Elementary Students with Autism

Learning-style element	Findings
Kinesthetic	Students with autism preferred to move while learning
Tactual	Students with autism indicated a preference to learn by touching
Intake	Students with autism prefer intake while learning
Morning	Students with autism indicated no preference
Late Morning	Students with autism preferred learning in late morning
Afternoon	Students with autism preferred learning in the afternoon
Evening	Students with autism indicated no preference

Mobility

Students with autism indicated varied preferences for more or less mobility when learning

Table 5 (continued)

Summary of Findings for Learning-Style Preferences of Elementary Students with Autism

Learning-style element	Findings
Reflective/Impulsive	Students with autism see themselves as impulsive
Analytical/Global	Students with autism prefer global learning environments
Design	No significance found

Summary

Interpretation of these data reveal students with autism prefer to learn in ways that indicate some commonality. In 24 of the 25 preferences tested, responses were significantly different beyond the .025 level between observed and expected frequencies as measured by a Chi-square Goodness of Fit Test (see Table 4).

The Dunn & Dunn learning style model consists of 20 elements, measured by 25 variables in five strands; Environmental, Emotional, Sociological, Physiological and Psychological. The following is a summary of findings as related to these five strands.

Students respond to a number of environmental factors when learning. This research showed that students with autism indicated a preference for learning in environments which included background noise, however 40% of the students tested indicated they preferred a quiet environment. Students also indicated a strong preference for bright light while learning compared to dim light and a significant preference for a warm environment with almost 50% of the students preferring warm temperatures while learning. These preferences are important for educators because when environmental needs of students are met they show better attitudes, higher retention rates, and greater achievement (Dunn, Rundle, & Burke, 2007). It should be noted that the element of Design which considers a formal or casual arrangement of the classroom did not meet the more stringent level of significance (.025) chosen for this study. However, the level of significance was found to be .035 which had the researcher opted for a more traditional level of significance (.05) would have been a consideration. Students with autism indicated a preference for a more structured environment.

Student preferences for varied sociological learning opportunities were also examined. Students with autism report that they learned best in a variety of social settings. While the social makeup of a classroom is usually teacher directed, peer collaboration and interaction in one-to-one and small group settings were important to these students with autism as is working with authoritative adults in a variety of different ways.

Physiological elements that influence learning include perceptual elements such as material being presented in a visual, auditory or tactual manner, time of day, intake, and opportunities for mobility during learning. This study reveals that students with autism preferred not to snack while learning. While fewer than expected students expressed preferences for learning at specific times of the day, those that did express preferences stated they learned best in the afternoon. They also expressed preferences for material to be presented to them through various perceptual modalities.

There are commonalities among the emotional needs of students with autism. They reported a strong need for structure and authority and felt they were motivated by others. This analysis also showed that students with autism were more multi-task persistent than single task persistent, desiring frequent breaks during work periods.

Students with autism see themselves as more global than analytical learners. Global thinkers prefer to develop an understanding of the concept and then develop the details. The implications of these findings will be discussed in depth in Chapter Five.

Research Question Two: Description of the Analysis

This data analysis refers to research question two: Are there significant differences between the preferred learning- style preferences of students with autism and

the learning-style preferences of their typical elementary level peers? To determine whether there was a significant difference for each of the 25 Dunn and Dunn learning-style preferences, 25 two sample 3 x 2 Chi-square Crosstabs were used. The Chi-square Crosstabs test is an appropriate nonparametric statistical test to determine if significant differences exist beyond the .05 level between observed and expected frequencies.

The three cells represent the collapsed version of the criteria used by the Elementary Learning Style Assessment (2007) where students from each of the two groups rated their preferences at five levels (Steinberg, 2008). Although categories on a variable--especially a dependent variable--may be collapsed, they cannot be excluded from a Chi-square analysis. Therefore, this analysis did not arbitrarily exclude some subset of the learning-style preferences from the analysis. The decision to collapse categories was carefully motivated, with consideration for preserving the integrity of the data as it was originally collected and with author permission. The categories which were collapsed were as follows: "Strong preference" and "Somewhat of a Preference" were collapsed and relabeled "Preference". "Strong non-preference" and "Somewhat of a non-preference" were collapsed and relabeled "Non-preference". The analysis of the 3x2 Chi-square is reported for each learning-style element using an alpha level of .025 (see Table 6). These findings listed below reveal the differences in learning styles between students with autism and their typical peers.

