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Effects of Parent Intervention via Tele-Practice on Children with Autism Spectrum Disorder in Rural Mississippi

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EFFECTS OF PARENT INTERVENTION VIA TELE-PRACTICE ON CHILDREN WITH AUTISM SPECTRUM DISORDER IN RURAL MISSISSIPPI

by
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A thesis submitted to the faculty of the University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College

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PREFACE

As a senior Sally McDonnell Barksdale Honors College student, I have had my fair share of difficulties completing this thesis. At the start of my research in Fall 2020, the COVID-19 pandemic was at its height. Due to my Communication Sciences and Disorders major, I was worried about how this pandemic would affect language development. With the growing concerns about COVID-19 and the increased need for tele-practice opportunities, I wanted to research the effectiveness of those opportunities, specifically for children with Autism Spectrum Disorder (ASD). While researching for my thesis, I found that data about parent-led intervention for children with ASD is limited to families living in non-rural areas. That fact is what drove the focus of this research toward areas in the heavily rural state of Mississippi. I had the pleasure of working with two amazing parents, both of whom I am thankful for allowing me to work with them and their children. I would also like to thank the other undergraduate and graduate students that have helped me throughout completing this research by assisting with participant meetings, data collection, and data analysis. Finally, I would like to address my team of readers and listeners. Thank you for your time and attention, and I hope you all enjoy my thesis.

ABSTRACT

ERIN BOWENS: EFFECTS OF PARENT INTERVENTION VIA TELE-PRACTICE ON CHILDREN WITH AUTISM SPECTRUM DISORDERS IN RURAL MISSISSIPPI

(Under the direction of Dr. Ying Hao)

Background

The present study explored the use of parent intervention via tele-practice for children with Autism Spectrum Disorders (ASD) and how effective that intervention was in increasing the child's language and communication skills and the parents' strategy use in the rural state of Mississippi.

Methods

Two dyads of participants were used. Dyad 1 included a mother and her 4-year-old son with high-functioning ASD, and Dyad 2 included a mother and her 4-year-old daughter with severe ASD. Standardized tests were administered to gather data about the children's diagnoses. The study included four phases across four months, including pre-test, intervention, post-test, and follow-up. Language samples were gathered each session and later analyzed for data on the children's language levels and the frequency of the parents' strategy usage using language and behavioral analyzing software.

Results

Dyad 1 child's percent of utterances with errors decreased to zero while the scores on the other language measures remained consistent throughout the process. The Parent Fidelity of Intervention Implementation (FII) scores for the Dyad 1 parent increased during the intervention phase and then remained consistent. The parent's strategy usage at the beginning of the study tended toward only a few strategies, but by the end, the mother used a wider range of strategies.

The Dyad 2 child's language scores increased through the intervention phase and the post-test phase. The FII scores for the Dyad 2 parent fluctuated throughout the study while gradually increasing. The parent's strategy usage was unvaried at the beginning of the intervention but diversified by the end of the study.

Implications/Conclusions

The results indicate the effectiveness of the parent-led intervention via tele-practice among the two children with ASD. The results imply that the intervention may be better suited for the child with lower-language abilities. Future research may include a larger population to gather more data about the use of parent-led intervention for children with ASD.

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LIST OF ABBREVIATIONS

ASD……..……..……..……. Autism Spectrum Disorder

ASHA…..…….……. American Speech-Language-Hearing Association

CARS 2-HF ……..…….. Childhood Autism Rating Scale- High Functioning

CARS 2-QPC……Childhood Autism Rating Scale- Questionnaire for Parents or Caregivers

CARS 2-ST ……..……..……Childhood Autism Rating Scale- Standard

CDC ……..……..……Centers for Disease Control and Prevention

CITI ……..……..……Collaborative Institutional Training Initiative

FII ……..……..……. Parent Fidelity of Intervention Implementation

ImPACT……..……..…… Improving Parents as Communication Teachers

IRB ……..……..……..…… Institutional Review Board

MLU ……..……..……..…….Mean Length Utterance

NDW ……..……..……..…… Number of Different Words

PIW ……..……..……..……..Percent of Intelligible Words

PUE……..……..……..……Percent of Utterances with Errors

SALT …….……..…… Systematic Analysis of Language Transcripts

TTR……..……..……..……Type-Token Ratio

Chapter I

INTRODUCTION

Autism Spectrum Disorder and Significant Areas of Deficits

Autism Spectrum Disorder (ASD) is characterized by repetitive behaviors, difficulties altering routines, difficulties making eye contact, and echoing words, phrases, and actions (Centers for Disease Control and Prevention [CDC], 2021). Those characteristics make it difficult for children with ASD to initiate play, take turns, and indicate wants and needs using verbal and nonverbal communication. Intervention to improve language and communication is imperative for their development and has shown to be effective in increasing target behaviors (CDC, 2021).

The prevalence of ASD in children is approximately 1 in 54 and is about 4.3 times more likely to occur in boys than in girls (Maenner et al., 2020). Since the introduction of the disorder, there has been an increase in children being diagnosed with ASD. That trend could be due to an increase in the awareness of ASD and/or an increase in more sensitive diagnostic techniques which has also heightened the demand for early intervention across various modalities and geographic locations (Parsons et al., 2017). Diagnosis of ASD consists of collaboration from a child's primary care physician, speech-language pathologist, and possibly, a pediatric neurologist (American Speech-Language-Hearing Association [ASHA], n.d.). The team will conduct standardized and/or non-standardized testing to discover any oddities in the child's bodily functions, comorbid conditions, and social communication skills. The use of norm-referenced standardized parent/caregiver reports is integral in accurately composing a diagnosis, as the child's caregiver is the primary observer of the child's day-to-day behaviors and functions. Treatment of the disorder focuses on three main goals (ASHA, n.d.). Clinicians will need to

encourage social participation from the child, address the specific weaknesses and maintain the strengths, and reduce any environmental barriers. They may do this by increasing and improving the facilitators in the child's life (e.g., parents and caregivers).

Children with ASD are also characterized as having language deficits, namely low vocabulary, shorter sentence length, and difficulties with grammar when compared to their typically developing (TD) peers. These impairments will often include morphosyntactic errors, such as an inability to use proper tense for regular past tense verbs, and third-person singular markers (Wittke et al., 2017).

In addition to the grammatical impairments, studies have explored the social-pragmatic difficulties associated with ASD. Social-pragmatic deficits include an inability to recognize and acknowledge social cues and contexts. In one study, children with ASD had significantly lower scores than their TD peers when asked to answer questions based on situational contexts (Loukusa et al., 2018). The children with ASD also were unable to expand on their answers after the correct answers were given. Vocabulary and gesture development are also delayed in children with ASD. In TD children, gestures develop pre-lingually as an attempt at communicating intentionally. As the child's language develops, gestures are then paired with vocabulary for various language functions (i.e., make requests or name objects) and to add on to word meanings (Özçaliskan et al., 2016). For children with ASD, the lack of intentionality in gestures is directly correlated to their language development, so the delay in gesture usage is connected to vocabulary delays. One study that examined the relationship between gestures and vocabulary in children with ASD substantiated that connection and found that the two were significantly positively related (Ökcün-Akçamuş et al., 2019).

Researchers have found that obtaining spontaneous language samples is especially helpful in recognizing any grammatical deficits, vocabulary size, and pragmatic skills. Language sampling is more sensitive to detecting dynamic changes among children with ASD than standardized tests (Barokova et al., 2020). Obtaining multiple samples on different days also reduces the effects that outside factors may have on a child. A child may participate more during one session than they do during another, so one sample may not provide an accurate representation of the child's language abilities. Continuous sampling potentially provides better representativeness of language abilities.

