Dental Visual Support Schedule App for Behavior Management of Pediatric Dental Patients with Autism: Pilot study

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DENTAL VISUAL SUPPORT SCHEDULE APP FOR BEHAVIOR MANAGEMENT OF PEDIATRIC DENTAL PATIENTS WITH AUTISM: PILOT STUDY

ANA L. GONZALEZ CACERES, D.D.S.

A Thesis Presented to the Faculty of the College of Dental Medicine of Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of MASTERS OF SCIENCE

August 2020
DENTAL VISUAL SUPPORT SCHEDULE APP FOR BEHAVIOR MANAGEMENT OF PEDIATRIC DENTAL PATIENTS WITH AUTISM: PILOT STUDY

By

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A thesis submitted to the College of Dental Medicine of Nova Southeastern University in partial fulfillment of the requirements for the degree of MASTERS OF SCIENCE
Department of Pediatric Dentistry
College of Dental Medicine
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August 2020
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I certify that I am the sole author of this thesis, and that any assistance I received in its preparation has been fully acknowledged and disclosed in the thesis. I have cited any sources from which I used ideas, data, or words, and labeled as quotations any directly quoted phrases or passages, as well as providing proper documentation and citations. This thesis was prepared by me, specifically for the M.S. degree and for this assignment.

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Abstract

DENTAL VISUAL SUPPORT SCHEDULE APP FOR BEHAVIOR MANAGEMENT OF PEDIATRIC DENTAL PATIENTS WITH AUTISM: PILOT STUDY

DEGREE DATE: September, 2020

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Background: Autism Spectrum Disorder (ASD) is a prevalent neurodevelopmental disorder in the U.S (about 1 in 54 children). Treating children with ASD in the dental office can be challenging due to their impairments in social interactions, communication and aversive behavior. Visual Support Schedules are visual aids or picture cues that have been beneficial for the behavior management of patients with ASD. There are limited studies regarding effective behavior management techniques that could help those patients have a better experience at the dentist. **Methods:** A Visual Support Schedule App was used for behavior management compared to Tell Show DO (TSD) on a randomized clinical trial study with a sample of 8 participants with ASD during a routine dental visit at Mailman Segal Center dental clinic. Data was collected regarding the number of tasks the patient was able to complete and the time required for their completion. The level of stress that patients experience during the dental visit was measured using biological markers (Heart Rate and Salivary Cortisol). Also, the perception of the patient’s behavior by parents was measured using a Likert Scale, as well as using the Frankl scale. **Objective:** Determine the efficacy of
a Dental Visual Support Schedule App to help children with ASD successfully complete a routine dental care visit. **Results:** Research was interrupted due to COVID-19. Only 8 out of 15 participants were enrolled. All participants were male. No significant difference was found in age, gender, and ethnicity between intervention and control groups. There was not statistical significance for the number of tasks completed. **Conclusion:** Overall, significant differences were not found between the groups. The deficient data collected limits the possibility of drawing strong conclusions that the App can facilitate a routine dental visit for patients with ASD. More research is suggested.
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CHAPTER 1: INTRODUCTION

1.1 Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social interactions, communication, and by restricted, repetitive patterns of behavior.\(^1\) It is considered a “spectrum” because people diagnosed with it can have a varying degree of impairment that can range from mild to severe.\(^2\)

Epidemiological surveys of Autism conducted in several countries have estimated a global median prevalence of the condition of approximately 1 in 588.\(^3,4\) In the United States, there has been an increase in the prevalence of children identified with ASD, from 1 in 59 to about 1 in 54.\(^5\) Systematic reviews of epidemiologic studies suggest that changes in case definition and increased awareness account for much of the apparent increase.\(^6\)

According to CDC’s Autism and Developmental Disabilities Monitoring (ADDM) Network, the median age for first diagnosis is by four years of age. ASD occurs in all racial, ethnic, and socioeconomic groups. Recently, it was found that there is no difference in the number of black children identified with autism compared to white children. However, the number of Hispanic children identified with autism is still lower compared to white or black children.\(^5\) It is about four times more common to occur in boys than in girls.\(^1,5\)

1.1.1 Comorbidities

Frequent comorbidities in individuals with ASD include epilepsy, gastrointestinal disorders, sleep disorders, feeding/eating issues as well as other mental problems as ADHD, depression, and anxiety.\(^7,8\) A study conducted by Van Steensel et. al (2017)
identified anxiety disorders as the most prevalent comorbidities (about 40%) in youth with ASD. The study also identified that children and adolescents with ASD have higher anxiety levels compared to typically developing children.9

1.1.2 Etiology

ASD is a heterogeneous neurodevelopmental disorder with unknown exact cause, however research suggests that there might be a genetic component as well as the environment can affect development leading to ASD.10 Some implicated risk factors for ASD include: older parents, having siblings with ASD, low birth weight, intrauterine infections, metabolic disorders, intrauterine exposures to some teratogenic drugs, and premature birth. Children with certain genetic conditions such as Down syndrome, fragile X syndrome, seizure disorder, phenylketonuria, and Rett syndrome are shown to have ASD more often than other children with no genetic conditions.11,12

1.1.3 Diagnosis

The American Academy of Pediatrics recommends screening for developmental delays at 9, 18, 24 or 30-months, and specifically for ASD at their 18 and 24 months well visits. The diagnosis of ASD is made by a collaboration of professionals including neurologists, psychologists, psychiatrists, and speech pathologists. Early signs of ASD may include: lack of babbling or pointing by age one, no single words by 16 months or two-word phrases by age two, unresponsiveness to name, lack of language or social skills, poor or no eye contact, repetitive behavior of lining up of toys or objects, and/ or lack of smiling or social responsiveness.2,13 Earlier diagnosis of ASD is crucial, preferably in the first two years of life, as early intervention provides the best opportunity to support healthy development and deliver benefits throughout life. Evidence suggests
that early treatment can maximize long term prognosis; treatment results decline when diagnosis is made later in life.14

Up to this date, the diagnosis of ASD is still mainly based on clinical observation.15 Advances in Neuroscience are expected in the fields of biomarkers as well as neuroimaging. ASD, as many other neuropsychiatric disorders, has evolved over time, secondary to the progress of scientific knowledge at its time. Nowadays, the most used diagnostic criteria are then ones stated in DSM5 and CIE11 from the World Health Organization: WHO, based upon the simultaneous presence of all three of the triad of severe impairment of reciprocal social interaction, severe impairment of reciprocal communication, and severe restriction of imagination and behavioral repertoire.16,17

(Appendix A)

1.1.4 Treatment

Only a few decades ago, autism was considered a rare childhood disorder.18,19 The progressive and substantial increase in the number and detection of children with ASD has led to increased visibility, social awareness and demand for care services. This fact has fostered growing interest in issues such as the most convenient and effective screening, diagnosis and treatment procedures.

Understanding and theoretically deepening in the knowledge of autism, developmental disorders and, in general, evolutionary neuropsychiatric disorders known as autism spectrum disorders, is a scientific challenge of remarkable significance.

Since Kanner first described autism in 1943,20 multidisciplinary teams have been applying and adapting the therapeutic means valid for these disorders in each time period as the concept of the disorder evolved. In the search for a definitive treatment, which is
yet to come, a wide range of therapeutic options have been tested, including those that come forth from the domain of modern Western medicine.