Table 6

Contingency Table for Learning Style Preference Comparisons Between Elementary-School Students with Autism and Their Typical Peers – 3 x 2 Chi-square

Learning Preference	Responses for Students with Autism	Responses for Typical Students	Chi-square Value
<u>Light</u>			14.84 *
Low	4	18	
Standardized Residual	-1.9	1.8	
No Preference	14	23	
Standardized Residual	-.8	.7	
Bright	34	19	
Standardized Residual	1.9	-1.8	
<u>Authority</u>			14.44*
Does not learn best with authority	7	10	
Standardized Residual	-.3	.3	
No preference	2	18	

	Responses for Students with Autism	Responses for Typical Students	Chi-square Value
Standardized	-2.4	2.2	
Residual			
Learns best with authority	43	32	
Standardized	1.4	-1.3	
Residual			

* $p > .025$

Table 6 (continued)

Contingency Table for Learning Style Preference Comparisons Between Elementary-School Students with Autism and Their Typical Peers – 3 x 2 Chi-square

	Responses for Students with Autism	Responses for Typical Students	Chi-square Value
<u>Auditory</u>			12.99*
Does not learn by listening	8	9	
Standardized	.0	.0	
Residual			
No preference	0	13	

	Responses for Students with Autism	Responses for Typical Students	Chi-square Value
Learning Preference			
Standardized	-2.5	2.3	
Residual			
Learns by listening	44	38	
Standardized	1.0	-.9	
Residual			
<u>Reflective/Impulsive</u>			16.08*
Reflective	18	43	
Standardized	-1.9	1.8	
Residual			
No Preference	5	5	
Standardized	.2	-.2	
Residual			
Impulsive	29	12	
Standardized	2.3	-2.1	
Residual			

*p < .025

Table 7

Contingency Table for Expected Frequency Count Comparisons Between Elementary-School Students with Autism and Their Typical Peers – 3 x 2 Chi-square

Learning Preference	Expected Count for Students with Autism	Expected Count for Typical Students
Light		
Low Light	10.2	11.8
No Preference	17.2	19.8
Bright Light	24.6	28.4
Authority		
Does not learn best with authority	7.9	9.1
No Preference	9.3	10.7
Learns best with authority	34.8	40.2
Auditory		
Does not learn best by listening	7.9	9.1
No preference	6.0	7.0
Learns best by listening	38.1	43.9

Table 7 (Continued)

Contingency Table for Expected Frequency Count Comparisons Between Elementary-School Students with Autism and Their Typical Peers – 3 x 2 Chi-square

Reflective/Impulsive		
Reflective	28.3	32.7
No preference	4.6	5.4
Impulsive	19.0	22.0

Light. There was a significant difference beyond the .025 level between the two groups, students with autism and typical elementary students, for the three levels of preference for learning in an environment with either low or bright light, $X^2(2, N = 112) = 14.84, p = .001$. A Chi-square Crosstabulation analysis revealed more students with autism had a preference for learning new and difficult information in an environment with bright light ($n = 34, R = 1.9$) or 65.4%, while fewer typical students expressed a preference for bright light ($n = 19, R = -1.8$) or 31% within this group. Furthermore, fewer students with autism expressed a preference for learning in an environment with low light ($n = 4, R = -1.9$) or 7.7% of students with autism, while more typical students expressed a preference for low light ($n = 18, R = 1.8$) or 30.0%. Fewer students with autism had no preference ($n = 14, R = -.8$) or 26.9% while more typical students expressed no preference ($n = 23, R = .7$) or 38.6%. These data indicated that students with autism preferred learning in an environment with bright light in contrast to their typical peers who expressed no preference.

Authority. There was a significant difference beyond the .025 level between the two groups, students with autism and typical elementary students, for the three levels of preference for learning with authority, $X^2(2, N = 112) = 14.44, p = .001$. A Chi-square Crosstabulation revealed students with autism had a preference for learning with authority ($n = 43, R = 1.4$) or 82.7% of this group, while fewer typical students expressed a preference for learning with authority ($n = 32, R = -1.3$) or 53.3%. In addition, fewer students with autism ($n = 7, R = -.3$) or 13.5% of this group and more typical students (n

= 10, $R = .3$) or 16.7% reported they did not learn best with authority. More typical students ($n = 18$, $R = 2.2$) or 30% of this group, than students with autism ($n = 2$, $R = -2.4$) or 3.8% showed no preference. These data revealed students with autism expressed more of a preference for learning with authority than their typical peers.

Auditory. There was a significant difference beyond the .025 level between the two groups, students with autism and typical elementary students, for the three levels of preference for learning by listening, $X^2(2, N = 112) = 12.99, p = .002$. A Chi-square Crosstabulation revealed students with autism reported learning best by listening ($n = 44$, $R = 1.0$) or 84.6% of this group, while fewer typical students expressed a preference for learning by listening ($n = 38$, $R = -.9$) or 63.3%. In addition, approximately the same number of students with autism ($n = 8$, $R = .0$) or 15.4% and typical students ($n = 9$, $R = .0$) or 15% reported they did not learn best by listening. More typical students ($n = 13$, $R = 2.3$) or 21.7% of this group, than students with autism ($n = 0$, $R = -2.5$) showed no preference. Significantly more typical students than students with autism indicated they had no preference.