Parent Training for Children with ASD

One way to treat the impairment in language and communication is parent training for intervention. A specific parent training program, known as Project Improving Parents as Communication Teachers (ImPACT), was introduced to provide intervention for children with ASD (Ingersoll et al., 2013). The purpose of the study that utilized this program was to measure the program's efficacy on parent fidelity and children's language scores. The ImPACT program trained parents to use both direct and indirect teaching techniques to improve a child's engagement, imitation, language, and play skills. This evidence-based intervention program was administered in an individual and a group setting. Based on the results of Ingersoll et al. (2013), parents that participated in Project ImPACT showed an increase in fidelity scores that was directly correlated with their child's number of spontaneous language occurrences.

Other programs have been used to train parents to implement intervention strategies with for children with ASD. For example, Radley et al. (2014) included five children with ASD and their parents and implemented a parent program known as Superheroes Social Skills. Researchers measured the child's social initiations, which were how many times they began a

new social sequence with gestures and statements, and social responses, which were how many times they responded to gestures and statements. Intervention fidelity and parent stress were also used as parent measures. The results of the study showed that fidelity reached 96% on average, and the lower rates were associated with parents who lost intervention material or did not complete all of the materials. Children also experienced slight increases in the percentage of social initiations and social responses.

Tele-practice

Although parent training has been found effective to improve language skills among children with ASD, service dissemination may be restricted by factors such as geographic location, family income, or transportation. Those obstacles may be alleviated by the use of tele-practice. ASHA defines 'tele-practice' as the utilization of various video conferencing and telecommunication devices to conduct therapy and professional services at a distance. The use of tele-practice can be especially helpful for families in rural areas, as resources may be scarce. Parsons et al. (2017) noted that there are financial benefits of remote intervention and that tele-practice visits allow for more flexibility in scheduling. It has become even more meaningful during the recent COVID-19 pandemic. During the pandemic, health officials have stressed the importance of wearing facial masks/coverings to protect against the virus (Wang et al., 2020). Although these masks help to keep people safe, they may also affect how clinicians provide therapy for their clients. Speech-language pathologists (SLPs) who have been holding in-person sessions have experienced difficulties using masks. Children with ASD have been found to have facial recognition deficits (Black et al., 2017), and those deficits may make therapy with masks more difficult. Tele-practice therapy sessions may be able to offset the barriers set by masks

because, during remote therapy sessions, clients and clinicians are video-conferencing in separate locations, so there is no need to wear masks.

Parent Training for Children with ASD via Tele-practice

The effectiveness of parent training for children with ASD has been further evaluated in tele-practice therapy. Various studies have shown the initial effectiveness of tele-practice on parents and their children with ASD. For example, Baharav et al. (2010)'s study describes possible discrepancies between the amount of intervention needed and the resources required for the intervention based on factors such as geographic location. The study utilized tele-practice and in-person meetings to administer parent-led intervention materials for families of children with ASD. Both tele-practice and in-person sessions were conducted once a week. The results showed that the parent participants stated that the information gathered from tele-practice sessions was as effective as in-person sessions. The results also suggested that the improvements made by the children receiving tele-practice were as comparable and maintainable as with in-person therapy (Baharav et al., 2010).

A study completed by Ingersoll et al. (2017) also explored the efficacy of Project ImPACT, and this study focused on administering the intervention via tele-practice, exclusively. The program was provided via its project tracking website. The website was able to confirm the participants' completion of the ImPACT knowledge quiz, a multiple-choice quiz, and an assessment of comprehension. Researchers tracked the participants' zip codes to track the area's median household income to ensure that all income levels were represented. After analyzing the participants' demographics, researchers found that a majority of the participants came from two-parent households where the parents had a college degree or higher. The results of the study showed that participants viewed the intervention as highly acceptable, and the number of

sessions attended was positively correlated to the improvements made in their knowledge of intervention materials (Ingersoll et al., 2017). However, conclusions of the efficacy of tele-practice are limited, due to the parents being relatively highly educated in the study.

In a study published by Hao et al. (2021), in-person and tele-practice parent-led interventions for children with ASD were compared, potentially providing more robust evidence for the effectiveness of tele-practice. Researchers utilized material from Project ImPACT and focused intervention primarily on the children's language skills (i.e., lexical diversity and morphosyntactic complexity). Parents' fidelity (FII) was measured, and the children's number of responses, initiations, and different words were measured. Parents showed a significant increase in fidelity, and children showed a significant increase in lexical and morphological complexity. Results also showed that parent training was positively related to children's language skills. There was a direct relationship between increased parent fidelity and increased child improvement in lexical diversity and morphosyntactic complexity. When compared to in-person sessions, the tele-practice scores for parents and children were not significantly different.

Based on the current literature, the single-subject study design has been used most frequently in exploring the effectiveness of tele-practice in parent-mediated intervention for children with ASD. It is desirable that large samples and group studies, especially randomized controlled trials, are employed, providing more robust evidence for the efficacy of tele-practice use in the research area. However, the number of hours and the amounts of effort serving each participating family make a large sample hard to achieve. A single-subject research study utilizes a within-subject control, meaning that the participants are tested at baseline before receiving any treatment. Those test scores serve as their controls to be compared to the participants' scores

during and after treatment. Therefore, a single-subject study will provide some evidence for the efficacy of tele-practice for parent training among children with ASD.

One study that used this design was presented by Vismara et al. (2012). Researchers focused on nine parent-child dyads of children with ASD to test the efficacy of tele-practice. Standardized tests such as Vineland and parent fidelity assessments were administered before intervention to obtain baseline scores, and after the intervention, researchers performed the same tests to measure any progress. Researchers randomly assigned dyads to baseline groups that included four to eleven one-hour-long meetings. Those meetings occurred twice a week with one hour per session. Following the baseline period, researchers implemented 12 one-hour-long intervention sessions and then 3 one-hour-long follow-up sessions. The results showed that after the tele-practice intervention, the children's language scores (i.e., the number of initiations) and parent fidelity scores increased from the baseline measure collection to the follow-up measure collection (Vismara et al., 2012).

Neely et al. (2016) also conducted a single-subject design study. This study evaluated if parent-led intervention via tele-practice was effective in teaching parents to increase their child's language opportunities. Eight parents of children with ASD participated in the study. During the baseline phase, researchers collected language samples before implementing any intervention materials. After the intervention phase of the study, researchers conducted a follow-up portion that was identical to the baseline phase. The results showed that the frequency of communication opportunities increased from the baseline to the follow-up and increased during the training sessions (Neely et al., 2016).

Another study that focused on the effects of using tele-practice for language intervention was presented by Douglas et al. (2021). In this single-case multiple-probe study, researchers

administered training to a family of a child with complex communication needs to improve the child's language preparation, waiting, and response skills. The intervention included a coach teaching the family members how to model language effectively. The results of the study showed that the family's fidelity of strategy usage increased, as well as the child's frequency of independent communication (Douglas et al., 2021). See similar findings in other studies (e.g., McDuffie et al., 2013).

Gaps

Although previous studies showed the initial efficacy of tele-practice serving families of children with ASD, most of the pilot tele-practice studies were conducted in non-rural areas with relatively highly educated families and reliable access to the internet, such as the Ingersoll et al. (2017) study, so the findings may be biased. In addition, the definition of 'rural' differs by population density and proximity to the nearest major city, so available research may use different criteria when selecting a geographic area. According to the Health Resources and Service Administration (HRSA), the term 'rural' when used to define a geographical location refers to an area with a population of 49,999 people or less (*Defining rural population,* 2021). That number accounts for micro areas, which are areas outside of urban metropolitan cities, and the counties that are not within metro- or micro areas. The current study offers the parent training program to rural families and centers tele-practice services, exclusively in Mississippi. The United States Census Bureau states that the population of the entire state of Mississippi is 2,961,279 people with a median household income of $45,792 per year, the lowest across the nation. Along with that, only 77% of Mississippi's population has access to the internet (Explore, n.d.). Additionally, only two of the major cities are inhabited by more than 49,999 people, making the state primarily rural (*USA: Mississippi,* n.d.).

