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A COMPARISON OF VIRTUAL AND IN-PERSON LEARNING ON THE OBSERVATION OF PUZZLE MANIPULATION AMONG NEUROTYPICAL AND NEURODIVERSE CHILDREN

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A COMPARISON OF VIRTUAL AND IN-PERSON LEARNING ON THE OBSERVATION OF PUZZLE MANIPULATION AMONG NEUROTYPICAL AND NEURODIVERSE CHILDREN

by

Katrina Verhagen

B.S., University of Wisconsin – Green Bay, 2012

A Thesis
Submitted in Partial Fulfillment of the Requirements for the
Master of Science Degree

School of Psychological and Behavioral Sciences
in the Graduate School
Southern Illinois University Carbondale
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THESIS APPROVAL

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Fulfillment of the Requirements

for the Degree of

Master of Science

in the field of Behavior Analysis and Therapy

Approved by:

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AN ABSTRACT OF THE THESIS OF

Katrina Verhagen, for the Master of Science degree in Behavior Analysis and Therapy, presented on April 8, 2021, at Southern Illinois University Carbondale.

TITLE: A COMPARISON OF VIRTUAL AND IN-PERSON LEARNING ON THE OBSERVATION OF PUZZLE MANIPULATION AMONG NEUROTYPICAL AND NEURODIVERSE CHILDREN

MAJOR PROFESSOR: Dr. Natalia Baires, Ph.D., BCBA-D

Virtual learning has been used long before the COVID-19 pandemic for mental health care or acute conditions but was rarely used as a replacement for in-person visits. Additionally, virtual learning was primarily used for those earning graduate and undergraduate degrees. Virtual learning for individuals younger than eighteen is not typically researched, as it has not been a subject of importance or seen as a replacement for in-person learning. The current study worked with four male children under the age of eighteen from both the neurotypical and neurodiverse populations. Participants were paired into dyads to assess learning done both virtually and in-person when presented with a brainteaser puzzle using a multiple baseline across participants design. Two of the four participants engaged in both treatment conditions. Percent of independently completed steps of a brainteaser puzzle and percent of on-task behavior were measured across conditions. Implications of the current study suggest that individuals that are considered severely delayed may learn more proficiently when in-person, however, others with less severe developmental disabilities and those that are considered neurotypical may be able to learn across either condition.

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I would like to thank Clay Verhagen for his unconditional support throughout my education, encouraging me to push further, and to continue aiming higher. Without your continued guidance and support, dad, this would not have been possible. Like you always said, “you can do anything you put your mind to.” Thank you for believing in me and never letting me settle for less. Additionally, I would like to thank Dr. Natalia Baires for her guidance throughout the research process and guiding me through my final semesters of my graduate career at Southern Illinois University.

DEDICATION

I want to dedicate this research to all educators and students navigating the COVID-19 pandemic, especially in the beginning, with little to no guidance on best practice and still rising to the challenge. Your dedication to teaching through all circumstances is admirable and was a motivation for the current study. Most importantly, to my nieces and nephews: Anakin, Mason, Oliver, Madilyn, and Khloe: never let the world tell you that you can’t do what sets your soul on fire.

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CHAPTER 1

INTRODUCTION

As many rang in the new year on January 1st, 2020 the excitement of a new decade, new experiences, and new challenges were at the forefront for many. Within weeks, the novel coronavirus (COVID-19) made its way around the world (Wijesooriya et al., 2020) pushing health care providers to expand the use of telehealth, insurance providers to modify requirements for the use of telehealth, and schools to investigate the use of telehealth for virtual learning with populations that had previously not utilized it such as special education or those with Individualized Education Plans (IEP). On March 11, 2020, the World Health Organization declared COVID-19 a world-wide pandemic with more than 118,000 cases across 114 countries, including the United States, and almost 5,000 deaths attributed to it (World Health Organization, 2020). Soon after, on March 13, the United States Government declared a national emergency due to COVID-19 (Faget, 2020). Quickly across the United States, “safe at home” orders were enacted to aid in slowing the spread of the virus (Rodriguez, 2020) which meant school-aged children would be attending school from home through virtual learning platforms while children receiving autism therapy services were forced to either place services on hold or request that their individual billing provider authorize the use of telehealth. For the purpose of the following research, telehealth and virtual learning are used synonymously.

At the initial peak of COVID-19, 55.1 million students across 124,000 public and private schools in the United States were impacted by school closures (Peele and Riser-Kositsky, 2020). When COVID-19 closures began to be placed, many school districts and behavioral analytic providers began to initiate ways to run a distance learning program; these programs included things such as virtual classrooms, digital homework or learning platforms, or homework packets created by teachers and sent home. However, during this time, many students remained vulnerable to missed services, disruption in services, or reduction in services (Fredrick et al., 2020). According to the U.S. Department of Education (2021), millions of students are currently receiving services under the Individuals with Disabilities Education Act (Individuals with Disabilities Act, n.d.) and are provided free and appropriate public education (FAPE) which states that school districts are still required to complete components of an individualized education plan (IEP) even in the pandemic (U.S. Department of Education, 2020). This adherence was to be followed to the highest extent possible by each school district. However, many students and families continued to lack services or service disruptions. Further, many approaches lacked research to aid in guiding decisions for both clinicians and school administrators.

Telehealth and Virtual Learning

Telehealth, or virtual learning, is the use of technology to assist in education as well as the treatment of health-related conditions (Ferguson et al., 2018). The utilization of telehealth has been rising over the last decade as high-speed internet access has grown across the nation. Initially, it was meant to fill a gap in health care service delivery during natural disasters or pandemics when in-person visits are prevented, limited, or discouraged (LeBlanc et al., 2020). However, an increase in research since the onset of the COVID-19 pandemic has been observed with special publications or issues on the topic to deliver peer-reviewed research to practitioners (LeBlanc et al., 2020). In an article by Currie (2020), the expansion of telehealth in the face of the COVID-19 pandemic has addressed barriers related to reimbursement, licensing restrictions, and practice restrictions.

Fredrick et al. (2020) created a modified delivery plan to ensure access to services despite distance learning to aid in success of students with an IEP. These services were run using multiple services deliveries and with the support of a collaborative team. Board Certified Behavior Analysts were utilized in service delivery to not only prepare individualized programming but supervise the behavior interventionists and support parents. Although there was still minimal data at the time of publication for the article, results were positive in that many individuals that would have otherwise lost services or had reduced services, continued to receive a minimum 15 hours per week of instruction from a behavior interventionist and support from a Board Certified Behavior Analyst. Fredrick et al. (2020) stated that collaboration was key to the success of the program and its continuation as well as continued data collection. Parents and students reported high satisfaction rates in the model and it also attained a 98% attendance level throughout implementation (Fredrick et al., 2020).

Tomaino et al. (2020) assessed how effective distance learning was and if it was actually feasible for students with severe developmental disabilities and/or higher behavioral needs. To do this, Tomaino et al. (2020) conducted surveys to parents and educators felt about the engaging in distance learning and if that would be beneficial, which resulted in neutral attitudes and then reviewed students goal progress in their IEP after the change to distance learning. Although this article does not engage in a determination of best practices for distance learning for those with severe disabilities or higher behavioral needs, they did find that students were able to maintain half of the skills in their IEP and did make progress on some goals within their IEP (Tomaino et al., 2020) when reviewing how quickly educators were required to make adjustments for students, these results show that there was some efficiency in evaluating programs and implementing distance learning for those with severe disabilities and behavioral needs (Tomaino et al., 2020).

The Kennedy Krieger Institute in Baltimore, Maryland released research regarding the fast shift to telehealth in order to continue services in their Behavioral Psychology department (Crocket et al., 2020). Throughout the article, it is discussed the process of creating a plan for telehealth, which included clinician training to achieve and maintain meaningful outcomes for clients (Crocket et al., 2020). Zhihui and Dixon (2020) provide a model of parent training utilizing telehealth on a virtual platform. Although the research was initiated prior to the start of the COVID-19 pandemic, it was continued through the pandemic and provided results relevant to current research. As parents became crucial in teaching and learning situations, either for school-based learning or implementing therapy techniques, it is critical to teach parents what is being asked of them.

Zhihui and Dixon (2020) created on on-demand program that parents were able to complete on their own time but within a 60-day timeframe. The program includes skill development, consultations and coaching, as well as check-ins based on completion of each portion of the lesson. This parent training is required to be completed prior to implementing telehealth models of learning to ensure that parents met a basic competency (Zhihui & Dixon, 2020). Though time consuming and difficult to implement quickly, this is an idea that can be utilized by clinicians and school administrators to build competency and fluency for a child's parent to aid in homework completion and as a proactive measure if needing to move remotely in the future.

There is minimal supportive research on how to conduct distance learning with individuals with an IEP in place and how to best serve the disabled community during a time of crisis. Zoder-Martell et al., (2020) reviewed three technologies and their effectiveness in facilitating telehealth Behavioral Analytic services. With more research reviewing telehealth, this can be a place to aid in creation and implementation of virtual learning set up and technologies to make learning effective. Web cameras or webcams, are the current common place when discussing telehealth as these are easily accessible, most are already in a computer's basic design, or inexpensive to purchase (Zoder-Martell et al., 2020). Further, web cameras are easy to use and only require the click of a few buttons to have a platform access for camera. There are limitations to the use of a web camera, such as limited mobility when using a basic web camera, and the inability to move with the individual being observed or engaged with. If a client or student no longer wants to be a part of the conference or class, they simply need to turn the camera off and a teacher or other clinician cannot change that.

Another option given by Zoder-Martell et al. (2020) is called a "Swivl" which has the ability to rotate to follow whoever is being monitored through a connected device that a "presenter" wears on their person. However, this device has a higher price point that a typical web camera and is not easily accessible to many and also requires the use of a tablet. Each of these costs can add up for someone that is not planning to use virtual learning as an extended option. When looking at options to aid in virtual learning, it is important to review if the option is sustainable for long-term success and individual success of those using it.