Reflective/Impulsive. There was a significant difference beyond the .025 level between the two groups, students with autism and typical elementary students, for the three levels of preference for being a reflective or impulsive learner, $X^2(2, N = 112) = 16.80, p = .000$. A Chi-square Crosstabulation analysis revealed fewer students with autism considered themselves to be reflective ($n = 18$, $R = -1.9$) or 34.6% of this group, while more typical students expressed a preference for being reflective ($n = 43$, $R = 1.8$) or 71.7%. In addition, more students with autism ($n = 29$, $R = 2.3$) or 55.8% of this group and fewer typical students ($n = 12$, $R = -2.1$) or 20%, expressed a

preference for being impulsive. The same number of students in both groups expressed no preference ($n = 5$) or 9.6% of students with autism and 8.3% of typical students. These data indicate that students with autism see themselves as less reflective students while typical students see themselves as more reflective.

Interpretation of these data indicates students with autism preferred to learn in ways that are sometimes significantly different from their typical peers. In four of the 25 preferences tested, responses were significantly different beyond the .025 level between observed and expected frequencies as measured by a Chi-square Crosstabulation (see Table 8).

Table 8

Summary of Findings for Learning-Style Preference Differences Between Elementary-School Students with Autism and Their Typical Peers

Learning Preference	Findings
Light	Students with autism preferred to learn in environments with bright light while their typical peers expressed no preference.
Authority	Students with autism had more of a preference than their typical peers for learning with an authoritative adult.
Auditory	While both groups preferred to learn by listening, no students with autism reported they did not have a preference.
Reflective/Impulsive	Students with autism saw themselves as less reflective than their typical peers.

Summary

Interpretation of these data indicates that students with autism prefer to learn in ways that are sometimes significantly different from their typical peers. In four of the 25 preferences tested, responses were significantly different beyond the .025 level between observed and expected frequencies as measured by a Chi-square Crosstabulation (see Table 6).

The Dunn & Dunn learning style model consists of 20 elements, measured by 25 variables in five strands: environmental, sociological, physiological and psychological. The following is a summary of findings as they relate to these five strands.

Several factors contribute to the physical makeup of the learning environment. This research revealed that students with autism prefer to learn in an environment which includes bright light whereas their typical peers indicated no preference for either dim or bright lighting in their learning environment.

Student preference for learning environments which varied sociologically was also examined. Students with autism indicated a strong desire to learn with authoritative adults, although their typical peers generally agreed, they also indicated having no preference.

The physiological elements examine student preference for the manner in which material is presented. More students with autism indicated they preferred to learn by listening. Yet approximately the same number of students with autism and typical students reported they did not learn best by listening, and more typical students reported no preference.

The psychological elements examine a student's preferences for reflection or impulsivity and for materials being presented in a global or analytical manner. Students with autism indicated being less reflective students while their typical peers saw themselves as more reflective. The same number of students in both groups expressed no preference. The implications of these findings will be discussed in depth in Chapter Five.

Conclusion

The analyses presented in this chapter summarized the responses to the two research questions presented in this study. The data analysis for research question one investigated the learning-style preferences of students with autism. The results indicated that there were significant commonalities in the manner in which students with autism preferred to learn.

The data analysis for research question two explored the similarities or differences between the learning-style preferences of students with autism and their typical peers. The results provided an indication of significant differences in learning-style preferences between students with autism and their typical peers in four of the learning-style elements studied.

These differences have implications for students and teachers in the inclusive environment of a general education classroom as well as the more specialized, smaller group classroom. These findings provide valuable information for educators of students with autism and will be discussed further in Chapter Five.

CHAPTER FIVE: SUMMARY AND CONCLUSIONS

The five sections of Chapter Five will expand upon and provide further understanding of the research conducted in this study. The Summary of the Study section provides an overview of the research conducted to determine preferred learning-styles of students with autism and examines the question of the uniqueness of these preferences to this population. The Findings section reviews the statistical analyses of the outcomes of this inquiry as they relate to learning and teaching of students with autism as discussed in Chapter Two. The Limitations of the Study section expands on the assertions made in Chapter Three through a candid discussion of issues and questions that arise from this research study. The Implications section offers suggestions on how the results of this study can be used to develop learning opportunities for students with autism which incorporate a consideration for preferred learning methods and environments. Finally, the Suggestions for Further Research section will indicate areas for possible expansion on this investigation into the learning style preferences of students with autism in efforts to provide the most beneficial learning experiences.