Research Questions

This study aims to answer the following questions: 1. Does the parent training via tele-practice improve parents' fidelity of intervention implementation and targeted strategy use? 2. Does the parent training via tele-practice improve children's language skills which are selected to be appropriate for the child's developmental levels (i.e., number of different words, mean length of utterances, etc.) These questions will be answered in the context of rural, low-income counties in the state of Mississippi as defined by the HRSA.

Chapter II

METHODOLOGY

Overview

This study included two dyads of participants. The dyads included a mother and a son and a mother and a daughter. Both children had a diagnosis of Autism Spectrum Disorder. Four phases (i.e., pre-test, intervention, post-test, and follow-up) were conducted over four months. Data was collected through parent questionnaires, standardized tests via parent reports, and language samples from play sessions. The language sample data was then analyzed using Systematic Analysis of Language Transcripts (SALT) software, a language analysis software, and the Mangold software, a behavior analysis software.

Study Design

This study implemented a single-case design. The content of the intervention materials via tele-practice acted as the independent variable. Multiple measures of parent and child skills served as the dependent variables. For the parent participants, their Parents Fidelity of Intervention Implementation (FII) scores and targeted intervention strategy use acted as the dependent variables. For the child participants, the dependent variables differed by the child's verbal capabilities. The lower-language child's measures included the type-token ratio (TTR), number of different words per minute (NDW), the percent of intelligible words (PIW), and the mean length utterance in morphemes (MLU). The higher-language child's measures included MLU, NDW, TTR, and the percent utterances with errors (PUE).

Risks

There were no anticipated risks from attending the study. However, some of the interview questions (e.g., questions about stress), had the potential to be sensitive for the parents.

Researchers explained to parents that they had the choice to not answer those questions. Also, researchers explained that the parents may feel a little overwhelmed with the new knowledge and the regular weekly meetings, but the meeting time can be adjusted to fit into their schedules.

IRB Approval

This study has been reviewed by The University of Mississippi's Institutional Review Board (IRB). The IRB has determined that this study fulfills the human research subject protections obligations required by state and federal law and University policies. Parents were given the study's IRB approval status. Researchers explained to the participants that if there were any questions or concerns, they could contact the University's IRB. The IRB's contact information was also given to participants.

Participants

The target population for this study was parents and their children between the ages of one and eight with ASD. Participants were recruited via different mediums. Flyers were distributed to HILL parents at the University, clinicians at the University of Mississippi Speech and Hearing Clinic (UMSHC,) Speech-Language Pathology (SLP) Facebook groups, and American Speech-Language-Hearing Association (ASHA) community directory clinicians. The inclusion criteria required the children to have a clinical diagnosis of ASD to be considered for this study.

Two dyads of mother and child served as the participants in the current study. Dyad 1 included a boy (H) aged 4 years, 4 months, and 26 days at the beginning of the study and was full term. H was also considered to be verbal with higher language abilities. The child's mother described her son as having age-appropriate language skills and stated that he prefers to converse with adults rather than with his peers. She added that he had difficulty playing with peers, as he

did not like to share with other children. The child would respond to his name when called but would avoid eye contact. After administering the Childhood Autism Rating Scale- Questionnaire for Parents or Caregivers (CARS-QPC) (more details about this test are specified in the following section of measures) to the mother, researchers then completed the Childhood Autism Rating Scale- High Functioning (CARS-HF), where H had a raw score of 33, which indicates mild-to-moderate symptoms of ASD. Along with a diagnosis of ASD, H was also diagnosed as having a sensory integration disorder, as reported by the mother. H is currently enrolled in occupational therapy once weekly for 30-minutes, speech therapy once weekly for 30-minutes, and play therapy once weekly for 60-minutes. Dyad 1 also included KW, H's mother. KW was a non-Hispanic white, 33-year-old woman. She has a graduate school degree and currently works in an administrative position. KW is married, and her husband, also a non-Hispanic white male, has a standard college or university degree and is an equipment operator. Their yearly household income is between $50,000 and $100,000.

Dyad 2 included a girl (K) aged 4 years, 2 months, and 16 days at the beginning of the study and was full-term. K had lower language abilities. The child's mother stated that her daughter used a few words but mostly communicated through screaming. She added that the child preferred to play by herself and had one friend with whom she would occasionally engage in parallel play. The child would not usually respond to her name being called and rarely made eye contact. After administering CARS-QPC to the mother, researchers then completed the Childhood Autism Rating Scale- Standard (CARS-ST), where K had a raw score of 44, which indicates severe symptoms of ASD. K was diagnosed as also having a language disorder and seasonal allergies, and K's mother also reported that at age 1, K had a 3-day long stay in the hospital for laryngitis. K is currently enrolled in occupational therapy twice weekly for 45-

minute sessions and speech therapy twice weekly for 45-minute sessions. K's mother, JW, is an African-American, 26-year-old woman. She has a high school diploma and currently works as a customer service representative. JW is separated and no information was given about the father's education status or current occupation. JW's yearly household income is between $20,000 and $50,000.

Procedure

The study was divided into four phases that were followed over about four months. The baseline phase was the first phase and consisted of a consent meeting and two pre-test meetings. During the consent meetings, clinicians introduced themselves and displayed a slideshow to give more details about the project. Parents were then read their rights and gave oral consent; there were no child participants over the age of seven, so child assent was not necessary. After gaining consent, clinicians and parents jointly completed a case history form for the child, and parent contact information was obtained. The parents gave their email addresses for meeting confirmations and primary communication, their phone numbers for communication in case of internet malfunctions during tele-practice meetings, and their address to send the instruction booklet. Before beginning the intervention, researchers mailed the participants an instruction booklet containing all of the necessary information for the study.

Parents received a quick training session on how to set up their homes for tele-practice sessions. They were instructed to have one person holding the recording device (or place the computer/device onto a place where we have a bird view of the parent-child interaction – a high place, e.g., on a shelf). Parents were also told that only one parent could attend the training and interact with the child during the sessions to ensure consistency. It was explained that the child needs to be present for the parent to practice using the intervention skills and for clinicians to

give feedback. To avoid technological obstacles, parents were instructed that if any internet disconnection happened, they should check the battery, reconnect the internet, and wait for clinicians to call for further instructions. Once the parents were given all of the information, researchers recorded a ten-minute parent-child play interaction.

Following the consent meeting, two pre-test meetings were held, and they both consisted of standardized test administration and a ten-minute parent-child play interaction. Researchers administered the Childhood Autism Rating Scale-2. The program's instruction booklet was mailed to the participants in preparation for the intervention phase, and parents were instructed to review the content for the upcoming intervention week.

The first week of the intervention phase, consisted of an overview of the Project ImPACT (Improving Parents As Communication Teachers) program, intervention benefits, research findings, and what core skills will be taught. Parents were also given information about setting up the home for successful meetings. Week 2 objectives included an introduction to interactive teaching techniques, modeling, and expanding language. The following intervention week continued discussing interactive teaching techniques. Researchers also explained how to create opportunities for the child to engage or communicate through some playful obstruction, balanced turns, and communicative temptations. Week 4 introduced the direct teaching techniques of prompting, reinforcing, and teaching the child expressive language. The fifth and final week discussed teaching the child receptive language and combining interactive and direct techniques. Before each intervention session, research clinicians made and distributed videos to explain the upcoming intervention materials. Also, parents were shown demonstration videos during the sessions to demonstrate the concepts explained in the meetings. The videos shown differed based on the child's verbal communication level. Also, each week of intervention, parents and children

had a ten-minute interaction where parents were able to practice that week's strategies and clinicians were able to provide feedback.

One week after the fifth week of intervention, the post-test phase began. The post-test phase was divided into two meetings. Researchers obtained a ten-minute parent-child interaction in each meeting and proceeded with parent interviews.

One month after the fifth intervention week, the follow-up phase concluded the study. During the first follow-up stage, three meetings were held where researchers gather ten-minute parent-child interactions in each meeting. After it had been confirmed that the participants finished the program, they were sent gift cards as a reward for completion.