The lack of such definitive curative treatment has generated a growing and enthusiastic widespread interest in advancing and discovering effective methods of intervention. In quite a few occasions, this has brought about disorientation and false expectations. In addition, a maelstrom of information and its problems, arising from the growing impact that the media and the new information technologies produce, even more, in this field.

Increasingly, the problem of uncontrolled dissemination of untested or scientifically proven therapeutic intervention proposals, based on testimonial or anecdotal information, but with an intense emotionally persuasive component, is being exacerbated. Therefore, current intervention models need to have proven evidence of their effectiveness through the use of methodologically rigorous research designs.21,22

Although there is sufficient evidence that the earlier therapeutic intervention in the lives of these children begins, the better results will be obtained,23 the correct choice of appropriate treatment for autism spectrum disorders is a deeply complex, controversial topic that casts doubt in both families and professionals interested in providing high quality early intervention.

Despite the uncertainty and conflict it generates, regarding the therapeutics of these disorders, it has been confirmed that it is possible, through the application of specific therapies and developing supporting resources, to improve the quality of life of these patients and their families. Unfortunately, this is only feasible for those in geographical areas with appropriate accessible clinical, educational, and social services.
The concepts of evidence-based interventions were originated in the field of medicine in the late 1960s, early 1970s, and gradually many other disciplines have incorporated them in recent years.\textsuperscript{24}

Due to the heterogeneity of the population and the limited number of research projects carried out, the American Psychological Association developed in 2006 a broader concept (evidence-based practice in psychology) that is better suited to interventions with people with ASD.

Evidence-based practice is defined as the integration of the best and most up-to-date evidence in scientific research with clinical-educational expertise taking into account the perspectives of relevant stakeholders, with the aim of facilitating decisions for evaluation and intervention that are considered effective and efficient for a particular person.\textsuperscript{25}

The term of evidence-based practice is broader than that of evidence-based treatment, since it is not only limited to clinical practice, but also takes into account the needs, values, cultural scope, and individual preferences of patients and their integration into decision-making on the care of the individual.\textsuperscript{26}

The term intervention is quite often used in Psychology and Education. It is introduced into Psychology through clinical-therapeutic application, following in a certain way the medical therapeutic model, and then it is transferred to the proper educational field.\textsuperscript{27}

With the main goal of evaluating the effectiveness and/or efficacy of psycho-educational interventions for the improvement of any of the symptoms of the ASD, international institutions and organizations have subsidized research through systematic
reviews to verify, investigate and identify the most effective intervention models in people with ASD.

These reviews allowed the publication of different clinical guidelines, which represent an important advance in the organization of the knowledge regarding the different types of treatment for ASD.

**Treatment modalities.** The range of treatments available for autism is extensive and classified in several different ways. Mesibov et al classified interventions into three main groups: Psychodynamic, Biological, and Educational and Behavioral. In the recent review by Medavarapu et al, after reviewing 130 articles searching for the evidence of the efficacy of each treatment for ASD. They organized the treatment modalities based on the evidence of proven and unproven benefits. As shown in Figure 1.

**Treatment goals.** Patients on the ASD require a comprehensive and multidisciplinary treatment approach that must be individualized and developmentally appropriate. Intensive behavioral and educational interventions are primary components of treatment programs for ASD. These interventions are more effective when initiated as early as possible. The goals of treatment are to maximize functioning, move the child towards independence by facilitating learning and acquisition of adaptive skills; and to improve the quality of life of individuals with ASD.
Figure 1: Treatment modalities with proven and unproven benefits. Source:²⁸
1.1.5 Behavioral Therapies

1.1.5.1 Applied Behavior Analysis

Applied Behavior Analysis (ABA) is a type of behavioral intervention that is focused on the improvement of socially significant behaviors to a meaningful degree.\(^{31}\) This evidence-based approach, has been used successfully to treat aberrant behaviors in people with developmental disabilities and mental conditions\(^{32}\) and to help caregivers, parents, and educators teach daily life skills to children with ASD.\(^{31}\) It can be applied in different settings and to different populations as suggested by Woods et al.\(^{33}\) Basic principles of ABA are based on research done by B. F. Skinner called Operant Conditioning. Skinner demonstrated that behavior response can be developed or changed over time by providing reinforcing consequences for the target behavior response referred to a behavior shaping.\(^{34}\) ABA treatment may target the development of new skills, and/or minimize behavior that can interfere with a child’s progress.

The core symptoms of ASD including impairment in communication and aversive behavior represents a challenge for dental professionals. In children with ASD, speech delay or inability to use verbal language often plays a central role in the outcome of successful dental treatment. Compromised communication can lead to an inability to express discomfort or pain related to dental treatment causing significant aggressive behavior in these children.

Dentists may need to learn alternatives and adjunctive behavior management techniques not currently addressed in most dental training curricula to successfully manage patients with ASD and to provide effective and complete oral health care to meet their needs. Romer et al has recommended and implemented an interdisciplinary and
A collaborative program to train general and pediatric dentists to individualize the dental experience of patients with ASD by implementing behavior management strategies based on ABA including positive reinforcement, systemic desensitization and visual support.\textsuperscript{35} The use of these procedures in dentistry has the potential to increase the acceptance of routine dental preventative procedures by patients with ASD.\textsuperscript{31}

1.2 Autism Spectrum Disorder and Oral Health

The oral health of individuals with ASD presents some particular characteristics. Although, there does not seem to be any oral manifestations specific to autism, certain conditions may appear due to behaviors related to autism, such as communication limitations, personal negligence, self-injurious behavior, eating habits, effects of medications, resistance to oral care, and hyposensitivity to pain.\textsuperscript{36} A study conducted by Loo et. al (2008) revealed a remarkable increase in caries among children with ASD as compared to neurotypical children.\textsuperscript{37} Major etiological factors contributing to higher incidence can be uncooperative behavior, eating habits, and poor oral hygiene. Furthermore, irregular eating habits with sweet snacks and longer duration of oral clearance can lead to dental decay in these patients.\textsuperscript{38} Recent studies have found that in spite all the risk factors that these children are exposed to, the caries index are not higher when compared to neurotypical individuals.\textsuperscript{36} For these reasons, children with ASD should have ready access to preventive dental care, needed dental treatment, and ongoing monitoring of their oral health by establishing a dental home by age 1 as recommended by the AAPD.
1.2.1 Dental Home

Dental home is the ongoing relationship between the patient and the dentist in a familiar and safe health supervision.\textsuperscript{39} It was defined by the Council on Clinical Affairs of the AAPD and adopted in 2006 following the medical home concept. For patients with Autism it is crucial to establish a dental home to provide anticipatory guidance regarding diet, oral hygiene, trauma prevention and preventive services as routine dental prophylaxis to prevent oral diseases.