Summary of the Study

The general focus of this study was to investigate the preferred learning-styles of students with autism and to determine if there was a significant difference between their preferences and that of their typical peers. The rise in the incidence of a diagnosis of autism is a pressing call to educators to develop a better understanding of the unique profile these students present and to carefully plan educational opportunities which have been thoughtfully created with mindful consideration of student preferences.

This study sought to measure the similarities and differences in the learning preferences of students with autism in comparison to their typical peers and to investigate the possible uniqueness of their learning preferences as a group by responding to the following questions:

1. Are there common learning-style preferences among students who are diagnosed with autism?
2. Are there significant differences between the preferred learning-style preferences of students with autism and the learning-style preferences of their typical elementary level peers?

Data on student learning-style preferences were collected from student responses to questions on the Elementary Learning Style Assessment (ELSA), a comprehensive diagnostic instrument that considered 25 different variables in each individual's environment, sociological, and cognitive processing traits as described in the Dunn and Dunn learning-style model. Responses were subjected to a statistical analysis using 25 one sample 3 x 1 Chi-square Goodness of Fit Tests for the data collected for research question one and 25 two sample 3 x 2 Chi-square Crosstabulations for the data collected for research question two.

The participants in this study represented a sample of convenience selected to suit the purposes of this study. The target population was students with autism representative of a cross-section of students whose diagnoses fall along the Autism Spectrum. These students attended a private school in a large metropolitan area which was characteristic of a diverse ethnic and cultural make-up.

Findings

The quantitative data analysis of this study included two types of Chi-Square tests, a Chi-square Goodness of Fit test to analyze the data collected for research question one and a Chi-square Crosstabulation to analyze the data collected for research question two.

Research question one required 52 students with autism to define their learning-style preferences for 20 elements on the Elementary Learning Style Assessment. To analyze their responses, 25 one sample 3 x 1 Chi-square Goodness of Fit tests were used. The 25 independent variables were rated by students with autism within a five option scale. The data collected were collapsed into a three option scale as discussed at length in Chapter 4. These findings revealed the following preferences. Students with autism had a significant within-group preference for learning in an environment which was warm and structured, included opportunities for food intake, movement and tactual strategies, and was designed for them to learn in a variety of different ways including by listening and by seeing. They reported a preference for learning alongside authoritative adults and being motivated by others. They showed a significant preference for learning at various times in the day with afternoon being their strongest choice. Students with autism revealed a significant preference for learning alone, in pairs and with peers with their strongest preference being with peers. The interpretation of these findings will be discussed in the implications section of this chapter.

Twenty five Chi-square Crosstabulations were used to analyze the data collected in answer to questions posed by research question two. These data compared the responses of 52 students with autism and 60 typical peers to questions about learning-

style preferences on the Elementary Learning Style Assessment. Again, 25 independent variables were rated by students with autism within a five option scale: “strong preference”, “somewhat strong preference”, “no preference”, “somewhat strong non-preference” and “strong non-preference” as designed by the instrument. The data collected were collapsed into a three option scale as discussed at length in Chapter 4. Analysis of these data revealed students with autism, when compared to their typical peers, reported a significant preference for learning in an environment which included bright light, and required them to listen to the teacher. In comparison, the responses of their typical peers were fairly evenly distributed across responses in choosing low, no preference or bright light (18, 23, and 19 students respectively) and 22% of their typical peers reported no preference for learning in an auditory manner while no students with autism chose “no preference” as their response. They also differed significantly in that they preferred to learn with an authoritative adult as opposed to their typical peers who, although they also preferred to learn with an authoritative adult, 30% said they had “no preference” whereas only 4% of students with autism chose this response. Students with autism also felt themselves to be impulsive (56% as opposed to 20% of typical peers) rather than reflective students, while their typical peers made choices which indicated they felt they were more reflective (72% as opposed to 35% of students with autism). The importance of these findings will be reviewed in the implications section of this chapter.