Measures

Child Measures

The Childhood Autism Rating Scale Questionnaire for Parents or Caregivers (CARS 2-QPC) was conducted. CARS 2-QPC is a standardized test administered to parents of children with ASD that focuses on the frequency of a child's language and behavioral difficulties. Parents responded with *not a problem*, *mild-to-moderate problem*, *severe problem*, *not a problem now*, or *don't know* to indicate the severity of the problem. Based on the results of CARS 2-QPC, researchers then used either CARS 2-HF (High-functioning) or CARS 2-ST (Standard) to further test the child and specify the areas of need. CARS scores and results were presented in the previous section when the two children were introduced.

To gather primary information about the child's language abilities, natural language samples from play interactions were recorded during each tele-practice meeting. Each sample was about ten minutes long, and the research team transcribed word-by-word the interactions between child and parent for further analysis. The language samples were used to gather

linguistic measures including the percent of utterances with errors (PUE) (indicating word omissions, false starts, and incorrect morpheme usage), the mean length utterance (MLU) (indicating morphosyntactic skills), the number of different words (NDW) (indicating vocabulary diversity), the type-token ratio (TTR) (indicating vocabulary diversity), and the percent of intelligible words (PIW) (indicating intelligibility). The tele-practice sessions were operated and recorded using the video conferencing application called Zoom. The current study also offered assistance in getting participants internet if needed which required participants to already have some internet connection, however, neither participant required internet assistance.

Parent Measures

Parent strategy usage measures were gathered from the parent-child interaction samples. Parents were scored on their usage of the strategies displayed in Table 1. The strategies were the targets during the intervention phase for parents.

Table 1. Parent strategies, levels, definitions, and examples

Level 1 Strategy	**Level 2 Strategy**	**Definition**	**Example**
Responsive Interactions	Contingent imitation	The parent copies the child's verbal and/or nonverbal communication act	Child says "car" and parent repeats "car"
	Mapping	The parent communicates a word or phrase to give meaning to the child's action	Child stomps foot and parent responds with "stomp foot"
	Expansion	The parent responds to the child by adding a word or higher-level communication to the child's verbal and/or nonverbal communication	Child says "ball" and parent responds with "yellow ball"
Modeling	Verbal/gesture routine/model	verbal, gesture, or routine models that the parent performs and/or communicates, and they do require the child's imitation	Parent points to the ball and picks it up while saying "ball"
Prompting	Physical Prompt (hand-over-hand)	the parent guides the child's body movements with their hands	Parent grabs the child's hand to physically guide them to point their finger

Prompting	Gesture Prompt	the parent uses some wort of nonverbal gesture to prompt the child's language and/or action	Parent models pointing by pointing their own finger
	Choice	the parent presents the child with various options for objects, actions, and activities	Parent gives the child a choice between two objects or activities
	Cloze	the parent leaves a blank for the child to fill in with words or phrases	Parent says "The ball is __" and waits for the child to say "yellow"
	Open-ended Question	questions that elicit answers other than yes or no	Parent asks the child how school went
	Direct Request	the parent tells the child to produce a word, phrase, or use a gesture	Parent tells the child to pick up the ball
	Time Delay	the parent waiting for the child's response with an expectant look and anticipatory body language	Parent sees that the child wants the ball but waits until the child says "ball" to give it to them
Reinforcement		strategies provide verbal praise to children for correctly using language and/or gestures	Parent says "Good job putting your toys away!"
Other		strategies that do not fit into any of the categories, such as rhetorical or yes/no questions	Parent asks the child if they like playing with the ball
Combined		the parent uses any blend of the strategies	The parent points at a truck and asks "Where is the truck going?"

Based on each 10-minute play sample, researchers administered another parent measure, the Fidelity of Intervention Implementation (FII), to gather data about the parents' frequency of implementing the direct and indirect teaching techniques. The FII is scored by researchers, based on scores 1-5, with 1 being the lowest fidelity and 5 being the highest fidelity. The scores are as follows: 1 *(Adult does not implement during session),* 2 *(Adult implements occasionally, but misses major opportunities),* 3 *(Adult implements half of the time, but misses many opportunities),* 4 *(Adult implements more than half of the time, but misses some opportunities), and* 5 *(Adult implements throughout the session).*

Analysis

To ensure that the researcher (main coder) and the reliability scorers were blinded when analyzing the data, the play videos were randomized before analysis began. The randomized videos were used for all the following analyses.

Language samples were transcribed and put through Systematic Analysis of Language Transcripts (SALT) software. SALT is software used to transcribe and analyze language samples. In SALT, the transcriptions were analyzed for sentence segmentation and morpheme segmentation to find MLU, NDW, PUE, PIW, and TTR. A reliability coder segmented sentences and morphemes for 20% of the samples using SALT independently. The agreement between the reliability coder and the author (the main coder) for Dyad 1 was 92.7% for utterance agreement and 98.1% for morpheme agreement. The agreement between the reliability coder and the author for Dyad 2 was 100% for utterance agreement and 96.2% for morpheme agreement.

The parent-child interaction samples were then coded through the Mangold Software, a video analyzing software for behavior coding, to analyze parent strategies. Parent strategies that were analyzed were responsive interactions (e.g., contingent imitation, mapping, and expansion), modeling (e.g., verbal, gesture routine, and model), prompting (e.g., gesture prompt, choice, cloze, open-ended question, direct request, and time delay), and reinforcement. The use of combined strategies was also analyzed, as well as the use of other strategies that are outside of the ones targeted in the previous strategies (e.g., rhetorical questions and close-ended questions). See Table 1. A reliability coder coded 20% of the samples using Mangold independently. The agreement between the reliability coder and the author (main coder) for Dyads 1 and 2 was a 69.5% Kappa score, which indicates substantial agreement in single-subject research according to Brown and Woods (2015).

The parent measures were also analyzed using Fidelity of Intervention Implementation (FII). If researchers' scores were different by more than one point, the videos were reevaluated until an agreement is met. A reliability coder scored 20% of the samples using FII independently. Both coders were blind to the session, and this was to prevent any expectations that may affect FII scoring. The agreement between the reliability coder and the author (the main coder) for both Dyad 1 and Dyad 2 was 100% for all samples that were collected.

Chapter III

RESULTS

Dyad 1

Child Measures

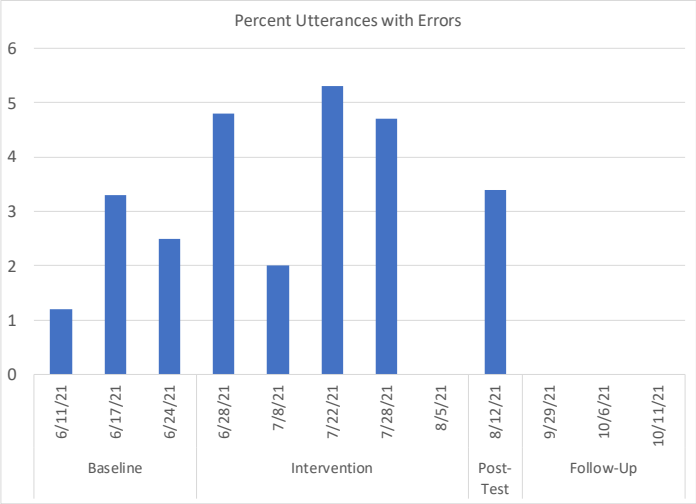

Figure 1. The Percent of Utterances with Errors for child H

Note. Sessions without a bar indicate the production was 0.

The child began the study with a PUE score of around 1 during the first baseline session. The score increased during the second baseline session and then slightly decreased during the third session while remaining above 1. The child's scores fluctuated during the intervention phase. The score increased to almost a 5 during the first session and decreased to 2 during the second session. During the third session, the child's score peaked a little over 5. The child's score slightly decreased at the fourth session and then drastically decreased to zero at the last intervention session. During the post-test session, the child scored around 3.5. Finally, the child consistently scored a zero for the Percent of Utterances with Errors during the entire follow-up phase. See Figure 1.