1.2.2 Barriers to Dental Care in Children with Special Health Care Needs

Dental care is identified as the most prevalent unmet health care need for approximately 10.2 million children in US with special health care needs.\textsuperscript{40} Low income and minority children with special health care needs are recognized to be at greatest risk due to poor oral health and deficient access to care.\textsuperscript{40} The prevalence of unmet dental need in children with ASD is 12-15\% compared to typical children which is approximately 5\%.\textsuperscript{41} A recent study done by Wirth and Gabor (2016) identified reasons for this disparity: imbalance between number of medical providers that are providing services to children’s with ASD and need for available medical provider.\textsuperscript{42} Similarly, Spangler (2016) reported increasing demand for dentists who work with special needs patients.\textsuperscript{43} Children with ASD have behaviors and sensitivities that make dental treatment one of the most difficult types of health care to receive. Lai et al. (2012) found that behavior of children with ASD was the prominent barrier to dental treatment, contributing to their unmet dental needs.\textsuperscript{44} The percentage of patients with ASD that require treatment under general anesthesia due to lack of cooperation varies between 37\% and 76\%, increasing the expenditures for dental treatment.\textsuperscript{45} Presence of cognitive
dysfunction, aggression, convulsions, and other associated symptoms can minimize in-office dental treatment of these patients. Other problems that may be exhibited by patients with ASD include the inability to manage emotions, repetitive body movements, hyperactivity associated with attention deficiency, and low frustration threshold which can generate peevishness and atypical vocalizations. Several studies have identified factors that are associated with difficulty in dental care; these include speech delay, developmental delay and inability to perform daily self-care activities. The dental team should be prepared for changes in atypical responses to sensory stimuli, as these patients are not easily adaptable to little changes in their environment and require similarity in their routine.

1.2.3 Behavior Guidance Techniques for Dental Care

It has been reported that there are unmet challenges for patients with ASD when seeking medical and dental care due to their impairment in communication, sensory aversions, anxiety, and difficulty with the management of new situations that can lead to defensive behaviors. Their fear and anxiety towards dental procedures cause reluctance in parents to take them to routine dental visits putting those patients at higher risk for oral diseases including caries, gingival inflammation, and infection compared to the general population. Their difficult behavior, extra time required for appointments, and lack of proper professional training to successfully manage the aberrant behavior in the dental visit also represents a challenge for dentists. ASD is one of the most frequent indications for providing dental care using pharmacologic behavior management techniques as treatment under general anesthesia or sedation. Therefore, desensitization and regular preventive dental visits are extremely important to maintain
the oral health of those patients since early in life and to avoid more invasive, extensive, and costly dental care under general anesthesia. 

For children with ASD, it is difficult to understand and cooperate with medical instructions. While neurotypical children may also have trouble being cooperative, it has been shown that ASD patients present more challenging behaviors. Furthermore, children with ASD often have heightened oral sensory perception, meaning they have hypersensitivity to textures and may become defensive to oral input. Despite all challenges, there is limited research addressing behavior management techniques and procedural modifications that dentists can use to treat children with Autism.

Behavior guidance techniques recommended by the American Academy of Pediatric Dentistry (AAPD) are applied universally in pediatric dentistry, including to patients with special needs. Tell-Show-Do, distraction and positive reinforcement are some of the techniques recommended by AAPD for behavior management. Treating children with Autism in the dental office can be challenging due to their impairment in social interactions, communication, and their difficulty to manage novel situations. Additionally, core symptoms of ASD including social and communication deficits like lack of joint attention may make commonly used behavior management techniques like Tell-Show-Do ineffective for some patient with ASD. Dentists may need to learn alternative and adjunctive behavior techniques not currently addressed in most dental training curricula to successfully manage patients with ASD and provide effective and complete oral health care.

Current behavior guidance procedures such as tell-show-do, voice control, and positive reinforcement are effective with children. However, these do not necessarily
address the behavioral characteristics of patients with ASD, because they are often
dependent upon the ability to attend to a model and sustain joint attention.\textsuperscript{31,52} Many
strategies have been proposed to facilitate routine dental care for patients with ASD.
These include desensitization, creating a minimally stimulating environment, structured
appointments,\textsuperscript{52} and visual pedagogy a technique used to familiarize children with the
treatment tools and processes through a set of pictures.\textsuperscript{38} Social stories (a behavioral
intervention used for children with ASD that consist of a short sequence of pictures and
sentences describing a situation),\textsuperscript{46,52} alternative and augmentative communication
systems,\textsuperscript{46} and visual supports are other methods described for behavior management in
the dental office. Unfortunately, none of these strategies are completely effective to
secure cooperation and more research is needed.

\textbf{Tell Show Do.} Tell Show Do is used with both the cooperative and uncooperative child
and involve a verbal explanation of procedure in a friendly and age appropriate terms
(Tell); allow the child to physically interact with aspects of the procedure as instruments
via senses (Show); and then perform the procedure (Do).\textsuperscript{53} The goal of the technique is to
familiarize the patient with the dental setting and shape the patient’s response to the
procedures. For patients with ASD this technique may be ineffective due to their lack of
join attention.

\textbf{Voice Control.} In Voice control procedures, the provider alters the voice volume, tone
and/or pace to influence and direct the patient’s behavior. The objective of this technique
is to gain attention and compliance from the patient as well as to establish adequate adult-
child role. This procedure might be ineffective for patients with ASD due to missing
receptive language to understand the directions given.
**Positive reinforcement.** Positive reinforcement rewards desired behaviors thereby strengthening the likelihood of recurrence of those behaviors. It includes social reinforcers as verbal praise and non-social reinforcers including toys. For patients with ASD positive reinforcement is required immediately after the occurrence of desired behavior.

1.2.3.1 Behavior guidance strategies based on ABA for dental setting

**Visual Supports/ Task Strips/Alternative and Augmentative Communication**

Procedures adapted from ABA can be used for management of patients with ASD in the dental office. Children with ASD have been characterized as visual learners. ⁵⁰,⁵⁴

Visual support are any visuals (pictures, photographs, objects, words) used to support individuals with ASD to increase their understanding of what is being said and what is expected. Alternative and augmentative communication systems (AAC) are forms of visual support, which consist in using pictures or photographs, and is a common tool in communicating and educating individuals with ASD. ⁵⁴ These procedures based on ABA, are used in autism not just to replace speech, but to assist learning and communication, regardless of the level of speech. Symbols, pictures, photographs and objects of reference, are all well established as helpful for people with autism in supporting the comprehension of what is said and in getting needs met. ⁵⁵

Visual support schedules can be used to communicate schedules and routines in either picture or written format, allowing individuals with ASD to more easily transition between tasks. ⁵⁶

In the dental setting, the use of visual supports can be a beneficial resource to build communication between the dentist and the individual with ASD. It can also allow the individual with ASD to anticipate dental treatment ahead of time before it is rendered. ⁵⁷
A study done by Cagetti et al (2015) demonstrated that use of visual supports can facilitate dental treatment in children with ASD. Additionally, it is also effective in non-verbal children with low intellectual disability as long as visual supports are used as the first line of behavioral approach to treat patient with ASD in dental settings.\(^{50}\)

The task strips or visual supports (illustrated in Figure 3) are the gold standard at the Nova Southeastern University Mailman Segal Center (MSC) for Development pediatric dental clinic during desensitization. The task strip provides the visual structure and routine of the dental visit which can help to reduce anxiety and behaviors in these patients. The task strip provides the child with a visual representation of each step; this visual shows the patient what they are doing and what they are expected to do next, allowing the child to be actively engaged in the process of the dental visit. After completion of task strip patient is rewarded with prize from the treasure box as a positive reinforcement along with praises after completion of every step in the task strip.

Figure 2. MSC task strip visualization

Technology-based intervention for Autism Spectrum Disorder

Touch screen devices as smartphones and tablets, have been the trend in the recent years and their accessibility and affordability have significantly increased. Developers are
consistently creating applications that run on these devices, and apps for individuals with ASD are not the exception. They are a non-expensive addition to existing therapies for patients with this condition\textsuperscript{58} and the literature have shown that there is a continuous increase in the use of technology-based interventions for Autism.