Comparison and Contrast of the Findings

The Review of the Literature in Chapter Two supports evidence for increased achievement and improved attitudes when responsive instruction was available for

diagnosed learning-style preferences (Lovelace, 2005). The importance of teaching in a climate where a student's learning-style preferences are apparent and honored was noted by many researchers (Burke & Dunn, 2003; Dunn, Beaudry, & Klavas, 1989; Dunn & DeBello, 1999; Dunn, Denig, & Lovelace, 2001; Dunn & Dunn, 1992). Previous studies also investigated the effects of teaching to student's learning-style preferences when there is the confounding presence of special education identification. Several studies documented the positive effects of teaching to all students' preferred learning-style (Braio, Beasley, Dunn, Quinn, & Buchannan, 2001; Brand, 1999; Brunner & Majewski, 1990; Fine, 2002; and Grebb, 1999) and serve as a foundation for this investigation. This study extended previous research to include a population of students with autism who were not specifically identified in previous research and found the uniqueness of its findings for this population to be in concert with that of other students identified as having special needs. The responses of the subjects with autism in this study indicated there were commonalities within diagnosis of students' learning-style preferences as was found by Brand (1999) and Greb (1999) with students diagnosed with ADD, Fine (2002) with students diagnosed with a learning disability or emotional disturbance and Brunner and Majewski (1990), and Braio, et al. (2001) who studied the learning-style preferences of students diagnosed as mildly handicapped. Drs. Dunn and Dunn (1992) maintain that everyone can learn, but differently. As evidenced by the responses of the subjects in this study, it is apparent that groups with common diagnoses make unique choices in just how they prefer to learn.

Educators must investigate varied methods of intervention and education models for students with autism (Jordan & Powell, 1995; Olly, 1999; Rogers & Vismara, 2008).

While some research has focused on the benefits of a particular method of intervention, this research focuses on the need for educators to possess a clear understanding of how their students with autism prefer to learn and to use that understanding when planning learning opportunities regardless of the chosen method of intervention. Teacher awareness and understanding of behaviors and perceptions unique to autism may facilitate the development and implementation of strategies created specifically to ease potentially overwhelming classroom experiences for both students and teachers (Friedlander, 2009). This research provides teachers with additional insight into the complex nature of students with autism.

Limitations of the Study

The most profound limitation of this research was the inability to pinpoint a generalization of the diagnosis of autism. Being a spectrum disorder, the very nature of the diagnosis encompasses students who may present very different profiles (Cohen & Volkmar, 1997). The subjects participating in this study were students who were able to read and understand questions presented to them on a computer screen and written at a second grade level, and possessed fine motor skills which allowed them to independently use a computer. They also had sufficient cognition for self reflection, completion of decision making tasks and following verbal direction. A profile including these skills is indicative of all students with autism and may be considered a threat to this study's external validity, therefore the results of this research should be carefully applied to this population and the extent to which the results of this study can be applied to all students with autism may be limited and should be cautiously considered.

Furthermore, while this sample of students with autism was somewhat diverse, it was a sample of convenience taken from a population at only one school at one location. Although these students may have fallen at different points along the autism spectrum, their educational experiences had generally been somewhat common, perhaps skewing their perspective of how they learned best. Furthermore, the academic levels of the participants in this study were assessed by teacher reported reading levels, the ungraded nature of the school which they attended made it difficult to draw an absolute comparison to the subjects selected from the ELSA database. Finally, students were recommended for this study by their classroom teacher as they were unknown to the researcher prior to the study. Teacher's may have recommended students who they felt would align more closely with typical students as they had worked hard to teach them, sometimes for multiple years. However, it should be remembered that students who attended this school were sent there by their hometown school districts because they lacked the resources to offer an appropriate instructional program.

The students with autism in this study were engaged by the researcher in a brief discussion about learning style. This took place in the test setting with the researcher and one or two students at a time. Students were able to ask questions for clarification and it was determined by the researcher that they had an understanding of how to proceed. This group was compared to a group of typical students through data taken from a national data base. The researcher has no knowledge of just how the topic of learning styles was presented and explained to this group by examiners, or the format in which the Elementary Learning Style Assessment was given other than the students used computers to answer the questions. The variation in presentation, explanation, and setting of the test

and could possibly have had some effect on the outcome and should be considered an internal threat to its validity.

Implications

The implications of this research may be far reaching and have the potential to change the lives of students with autism. Good science takes what we thought we knew and rewrites the course. Studies examining the academic, social, emotional, and behavioral benefits to students who are taught in a learning environment which considers their preferred learning style have been discussed and well documented in this and previous chapters (Burke & Dunn, 2003; Dunn, Beaudry, & Klavas, 1989; Dunn & DeBello, 1999; Dunn, Denig, & Lovelace, 2001; Dunn & Dunn, 1992). Researchers have delineated student groups by age, gender, ability, and diagnosis, finding a common thread among groups for preferred learning styles, and differences between delineated groups and the general education population (Braio, et al., 2001; Brand, 1999; Brunner & Majewski, 1990; Fine, 2002; Greb, 1999). This knowledge has allowed educators the opportunity to craft learning environments to meet the needs of all students through their preferred learning style, assisting in the development of opportunities that capitalize on individual strengths and support a student's exploration of their world.