In a study by Singh et al. (2017), three teachers in rural districts were taught to utilize telehealth to teach mindfulness-based procedures in their own classrooms serving students with intellectual and developmental disabilities (IDD). This study consisted of two dependent variables teaching teachers how to deliver mindfulness-based procedures and teaching students how to use mindfulness-based procedures. Results showed that the rural teachers were able to learn the intervention via telehealth and maintain those skills for a minimum of a month after training (Singh et al., 2017). Results also showed high rates of treatment fidelity when the steps outlined in the training manual for the intervention were measured for adherence. Additionally, each of the students, who had previous engaged in verbal or physical aggression, were able to utilize the taught skills when needed to regulate their emotional responses (Singh et al., 2017).

In a study using telehealth to conduct language assessments with children with autism, researchers discovered that assessments can reliably be conducted through a telehealth model (Sutherland et al., 2018). The dependent variables were the language assessment scores obtained by Speech Language Pathologists in either telehealth and face-to-face formats, as well as the behavior observation scores during the two conditions (Sutherland et al., 2018). Thirteen children participated in the research with only one participant having more difficulty remaining in one area to complete the assessments. The congruency between scores in both environments were high, which support the use of telehealth for conducting assessments, such as language assessments, for school-aged children on the autism spectrum (Sutherland et al., 2018).

Lindgren et al. (2015) reviewed the use of telehealth for treating challenging behavior. Three different service-delivery systems were reviewed: in-home treatment, clinic-based telehealth, and home-based telehealth. The lowest cost option was the home-based telehealth and the in-home therapy was the costliest. The review included 107 children with autism or other developmental disabilities and their parents or caregivers. The parents were taught to conduct both Functional Assessments (FA) and Functional Communication Training (FCT) to replace the maladaptive behaviors observed. The research by Lindgren et al. (2015) suggested that parents are able to not only learn how to conduct an FA or implement FCT, but were able to use the skills to treat moderate to severe behavior problems across all settings. As treatment was successful across settings, it is hypothesized that an increase in telehealth delivery for training can occur with socially significant results (Lindgren et al., 2015).

Observational and Social Learning

According to Cooper et al. (2020), observational learning occurs when one observes another person's behavior and the consequences that follow to determine if the behavior should be imitated or not. It is crucial that the observer is able to discriminate the consequences contacted by the model (Cooper et al., 2020). This may pose a challenge for individuals diagnosed on the Autism Spectrum of Disorders (ASD), as they often have deficits with the prerequisite skills required to engage in observational learning (i.e., attending, imitating, and discriminating) as a higher-order behavior (Catania, 2013; Cooper et al., 2020). According to the Mayo Clinic (n.d.), Autism Spectrum Disorder, or ASD, is a developmental disorder related to brain development. ASD impacts all areas of development, especially in the areas of social interactions, communications, and leading to limited and repetitive behavior (Mayo Clinic, n.d.). Observational learning is an important skill for individuals to have in their repertoire as they can learn a variety of skills that are not directly taught, which saves time and increases appropriate responding within new contexts (Catania, 2013; Cooper et al., 2020). Although research pertaining to observational learning is not as expansive as other forms of learning, more researchers are focusing on observational learning, especially with individuals with ASD.

Research by Nadel et al. (2011) compared the effects of observational learning on 20 low-functioning children with ASD to 20 typically developing peers by presenting them with an action-effect task. A wooden box, much like a puzzle, was presented to participants to open. A video demonstration of how to open the box was provided, along with the discriminative stimulus of "Take it." Over nine days, participants were presented with the wooden box four times, with two times including the video demonstration (Nadel et al., 2011). Participants were not given the wooden box while watching the video demonstration. Nadel et al. (2011) found that both ASD participants and typical developing participants were able to learn through observation but the participants with ASD were not able to correctly complete the puzzle after just one observation. Overall, this study demonstrated that low-functioning children with ASD are able to learn through observation, even without prior experience with the task (Nadel et al., 2011).

Fletcher and Orr (1967) worked with preschool-aged children without any prior object discrimination training via observational learning. Participants were separated into two groups, a "look" group and a "point" group who either received the discriminative stimulus to "Look" or were provided a point prompt to look where either a piece of candy or a raisin was placed. Following, participants were then instructed to find the corresponding item. Prompts were then faded to test for observational learning (Fletcher & Orr, 1967). Both groups averaged over 90% correct during the prompting trials. However, when the prompt was removed, the participants in the "point" group were more likely to engage in observational learning (Fletcher & Orr, 1967). These results suggested that the individuals in the "look" group may have primarily attended to the verbal directive, whereas those in the "point" group may have attended more to the object that was pointed to (Fletcher & Orr, 1967).

DeQuinzio et al. (2018) assessed if children with autism were able to discriminate between both known and unknown stimuli when engaging in observational learning. This research utilized a multiple baseline across participants when evaluating the effects of discrimination training of consequences to modeled responses (DeQuinzio et al., 2018). Three children with ASD took part in the study, with the main dependent variable being the percentage of correct responses during test sessions. Twelve pictures (six of which were correctly identified during the pre-test condition) were used as training stimuli in discrimination training sessions. Results from DeQuinzio et al. (2018) showed that participants were able to learn to discriminate contingencies when responses were modeled for unknown stimuli, meaning that children with autism are able to learn through observational learning.

In reviewing Fletcher and Orr (1967), Nadel et al. (2011) and DeQuinzi et al. (2018) articles, observational learning can occur regardless of developmental level or age of the participants. Although results from Fletcher and Orr (1967) did not support the use of observational learning, they were able to show that when given a directive, children were able to learn where a reinforcing item was. Additionally, low-functioning individuals on the ASD were able to engage in observational learning when given additional learning trials to their typically developing peers (Nadel et al., 2011). The current research aims to pair typically developing participants with participants diagnosed on the ASD regardless of functioning level. It is important to ensure that participants are able to engage in imitative skills as well as attending to directives as described by Catania (2013) and Cooper et al. (2020) prior to initiation of the research as these are foundational skills to observational learning.

Vincent et al. (2018) utilized a concurrent multiple baseline across participants design in research on the implementation of the FRIEND Playground Program to increase social skills for students with Autism Spectrum Disorders (ASD) and other socially related challenges. During this time, activities were structured by facilitators in a way for all students on the playground and to increase the motivation of those with ASD to engage in play with their typically developing peers (Vincent et al., 2018). Further, the facilitators worked to increase interaction between both the ASD students and their typically developing peers, an example given is engaging in an egg race. One student would be given eggs and the other would be given the spoons, if an ASD student was given eggs, a typically developing student would be given the spoons and if the child wanted to participate, they would be required to seek out a peer with the other material to engage in the activity (Vincent et al., 2018). The study resulted in increased interactions between ASD students and their typically developing peers with engagement at 96% during the treatment condition, an increase from the 78% at baseline (Vincent et al., 2018).

This intervention leads to increased awareness in the impact that interaction between typically developing individuals and those diagnosed with ASD can improve skills and lead to learning. The research, however, does not engage in a follow up which leaves the question of maintenance of the skill; however, this is a promising start. In research conducted by Cardon & Wilcox (2011), imitation training using reciprocal models and video models were used pairing typically developing children with children diagnosed with Autism using a multiple baseline design. In the study, participants in both the reciprocal model and video model increased the ability to imitate others with generalization to both the researcher and a caregiver (Cardon & Wilcox, 2011). Imitation of others is a piece of learning that is utilized across environments, especially within schools. The difficulty imitating for a child with Autism can inhibit learning new skills and opening up their ability to learn other, more complex skills, or join the workforce as an adult. Finding ways to teach children ways to imitate can open new opportunities to learning other skills.

McKay et al. (2014) reviewed prompting hierarchies and skill acquisition when teaching leisure skills and vocational skills. Initiating the research, it is put forward that there is little research (at the time of publication) for prompting hierarchies, where and how to start, and how that can impact learning of a skill. McKay et al. (2014) worked with three adolescent girls diagnosed with intellectual disabilities in putting together a Lego structure. When teaching the chains of building, where as in the actual training trial, most-to-least prompting methods were utilized. The most-to-least prompt with a two-second delay method resulted in fewer trials to mastery. When teaching leisure skill, as this research sets to do, understanding prompting and the best way to engage in that teaching can aid in development of a plan.

Purpose of the current study

When looking at the initial months of the COVID-19 pandemic, many educators had to develop plans to move what was created for a classroom to a virtual setting; with little research to aid in decision making, many students may have fallen behind or did not engage in a way of learning that aided their comprehension. Students with disabilities, especially, may have fallen further behind due to the lack of resources to implement a functional form of virtual learning. Although research is still in its infancy for telehealth and virtual learning, the COVID-19 pandemic prompted an increase in awareness for the lack of substantive research and encouraged ways of researching the use of telehealth, virtual learning, and a variety of ways to teach using these modalities. Many academic journals published special publications pertinent to the COVID-19 pandemic to aid in decision making for providers and educators alike. The purpose of the current study was to compare virtual and in-person learning on observation of puzzle manipulation for neurotypical and neurodiverse populations. Two treatment phases, a baseline, and a one-week follow-up were utilized within the current study.

CHAPTER 2

METHODOLOGY

Participants

Four male participants under the age of fifteen took part in the current study. Participants were recruited in a small city in Wisconsin through a recruitment email sent by the primary researcher. Parents of potential participants replied to the email if interested in participating and the recruitment process was initiated at that time. To be eligible to participate in the current study, potential participants had to meet the following criteria: a) be under the age of 18 years old, b) not have been diagnosed with a developmental disorder (i.e., neurotypical) or have a primary diagnosis of ASD, c) have a form of functional communication (i.e. vocal language or the use of an Augmentative Communication Device) by communicating in complete sentences, d) attend to a screen for a minimum of 30 seconds, e) follow instructions within five seconds, f) have reliable internet connection within their home, g) have access to a device capable of connecting to the internet and running a virtual meeting platform such as Zoom, h) receive a score of "average" or above on the Developmental Profile – 3 if the participant was neurotypical, and i) receive a score of "below average" or "delayed" on the Developmental Profile– 3 if the participant had Autism Spectrum.