A systematic review completed by Lorah et. al reported that in 2014 there were about 400 iPad applications on the Autism Speaks website and the majority of those Apps are supported only by anecdotal evidence.\textsuperscript{59} As of today a Google search of “autism and app” generates over 100 million hits in (0.56 seconds) and about 36,500 results in google scholar.

Effective technology-based programs dedicated to addressing the core symptoms of ASD are gradually gaining recognition among researchers and practitioners and have gone considerably beyond the use of desktop computers. This now includes the use of robotics, handheld and touch pad devices, Internet based collaborative virtual environments, eye tracker–based gaze-contingent visual displays, among others. Innovative technology-based interventions address a variety of skills essentials for individuals with ASD, including the ability to initiate, maintain, or terminate a behavior; functional activities of daily living, and to enhance vocal imitation.\textsuperscript{60}

After years of dedicated intensive research in this field, technology-based treatment is still perceived as “emerging” rather than “established”, and their clinical validity is still in debate because due to the novelty and interdisciplinary nature of the field, not all published articles assess treatment efficacy. The evidence suggests that technology may enhance motivation, increase attention, and reduce challenging behavior in
individuals with ASD. According to the New Zealand Autism Spectrum Disorder Guideline, use of visual supports and technology should be available to support the development of both, expressive and receptive communication.\textsuperscript{61}

The use of handhelds as an assistive technology for visual supports and video modeling for students with disabilities has many benefits over traditional low-technology options including enhancing receptive communication, more timely delivery of instructions, providing a clearer understanding of the task at hand, reducing instructional wait time, and increasing time on-task.\textsuperscript{62} Apps can provide teachers with easily accessible tools to enhance teaching and learning. Particularly, there are a multitude of apps available that can assist with the specific learning needs of students with ASD. The use of visual pedagogy through visual activity schedules is a common and efficient practice in children with ASD. Furthermore, numeric devices, such as the iPad\textsuperscript{®}, are increasingly integrated in the education of children with ASD, and this device has shown some promising results, even in the dental domain.\textsuperscript{50}

In dental care setting, there are many strong sound-visual stimulations that are different from those in any other setting. This usually upsets a patient with autism, often forcing dentists to administer an anesthetic in order to carry out dental procedures. However, the positive attitude of people with autism regarding technology has been used to simplify oral care with positive results.\textsuperscript{15}

A recent study completed using a digital iPad application with patients with Autism shows positive results, with patients becoming more compliant and less anxious during dental appointments.\textsuperscript{48}

A wide knowledge of the positive effects of technological interventions in the life
of people with ASD emerges from the literature, but there is little research in the specific field of personalized digital tools to facilitate ASD dental care.  

1.3 Mailman Segal Center for Human Development

1.3.1 Baudhuin Preschool

Baudhuin preschool, located at Mailman Seagal Center is a special school that models international recognized programs for children with ASD. This school program utilizes principles of Applied Behavior Analysis (ABA), which focuses primarily on the development of cognitive, social, adaptive, behavioral, motor, and communication skills with these children.

1.3.2 Kapila Family Foundation Starting Right

Starting Right is an early intervention program for children with delay in communication and social skills that is part of Nova Southeastern University's Mailman Segal Center. The program, provided by behavioral specialists, is designed to increase communication, social and school readiness skills. It also familiarizes caregivers with strategies to use with their children in different settings.

1.3.3 Pediatric Dentistry Residency Program

The residency program in Pediatric Dentistry at Nova Southeastern University is a two year post-doctoral program, accredited by the Commision on Dental Accrediation (CODA). The programs is designed to train residents to successfully achieved the knowledge and skills to provide evidence based, high quality oral health care to children and adoelcents including patients with special needs. Residents have the opportunity to rotate through different hospitals and extra-mural afiliations including the Mailman
Seagal Center where they can achieve proficiency in the management of patients with ASD.

1.3.4 Health Resources & Services Administration (HRSA)

The Health Resources and Services Administration (HRSA) is a federal agency that aims to improve health outcomes and address health disparities through access to quality services, a skilled health workforce, and innovative, high-value programs. In 2010, HRSA funded a grant to Nova Southeastern University College of Dental Medicine (NSU-CDM) under the Residency Training in General and Pediatric Dentistry program to help meet the oral health needs of special needs patients, specifically those with ASD and the training needs of pediatric dental residents. This funding allowed the creation of the one operatory dental clinic located at MSC, which is equipped to provide comprehensive pediatric dental care to children with ASD from infancy to late childhood.35

1.3.5 Mailman Segal Center Dental Clinic

MSC dental clinic, located in Broward county, Florida is a single chair dental clinic that is specialized for the dental treatment of children with ASD. All the treatment provided by the dental clinic if fully funded by HRSA grant. The clinic has dedicated ABA therapist on staff that provide there expertise and guidance for behavior management during the dental treatment. Pediatric dental residents are part of a collaborative team and learn different techniques and skills utilized by the onsite faculty pediatric dentist, clinic staff including ABA therapist on the grant, and the Baudhuin preschool employees.

Current Study

Considering that people with autism have preference for processing visual
information and they are very attracted by technology, we are implementing the use of a visual support free App (Figure 2) created by the principal investigator based on the same principles of the existing task strips used at MSC clinic to improve dental behavior in children with ASD. A dental visual support App was created using an interface at Mobincube website with the objective to make an electronic and easily accessible version of the existing task strips. Colorful and more appealing images were used. This App has an easy to use (back and forward) design for children, caregivers, and dentists.

Figure 3. Visual Dental Schedule App

1.4 Purpose, Specific Aims and Hypotheses

1.4.1 Purpose

ABA has been shown to teach children with ASD to be compliant with medical procedures, however research on training these children to be compliant with dental
procedures are limited. Few studies have examined the efficacy of initial dental desensitization in relation to successful dental exams, and studies are needed to examine the effectiveness and long-term sustainability of dental desensitization in improving the comprehensive dental health and behavior of children with ASD. In order to reduce the caries occurrence, facilitate tolerance, and increase the compliance toward dental treatment, research is needed to determine the factors that can predict sustainable positive attitudes and successful dental visits in these children.

There is limited research supporting electronic behavior management techniques to treat patients with ASD in the dental office. There are many basic and advanced non-pharmacological behavior management techniques including Tell-Show-Do, positive reinforcement, and physical protective stabilization used to improve the outcome of the dental visit. It has been reported in recent research that using a visual support schedule (task strips) helps patients with ASD to see and understand step-by-step what is needed to complete a routine dental visit. Considering that people with autism have preference for processing visual information and they are very attracted by technology, an app was created to improve dental behavior management of patients with ASD. One of the advantages of the App over the existing task strips is the availability to be downloaded by all interested dental health care providers and parents to train the child about the dental visit prior to coming to the actual dental appointment. This App is easy to use, appealing with child friendly images and very simple (back and forward) design, interactive and didactic for children. It also advances the dentist’s clinical behavioral interventions. A recent study completed using a digital iPad application with patients with Autism shows positive results, with patients becoming more compliant and less anxious during dental
appointments.\textsuperscript{48}

This research project innovation sought to identify the role of the App as behavior management in the dental clinic by improving their compliance and tolerance towards dental visits. The use of the app based on visual pedagogy has shown to be able to facilitate children with ASD to undergo dental treatments even in non-verbal children with a low intellectual level when used as the first strategy in dental setting.\textsuperscript{50} Research indicates that regular and gradual exposure to stimuli can improve acceptance of the instruments and materials used in the dental office.\textsuperscript{54} This project may also serve as a resource to inform academic organizations in dentistry and medicine (ADA, AAPD, AAP) to implement certain guidelines regarding behavior management and health promotion aspects in children with ASD. Thus, sustained effects of ABA may be efficacious in improving dental outcomes for young children with ASD. This project aims to inform dentists, specialists, and physicians of the potential of digital visual support in building sustainable patient tolerance and acceptance towards the dental visits.