Students with autism have not previously been identified as a research group in the area of preferred learning style although the Amendments to the Individuals with Disabilities Education Act (IDEA, 1999), as well as many other initiatives, provide for scientifically-supported interventions. This omission may, in part, contribute to the feelings of frustration and lack of knowledge and understanding expressed by some teachers who teach students with autism. As more and more students are labeled with

this sometimes elusive and complex diagnosis teacher must possess the competence and appropriate strategies to teach them, as considerable expertise is required. Personnel preparation remains one of the weakest elements in effective programming for students with autism (National Research Council, 2001). This study will assist teachers as they search for this understanding and its findings should be included in professional development activities for all teachers.

This study showed diverse preferences among students with autism which may not have been considered by previous researchers. A significant number of students with autism expressed strong preferences within categories which suggested an autonomy and self-realization not previously stressed. For example, they expressed a desire to engage in sociological learning opportunities as varied as learning in a one-to-one setting or in a small group setting. These findings are not surprising when considered within the profile of autism. These students generally have idiosyncrasies in play and social relationships, which make it difficult for them to engage in shared focus and reciprocal social interest and they can often be overwhelmed in a larger group setting (Sigmund, Mundy, Sherman, & Ungerer, 1986). This insight into the preferred social interactions of students with autism may allow teachers to create opportunities within the classroom where all students can be comfortable while engaging in cooperative learning experiences. Thoughtful planning may benefit students with autism in all areas of learning especially communicative and behavioral and social realms.

Students with autism also expressed significant preferences for material to be presented in many different ways such as visually, tactually or in an auditory manner. While researchers have underscored the importance of visually cued instruction

(Attwood, 1998; Grandin, 1995; Quill, 2000), students with autism stated that they, in fact, had varied preferences for the way material is presented. Teachers are now faced with the possibility that they may not have considered each and every teaching strategy when planning for their students with autism. Armed with new insight into how these students prefer to learn, teachers can now make more informed choices when planning instruction, drawing from a more varied bank of resources.

The differences between typical students and students who have autism can be quite apparent in a classroom setting. However, these differences may not be addressed either in delivery of instruction or when considering how children learn best. While typical students generally have the language and social skills to make their wants and needs known to the teacher, students with autism may lack some of these skills making it difficult to voice their discomfort, ultimately producing challenging behaviors. Behavior can be looked at from two perspectives, the teacher's perspective where a child with autism is seen as non-compliant, destructive of property or disruptive, and the child's perspective of not understanding the demands of the classroom, difficulty in developing and maintaining social interactions, and a general discomfort with their environment causing distress and behaviors which may not be seen as acceptable in a general education classroom (National Research Council, 2001). This research evidences that students with autism are capable of making choices about their environment, social, physiological, and psychological preferences, which may enable them to better navigate their world, and that these preferences, may indeed differ from those of their typical peers. In fact, this researcher was struck by the swiftness and clarity of students' answers. They had definite ideas about their preferences and were eager to record and

discuss them. The awareness and manipulation of environmental components empowers students and teachers to develop learning places and plans, which address the needs of students on various levels enabling higher achievement.

A teacher's greatest challenge is to gain an understanding of how students learn best. Their mission is to create thoughtful learning opportunities which consider how each student is likely to learn most efficiently. However, teachers have learned that their input is not enough; they must take instruction to the next level, which is careful observation and assessment of student understanding using valid and reliable methods of evaluation. If student evaluation is presented in a manner which is counter-intuitive to how a student learns best, the validity of this assessment could be in question. This underscores the importance of the need for a deep understanding of each student's preferred learning style, especially students who are known to have developed differently from their peers and who have a unique world perspective.

Suggestions for Future Research

While there are several researchers from many theatres of expertise investigating just how students with autism experience their world, it is evident from a careful review of the literature in this field that researchers have not addressed the learning-style preferences of this particular group of students. Now that teachers have gained this awareness, the implications for classroom and instructional design are widespread. Managing diverse behaviors and learning needs is one of the most challenging tasks for a teacher. The possibility of a greater understanding of perhaps why these behaviors are occurring and how sometimes small changes in the environmental, social, emotional, psychological, or physiological makeup of the classroom can help to facilitate a more

comfortable classroom for students with autism, has the potential to guide teachers to create more meaningful learning opportunities for students with autism.

Future researchers may want to explore how a student's placement on the spectrum affects their choices. While students included in this study were felt to be somewhat of a cross-section of elementary level students with autism, a magnified look along the spectrum might isolate certain preferences for students at particular points. This refined data will allow educators to design more effective learning opportunities for all students with autism.