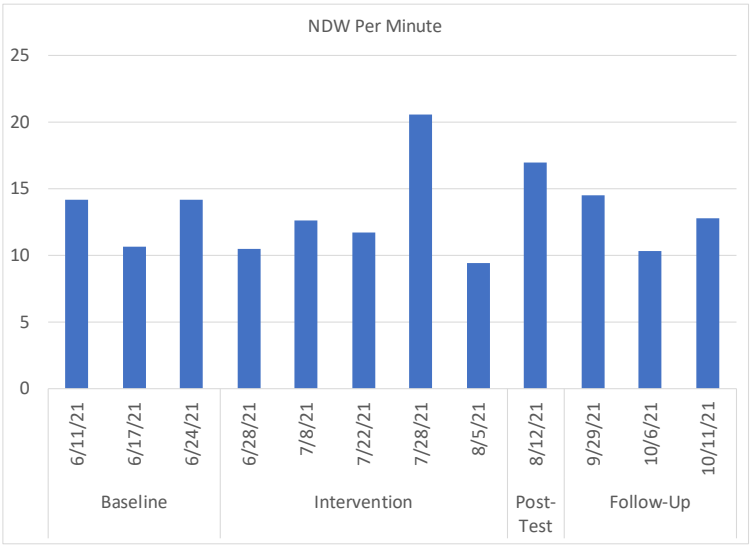

Figure 2. The Number of Different Words per minute for child H

As can be seen from Figure 2, the child's NDW scores fluctuated throughout the entirety of the research process but remained roughly within the range of 10 to 20. During the baseline phase, the child scored almost 15 during the first session, decreased slightly to about 10 during the second session, and then increased back to about 15. The child began the first intervention session with a score of about 10, increased to about 13 during the second session, and then decreased slightly again. The client's score peaked during the fourth intervention session and then decreased at the final session. The client showed an increase in his NDW from the last intervention session to the post-test phase. During the first follow-up phase session, the client's scores decreased slightly from the post-test phase, decreased during the second session, and then increased during the final follow-up session.

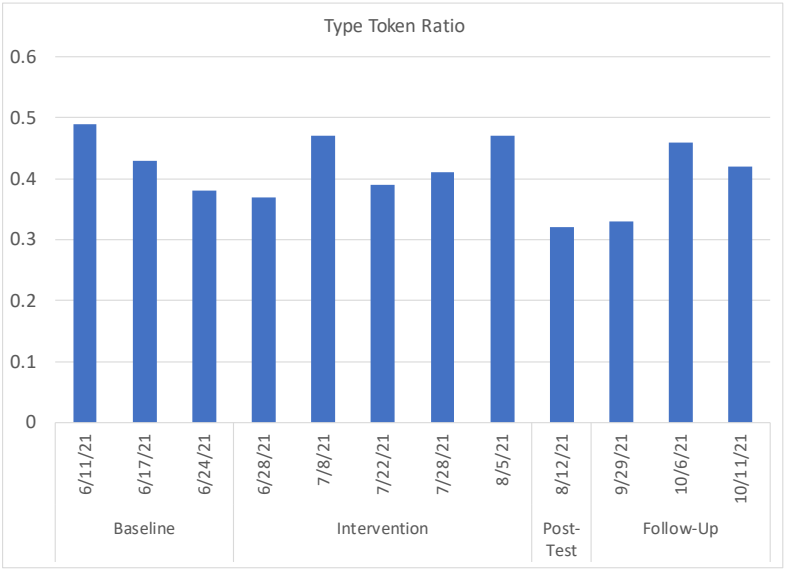

Figure 3. The Type Token Ratio per minute for child H

The child's TTR scores fluctuated throughout the entirety of the research process but remained roughly within the range of 0.30 to 0.50, as can be seen in Figure 3. During the baseline phase, the child scored almost 0.50 during the first session, decreased slightly to about 0.42 during the second session, and then decreased again to 0.39. The child began the first intervention session with a score of about 0.38, increased to about 0.47 during the second session, and then decreased slightly again. The client's scores increase during the fourth and fifth interventions sessions but decreased during the post-test session. During the first follow-up phase session, the client's scores increased slightly from the post-test phase, increased again during the second session, and then decreased slightly during the final follow-up session.

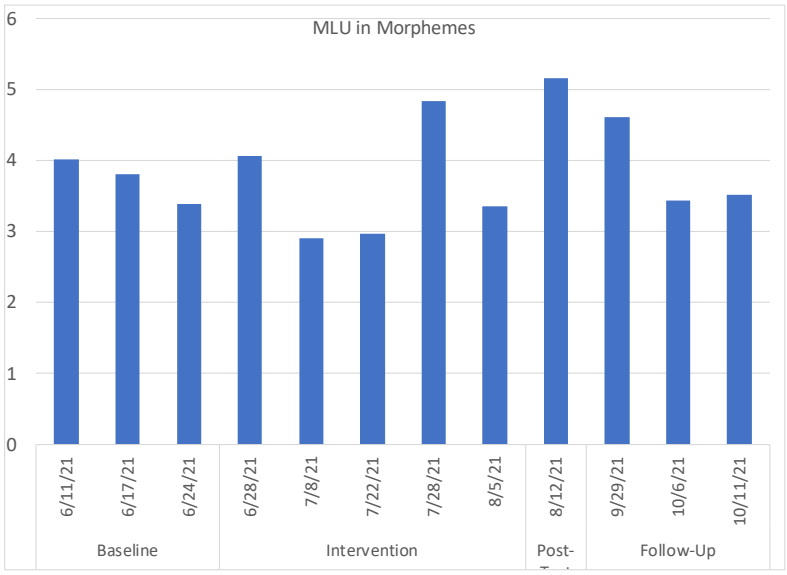

Figure 4. The Mean Length Utterance in morphemes for child H

The child's MLU scores fluctuated throughout the entirety of the research process but remained roughly within the range of 3 to 5. As shown in Figure 4, during the baseline phase, the child began with a 4 and then slightly decreased during the second and third sessions. At the start of the intervention phase, the child's score increased slightly from the third baseline session and then decreased slightly during the second and third intervention sessions to about a 3. The child's score increased to almost 5 during the fourth intervention session and then decreased to around 3.5 during the final intervention session. The child's score peaked during the post-test session at a little over 5, decreased slightly during the first follow-up session, and then remained consistent for the last two sessions.

Parent Measures

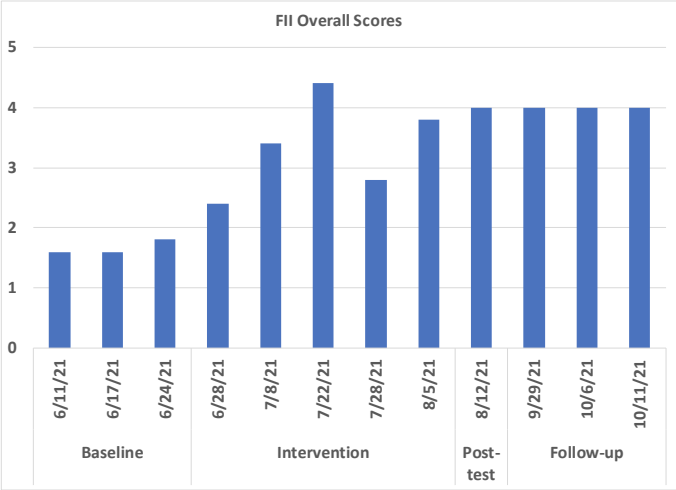

Figure 5. The overall FII scores for KW

The parent measures during the baseline phase were a little over 1.5 for the first two sessions and increased slightly during the third session. Throughout the intervention phase, the parent's scores increased for the first three sessions, decreased for the fourth session, and increased again for the fifth and final session with all scores falling above 2. The parent consistently scored a 4 for the fidelity intervention. Overall, the final FII score was 2.4 points higher than the first meeting, as shown in Figure 5.