This study based on data collected at the MSC could be beneficial in developing awareness among parents and healthcare workers regarding the benefits of ABA in improving oral health and behavior along with reduction in cost to achieve the optimal care. This study may be a valuable in future behavior management and health promotion research in the dental field. Thus, this research can contribute to the solution of unmet dental needs in children with ASD and improve the oral health in these children.

\textbf{1.4.2 Specific Aims}

This study considers the limited research regarding effective behavior management techniques that could help patients with Autism during a dental visit. For the purpose of
this crossover pilot study the use of an App was compared with the Universal Standard of Care recommended by AAPD for behavior management of children (TSD: Tell- Show-Do). The Mailman Segal Center (MSC) current standard of care is the use of visual task strips and TSD for patients with ASD. The use of the App was only used for patients participating in this study.

The overall goal of this pilot clinical trial was to evaluate the efficacy of the Dental Visual Support Schedule App to help children with ASD successfully complete a routine dental care visit at the MSC.

My specific aims were as follows:

1: Determine if the use of the Dental Visual Support Schedule App helps patients with ASD improve the behavior during a routine dental visit by evaluating the number of task completed, the time needed to complete all tasks, parental perception questionnaire, and by Frankl Behavior Rating Scale.

2: Evaluate if using the Dental Visual Support Schedule App decreases the distress level that patients with ASD experience during a routine dental visit determined by physiological biomarkers: heart rate and salivary cortisol levels.

3: Determine if the use of the Dental Visual Support Schedule App allows patients with ASD to complete all tasks with fewer dental appointments, indicating greater desensitization.
CHAPTER 2: METHODS

2.1 Study Design

This was a single center, randomized, clinical trial pilot study that involved eight participants from Nova Southeastern University’s Pediatric Dental Clinic at the MSC.

2.1.1 Institutional Review Board (IRB) Approval

IRB approval was granted on December 19, 2019 for this study. Approved IRB number: 2019-552-NSU.

2.1.2 Ethical Issues

Since this study was conducted on human subjects, informed consent was obtained. The following items were communicated to each participant’s authorized surrogates:

- purpose of the research, its expected duration, and the nature of any interventions/experiments;
- anticipated risks and benefits of participation and the reasonable alternatives to participation in the research protocol;
- confidentiality provisions relating to the research records;
- the right to not participate and to discontinue participation at any time without penalty.

All Protected Health Information (PHI) identifiers were removed to comply with IRB and HIPPA regulations.

2.1.3 Grant

This research study was awarded funding by the Health Professional Division Research Committee at Nova Southeastern University (HPD Grant No: 334586)
2.1.4 Sample Size

The estimated sample size was 15 patients. The convenience sample was based on eight published crossover studies conducted in dentistry, which had a mean sample size of 25 participants (with a minimum of six and a maximum of 40 individuals.\textsuperscript{63-70} To confirm the sample size, we employed the following formula:

\[
n (\text{per group}) = \frac{2 \times (\sigma^2) \times \left[ Z_{\alpha/2} + Z_{\beta} \right]^2 \Delta^2}{\delta^2}
\]

The sample-size estimate was based on exact tests with actual levels of significance and power. In a single-arm study with \( P_0 \) (unacceptable response rate) =10%, \( P_1 \) (response rate that is desirable)=90%, specified \( \alpha=5\% \) and power=80%, the A'Hern approach yields \( n=15 \) (exact \( \alpha=0.02\% \), power=79.8%).

Due to the COVID-19 pandemic and associated closure of the Mailman Seagal Center (MSC) dental clinic, the study was interrupted and as a result, we ended up with a sample of 8 patients enrolled.

2.1.5 Sample Description

The eight patients enrolled in this study were new patients at the MSC dental clinic located in Broward county, Florida. All patients were diagnosed with Autism by a physician before participating in the study. The MSC clinic is a single chair dental clinic that is specialized for the dental treatment of children with ASD. All the treatment provided by the dental clinic was fully funded by HRSA grant.
2.2 Sample Population

2.2.1 Inclusion criteria and exclusion criteria

Inclusion criteria:

- Patients diagnosed with Autism Spectrum Disorder.
- Patients between 3 and 9 years old.
- Patients from both genders (females and males) were included. Prior to recruitment, it was anticipated that we would have a higher number of males enrolled due to the significantly higher prevalence of Autism in males (4 males to 1 female).

Exclusion criteria:

- Patients previously treated at Mailman Segal Center who were already desensitized with a visual task strip.
- Low vision patients impeding visualizing the App.
- Patients (parents/caregivers) refusing consent for participating in the study.

2.2.2 Dependent variable

1. Number of tasks completed (Discrete)
2. Time to complete all tasks (Continuous)
3. Number of visits needed to complete all tasks (Discrete)
4. Parental Perception of children’s behavior improvement (Dichotomous)
5. Parental Perception of overall behavior (Ordinal)
6. Parental Perception of aggressive behavior (Dichotomous)
7. Parental Perception of cooperative behavior (Dichotomous)
8. Score obtained from Frankl Behavioral Rating Scale (Ordinal)
9. Score obtained from modified Venham Anxiety Scale (Ordinal)

10. Heart Rate (Continuous)

11. Cortisol levels (Continuous)

2.2.3 Independent Variables

1. The patient’s demographics (age, gender, ethnicity)

2. Exposure to Visual Support App (Dichotomous)

2.2.4 Limitations

External validity was affected by the sample size and limited to children with ASD aged 3 to 9 years old, which is the age limitation for the Mailman Segal Center. Due to COVID 19 pandemic it was not possible to continue with the study to complete the washout period and the crossover for the second intervention for each group.

2.2.5 Cofounders

Potential cofounding variables included participants exposure to different resident providers for follow up visits during the research and other undiagnosed comorbidities such as depression, anxiety and unreported ADHD in young children with ASD.

2.3 Design and Procedure

This was a single center, randomized, crossover pilot study design. In this pilot study, it was proposed that participants receive a sequence of different treatment approach, and each participant would be its own control.

However, due to COVID 19 pandemic and the closure of the MSC dental clinic, the study was interrupted, and it was not possible to reach the washout period or complete the crossover.
After IRB approval, informed consent was obtained. Participants were randomly assigned consecutively to start the study in the control or experimental group.

Due to limited time frame for the study, sessions were completed once a week for eight weeks. All groups were equally treated except for the intervention (use of the App).