Researchers might take information from this study and apply it within the confines of various educational approaches. Since there is no general consensus on just which educational intervention might be most beneficial for students with autism, perhaps if each approach were studied through a lens of consideration for student's learning-style preferences, a more definitive program could be implemented with better results.

For researchers to gain a better understanding of how students with autism will benefit from knowledge of their learning-style preferences it must be put into practice. Until teachers who are responsible for the education of this population actually create and study classrooms which honor their individual preferences, there is no complex understanding of the impact on their learning. More studies need to be conducted in settings where quantitative, as well as qualitative, data can be collected and analyzed. Researchers must not limit their studies merely to what students learn, but equally important, they must examine just how students are learning.

As we struggle to educate more and more students with autism our schools must turn to current research and adopt programs and practices that support these data. Generally speaking students with autism are no longer committed to spend their school days in self-contained rooms where their emotional and social needs are sometimes left unmet. That being said, the general education classroom is often overwhelming and hard to navigate without a formidable plan in place. Data obtained from this and subsequent studies will help inform and guide professionals in creating those plans.

This research gives us a unique vision into how students with autism prefer to learn and how those preferences sometimes differed significantly from typical students. It is the responsibility of educators to heed this call for diversity when making instructional decisions. The presence of an autism diagnosis in a student's profile infers many challenges which manifest themselves in many domains. Insight and a deep understanding of this vision are important tools that must be utilized to help overcome these challenges and to maximize every student's learning potential.

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Appendix A: The Elementary Learning Styles Assessment (ELSA)

Elementary Learning Style Assessment (ELSA) (Dunn, Rundle, & Burke, 2007)

ELSA consists of 75 questions interspersed among three sections. Students may choose between two stories: 1) a circus story, or 2) a pirate story. Once a student chooses a story, that story theme is continued through the next two sections of ELSA. It is not necessary for children to read every story, unless they wish to do so. Once they understand what is required after reading the first or second story, they need only answer the questions at the end of each of the three stories.

The following readability rates were assessed for ELSA:

- Flesh Reading Ease = 97.4
- Flesh-Kincaid Grade Level = 2.0

The Flesh Reading Ease rated text on a 100-point scale under the assumption that the higher the score, the easier it was to understand the document. For most standard documents, it was recommended to aim for a score of approximately 60 to 70. For the purpose of assessment, it was recommended to increase the ease of readability. The Flesh-Kincaid Grade Level score rated text on a United States' grade-school level. The second- grade reading level was deemed low enough to avoid frustrating elementary-school students. The Flesh-Kincaid Reading Ease is 97.4 and still contains vocabulary that would be interesting and challenging.

Each question is repeated three times throughout the test for the purpose of assuring response consistency. Students respond to each question using a multiple-choice answer format. Each possible response includes a picture image that is representative of the answer. The inclusion of both verbal and nonverbal message forms is a major feature of

the instrument to allow response options to be processed in the style of individuals' either global or analytic preference or through their preferred modality. The inclusion of picture images allows global students to focus holistically on the subject matter.

The students can be tested individually, in small groups, in a classroom, at home, or in a computer lab. The stories and questions may be read to students. Although, the test should take no longer than 40 minutes to complete, it is not necessary to finish in one period. Students may stop after any one of the five stories and log on later to complete the assessment.

Appendix B: Dunn and Dunn Learning Style Model Elements

Learning Style Model

DESIGNED BY
DR. RITA DUNN
DR. KENNETH DUNN

STIMULI

ELEMENTS

Environmental

Sound 	Light 	Temperature 	Design 
---	---	---	--

Emotional

Motivation 	Responsibility 	Task Persistence 	Structure 
---	--	--	---

Sociological

Self 	Pair 	Peers 	Team 	Adult 	Varied 
--	--	---	---	---	--

Physiological

Perceptual 	Intake 	Mobility 	Time of Day 
--	--	---	---

Psychological

Analytic 	Global 	Reflective 	Impulsive 
--	--	---	---

Appendix C: Letter of Authorization for Study

THE FORUM SCHOOL

107 WYCKOFF AVENUE

WALDWICK, NEW JERSEY 07463

(201) 444-5882

FAX: (201) 444-4003

February 10, 2009

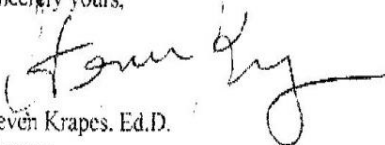
Diana Friedlander

Dear Diana:

After meeting with you and reviewing your Dissertation Proposal, I am prepared to allow you to approach parents of children attending The Forum School and to ask their permission for the children to participate in your study.