Potential participants were excluded from the study if they a) were 18 years or older, b) diagnosed with a primary diagnosis other than ASD such as a neurological disorder, c) did not have a reliable form of functional communication by communicating in complete sentences, d) were unable to attend to a screen for less than 30 seconds, e) followed instructions after six seconds, f) lacked internet connection within their home, g) did not have access to a device capable of connecting to the internet and running a virtual meeting platform, h) received a score of “below average” or “delayed” on the Developmental Profile– 3 if they were neurotypical , and i) received a score of “average” or above on the Developmental Profile– 3 if the participant had ASD. Once potential participants were identified, parents were emailed the consent form, assent form, and Developmental Profile (Western Psychological Services, 2007; see Appendix A), and asked to complete them within one week.

Participant one, Scott, was a vocal 8-year-old Caucasian neurotypical male in second grade at a local public school. Scott lives at home with his biological parents and two younger siblings. He attended school virtually from March 2020 at that start of the COVID-19 pandemic until January 2021. Scott had been attending school in-person for about 4 weeks prior to participating in the current study. His parents stated that they were highly involved when Scott was engaged in virtual learning and noticed some inattentive tendencies while learning. Scott’s parents did report, however, that while in the classroom, Scott is described as attentive and that he “enjoys helping his teacher when possible.” Scott is in a general education room and does not require an Individualized Education Plan. He is stated to have many friends that he spends time at recess and does not have difficulty with social interactions or difficult subjects in school such as math. Scott’s parents reported that he is highly skilled in math, problem solving, and reading. Scott reported to the researcher that he enjoys cats, Minecraft video games, and playing outside. Scott does not take any medication. Scott had primarily average scores on his Developmental Profile– 3 with the exception of his communication skills which rated as “above average.” His results show that his abilities, as measured on the Developmental Profile– 3, are within the range that is expected for his age.

Participant two, Arthur, was an eleven-year-old Caucasian male with a primary diagnosis of ASD, and also has secondary diagnoses of Generalized Anxiety Disorder and Attention

Deficit Hyperactivity Disorder. Arthur engages in vocal verbal behavior and lives at home with his biological parents and an older, biological brother. He attends fifth grade at a local public elementary school, where he currently has an Individualized Education Plan. Due to the COVID-19 pandemic, Arthur engaged in virtual learning from March 2020 to January 2021. While in school, Arthur does not receive any additional services such as Speech or Occupational Therapy but does have the option to go to the Autism classroom when needed. Arthur spends the majority of his day with neurotypically developing peers and was reported to be doing well. It was reported that he had been successful with virtual learning but needed to be monitored closely to ensure he was remaining on task and not engaging in the discussion board with peers.

Arthur also had been receiving services based on Applied Behavior Analysis through a clinic-based provider 8 hours per week but had ended services in October 2020 due to lack of significant progress in goals. His parents are currently seeking social skills groups in the local area as they report that Arthur has a difficult time making and maintaining friendships. Arthur is highly skilled at math and science as well as reading. He enjoys playing with his iPad, number blocks, and other math-derived games. Arthur is currently on the following medications: 3 mg Clonidine for sleep, 36mg Concerta for Attention Deficit Hyperactivity Disorder, 2mg Guanfacine for Attention Deficit Hyperactivity Disorder, 4mg Cyproheptadine to increase appetite, and 10 mg Escitalopram for anxiety. Many of Arthur's scores on the Developmental Profile– 3 fell "below average" with the exception of his social-emotional score, which was considered delayed when compared to the typical range that is expected for his age.

The third participant, Ryan, was a non-vocal thirteen-year-old Caucasian male attending seventh grade at a local middle school for half days. He lives at home with his biological parents and a younger, biological brother. Ryan has a primary diagnosis of ASD and has secondary diagnoses of Chronic Migraines and Generalized Anxiety Disorder. He spends his day in a Special Education room, has an active Individualized Education Plan, and receives both Speech and Occupational Therapy through school. He also attends a clinic-based Autism Treatment Provider 16 hours a week. Currently, Ryan uses an Augmentative and Alternative Communication (AAC) device with Proloquo-To-Go. Although his preferred method of communication is via grunts and pointing, Ryan uses the AAC device proficiently and builds sentences quickly. When engaging in vocal verbal behavior, Ryan's communication is understood mainly by those who interact with him on a daily basis, such as his family, but is not understood by those who infrequently interact with him.

Through a Functional Behavior Assessment conducted by the Board Certified Behavior Analyst at the current clinic he attends, Ryan engages in self-injurious behavior that is hypothesized to be maintained by escape from demands and as a way to gain sensory input. This self-injurious behavior can occasionally become severe, as he will hit his head or jaw with a clenched fist with enough force to leave a bright, red mark if not stopped. He does use a helmet during these escalation times, parents report that he will stop engagement in the self-injurious behavior when the helmet is in sight. Ryan's parents reported that a formal functional assessment was not conducted throughout his years of intervention services. Ryan experiences incontinence at night and does, at times, wear a pullup to bed but has been working on night training in recent months, as reported by his parent. Ryan enjoys playing on his iPad, watching clips from movies on YouTube, being outside, and playing with beads. Currently, he takes the following medications: 3mg Clonidine for sleep, 20mg Escitalopram for anxiety, 80mcg Onasl for allergies, 1 Xlax daily to aid in bowel movements, 30 mL Lactulose for constipation, 1mg Lorazapam (as needed) for anxiety due to self-injurious behavior or dental procedures, 125mg

Naproxen (as needed) for headaches, and 5mg Rizatriptan (as needed) for migraines. All of Ryan's scores on the Developmental Profile– 3 scored as delayed and do not meet the range that is expected for his age.

The fourth participant, Clayton, is a vocal, Caucasian three-year-old neurotypical male living with his biological parents, two biological siblings, an older brother and younger sister. He currently does not attend pre-school; however his parents intend to enroll him in the Fall. Enrollment in formal schooling was delayed one year due to the COVID-19 pandemic. Currently, Clayton is working on becoming toilet trained but continues to wear pullups and has accidents when in his underwear. Clayton's parents report that he was late to develop clear language but matches identical colors, letters, numbers, and shapes and recalls information from more than one month prior. He also mands for more information on subjects that he does not understand and, as parents reported, frequently asks why things occur as they do. Clayton enjoys superheroes, dinosaurs, his tablet, dessert foods, and playing with his older brother. His parents reported that if not monitored, he can engage with his tablet for more than thirty minutes but can transition easily away from his tablet to other activities. He currently does not take any medications. Clayton's Developmental Profile– 3 scored "above average" for both the physical and adaptive behavior scale and "average" for social-emotional, cognitive, and communication scales. He is within range of what is expected for his age.

Setting

The current study took place within each child's home with at least one caregiver present. Procedures were conducted in a quiet area of the participants' home to aid in simulating their virtual academic environment. Each participant had a device with the Zoom application downloaded. Further, each participant also had an adult with them (e.g., the participant's caregiver or the researcher). Depending on the experimental condition, either the caregiver sat on the other side of the room or the researcher sat next to the participant.

Materials

As previously mentioned, Zoom was utilized for the current study. Each participants' house was equipped with a computer or tablet that Zoom was downloaded onto. A brainteaser puzzle was made available to each participant when sessions were conducted and was stored out of reach when sessions were not occurring. The brainteaser puzzle was determined based on the participants' functioning levels. There were two brainteaser puzzles per participant dyad, per session to ensure that each participant in the dyad was utilizing the same brainteaser puzzle. Different brainteaser puzzles were used for the in-person teaching condition and the virtual observational learning condition. Additionally, the Developmental Profile – 3 (Western Psychological Services, 2007) was completed by participants' caregivers to establish participant dyads. The Developmental Profile – 3 is a checklist designed for caregivers to fill out with yes or no questions regarding development across domains of milestones such as physical, adaptive behavior, social-emotional, cognitive, and communication.

Experimental Design

As a variation of a typical AB design, an ABC (Additive) design (Bailey & Burch, 2017) with baseline, treatment, and a one-week follow up was utilized, as it can show a relation between the treatment and dependent variable (Cooper et al., 2020) and can be extended with additional treatments if needed (Bailey & Burch, 2017). However, a limitation of the ABC design is that it cannot, without doubt, that change was due to treatment delivered and confounding effects can be observed within the design (Bailey & Burch, 2017; Cooper et al., 2020).

The dependent variables were the percentage of intervals engaged in on-task behavior during the virtual and in-person conditions and the percentage of steps independently and accurately completed during the virtual and in-person conditions. On-task behavior for the virtual condition was defined as the participant completing the puzzle when asked to and actively looking, at the screen while directives were given, as measured by a momentary time sample of 10 second intervals (see Appendix G). On-task behavior for the in-person condition was defined as the participant manipulating the puzzle when asked to and actively looking at the researcher when being shown how to complete the puzzle, as measured by a momentary time sample of 10 second intervals (see Appendix F). Four task analyses of the brainteaser puzzle solutions were created (see Appendices B-E). To calculate the percentage of steps independently and accurately completed, the number of steps independently completed was divided by the total possible number of steps and multiplied by 100. To calculate the percentage of on-task behavior measured by the momentary time sample, the total number of plus marks (to indicate behavior engagement) was divided by the total number of ten-second intervals and multiplied by 100.

Due to the ongoing nature of the COVID-19 Pandemic, specific COVID-19 Protocols (see Appendix M) were put into place that were required adherence by both participants and their families as well as the researcher. Protocols aligned closely with those that had been implemented in local school districts and Autism treatment clinics in the state of Wisconsin. Additionally, researcher reviewed recommendations from the Wisconsin Department of Health Services, as listed on their "COVID-19: You Stop the Spread" webpage (Wisconsin Department of Health Services, 2021).

Procedures

All sessions were recorded via Zoom with a time stamp enabled. After the consent forms, assent forms, Developmental Profile – 3 (Western Psychological Services, 2007) were completed, sessions were scheduled to begin. Prior to implementing procedures, a forced-choice preference assessment (Cooper et al., 2020) was used to identify preferred stimuli for participants. These stimuli were delivered after the completion of the brainteaser puzzle within both conditions of the study. Each participant was assigned to a dyad based on their parent-report scores from the Developmental Profile– 3. From the Developmental Profile– 3, Clayton and Ryan were placed into a dyad and Scott and Arthur comprised the other dyad. These placements were due to scores on the "Cognitive", Adaptive Behavior, and Communication scales primarily.