- **Intervention group (Task-oriented training):** A Dental Visual Dental Support App created by the principal investigator available at Google Play for Android Devices was used for the intervention group as behavior management. The App consists of an electronic visual support schedule with a total of 8 tasks that correspond to all steps of a routine dental visit: Task 1- Sit down (patient seating in the dental chair with or without parents), Task 2- Dental mirror (presenting the dental mirror to patient and acceptance in patient’s mouth for visual examination of teeth), Task 3- Open mouth (opening the mouth as requested - after mirror was used in previous step- for additional examination of soft tissue including gingiva, tongue, and palate), Task 4- Brush teeth (consists in completion of dental cleaning), Task 5- Mr. Thirsty (presenting and acceptance of dental suction), Task 6- Mr. Shakey (presenting and allowing the use of dental floss), Task 7- Little Brush (application of fluoride varnish), Task 8- Treasure box (represents the end of the dental appointment and patient can have a small prize from the clinic’s treasure box).

- **Control group:** Tell-Show-Do, a basic non-pharmacological behavior management technique was used for the control group. Tell-Show-Do consists of verbal explanations of procedures in phrases appropriate to the developmental level of the patient (tell); demonstrations for the patient of the visual, auditory, olfactory, and tactile aspects of the procedure in a carefully defined,
nonthreatening setting (show); and then, without deviating from the explanation and demonstration, completion of the procedure (do). Tell-Show-Do will be used throughout the appointment for the completion of the same 8 tasks as the intervention group.

During the first visit for both groups, the distress level measurements was recorded by 1) physiological markers: Heart Rate (HR) and a swab salivary cortisol test; and 2) Venham’s Clinical Anxiety Scale. Distress was defined as the stress behavior displayed by the child during the intervention. Heart Rate and Salivary cortisol are biomarkers that have been previously used in studies as markers for stress assessment, including in patients with ASD.

- Heart rate (HR): HR was measured at two moments during each dental visit with a pulse oximeter for children. First, at the arrival of the patient, after seating in the dental chair, before any other measurement is initiated, and at the end of all procedures while patient is still seated in the dental chair.

- Salivary cortisol test: It was planned that a total of 4 collections of saliva will be completed for each participant. Two at the baseline visit (visit #1) and two at the last visit (visit #8). Only the two collections during the first visit were completed. Saliva collection was performed using a swab method (SalivaBio children swab) obtained from Sialimetrics®. The salivary collections were done in intervals as needed due to behavior until the lower third of the swab was saturated. The first salivary collection during visit #1 was collected during the open mouth step of the Visual Dental Support App. The second salivary collection of visit #1 was completed after the patient completed the fluoride application. The salivary
samples were frozen at -80 degrees within 6 hours of collection.

Material was sent to Sialimetrics SalivaLab for cortisol test on dry ice.

- Venham’s clinical anxiety rating scale: Was completed by the pediatric dental resident/faculty after the last task was completed during every visit.

Immediately after the last task was completed for every visit, the pediatric dental resident or faculty administered the perception questionnaire to parents and coded the patient’s behavior using the Frankl Behavioral Rating Scale.

- Parental perception of behavior questionnaire: At the end of each visit, the parents were asked to complete a short questionnaire about their perception of the children’s behavior during the dental visit.

During the procedures, all data was recorded in a tool form (Appendix C) created for the purpose of this investigation by the principal investigator.

**Instrumentation:**

The assessment of patient’s behavior was determined by the number of tasks completed, the time needed to complete all tasks, parental perception questionnaire, Venham’s clinical anxiety rating scale, and by Frankl Behavior Rating Scale.

- Venham’s clinical anxiety rating scale: This tool was created by Venham, et al to measure the anxiety level of children during the dental visit and it has been validated. This scale has the following ratings: (1) relaxed; (2) uneasy; (3) tense; (4) reluctant; (5) interference; and (6) out of contact or untreatable.

- The Frankl Behavioral Rating Scale (4-point scale) is a reliable and frequently used behavior rating systems in both clinical dentistry and research. This scale separates observed behaviors into four categories ranging from definitely negative
to definitely positive: (1) Definitely negative. Refusal of treatment, forceful crying, fearfulness, or any other overt evidence of extreme negativism; (2) Negative. Reluctance to accept treatment, uncooperative, some evidence of negative attitude but not pronounced; (3) Positive. Acceptance to treatment, cautious behavior at times, willingness to comply with the dentist, at times with reservation, but patient follows the dentist’s directions cooperatively; (4) Definitely positive. Good rapport with the dentist, interest in the dental procedures, laughter, and enjoyment.

- Parental perception of behavior questionnaire was designed by the principal investigator to be used only for this study to obtain the parental perception of the child’s behavior during the dental visit. The questionnaire consists of four questions: Three yes or no questions and one Likert type question. (Appendix B)

The level of distress was determined by the heart rate and salivary cortisol levels. In the original study design, the level of desensitization, defined as the diminished emotional responsiveness to a negative, aversive or positive stimulus after repeated exposure to it\(^{75}\) was to be determined by the number of visits needed to complete all the tasks. Since the study was interrupted and multiple visits were not possible, this data point was not included in the analysis.

### 2.4 Data Storage

All data collected was de-identified and entered in an Excel spread sheet. This data was housed on a password protected computer. To stay in compliance with HIPAA regulations and to maintain patient’s privacy, only research staff had access to the study files. No identifying information was retained in the database.
2.5 Statistical Analysis

Given that the study was interrupted, we were only able to enroll a total of 8 participants (4 assigned to the control group, and 4 assigned to the intervention group) instead of the proposed 15. In addition, complete data was not collected for all participants for the proposed 8 visits. Data for the proposed variables was collected during the first visit from both the control and intervention groups. Unfortunately, due to the discontinuation of the study, follow up data was only available for visits 2 and 3, but not for all participants. For example, there was only 1 intervention group participant and 3 control group participants with data for 3 visits. Given this, we did not have enough participants or follow up data to compare. As such, the original data analysis plan had to be completely restructured.

Descriptive statistics were calculated for all study variables. In addition, mean values were calculated for all variables including heart rate, cortisol levels, number of tasks completed, time to complete all tasks, and behavior and anxiety scales. Independent t-tests based on data from visit 1 were conducted to compare the control and intervention groups on all the proposed variables. Significance level was set at p=<0.05 for all comparisons. Mean differences across 3 visits for the few available participants (1 participant from intervention versus 3 in the control group) were plotted and examined for the following variables: number of tasks completed, number of minutes to complete the tasks, and the Frankl behavioral scale. For this design, the dependent variable was either number of tasks completed, number of minutes to complete the tasks or score on the Frankl Behavioral Scale; the within-subjects factor was "time" and the between-subjects factor was the
condition (control or intervention group). General trendlines were examined, significance could not be calculated.

Null hypothesis is that there was no difference in between the groups. ANOVA models with the trough Heart Rate, Cortisol at baseline, and Time to complete all tasks (in minutes), N. of tasks completed as dependent list and the intervention group as factors were used.

2.6 Quality Control and Data Management

To maintain the quality of data collection, the principal investigator was the sole person responsible for collecting and entering data. All the information collected on paper was shredded and disposed according to the NSU IRB policy. Password protected, de-identified datasets will be retained for 36 months following the completion of the study, upon which they will be destroyed. Files from the computer will be deleted from hard drive. The Protected Health Information will not be reused or disclosed to any other person or entity, except as required by law, for authorized oversight of the research study, or for other research for which the use or disclosure of protected health information would be permitted.
CHAPTER 3: RESULTS

The estimated sample size for this pilot study was 15 participants. Due to COVID 19 clinic closure, only 8 participants were enrolled in the study at the time of the closure. Participants were aged 3 to 6 years old (mean age 4.1 years) and all were diagnosed with ASD at the time of the study. Four participants completed routine dental care using the App, and four using Tell Show Do. No significant difference was found in age, gender, and ethnicity between intervention and control groups. The demographics of study participants are shown in Table 1.