If I can be of any further assistance, please do not hesitate to contact me.

Sincerely yours,



Steven Krapes, Ed.D.
Director

SK:llo

Appendix: D Researcher's Letter to Parents

WESTERN CONNECTICUT STATE UNIVERSITY
Student Consent Form to Participate in a Research Study

Dear Parent or Guardian,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. This study will occur during the spring of 2009.

The purpose of this study is to identify the learning-style preferences of students with autism. Researchers have described the learning style preferences of various special populations such as gifted students, students diagnosed with Attention Deficit Hyperactivity Disorder, low achieving students and mildly emotionally disturbed students. However, there is limited research on the learning styles of students diagnosed with autism spectrum disorder. More research is needed to explore this particular population and to examine whether or not the presence of autism influences these preferences.

The *Elementary Learning Styles Assessment* will be administered to your child to evaluate his/her preferred learning style. This computerized test takes approximately 40 minutes to complete and will be fun for your child while providing valuable information.

Results will be made available to your child's classroom teacher. Student names will be coded and remain confidential throughout the study.

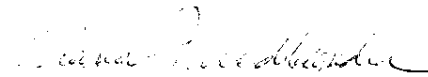
This research study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. It is hoped that the results of this study will help teachers, school administrators, and educational policy makers understand how student with autism concentrate on, process, internalize and remember new and difficult academic information.

Participation in this study is completely voluntary. You are free to withdraw your child from the study at any time. All information is completely confidential.

If you have any questions, please contact me via email at dfriedlander@ridgefield.org or phone at (203)438-1635.

If you agree to have your child participate in this study, please sign the attached statement and return it to your child's classroom teacher.

Sincerely,



Diana Friedlander

Appendix E: Director's Letter to Parents

THE FORUM SCHOOL

107 WYCKOFF AVENUE
WALDWICK, NEW JERSEY 07463

—
(201) 444-5882
FAX: (201) 444-4003

March 3, 2009

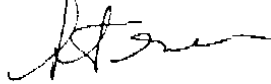
Dear Parents:

Attached is a letter to parents about a research project about to be undertaken by Diana Friedlander. Ms. Friedlander was the art teacher at The Forum School in the early 1980's and then moved to Connecticut with her family, where she continued to work in the special education field.

We have remained in contact with Ms. Friedlander, and when she asked us about the possibility of carrying out research in the field of autism with Forum School students, we were happy to cooperate.

Your participation is entirely voluntary. If you have any questions you can contact Diana Friedlander directly or call me. Thank you!

Sincerely,



Steven Krapes, Ed.D.
Director

Appendix F: Permission to Participate in Study Form



I, _____, the parent/legal guardian of the student minor below, acknowledge that the researcher has explained to me the purpose this research study, and offered to answer any questions I may have about the nature of my child's participation. I voluntarily consent to my child's participation. I understand all information gathered during this project will be completely confidential.

Student/Minor's Name: _____

Signature of Parent or Guardian: _____



Date: _____

Appendix G: Sample Student Report (Partial)

SOUND   **Quiet** **Sound**



Strong Preference...Quiet

You really need quiet when learning something new or studying. Find a silent area away from noise and distractions, or perhaps a carrel if one is available, as in the library. Earphones or earplugs without sound can be used to insulate you against activity and noise.

LIGHT   **Dim** **Bright**



Preference...Bright

You often do your best work in bright light. You concentrate well either on a bright, sunny day or in a well-lit area. You may want to ask your teacher's permission to either sit near a window or to bring a lamp to class for your desk. Just honestly explain that you do your best thinking in lots of light!

TEMPERATURE   **Warm** **Cool**



Preference...Warm

You usually do your best studying or homework when you are warm. You definitely cannot concentrate when you are cool. You enjoy sunshine and, on a bright, sunny day, may want to do homework near a window-unless that area becomes too warm for you! Dress so that you feel comfortable, regardless of how other people feel. There are many people who need a great deal of warmth and who feel exactly the way you do!

SEATING   **Informal** **Formal**

Strong Preference...Formal

You always do your best thinking in formal seating. Use a desk or table and hard chair when you are studying or doing homework. You will not concentrate well on a soft chair, couch, or bed. Indeed, when seated informally and studying new and difficult academic material, you might actually feel sleepy and begin to snooze!

MOTIVATION   **Does Not Need Motivation** **Needs Motivation**

Strong Preference...Does Not Need Motivation

You are really "tuned-in" to doing as well as you can academically! You get a sense of accomplishment from doing well. Occasionally you do even more than just required homework assignments. In addition to extra reports and projects, you expand on the topic or present it in a unique way. You are a very special student! Teachers often wish that all their students were like you!