Baseline

The study began with baseline procedures. To begin baseline, the first brainteaser puzzle was presented to the participant with the discriminative stimulus, "Solve the puzzle." The participant was given 10 minutes to manipulate the brainteaser puzzle. At the conclusion of the 10 minutes, the brainteaser puzzle was removed and a mastered receptive instruction (e.g., "Clap hands," "Stop feet," "Copy me") was provided. After a successful response to the mastered instruction, a preferred stimulus was delivered and the participant was given 10 minutes to engage with the stimulus. After the preferred stimulus was removed, the second brainteaser puzzle was presented with the discriminative stimulus, "Solve the puzzle." The participant was given 10 minutes to manipulate the brainteaser puzzle. At the conclusion of the 10 minutes, the brainteaser puzzle was removed, a different mastered instruction was presented, and preferred stimulus was given for 10 minutes. The aforementioned sequence occurred four across all four participants.

Treatment

Prior to the start of the study, participants were split into dyads based on the scores from the parent-completed Developmental Profile. Once dyads were created, each participant was placed into a treatment condition at random by flipping a coin. This was to determine which participant would engage in the in-person condition first, while the other participant would begin with the virtual condition. Due to the ongoing COVID-19 pandemic, precautionary measures were put in place to aid in prevention of spreading the virus (see Appendix L) and only one home would be visited per day with sanitizing practices for the brainteaser puzzles in place.

Dyad A consisted of Scott and Arthur due Scott's scores on the Developmental Profile – 3 of primarily "average" and Arthur's scores of "below average." Further, both participants were vocal and relatively close in age. Moreover, many of the "suggested activities" on the Developmental Profile – 3 for Scott and Arthur were similar suggesting that each are similar in a developmental level. Dyad B consisted of Ryan and Clayton due to Ryan's scores primary scoring of "delayed" on the Developmental Profile – 3 and Clayton's scores primarily scoring of "average." Moreover, many of the "suggested activities" on the Developmental Profile – 3 for both Ryan and Clayton were similar, which suggested that each are similar in developmental level. There were two phases of treatment: in-person learning and virtual learning. The total amount of sessions completed by each participant for the in-person condition was dependent on meeting mastery criteria for solving the puzzle. Mastery criteria is considered three consecutive trials at 100% independent step completion for the assigned brainteaser puzzle. Each session contained a maximum of 10 trials. After participants completed the first condition (e.g., in-person), they completed the other condition (e.g., virtual).

In-person learning. During the in-person condition, participant A was either seated next to the researcher or with the researcher directly behind him. A small cellphone running the Zoom application was opened on the screen and placed on a tripod that sat to the left of participant A with the view set on the participants' hands. During this time, the researcher was out of view of the video. A computer was also set up, facing away from participant A, so the researcher could monitor participant B (i.e., the other participant in the dyad; information on what participant B did during this condition is provided in the following section). The video and sound were turned off on the computer that was being used to monitor participant B; only the cellphone camera and microphone were turned on for participant A.

A forward-chaining procedure (Cooper et al., 2020) was utilized to teach steps during the in-person condition. The chain was faded as participant A demonstrated independence in completing the puzzle which was based on participant A completing the step independently three times, based on data. A least-to-most prompting procedures (Cooper et al., 2020) were utilized if a participant was unsuccessful with the visual model. If more invasive prompting procedures were necessary, prompt level began with a point prompt to the portion of the puzzle that required moving. If this prompt level was still unsuccessful, the researcher would place an open hand on the side of the participant's hand to guide movement; if further prompts were necessitated, the researcher moved into a hand-over-hand prompt (Cooper et al., 2020). This prompt was then faded in the same way as the initial teaching, just reversing the prompted steps until independence was achieved. Each prompt was based on a task analysis of the brainteaser puzzle being completed (see Appendices B-E) and marked as either a "yes" for completing the step or "no" for not completing the step. After each completed trial, while data was recorded, the prompt level was distinguished on the data sheet for participant A and an additional line was placed between steps where prompting was either stopped or faded and independence was allowed.

Mastery criterion was set at participant A completing the puzzle independently and with 100% accuracy across three consecutive trials. If mastery criteria were not met during the in-person condition within either six sessions (i.e., 60 trials), the condition was terminated. Once mastery criterion was met or a condition was terminated, participant A and B then switched roles (i.e., participant A moved from the in-person condition to the virtual condition and participant B moved from the virtual condition to the in-person condition).

Virtual learning. During the virtual learning condition, a computer was set up in front of the participant (e.g., participant B) with the camera turned on and microphone muted while in the same Zoom meeting as participant A. Participant B was required to sit in view of the camera to observe participant A complete the puzzle. Participant B also had access to the brainteaser puzzle and was informed when to pick up the puzzle to begin following directives as viewed on screen and when to put the brainteaser puzzle away. The brainteaser puzzle was put away at the conclusion of each trial to prevent the participant from manipulating the puzzle and independently solving it outside of sessions. Mastery criteria was not required for the virtual learning participant as measurement was for the steps that were observed and able to be completed.

One of the participant B's caregivers was required to be in the room with the participant but remain on either the other side of the room or out of reach of participant B while engaged in a personal task. Prompts (i.e., physical, modeling, gestural, verbal) for puzzle completion were not required of caregivers; caregivers were instructed not to provide any directives related to the learning task but were asked to provide directives to the participant to remain seated. Specifically for Ryan, caregivers were instructed to follow what is typically done in the home if self-injurious behavior occurred.

Follow-Up

One-week after the completion of the final treatment session, participants completed a follow-up session. Follow-up sessions mirrored the same procedures as baseline sessions, where 10 minutes were allotted for the participant to manipulate the puzzle and 10 minutes were allotted to engage with a preferred item or in a preferred activity, as identified via the preference assessment. If the participant completed the puzzle independently in the follow-up condition, a mastered instruction was not delivered and a preferred item/activity was delivered. If the participant was unable to solve the puzzle independently, a mastered instruction was delivered and access to a preferred item/activity was permitted contingent on a corresponding response. A mastered instruction was delivered to ensure that the participant's behavior contacted reinforcement for accurately completed tasks.

Brainteaser puzzles from both conditions were presented during this time in an alternating presentation, with each being presented twice for a total of four trials completed. Measurement of independently completed steps and on-task behavior was measured during the follow-up condition using the task analysis of the brainteaser puzzle (see Appendices B-E) presented and the momentary time sample data sheet (see Appendix F).

Interobserver Agreement and Treatment Integrity

Interobserver agreement. Interobserver agreement (IOA) was calculated for 33% of sessions across all treatment conditions and participants by an independent observer. The exact count-per-interval formula (Cooper et al., 2020) was used. This consists of dividing the number of intervals in agreement by the total number of intervals for the trial multiplied by 100 (see

Appendix J). IOA across conditions equaled an average of 96.6% agreement for the percentage of independently completed steps and 97% agreement for the percentage of on-task behavior.

Treatment Integrity. Treatment integrity was also assessed using the Treatment Fidelity Checklist (see Appendices H and I). Treatment fidelity was calculated by simply dividing the total "yes" circled by the total number of questions answered by the independent observer and multiplied by 100. Treatment integrity for both in-person and virtual learning conditions equaled 94.5%.

CHAPTER 3

RESULTS

Baseline

In the baseline phase, none of the participants were able to successfully complete any steps of the puzzle independently (see Figure 1 and Figure 3) or solve either puzzle they were presented with, each having 0% independently completed steps. Arthur (dyad A) and Clayton (dyad B) had the highest average percentage of on-task behavior (see Figure 2 and Figure 4) for the dyad that each were assigned.

In-Person and Virtual Learning

During the in-person condition, Scott required 13 trials to complete the brainteaser puzzle (see Figure 1) and attained mastery criteria during trial eight. In the first session of in-person learning he ranged from 0%-20% independently completed steps, in the second session, he ranged from 40% to 100% independently completed steps, and in the third and final session, averaged 100% for each brainteaser puzzle trial of independently completed steps (see Figure 1). During this time, Arthur engaged in the virtual learning condition and did not meet mastery criteria of the brainteaser puzzle (see Appendix B) he observed Scott complete, however did attain 100% independent step completion for two trials (see Figure 1). His independent step completion ranged from 0% to 33%. Arthur averaged 32% of steps completed independently and accurately throughout all 13 trials, with a range of 0% to 100%. In relation to the independently completed steps, Arthur engaged in an average of 82% on-task behavior throughout the virtual condition (see Figure 2), whereas Scott engaged in on-task behavior for an average of 86% (see Figure 2).

After roles were reversed, Arthur required 13 trials to complete the brainteaser puzzle in the in-person condition (see Appendix C; see Figure 1). Arthur engaged in on-task behavior 100% of the trials (see Figure 2). Scott, in the virtual learning condition, did not meet mastery criteria for the brainteaser puzzle (see Appendix C) he observed Arthur complete, only averaging 6% of independent, accurately completed steps (see Figure 1). Further, Scott's on-task behavior was highly variable, averaging 37% and only engaging in 100% of on-task behavior in trials two and 13 (see Figure 2).

Clayton required 53 trials to complete the brainteaser puzzle during the in-person condition (see Appendix D). He was able to meet mastery criteria in trials 50-53 (see Figure 3). Clayton did require a hand-over-hand prompting method which was faded as independence in step completion and accuracy were attained. In trial 42, Clayton was manipulating the puzzle independently. His independent step completion ranged from 0% to 100% across trials. Additionally, Clayton engaged in 90.6% of on-task behavior throughout the in-person condition (see Figure 4). Ryan, in the virtual learning condition, averaged 3.2% of independently completed steps; during trials four and five, he reached 29% of independently completed steps (see Figure 3). His independent step completion ranged between 0% to 29%. Further, Ryan engaged in on-task behavior 62% of the time during trials, demonstrating 100% of on-task behavior in trials one, 13, 23, 29, 36, 44, 45, 52, and 53 (see Figure 4).