Table 1. Demographic characteristics of all study participants

<table>
<thead>
<tr>
<th>Demographics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8</td>
<td>100</td>
</tr>
<tr>
<td>Female</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>3</td>
<td>37.5</td>
</tr>
<tr>
<td>African American</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>37.5</td>
</tr>
</tbody>
</table>

All participants completed the first baseline visit. The baseline descriptive statistics of participants are shown in Table 2.

Table 2. Baseline Descriptive Statistics at First Visit

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>7</td>
<td>3</td>
<td>6</td>
<td>4.14</td>
<td>1.069</td>
</tr>
<tr>
<td>HR Initial</td>
<td>8</td>
<td>50</td>
<td>170</td>
<td>95.88</td>
<td>36.436</td>
</tr>
<tr>
<td>HR Final</td>
<td>7</td>
<td>94</td>
<td>113</td>
<td>101.57</td>
<td>6.321</td>
</tr>
<tr>
<td>Cortisol Initial</td>
<td>7</td>
<td>.096</td>
<td>2.871</td>
<td>.60743</td>
<td>1.012235</td>
</tr>
<tr>
<td>Cortisol Final</td>
<td>6</td>
<td>.073</td>
<td>2.716</td>
<td>.65033</td>
<td>1.021764</td>
</tr>
<tr>
<td>N. of tasks completed</td>
<td>8</td>
<td>2</td>
<td>8</td>
<td>6.75</td>
<td>2.188</td>
</tr>
<tr>
<td>Time to complete all tasks (in minutes)</td>
<td>8</td>
<td>8.31</td>
<td>28.00</td>
<td>13.8025</td>
<td>6.11868</td>
</tr>
</tbody>
</table>
Primary outcome

The primary and co-primary clinical outcome are reported in Table 3. With response defined as number of tasks completed and time to complete all tasks in minutes for participants using the App as compared to 50% (n=4) of participants using TSD. No significant differences were observed between groups at second visit.

The dependent variables were "number of tasks completed" (as shown in Table 4 and figure 4) and the “time to complete all tasks” (as shown in Table 5 and figure 5), the within-subjects factor was "time" and the between-subjects factor was the "conditions."

In one group, participants used a Tell Show Do during the dental visit (control group), and in the other group, an Application on a tablet was used (treatment group).

Table 3. Change from baseline in mean of primary & co-primary outcome at second visit

<table>
<thead>
<tr>
<th>Measure</th>
<th>All (n=8) mean (SD)</th>
<th>App (n = 4) mean (SD)</th>
<th>TSD (n = 4) mean (SD)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heart Rate (bpm)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>95.88 (36.4)</td>
<td>86 (25.2)</td>
<td>105.75 (46.9)</td>
<td>.486</td>
</tr>
<tr>
<td>Final</td>
<td>101.57 ()</td>
<td>99.25 (4.5)</td>
<td>104.6 (8.0)</td>
<td>.301</td>
</tr>
<tr>
<td>Change at 2 Visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>134.67 (30.0)</td>
<td>111.5 (17.6)</td>
<td>134.67 (30.0)</td>
<td>.410</td>
</tr>
<tr>
<td>Final</td>
<td>93.60 (18.6)</td>
<td>94.0 (28.2)</td>
<td>93.33 (17.15)</td>
<td>.975</td>
</tr>
<tr>
<td><strong>Cortisol (mmHg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>.607 (1.01)</td>
<td>.950 (1.29)</td>
<td>.149 (0.32)</td>
<td>.344</td>
</tr>
<tr>
<td>Final</td>
<td>.650 (1.02)</td>
<td>.874 (1.24)</td>
<td>.202 (0.18)</td>
<td>.510</td>
</tr>
<tr>
<td>Change at 2 Visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Final</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Time to complete all tasks (in minutes)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>13.80 (6.11)</td>
<td>11.38 (2.51)</td>
<td>16.22 (8.09)</td>
<td>.297</td>
</tr>
<tr>
<td>Change at 2 Visits</td>
<td>11.04 (8.8)</td>
<td>4.8 (5.9)</td>
<td>15.19 (8.71)</td>
<td>.245</td>
</tr>
<tr>
<td><strong>N. of tasks completed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>6.75 (2.18)</td>
<td>7.75 (0.50)</td>
<td>5.75 (2.87)</td>
<td>.219</td>
</tr>
<tr>
<td>Change at 2 Visits</td>
<td>7.40 (1.34)</td>
<td>8.0 (.00)</td>
<td>7.0 (1.73)</td>
<td>.495</td>
</tr>
</tbody>
</table>

*ANOVA models with the trough Heart Rate, Cortisol, at baseline, and Time to complete all tasks (in minutes), N. of tasks completed as dependent list and the intervention group as factors were used.
During this period, the dependent variable (number of tasks completed) was measured three times: at the beginning of the study (baseline), at visit 1 (Time 1), visit 2 (Time 2) and Visit 3 (time 3).

Table 4. Number of Tasks Across Visits (Descriptive Statistics)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed Visit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>6.00</td>
<td>3.464</td>
<td>3</td>
</tr>
<tr>
<td>intervention</td>
<td>8.00</td>
<td>.</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>6.50</td>
<td>3.000</td>
<td>4</td>
</tr>
<tr>
<td>Number of Tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed Visit</td>
<td></td>
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*Note: there was only 1 intervention group participant with data for 3 visits.

Figure 4. Estimated Marginal Means of Tasks completed
Table 5. Number of Minutes to Complete Tasks (Descriptive Statistics)

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<th>Mean</th>
<th>Std. Deviation</th>
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*Note: there was only 1 intervention group participant with data for 3 visits.

Figure 5. Estimated marginal means of minutes to complete all tasks.
The mean Frankl Behavior score in the Intervention group (App) was 2.50 (SD=1.00) and 1.75 (SD=.500) in the control group (Tell Show Do). No significant difference was found between the two groups (Independent Samples t-test: P = 0.953).

![Graph showing Frankl Behavior scores by groups with error bars]

**Figure 6.** Clustered Bars of Frankl Behavior Scores by groups (Higher Scores=More Positive Behavior). *Note: there was only 1 intervention group participant with data for 3 visits. Independent Samples t-test: p = 0.953.

The parental perception of overall child behavior during the dental visits is shown in figure 7 with no statistical significance between groups. Independent Samples t-test: p = 0.168.

The perception of the parents regarding the improvement in behavior towards the end of the visit as shown in figure 8 was not statistically significant. Using a Fisher’s Exact test, no difference was found (p = .214).
There was no statistical difference of children cooperativeness during the dental visit between groups as perceived by parents (p= .429).

Figure 7. Parents perception of the overall child behavior by groups. Pearson Chi-Square (p= .102).

Figure 8. Parental perception of behavior improvement toward the end of the dental visit. Using a Fisher’s Exact test, no difference was found (p = .214).
Figure 9. Child cooperativeness as perceived by parents by groups. Using a Fisher’s Exact test, no difference was found (p = .429).