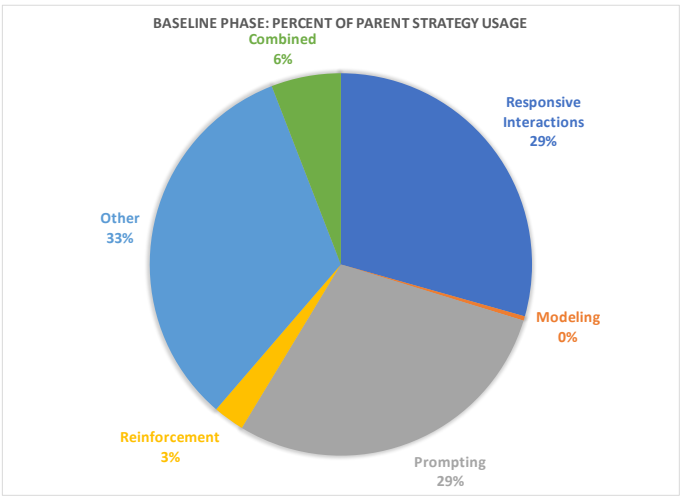

Figure 6.1. Average percentage of parent strategy usage for KW during the baseline phase

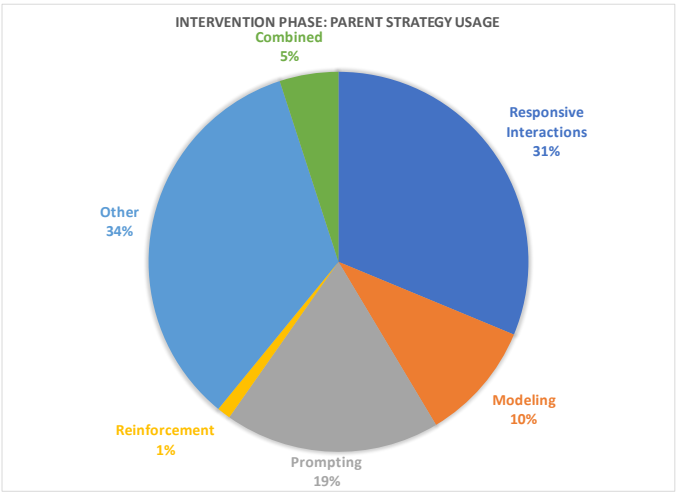

Figure 6.2. Average percentage of parent strategy usage during the intervention phase

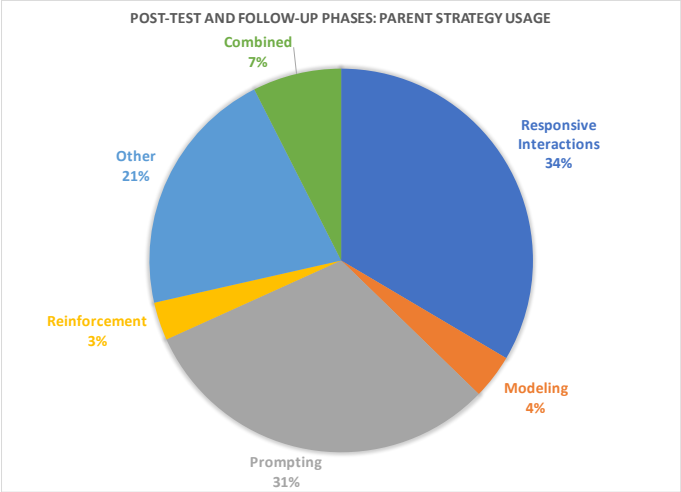

Figure 6.3. Average percentage of parent strategy usage during the post-test and follow-up phases

See Figures 6.1, 6,2, and 6.3 for KW's strategy composition in different phases. During the baseline phase, KW primarily used strategies labeled 'other.' The second most frequently used strategies were a tie between prompting and responsive interactions. The next most frequently used strategies were combined strategies followed by reinforcement and then modeling. During the intervention phase, the parent still primarily used strategies considered *other,* but the second most frequently used strategy was responsive interactions. Following responsive interactions, the next strategies were prompting, modeling, combined, and lastly, reinforcement. Compared to the baseline phase, there was a drop of prompting and an increase of modeling. During the post-test and follow-up phases, the order of most to least in frequency of use is as follows: prompting, responsive interactions, other, combined, reinforcement, and modeling. Throughout the study, the parent showed a slight increase in reinforcement usage. There was fluctuation with the parent's prompting and modeling usage. The parents remained

consistent in their frequency of other strategy, combined strategy, and responsive interactions usage.

Dyad 2

Child Measures

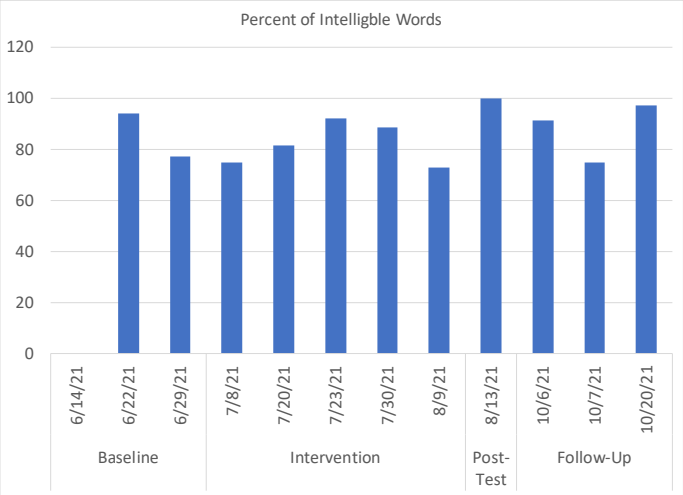

Figure 7. The Percent of Intelligible Words (PIW) for child K

Note. Sessions without a bar indicate the production was 0.

The child's PIW scores fluctuated through the duration of the study while remaining within the range of 70 to 100 percent. The child scored a zero during the first baseline session due to that she was completely nonverbal during that session. She increased her score during the second baseline session, and then decreased during the third baseline session. During the intervention session, the child's score decreased slightly from the baseline session to the first intervention session. The child's scores increased during the second and third intervention sessions and then decreased during the fourth and fifth intervention sessions. The child's scores increased and peaked at the post-test phase and slightly decreased at the first follow-up session.

Finally, the scores decreased during the second follow-up session and increased in the last session. Overall, the child scored higher at the end of the study, which can be seen in Figure 7.

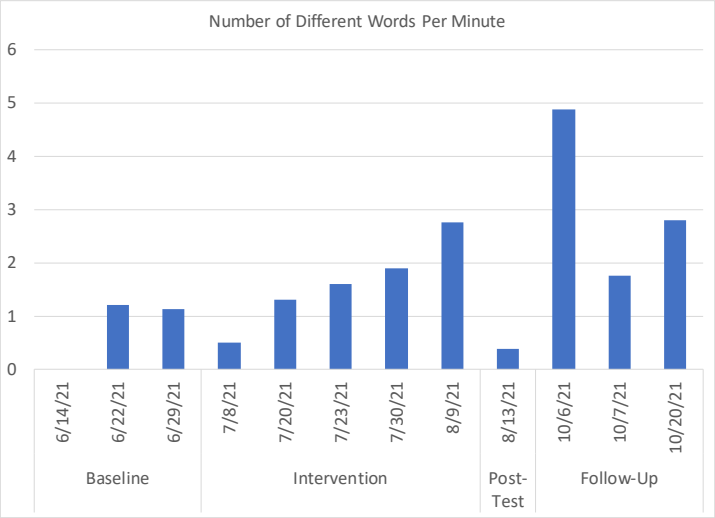

Figure 8. The Number of Different Words (NDW) per minute for child K

Note. Sessions without a bar indicate the production was 0.

The child's NDW per minute began at zero for the first baseline session and increased at the second baseline session. During the third baseline session, the child's score decreased and then decreased again at the first intervention session. The client's scores gradually increased from the second intervention session to the final intervention session. During the post-test session, the client's score decreased. Finally, the client's score increased and peaked during the first follow-up session, decreased in the second session, and increased again in the third session. Overall, the client's NDW per minute increased by almost 2 throughout the study, as shown in Figure 8.