Once Clayton attained mastery within his in-person learning trials, conditions were switched for both Clayton and Ryan. Ryan was able to complete 30 trials of in-person learning of the brainteaser puzzle averaging 59.3% independently completed steps (see Figure 3) with percentages ranging from 20-80% independently completed steps. A hand-over-hand prompt was also necessary for Ryan to engage in independent step completion but was able to fade within seven trials back to the model prompting procedure. Further, Ryan engaged in on-task behavior 78.5% of the time (see Figure 4). During this time, Clayton was engaged in the virtual learning condition averaging 76.6% independently completed steps (see Figure 3) across the 30 trials and reaching mastery criteria multiple times: trials 10, 14-16, 18, 22-24, 26, 28-30 (see Figure 3). He also engaged in on-task behavior 88.7% of the time (see Figure 4) during his virtual learning conditions.

Follow-Up

Only two participants, Scott and Arthur, completed the follow-up condition, as each had met mastery criteria in their in-person conditions (see Figure 1; see Appendices B-C). Scott maintained mastery criteria of the brainteaser puzzle he learned in during the in-person condition, with 100% independently completed steps (see Appendix B) while also maintaining mastery criteria for the puzzle he learned during the virtual learning condition with 100% independently completed steps (see Appendix C; see Figure 2). During follow-up, Scott engaged in on-task behavior 100% of the time. Arthur did not maintain mastery criteria for either brainteaser puzzle (see Appendices B-C) during his follow-up condition (see Figure 1) averaging only 34% independently completed steps for brainteaser puzzle one and 20% independently completed steps for brainteaser puzzle two. Further, he engaged in on-task behavior an average of 77.5% of the time (see Figure 2).

Clayton and Ryan also engaged in one follow-up condition utilizing the first puzzle used which was Claytons in-person condition puzzle and Ryan's virtual condition puzzle. Clayton maintained mastery of the puzzle at 100% independently completed steps (see Figure 3) and 100% engagement in on-task behavior (see Figure 4). Ryan, however, did not achieve mastery within the virtual condition and did not achieve mastery within the follow-up condition, remaining at 0% independently completed steps (see Figure 3) and 69% engagement of on-task behavior (see Figure 4).

CHAPTER 4

DISCUSSION

The purpose of the current study was to compare virtual and in-person learning on the observation of puzzle manipulation for neurotypical and neurodiverse populations. The terminal goal of the current research was to add to the research base of comparing modalities (i.e., in-person versus virtual) of observational learning between neurotypical and neurodiverse populations. When the COVID-19 pandemic began, schools closed and disrupted everyday life. At the peak of the pandemic, over 55 million students were impacted by school closures (Peele & Riser-Kositsky, 2020) and continued to impact students after the pandemic was hypothesized to end, which led to another school year of distance learning for many students. Although the research has grown tremendously within recent months, there was little research in the literature to inform on teaching approaches for a wide range of individuals and learning repertoires, which allows for expansion of the literature.

When comparing dyad A in the in-person condition, data on both dependent variables demonstrated an upward trend. In other words, participants completed the puzzle independently as prompts were faded and engaged in high percentages of on-task behavior. In the virtual learning condition, results varied for both percentage of independently completed steps as well as on-task behavior. Arthur independently completed more steps in the virtual learning condition than Scott and also engaged in more on-task behavior throughout the virtual learning condition. When comparing data from the one-week follow-up conditions, Arthur did not maintain mastery of either brainteaser puzzle, although he had higher percentages of on-task behavior and independent puzzle completion. In contrast, Scott not only maintained mastery of the brainteaser puzzle learned during the in-person condition, but he also mastered the brainteaser puzzle from the virtual learning condition even though he had not mastered the brainteaser puzzle while observing. During Arthur's virtual condition, his caregiver was observed to hold the brainteaser puzzle, which did not allow an opportunity for Arthur to solve the puzzle before the trial began. Although Arthur's caregiver continued to withhold the puzzle throughout learning trials or permitted access to the puzzle at a later time in the learning trial, this removed the opportunity for Arthur to imitate what he was observing during that condition.

The current research was able to draw initial comparisons for dyad A, which consisted of two school-age participants. Each of these participants had been impacted by the COVID-19 school closures in the state of Wisconsin and had only recently begun to return to in-person instruction. Data of the current study demonstrate that both Scott and Arthur engaged in higher percentages of on-task behavior during in-person learning. However, Scott maintained the skill to independently complete each step to solve the brainteaser puzzle across both treatment conditions whereas Arthur was unable to do so. These data suggest that Ryan could engage and learn more adequately via in-person learning. This is hypothesized due to the low rates of completion of his puzzle and the variable on-task behavior shown during the virtual condition.

A preliminary comparison between Clayton and Ryan in dyad B can be made based on the results obtained, although Ryan did not complete the in-person learning condition. When reviewing the data, Ryan had a high percentage of on-task, but only independently completed an average of 3% of steps for the puzzle during the virtual learning condition. During the virtual learning condition, frequent breaks were required and a caregiver was seated directly next to Ryan throughout the trials. This was due to Ryan's history of engagement in severe self-injurious behavior. This arrangement may have impacted his on-task behavior, as Ryan may have only remained in his seat due to a caregiver being directly next to him. Additionally, there were times when he was engaged with an item other than the brainteaser puzzle (e.g., a preferred item), which may have also impacted results. There were multiple instances where Ryan was observed to shake the brainteaser puzzle with his hands cupped together. After he opened them, the puzzle came apart. His caregiver would then provide reinforcement, which was a confounding variable, as it impacted the data obtained on his on-task behavior and attending to the screen.

Results from the current study had a number of implications, areas for future research, and limitations. For instance, the current study extended that of Nadel et al. (2011), which demonstrated that children diagnosed with ASD can learn through observation. However, results obtained from the current study found that puzzles learned during the virtual learning condition maintained at lower percentages compared to puzzles learned during the in-person learning condition. In addition, the current research utilized a different type of puzzle than Nadel et al. (2011), which procedures carried out across fewer weeks. However, the current results may provide some preliminary evidence that children with ASD can learn virtually, although that learning looks topographically different from their neurotypical peers. More research on best practices for teaching using observational learning through a virtual learning condition is warranted, as well as increased research on the learning environment that an individual is in while engaged in virtual learning. Each of these can impact on-task behavior, engagement in learning, and engagement in the activities as required.

In expanding research from Nadel et al. (2011), the current study also utilized a video component in the form of the virtual component rather than having all observations occur in person. This expanded on research by Cardon & Wilcox (2011) as well, who utilized both video modeling and reciprocal modeling to teach imitation training between children diagnosed with ASD and neurotypical peers. In Cardon & Wilcox (2011), participants were able to engage in imitation of others in both treatments and also were able to generalize the skill to researchers and caregivers. The current study observed some imitation of puzzle manipulation by participants in the virtual learning condition, showing observational learning occurring in some capacity. Although results slightly differed from those of Nadel et al. (2011) and Cardon & Wilcox (2011), the current study expanded on elements from both by adding to the current research base, while also allowing for other areas to be researched, such as continued training, adjusted mastery criteria, and the possibility of carryover effects (Cooper et al., 2020) occurring if a participant engaged in in-person learning prior to virtual learning.

During Scott's virtual learning sessions, he routinely turned off the camera, closed the computer, or walked away from the computer. The researcher was unable to prevent this from occurring, especially since there was not an option to turn on the camera by the researcher that was facing Scott. Therefore, having a camera that is able to follow participants or another option for viewing video and recording is another area for future research, similar to the research of Zoder-Martell et al. (2020) who evaluated the most optimal devices to be used during virtual learning sessions and provided reviews of three options from the most cost-effective to most costly. The current study utilized a basic webcam built into the computer or a cellphone; this choice was more cost-effective and widely available than other options. However, in the future, it may be advantageous to invest in a camera that follows the movements of a participant or researcher, such as the Swivl, to increase visibility of the task (Zoder-Martell et al., 2020).

Other ways of implementing Individualized Educational Plan's (IEPs) in the time of crisis is also warranted for further research. This was observed in the research conducted by Fredrick et al. (2020) who sought to implement a best practice for IEP follow through during the initial two weeks of the COVID-19 Pandemic school closure. A modified delivery plan that relied heavily on collaboration between various teams and people part of the IEP were crucial to the success of the intervention. When increased support was given to both caregivers and interventionists, students that would have otherwise been without services during the COVID-19 closures were able to continue to receive at least 15 hours a week of services (Fredrick et al., 2020). This modification is crucial when reviewing adjustments that can be made to the current study if completed in the future, such as increased collaboration between caregivers and researcher, increased training on the brainteaser puzzle for caregivers, or even a modified delivery system, as mentioned earlier, with a different type of camera to increase success for each participant.

Research on virtual learning and individuals with high behavioral needs, such as those of Ryan, are limited at this time. However, Tomaino et al. (2020) looked into the feasibility of using virtual learning with individuals that had severe developmental disabilities and/or high behavioral needs. This study found that virtual learning is possible for this group of individuals, however, adjustments and accommodations were needed to create success. Researchers found that this population was able to maintain at least half of the skills within their IEP and also were able to continue to make progress on some IEP goals (Tomaino et al., 2020). The current research showed that this was also feasible ,as there were no breaks needed for Ryan due to self-injurious behavior, but a seating accommodation was required. Future research evaluate alternative seating or learning environments for individuals with severe developmental disabilities and/or high behavioral needs when they engage in virtual learning.

Limited data were collected given the small time frame for research completion. This limited time frame may have impacted acquisition of the skill and completion of both in-person and virtual learning conditions for dyad B. Although the second phase of treatment was initiated, it was not completed in the allotted time frame. Further, virtual learning demonstrated more efficacy for one participant, Clayton, who reached mastery criteria. This, however, may have been due to carryover effects from having previously completed the in-person learning condition, although this was not observed for Scott, who engaged in the same sequence. Further research is needed to clarify this discrepancy. Moreover, it is recommended that research include a minimum of four weeks to ensure that each participant is completes both learning conditions. Additionally, increased caregiver training on expectations may be warranted to prevent interference in the study, as in the case of Ryan.