Secondary outcomes

To assess the distress level experienced by children with ASD during the dental visit was measured through the anxiety scale (Table 6) and physiological biomarkers: heart rate and cortisol levels (Table 7, which also shows control versus intervention statistics in all measures). Change from baseline in mean sitting heart rate and cortisol between baseline and visit 2 is shown in Table 3.
Table 6. Venham’s Clinical Anxiety Rating Scale Descriptive Statistics

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Venham’s Clinical Anxiety Rating Scale: Higher score=More anxiety

Figure 10. Estimated marginal means of anxiety scale
Table 7. Control versus Intervention Group Statistics on all measures at baseline

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Independent Samples T-test Results: Control versus Intervention Group on all measures

*No statistically significant difference between the groups on any of these measures.
CHAPTER 4: DISCUSSION

Demographic characteristics of this study’s participants showed a higher prevalence of males, since all participants were males. It is thought that this was due to the limited number of patients and represents a limitation for the study. But this corresponds to the epidemiology of ASD with a current prevalence of 4 males to 1 female.\(^5\)

Patients with Autism Spectrum Disorder represent a challenge for dental providers. The combination of their behavioral deficits and the nature of the therapeutic intervention usually requires the administration of general anesthesia in about 40 percent of cases.\(^76\)

There are limited studies evaluating possible strategies for the management of behavior for patients with ASD in the dental setting. This pilot study experimentally compared the effectiveness of a visual support schedule App and Tell-show-do (TSD) intervention for improving the behavior during a routine dental visit. The innovation of this study involved using a digital tablet as a mediating tool between children with ASD and the dentist to facilitate the dental visit. Due to the multiple advantages including ease of use and the level of engagement for typically developing children and children with ASD. The first null hypothesis was there is no improvement in behavior during a routine dental visit for patients with ASD when using a visual support schedule App. Statistically the null hypothesis was accepted. These results do not support the results by previous studies.\(^{48,57}\) A previous study completed on 2019 using an iPad as a training program during the dental visit showed an improvement in oral assessment because the children became compliant and less anxious.\(^{48}\) Also, Zink et al reported an improvement in
communication between the dentist and patients when using an App versus using Picture Exchange Communication System (PECS), decreasing the number of appointments required for preventive dental care and clinical examinations.\textsuperscript{57}

Even though there was no statistical significant difference between the groups, clinically within the intervention group all participants were able to complete all tasks given during the dental visit. Within the control group 50\% (n=2) of participants could complete all the tasks. A pilot study using visual support system in dental care for patients with autism showed some promise in helping children with autism successfully complete more tasks, progress at a quicker rate, and exhibit lower levels of behavioral distress within a dental appointment, compared to a traditional tell-show-do approach. In the current study the mean differences in time to complete all tasks between the groups did not show a significant difference, that could also be due to limited number of participants and premature interruption of the study.\textsuperscript{51}

Dental anxiety has been considered one of the main challenges of behavior management in pediatric dentistry and it should be addressed in order to provide high quality dental treatment.\textsuperscript{63} It has been reported in the literature that one of the most common comorbidities of individuals with autism is their high anxiety levels.\textsuperscript{9} The present study did not show a significant difference in the level of distress. A difference from the study completed by Ghadimi, et. all that reported a significant reduction on Self-reported dental anxiety when using visual distraction tool compared to conventional tell-show-do.\textsuperscript{63} Within the variables used to approximate to the distress levels of the participants, biological markers as salivary cortisol levels were used, without a
statistically significant result. Even though studies have proven that the measurement of
salivary cortisol may be a convenient method for the assessment of dental anxiety.⁷⁷

Some of the key strengths of this study include the practical application providing
alternative strategies to families and dental care providers to benefit children with oral
health care needs and behavior challenges. This project also included a multidisciplinary
approach for the management of patients with autism in the dental office consisting of
dentists and behavior analysts to provide individuals with patient focused, high quality
oral care. The study also has many limitations. Since it was a pilot study with a small
sample size, it was not possible to have enough statistical power to detect significant
differences between interventions. Discrepancy due to undiagnosed comorbidities such as
depression, anxiety and ADHD in young children with ASD not reported by parents
could also be a confounder in this study. Since the majority of our patients age ranged
from three to 6 years in age, it should be valuable to examine the use of the app among
children with ASD in different age groups in different clinical settings.

Even though numerous limitations exist our current investigation, this study can
be a contribution to the solution of unmet dental needs in children with ASD and can be
an addition to the literature in treating children with ASD.
CHAPTER 5: CONCLUSION

Within the limitations of this study, it can be concluded that there was no association between the use of the App and improvement in behavior during routine dental visit for patients with ASD. The intervention did not improve the number of tasks completed or decreased the time to complete all tasks. The same was evident when comparing the groups regarding the behavior and anxiety scale.

The effectiveness of the App reducing anxiety and improving behavior in young patients, to facilitate the dental intervention was not proven by this study. Biological biomarkers were not statistically different between the groups. The deficient data collected limits the possibility of drawing strong conclusions that the App can facilitate a routine dental visit for patients with ASD.

It is suggested this research is allowed to continue in order to consider if the App has more benefits for patients with ASD when visiting the dental office compared to the existing standard of care for behavior management. We hope that successful routine dental care can be made possible for these patients, using the methods outlined here, without relying on advanced pharmacological techniques.
Appendix A - ASD Diagnostic Criteria DSM5

Autism Spectrum Disorder

Autism Spectrum Disorder

Diagnostic Criteria 299.00 (F84.0)

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior (see Table 2).

B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).
3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior (see Table 2).

C. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.
E. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

Note: Individuals with a well-established DSM-IV diagnosis of autistic disorder, Asperger's disorder, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder. Individuals who have marked deficits in social communication, but whose symptoms do not otherwise meet criteria for autism spectrum disorder, should be evaluated for social (pragmatic) communication disorder.

Specify if:

With or without accompanying intellectual impairment
With or without accompanying language impairment
Associated with a known medical or genetic condition or environmental factor (Coding note: Use additional code to identify the associated medical or genetic condition.)
Associated with another neurodevelopmental, mental, or behavioral disorder (Coding note: Use additional code[s] to identify the associated neurodevelopmental, mental, or behavioral disorder[s].)

With catatonia (refer to the criteria for catatonia associated with another mental disorder, pp. 119–120, for definition) (Coding note: Use additional code 293.89 [F06.1] catatonia associated with autism spectrum disorder to indicate the presence of the comorbid catatonia.)
Appendix B- Parental perception of behavior questionnaire

Parental perception of Children’s Behavior During Dental Visit.

Ana L. Gonzalez, DDS
Nova Southeastern University
Pediatric Dental Resident

1- Overall, how do you consider your child’s behavior during the dental visit today:
   □ Very bad
   □ Bad
   □ Good
   □ Very good

2- Was your child aggressive?
   □ Yes
   □ No

3- Do you consider there was an improvement of your child’s behavior towards the end of the procedure?
   □ Yes
   □ No

4- Was your child cooperative overall for dental procedures today?
   □ Yes
   □ No
## Appendix C - Data Collection Form

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### Washout Period and Crossover

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### Appendix D - Raw Data

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Bibliography and References Cited


43. Chung J. *Connecting the Pieces: An Appreciative Inquiry of Didactic Training Module for Pediatric Dentistry Residents Treating Children with ASD and their Families.* Fort Lauderdale, FL: College of Arts, Humanities, and Social Science, Nova Southeastern University; 2018.
47. Turk N. *Characteristics associated with successful dental treatment in children with Autism spectrum Disorder.* Fort Lauderdale, FL: College of Dental Medicine, Department of Pediatric Dentistry, Nova Southeastern University; 2017.