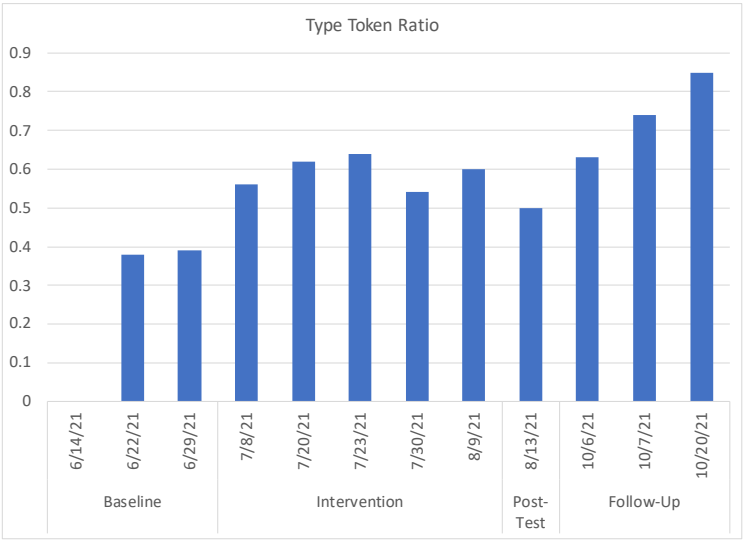

Figure 9. The Type-Token Ratio (TTR) per minute for child K

Note. Sessions without a bar indicate the production was 0.

The child's type-token ratio (TTR) scores began at 0.00 at the first baseline session and increased to about 0.40 at the second baseline session, as displayed in Figure 9. The third baseline session showed scores consistent with the second session. The child's scores increased through the first, second, and third intervention sessions. The fourth session showed a slightly decreased score, but the scores increased again in the fifth intervention session. From the post-test session and throughout the follow-up sessions, the scores increased and peaked at the final session. Overall, the child's TTR gradually increased through the duration of the study.

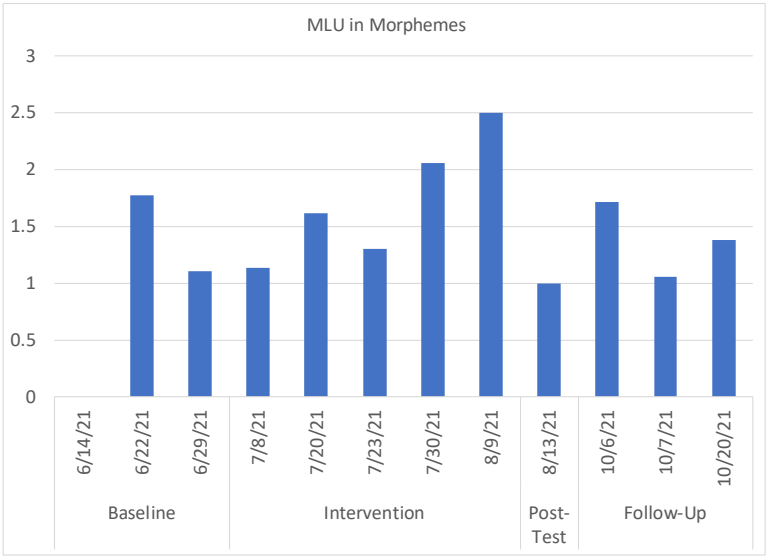

Figure 10. The Mean Length Utterances (MLU) in morphemes for child K

Note. Sessions without a bar indicate the production was 0.

The child's MLU in morphemes scores fluctuated through the duration of the study while remaining within the range of 1.0 to 2.5. Displayed in Figure 10, the child's MLU scores began at 0.00 at the first baseline session. From the first baseline session, the child's score increased to about 1.75 in the second session and decreased during the third baseline session. The child's score for the first intervention session stayed consistent with the previous session's score and then increased in the second intervention session. The score then decreased in the third session and increased through the fourth and fifth sessions. The child's MLU peaked during the fifth intervention session. The child's scores decreased during the post-test phase, increased in the first follow-up session, decreased in the second session, and finally increased in the third session.

Parent Measures

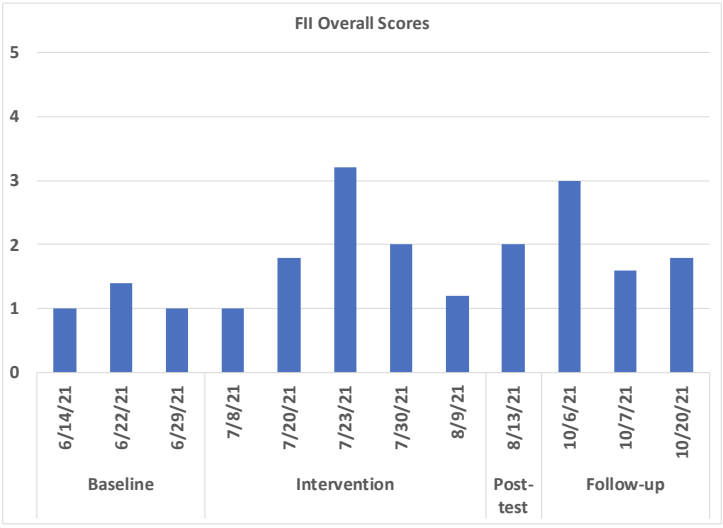

Figure 11. The overall FII scores for JW

The parent measure during the baseline phase were at 1 for the first session, increased slightly during the second session, and then decreased back to 1 for the third baseline session. Throughout the intervention phase, the parent's scores increased for the first three sessions with a peak during the third session and then decreased for the fourth and fifth sessions. The parent's scores increased during the post-test session and the first follow-up session. Finally, the parent's score decreased during the session follow-up session and increased slightly for the last follow-up session. Overall, the parent's scores final score (1.8) was almost one point higher than the first score they received. See Figure 11.

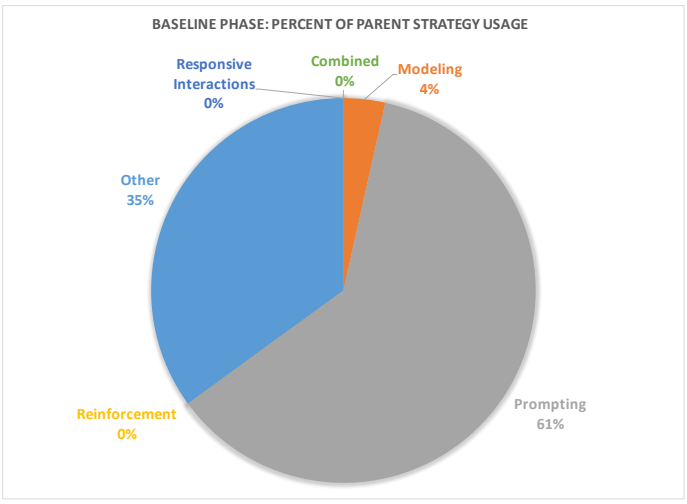

Figure 12.1. Average percentage of parent strategy usage during the baseline phase

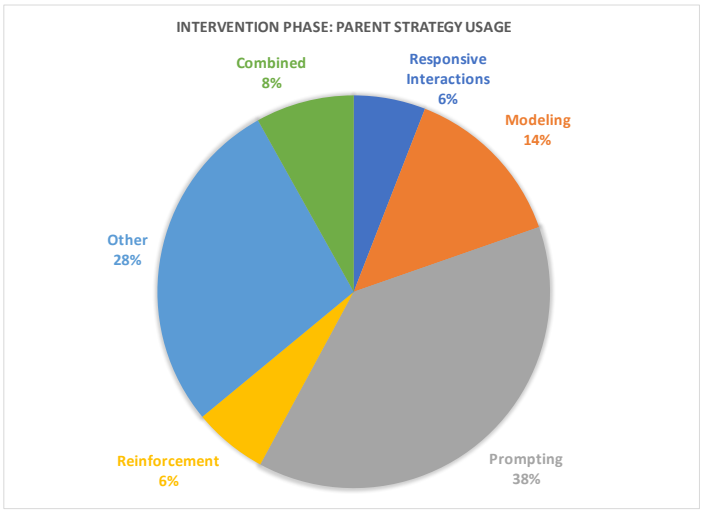

Figure 12.2. Average percentage of parent strategy usage during the intervention phase