Although nothing can fully replace the value of in-person learning and children being in the classroom, understanding the best practice for virtual learning can aid in preventing disruption for students during a crisis. Further, it may also help keep some consistency in a child's life during times of disruption which may have impact in other areas of a child's life. However, more research is needed in the area of virtual learning and comparisons between neurodiverse and neurotypical populations and how to effectively teach each population. Although global pandemics are rare, there are other instances that virtual learning may be necessitated, such as snowstorm closures, natural disasters, and other adverse events. Giving our educators research to help determine the best practice for all students, not just those that are neurotypically developing, is critical to ensure all students are able to have access to free and appropriate education which is a requirement of school districts across the United States (U.S. Department of Education, 2020).

EXHIBITS

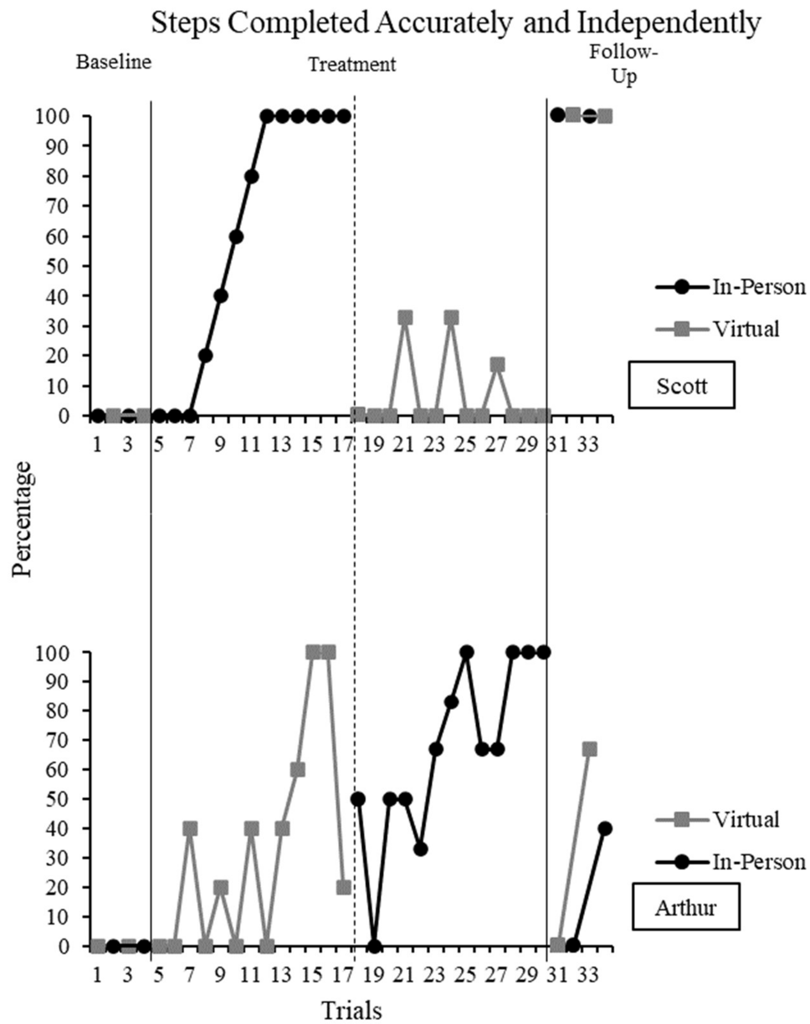

FIGURE 1: PERCENTAGE OF INDEPENDENTLY COMPLETED STEPS – DYAD A

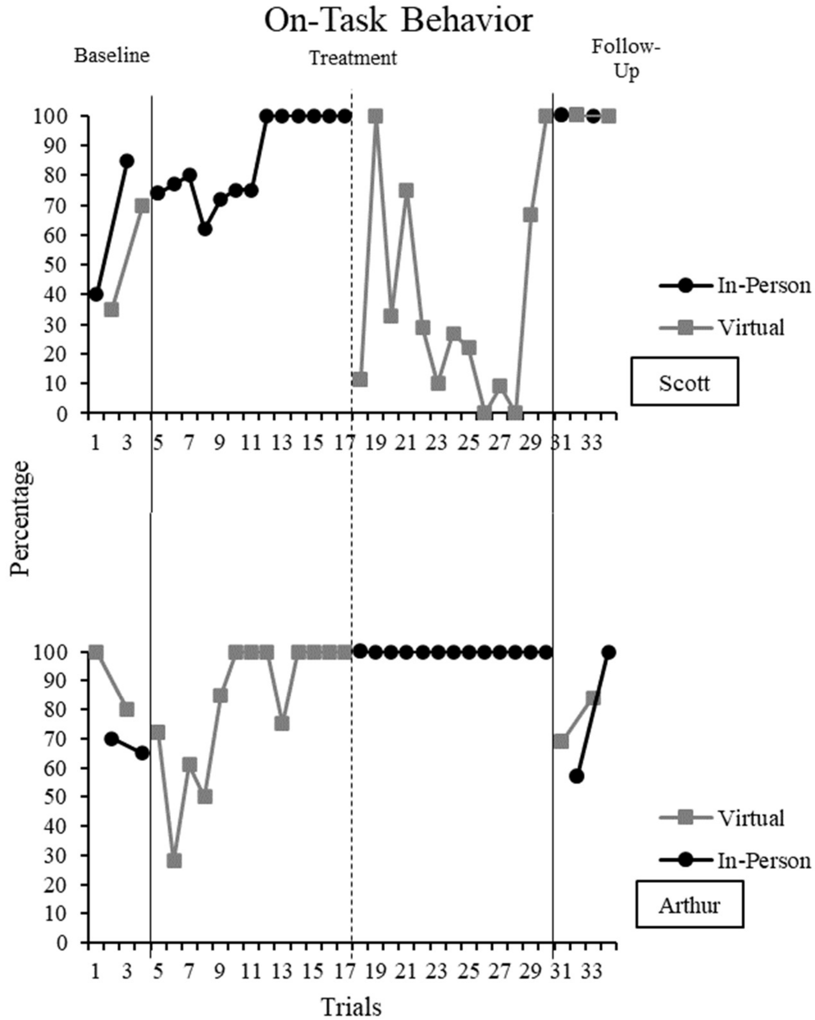

FIGURE 2: PERCENTAGE OF ON-TASK BEHAVIOR – DYAD A

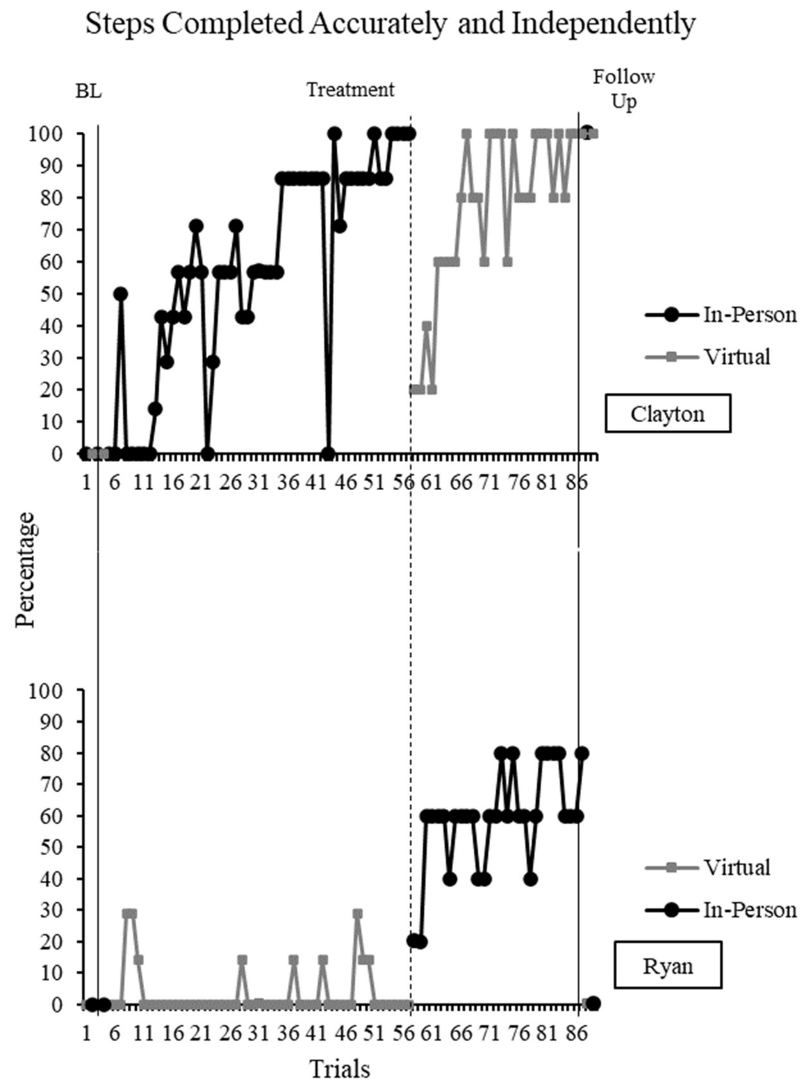

FIGURE 3: PERCENTAGE OF INDEPENDENTLY COMPLETED STEPS – DYAD B

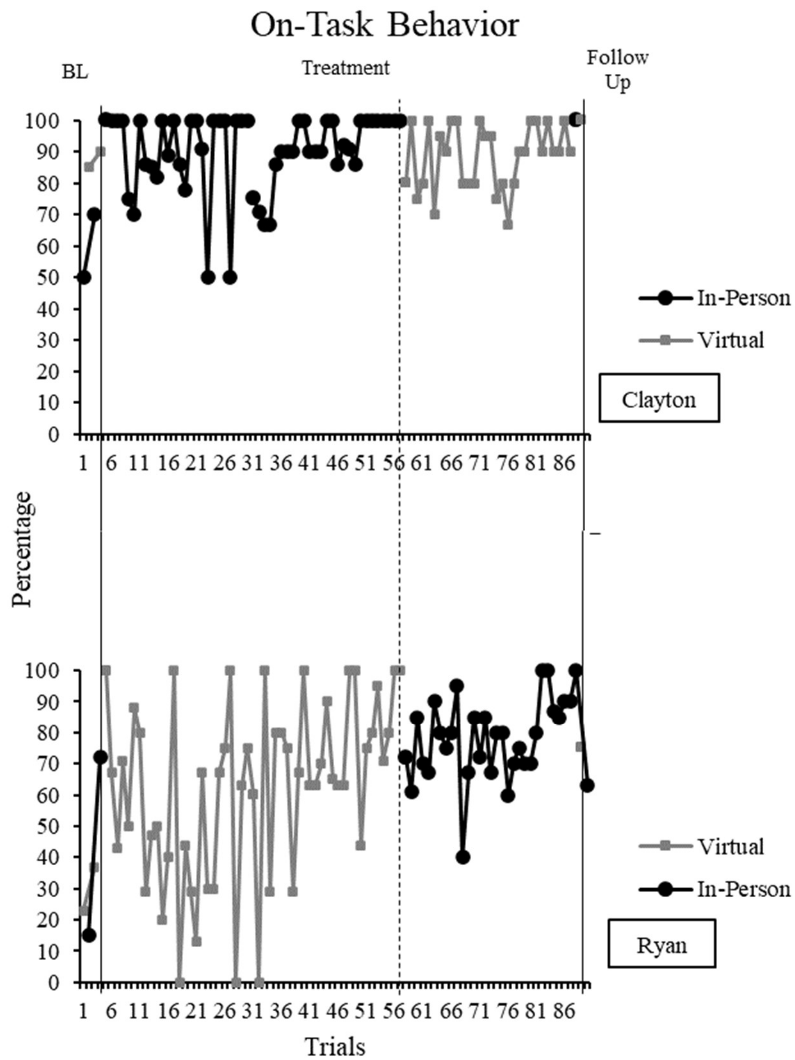

FIGURE 4: PERCENTAGE OF ON-TASK BEHAVIOR – DYAD B

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APPENDIX A

DEVELOPMENTAL PROFILE – 3

The following provides an example of the Developmental Profile – 3 (DP3), including one example of an item from each scale within the document, listed in order of the document. For the complete scale, please refer to the following work:

Alpern, G.D. (2017). *Developmental profile 3 (DP-3): Parent/caregiver checklist.* Western Psychological Services.

Read and answer all of the questions on the following pages by circling *Yes* or *No.*

P18.	Does your child usually walk up stairs and down stairs by putting only one foot on each stair?	Yes	No
A19.	Does your child select and play a video recording (DVD, videotape)? This means being able to turn on the TV, insert the recording, and work the controls without help	Yes	No
S20.	Does your child play group games with other children, without needing constant watching by an adult? Examples of games are tag, hide-and-seek, hopscotch, jump rope, or marbles.	Yes	No
G9.	When asked, does your child point to at least one body part, either on herself or on a doll?	Yes	No
M16.	Does your child use at least 50 different words when speaking?	Yes	No

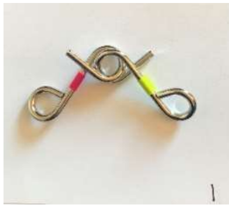
APPENDIX B

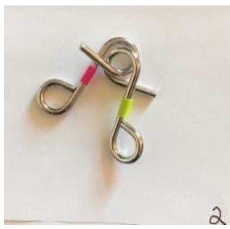
TASK ANALYSIS – BRAINTEASER PUZZLE, DYAD A, 1

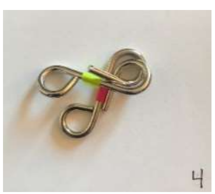
STEP	PICTURE	DIRECTIVE	COMPLETED
1		Creating an upside L, have blue on top with prongs facing right and purple prongs facing down	**YES** **NO**
2		Move purple up to the right Blue closest to your person, purple on the outside	**YES** **NO**
3		Bring purple clockwise away from you, so purple prong faces you Continue clockwise motion to make an X with metal pieces	**YES** **NO**
4		With purple facing left and blue facing right begin pulling in opposite directions	**YES** **NO**
5		Pull pieces fully apart to solve puzzle	**YES** **NO**

APPENDIX C

TASK ANALYSIS – BRAINTEASER PUZZLE, DYAD A, 2

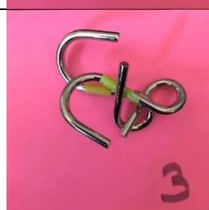
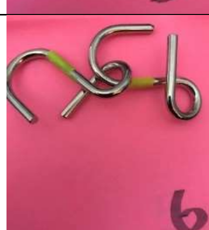
STEP	PICTURE	DIRECTIVE	COMPLETED
1		• Face two loops down • Pink should be on the left • Yellow should be on the right • The "q" hook on the pink piece should be "on top" • The "q" hook on the yellow should be "on the bottom"	**YES** **NO**

2		• Begin to move yellow toward pink
		  ○ loops facing away from each other
		  ○ yellow will move slightly down
		• Yellow and pink colors will be parallel to each other
		• The "q" hook on yellow will slightly overlap with the pink – they will face away from each other
			YES
			
			NO

3		• Push yellow up slightly (about 1/8") • Turn yellow toward the right, the "q" hook will face down • The two pieces will run perpendicular to each other • Begin to move yellow loop to the left, making a "+" sign with metal pieces	**YES** **NO**
4		• Starting with "+" sign, move yellow loop down and left • "Q" hook on yellow should be perpendicular to pink "q" hook • Two color spots should be touching	**YES** **NO**
5		• Move yellow up toward the pink "q" hook • Yellow and pink pieces will run parallel to each other • As you roll the yellow away from your body, making it run parallel, begin to pull two "q" hooks away from each other	**YES** **NO**
6		• As you pull the two "q" hooks away from each other and move yellow hoop up, the two pieces should begin to come apart • Continue to pull the two pieces apart • You have solved the puzzle • *To put back together, reverse the steps*	**YES** **NO**

APPENDIX D

TASK ANALYSIS – BRAINTEASER PUZZLE, DYAD B, 1

STEP	PICTURE	DIRECTIVE	COMPLETED
1		First have yellow run parallel to green.	**YES** **NO**
2		Turn green upwards	**YES** **NO**
3		Bring green left and hook onto yellow	**YES** **NO**
4		Pull green to the right	**YES** **NO**
5		Move green toward you and make an L with inner circle on the right	**YES** **NO**
6		Pull green toward hook on left	**YES** **NO**
7		Pull apart	**YES** **NO**

APPENDIX E

TASK ANALYSIS – BRAINTEASER PUZZLE, DYAD B, 2

STEP	PICTURE	DIRECTIVE	COMPLETED
1		• Place green and orange side-by-side creating a “W” shape • Have green on the right • Have orange on the left	**YES** **NO**
2		• Fold bottom of the “W” shape inward, brining green and orange together • Green will be on the left side now • Orange will be on the right side • An “X” shape should take form	**YES** **NO**
3		• Move green clockwise, moving it up toward the ceiling • A backward “L” should take form on the left side • Green prongs should lay flat while orange prongs remain on its side	**YES** **NO**
4		• Pull the green toward the left and away from orange	**YES** **NO**
5		• Continue to pull pieces away from each other until fully released • *To put back together, reverse steps*	**YES** **NO**

APPENDIX F

MOMENTARY TIME SAMPLE RECORDING SHEET – IN PERSON CONDITION

Behavior: On Task Behavior

Definition of Behavior: Participant actively looking at the researcher when being shown how to complete the puzzle and manipulating the puzzle when asked to.

Interval Time: 10 seconds

Total Observation Time:

Date	Condition	Participant	1	2	3	4	5	6	7	8	9	10	Total

APPENDIX G

MOMENTARY TIME SAMPLE RECORDING SHEET – VIRTUAL CONDITION

Behavior: On Task Behavior

Definition of Behavior: Participant actively looking at the screen while directives are given and completing the puzzle when asked to.

Interval Time: 10 seconds

Total Observation Time:

Date	Condition	Participant	1	2	3	4	5	6	7	8	9	10	Total

APPENDIX H

TREATMENT FIDELITY CHECKLIST – IN-PERSON CONDITION

While reviewing video of treatment, complete the following checklist. Circle yes if the objective was completed, circle no if the objective was not completed.

Objective		
Conducts preference assessment	YES	NO
Gives brainteaser puzzle to participant	YES	NO
Delivers appropriate discriminative stimulus, "solve the puzzle", when appropriate	YES	NO
Preferred item delivered upon completion	YES	NO

How many items were completed correctly? ______________

The percentage of treatment fidelity: __________%

APPENDIX I

TREATMENT FIDELITY CHECKLIST – VIRTUAL CONDITION

While reviewing video of treatment, complete the following checklist. Circle yes if the objective was completed, circle no if the objective was not completed.

Objective		
Attends to screen when instruction being given	YES	NO
Manipulates brainteaser puzzle when directive is given	YES	NO
Parents do not provide directives beyond requesting to remain seated	YES	NO

How many items were completed correctly? ______________

The percentage of treatment fidelity: __________%

APPENDIX J

INTEROBSERVER AGREEMENT FORM

Observer Initials	Session Date:			Participant:			Condition:						
	1	2	7	4	5	6	7	8	9	10	Total Agree	Total	Percentage
A													
B													

APPENDIX K

CONSENT FORM

Parent/Guardian Informed Consent Agreement

My name is Katrina Verhagen. I am a graduate student at Southern Illinois University-Carbondale, and I am asking for permission for your child to participate in my research study. Please read this consent agreement carefully before you decide to allow your child to participate in the study. Your child will also be asked to agree (assent) to participate in this project.

Purpose of the research study: The purpose of the study is to study observational learning through a peer model in both an in-person and virtual learning environment.

What your child will do in the study: Your child will be requested to complete two separate brainteaser puzzles; one puzzle will be solved through observing another peer in a virtual condition. We will use Zoom virtual meetings for this purpose. Your child will be asked to participate in both virtual and in-person learning sessions. During the in-person learning session, you child will sit with the researcher and be taught how to complete a brainteaser puzzle. While your child is learning how to complete the brainteaser puzzle with the researcher, a camera will be placed above them for another participant to view the puzzle being completed. Your child will also earn small tokens that will be decided in collaboration between you (the caregiver) and researcher. Examples include small "grab bag" items, stickers, bouncy balls, or small amounts of money such as five cent coins. These tokens will be chosen with you to ensure that you are comfortable with what your child is receiving as well as the item being valuable to your child.