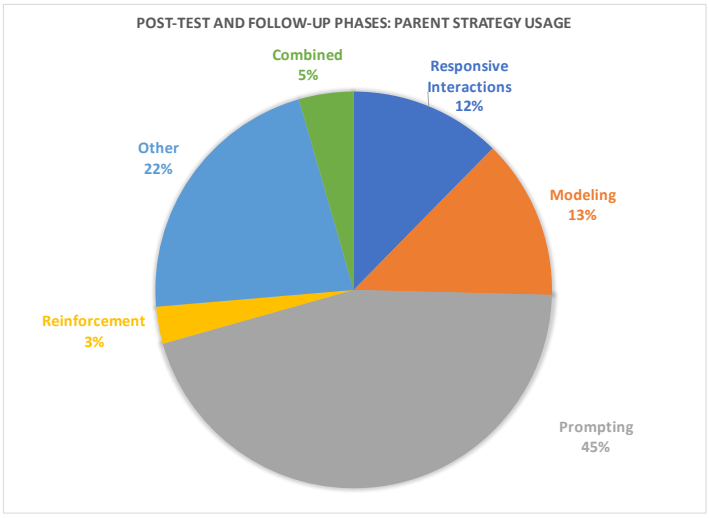

Figure 12.3. Average percentage of parent strategy usage during the post-test and follow-up phases

Figures 12.1, 12,2, and 12.3 displayed JW's strategy composition in different phases. During the baseline phase, the parent most frequently used prompting. The second most frequently used strategy was the other category, and the modeling category was used to a much lesser degree. Responsive interactions, combined strategies, and reinforcement were not used. During the intervention phase, the strategies become more diverse. The parent most frequently used prompting, which is followed by other, modeling, responsive interactions, reinforcement, and combined strategies. It should be noted that there was an obvious reduction of prompting during this phase compared to the baseline phase. During the post-test and follow-up phases, the ranking of frequency was the same as it was during the intervention phase. Throughout the study, prompting, combined strategies, and reinforcement experienced a fluctuation. Modeling and responsive interactions experienced an increase while the other strategy experienced a decrease.

Chapter IV

DISCUSSION

Interpretations

The results of the research study showed that the use of intervention materials via tele-practice yielded positive effects for the parent scores. For the children's scores, the results showed more improvement for the child with lower-language skills than the child with higher-language skills. Those results help to answer the research question of the effectiveness of parent training via tele-practice in improving parents' fidelity of intervention implementation and targeted strategy use. The findings were generally consistent with previous studies researching the effectiveness of parent-led intervention via tele-practice for children with ASD (e.g., Ingersoll et al. (2017) and Hao et al. (2021)). However, the previous studies did not note the same difference in results between higher-language and lower-language children that the current study noted. Additionally, the results provide answers to the question the parent training via tele-practice improving children's age-appropriate language skills.

The mother from Dyad 1remained consistent in her frequency of usage for the strategies she was previously using and overall increased the diversity of the strategies she was using. The increase in the use of reinforcement could have been caused by an increase in competence as the parent learned more from intervention materials. The Dyad 1 child with higher-language skills maintained consistent scores for NDW, TTR, and MLU. This could have been due to the parent primarily focusing on pragmatic skills, causing the language scores to experience very little increase. However, the child showed improvement in the percent of utterances with errors (PUE). The child's PUE improvement may have been related to the increase in verbal feedback (e.g., modeling, etc.) given from the mother throughout the study. The fluctuation of scores from

the child could have also occurred because both the parent and child tested positive for COVID-19 during the research process. To ensure the participants were healthy and able to participate, sessions were rescheduled. By postponing session dates, the parents could have forgotten some intervention strategies, causing their scores to decrease. Another explanation for the fluctuating language by the child and FII scores by the mother could be due to the activities the child was interested in during the play sessions. For example, during play sessions where the child asked the parent to read, there was a decrease in the amount of conversation and a reduction of child vocabulary diversity. During the reading activities, the parent increased their use of cloze prompting, so the child was only required to give short responses.

The mother from Dyad 2 diversified her strategy usage throughout the study after going through the intervention process. Similar to Dyad 1 parent, the increase in this parent's use of reinforcement could have been caused by an increase in competence from the parent. The Dyad 2 child with the lower-language skills scored higher throughout the study for TTR, NDW, and PIW, but her MLU fluctuated. Also, both the mother and child of Dyad 2 tested positive for the virus and session dates were postponed. Similar to Dyad 1, postponing the session dates could have caused the parent to forget some of the strategies, leading to score fluctuation. Along with the implementation of intervention at home, a possible explanation for the child's increase in language skills outside of the given intervention was the child's enrollment in school. The child's scores could have increased due to the increase in peer interaction paired with the effectiveness of the current project.

The intervention program appeared to work better for Dyad 2 than it did for Dyad 1. This could be because the intervention was geared more toward increasing language skills, and the child from Dyad 1 already had age-appropriate language. The child from Dyad 1 did show a

decrease in errors, so the intervention worked to fine-tune skills that were already present whereas the intervention helped build skills that the Dyad 2 child did not have. The difference in the effectiveness of the intervention could also be due to the mothers' education and socio-economic statuses. The mother from Dyad 1 had a higher education level than the mother from Dyad 2, which means she could have had access to more educational materials and toys. According to Magnuson et. al. (2009), parents from higher socio-economic statuses tend to use more higher order thinking and give more feedback rather than direct requests. Davis-Kean (2005) also states that parents with higher education levels and family income provide a richer language learning environment for their children. This can be seen in Dyad 1's average percent of strategy usage (see Figures 6.1, 6.2, 6.3) showing less prompting use than Dyad 2's average percent of strategy usage (see Figures 12.1, 12.2, 12.3).

Limitations

One limitation of the study was the smaller population size. Although a larger population would be beneficial in other fields, single-subject designs are widely used and valid in the area of parent-led intervention for children with ASD via tele-practice. The quality of internet connection and technology was also a limitation. When the internet connection was slow, the Zoom videos and audio lagged. During a few sessions, the camera quality for Dyad 2 had to be fixed to improve the quality of the language samples. Another limitation was that Dyad 1 mom focused primarily on pragmatics. This caused the mom to somewhat veer away from the strategies that increase language scores.

Implications for Future Research

Further research is necessary to explore the effectiveness of parent-led intervention via tele-practice in rural areas for Autism Spectrum Disorders. The additional research should

include a greater number of participants to provide more data about the population. The effectiveness of parent-led intervention for other disorders such as Attention Deficit Disorder (ADD) or Attention Deficit Hyperactive Disorder (ADHD) should be explored as well. Future research could also focus on some parent-led intervention that works toward improving pragmatic skills for children that already have higher language skills.

Conclusion

This single-subject research was generally successful in exploring the effects of parent-led intervention via tele-practice for children with ASD. The study focused on families living in rural areas with children of varying severities of ASD and language deficits. For four months, the families received intervention, and language samples were taken during each meeting. The child from Dyad 1 (higher-language child) maintained consistent language scores and decreased their percentage of utterances with errors to 0 percent by the end of the study. The child from Dyad 2 (lower-language child) experienced gradual improvement in language scores. Those differences in improvement show that the parent-led intervention via tele-practice may be more effective for the lower-language child than it was for the higher-language child. The parents from each dyad gradually improved their fidelity of implementation and the diversity of strategy usage. The improvements show that the parent-led intervention via tele-practice was effective in improving parent's fidelity of implementation and their diversity of strategy usage.

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