What you will do in the study: You will be asked to be home, but not in the room, while your child is engaging in the in-person session with the researcher. You will be present in the room with your child during the virtual learning session, but you will not need to intervene unless your child attempts to leave the room while the session is running and has not been dismissed by the researcher. You will be asked to engage with a different activity during this time. During the in-person learning session, you will not be required to participate but be within the home. You will also be required to complete a Developmental Profile for your child which will consist of a series of questions asking about your child's physical scale, adaptive behavior scale, social-emotional scale, cognitive scale, and communication scale. Based on the score obtained from the Developmental Profile, your child may or may not be eligible to participate in the current research. Specific criteria need to be met based on the Developmental Profile to effectively participate.

Time required: The study will require about 4 hours of your child's time and about 4 hours of your time this study will run over the course of three weeks as your child will be asked to engage in two different learning environments as well as a one-week follow-up condition.

Risks: There are no anticipated risks in this study.

Safety Measures against COVID-19:
Katrina Verhagen will:
1. Wear a mask at all times while in others homes
2. Wash hands immediately upon arrival
3. Have hand sanitizer immediately available throughout research

4. Take her temperature prior to entering the home of participants and will not hold a session if her temperature reads above 100°F
5. Sanitize all brainteaser puzzles before and after use
6. Keep all items used in the research project in a sealed ziplock bag
7. Have a face shield available if requested to be worn by caregivers of participants
8. Communicate any contact with an individual that tests positive for COVID-19 for two weeks after research has been completed; all sessions will be rescheduled if researcher comes into direct contact with an individual that tests positive for COVID-19
9. Sanitize any surfaces utilized for research both before and after research session
10. Separate in-person sessions by days; only participant (or household) will be seen per day.

Participants & their families will:

1. Take temperature of participant prior to arrival of researcher
    a. Session will be rescheduled if participants' temperature is above 100°F
2. Communicate any contact with individual(s) that have tested positive for COVID-19
3. Communicate any required isolation by schools that participants are in attendance of
4. Wash their hands prior to the start of the research session as well as at the end of the research session

Benefits: The potential benefits of the research are adding to work regarding in-person versus virtual learning for all populations. Minimal research compares neurotypical and neurodiverse populations as to which setting may be most beneficial to each group. With the current COVID-19 pandemic, an ongoing question is how to best teach children and what those benefits may be.

Confidentiality: The information that you and your child give in the study will be handled confidentially. Your child will be assigned a unique code that is accessible only to the researcher and advisor. An example of this is K1V1, the first portion of the code, K1, would denote a reference to a list with your child's name and the second half of the code explains which trial they have participated in for that piece of data collected. The particular code for your child will be created prior to the start of experiment.

Video recordings will also be obtained in the current research which will be stored on a digital file sharing platform, Dropbox, which will be password protected. The Dropbox subscription that will be utilized adheres to HIPPA requirements and has strict security measures in place. The video will only be viewed by the researcher, thesis chair, and an independent observer who is measuring agreement of data measurement. At the completion of the thesis project, the video will be deleted. However, confidentiality cannot always be guaranteed as video will be shared through a digital cloud sharing platform for the independent observer and thesis chair to review. Due to this, it is possible that others may know what you have reported.

Exceptions to Confidentiality

Under Illinois and Wisconsin law, an exception to confidentiality is incidents of child abuse or neglect. If, in the course of my research, I develop reasonable cause to believe such an incident has occurred, I am required to contact the Illinois Department of Children and Family Services (DCFS).

Voluntary participation: Your child's participation and/or your participation in the study is completely voluntary. Your child may not be selected to participate within this research study. If your child is not chosen, you will be notified of the decision as well as why your child was not chosen to participate.

Right to withdraw from the study: You have the right to withdraw your child and yourself from the study at any time without penalty. If you decide to withdraw your child from the study, any video up to that point will be deleted promptly.

How to withdraw from the study: If you and/or your child want to withdraw from the study, please contact the principal researcher, Katrina Verhagen, at (920) 209-2548 or via email at Katrina.verhagen@siu.edu There is no penalty for withdrawing.

Payment: You will receive no payment for participating in the study.

If you have questions about the study, please contact me or my advisor:

Katrina Verhagen
Behavior Analysis and Therapy
Southern Illinois University – Carbondale
(920) 209-2548
Katrina.verhagen@siu.edu

Natalia Baires, PhD, BCBA-D
Clinical Assistant Professor / Advisor
Behavior Analysis and Therapy
Southern Illinois University - Carbondale
Natalia.baires@siu.edu

Agreement:

- I am the legal guardian authorized to provide consent for this child.
- I agree____ I disagree ____ that Katrina Verhagen can audio/video tape my child for her research study.

Child Name:________________________________

Signature: ____ Date: _____________
You will receive a copy of this form for your records.

This project has been reviewed and approved by the SIUC Institutional Review Board. Questions concerning your rights as a participant in this research may be addressed to the committee chairperson, Office of Research Compliance, SIUC, and Carbondale, IL 62901- 4344. Phone (618)-453-4534. E-mail: siuhsc@siu.edu

APPENDIX L

ASSENT FORM

Assent to Participate

Hi! My name is Katrina Verhagen. I am a student at a University studying how humans learn and why they do what they do! I am trying to learn more about how people learn and if we learn better when we are with our teachers or if we learn better when we use a computer to see our teachers. I would like to work with you in learning more about this! When we all left our classrooms in the spring, we had to do virtual learning instead of in-person learning which was hard sometimes. I am asking for you to work with me by watching someone learn how to do something and then have them watch you learn something! I am interested in how you learn the best and how others might learn the best and if that means you are watching someone learn something.

Your parents or guardians have already given permission for you to participate.

Agreement:

- I agree to participate in the research study with Katrina Verhagen.
- I agree to do my best to learn what I am taught.
- I understand that doing these activities will not hurt me.
- I understand that if I want to stop, I can without getting in trouble.
- I understand the researcher will not tell anyone what I tell them without my permission, unless it is something that could be unsafe for me. If I tell them that someone is or has been hurting me, they have to tell that to people who are responsible for protecting children so they can make sure I am safe.
- I understand that my information will between you and me to the best of my ability.

Mandatory reporting: In Illinois & Wisconsin, it is the law (rules that people must follow) that an adult will not tell anyone what a child tells them while working together, unless the child tells an adult that they are being hurt or uncared for by another person. If someone working with a child believes that he or she is unsafe in anyway, the person in charge of their project with have to call the Department of Children and Family Services (DCFS), to inform them.

Name of participant: ________________________________

Signature of participant: ____ Date: ___________

Researcher: ____ Date: ___________

This project has been reviewed and approved by the SIUC Institutional Review Board. Questions concerning your rights as a participant in this research may be addressed to the committee chairperson, Office of Research Compliance, SIUC, and Carbondale, IL 62901- 4344. Phone (618)-453-4534. E-mail: siuhsc@siu.edu

APPENDIX M

COVID-19 PRECAUTIONARY MEASURES

COVID-19 PRECAUTIONARY MEASURES

The following are the precautionary measures that will be utilized by Katrina Verhagen while implementing research procedures. These measures were created using information released by the state of Wisconsin regarding precautions recommended to schools, doctors' offices, and other businesses. Precautionary measures will be implemented throughout the research projected and will be strictly adhered to by all parties.

Katrina Verhagen will:

1. Wear a mask at all times while in others homes
2. Wash hands immediately upon arrival
3. Have hand sanitizer immediately available throughout research
4. Take her temperature prior to entering the home of participants and will not hold a session if her temperature reads above 100°F
5. Sanitize all brainteaser puzzles before and after use
6. Keep all items used in the research project in a sealed ziplock bag
7. Have a face shield available if requested to be worn by caregivers of participants
8. Communicate any contact with an individual that tests positive for COVID-19 for two weeks after research has been completed; all sessions will be rescheduled if researcher comes into direct contact with an individual that tests positive for COVID-19
9. Sanitize any surfaces utilized for research both before and after research session
10. Separate in-person sessions by days; only one participant (or household) will be seen per day

Participants & their families will:

1. Take temperature of participant prior to arrival of researcher
    a. Session will be rescheduled if participants' temperature is above 100°F
2. Communicate any contact with individual(s) that have tested positive for COVID-19
3. Communicate any required isolation by schools that participants are in attendance of
4. Wash their hands prior to the start of the research session

These procedures align closely with local school districts procedures while still allowing for participants to remain comfortable and for the participant that is engaging in virtual learning to see and hear the session that is occurring in-person.

APPENDIX N

RECRUITMENT EMAIL

Hello,

My name is Katrina Verhagen. I am a graduate student at Southern Illinois University-Carbondale.

Participation is voluntary. If you choose to allow your child to participate in the study, it will take approximately four hours per day across three weeks. Your child will engage in an in-person and virtual learning situation; your child will be asked to observe a peer complete a puzzle and then he/she will complete the puzzle that was just observed. Your child will also be taught how to complete a puzzle with the researcher in a one-to-one teaching session while being observed by a peer through a virtual meeting platform, Zoom.

Participation in initial direction following tasks indicate voluntary consent to participate in this study.

Thank you for taking the time to assist me in this research.

Katrina Verhagen
(920) 209-2548
Katrina.verhagen@siu.edu

This project has been reviewed and approved by the SIUC Institutional Review Board. Questions concerning your rights as a participant in this research may be addressed to the committee chairperson, Office of Research Compliance, SIUC, and Carbondale, IL 62901- 4344. Phone (618)-453-4534. E-mail: siuhsc@siu.edu

VITA

Graduate School
Southern Illinois University

Katrina E. Verhagen

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University of Wisconsin – Green Bay
Bachelor of Science, Psychology, December 2012

Florida Institute of Technology
Certificate – Verified Course Sequence, November 2018
Applied Behavior Analysis Basic Series

Special Honors and Awards:
Golden Key International Honour Society

Thesis Paper Title:
A Comparison of Virtual and In-Person Learning on the Observation of Puzzle Manipulation Among Neurotypical and Neurodiverse Children

Major Professor: Dr. Natalia Baires, BCBA-D