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Treatment of Foundational Reading Skills through Telepractice and Face-to-Face Environments: Single Subject Design

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TREATMENT OF FOUNDATIONAL READING SKILLS THROUGH TELEPRACTICE AND FACE-TO-FACE ENVIRONMENTS: SINGLE SUBJECT DESIGN

A Dissertation Presented

by

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DEDICATION

To all of my family and friends who loved, supported, and encouraged me during this process. I could have never done this without all of you. To my parents, you have always been there. To my children, Jaclyn, Billy and Carolyn this is a lesson that with love, support, perseverance and hard work you can have your dream. To Jimmy, your love and patience helped me finish what I started. To Katie, I did it with you in my heart, miss you. Thanks and love to you all.

ABSTRACT

TREATMENT OF FOUNDATIONAL READING SKILLS THROUGH TELEPRACTICE AND FACE-TO-FACE ENVIRONMENTS: SINGLE SUBJECT DESIGN

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Service delivery and the access to specialized instructions to consumers, encounters many barriers within the profession of speech-language pathology. This state of affairs is largely due to the disparate distribution of speech language services (ASHA, 2005). This restricted access, or an inability to access services, is a result of a number of factors, which include lack of clinicians, insufficient number of facilities in geographic area, and transportation issues (ASHA, 2004e). As a result, students who require specialized reading instruction are not afforded the opportunity to access the necessary treatment. It is essential that the literacy needs of all children be addressed, including those who require specialized instruction (Foorman & Torgesen, 2001; Allington, 1994). Technology, specifically telepractice, is a potential solution to address this dilemma. The purpose of this study is to investigate the reliability and validity of systematic multisensory reading treatment for students who have been identified with a delay in foundational reading skills, addressing foundational reading skills via an internet-based video conferencing system. The results will establish the groundwork for the efficacy, reliability, and validity of internet-based video conferencing as a means of service delivery for foundational reading skills. The foundational reading skills targeted in this study are letter naming knowledge (LNK), letter sound knowledge (LSN) and decoding.

Keywords: letter naming, letter sound, decoding, telepractice, service delivery

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CHAPTER I

**PROVIDING MULTISENSORY READING TREATMENT FOR FOUNDATIONAL
READING SKILLS THROUGH TELEPRACTICE**

<u>**Introduction**</u>

Reading is the product of decoding and comprehension (Gough, Juel, & Griffith, 1992).

Comprehension is the ultimate goal of reading; it is what reading is all about (Harris & Hodges, 1995). The

ability to decode words is a critical link in the reading process and its absence inhibits understanding of

written material (Klingner, Vaughn, & Boardman, 2007). Therefore, competent decoding facilitates reading

comprehension (McCandliss, Beck, Sandak, & Perfetti, 2003).

Decoding is the process of using letter sound correspondences to recognize words.

The earliest stage involves sounding out individual phonemes one by one, symbol by symbol (b----e-----d).

As the learner becomes more accomplished with the letters and sounds, the skill becomes more automatic.

Moving toward this automaticity by increased ability to accurately identify and remember words

demonstrates the Alphabetic Principle.

The University of Oregon Center on Teaching and Learning (2009) breaks down the Alphabetic

Principle into two parts: alphabetic understanding and phonological recoding. Alphabetic understanding is

the awareness that words are composed of letters and that these letters represent sounds. Phonological

recoding is the ability to systematically determine the sound (phoneme) symbol (letter) relationship to read

the word or spell the word (The University of Oregon Center on Teaching and Learning, 2009). In

summary, the alphabetic principle is "the understanding that there are systematic and predictable

relationships between written letters and spoken sounds" (Armbruster, Lehr, & Osborn, 2001, p. 12).

The component behaviors targeted in this study fall within the Alphabetic Principle. The

alphabetic principle occurs across several stages of reading acquisition and is accounted for in a number of

developmental reading models, such as Marsh, Desberg, and Cooper, (1977), Marsh, Friedman, Desberg,

and Welch (1980), Marsh, Friedman, Desberg, and Welch (1981), Frith (1985) and Chall (1996). Each

model proposes various levels of developmental progression. These stages are fluid and overlapping.

Stages focus on the pre-reading foundational skills, middle stages of learning letters/sounds, building

automaticity and concluding with orthography, sight words, fluency, and comprehension.

Marsh et al. (1977, 1980, 1981) developmental reading model's second stage delineates the Alphabetic Principle groundwork. The learner begins to use visual letter cues along with linguistic context for primitive decoding. This is followed by the third stage with implementation of sequential decoding letter by letter. In the final stage, the reader has achieved a skill level where he/she is able to read words as wholes based on the acquisition of orthographic rules.

According to Frith's reading developmental model (1985), the second stage of reading development is the alphabetic stage. The sound symbol correspondences are established and this skill becomes rote and automatic. This automaticity reduces the need for the monotonous nature of phonological decoding letter/sound by letter/sound. Gradually, familiar words are read as whole.

Within stage one of Chall's (1996) model of reading development, the learner begins to establish the association between letters (symbols) and the sounds they represent, i.e., letter-sound correspondence. Each individual letter is pronounced as a phoneme and blending sounds together result in the production of the whole word. Knowledge of this relationship continues to develop, resulting in the ability to apply this knowledge not only to individual words but to longer written units, such as sentences, paragraphs and text. Decoding precision increases through stage two, as words are now read without sounding out each individual phoneme.

Each of these developmental reading models presupposes that a potential reader needs to acquire knowledge of letter names and relate these letters to specific phonemes they represent. Such skills necessitate precision and automaticity, which then leads to blending sounds for whole word decoding. The skills of letter naming knowledge, letter sound knowledge and decoding are the core foundational aspects within the developmental "stage theories" models (Marsh et al., 1977, 1980, 1981, Frith, 1985, Chall, 1996).

Learning to read, as a developmental process, does not occur naturally and requires direct instruction (Lyon, 1998). This same set of reading skills is required for good readers as well as for those at risk for failure (Foorman & Torgesen, 2001). Effective reading instruction consists of directly teaching the five basic, yet necessary components to successful reading, i.e., phonemic awareness, decoding, fluency, vocabulary, and comprehension (National Reading Panel, 2000).

Decoding is an essential and primary means of recognizing words (University of Oregon Center on Teaching and Learning, 2009). Hoover and Gough (1990) describe decoding as the skill of mapping the regularities of words with their alphabetic representations. A reader who decodes at this level can read both new words and pseudo-words with regular spelling patterns. The use of pseudo-words to assess decoding competency is a common practice of assessing decoding skills as it demonstrates the readers' achievement within the alphabetic stage of reading development.

Phonics is the instructional method for teaching decoding. Phonics stresses the acquisition of letter-sound correspondences and their use in reading and spelling. Direct instruction of phonics is critical to the development of reading (National Reading Panel, 2000, Adams, 1990, Chall, 1987).

The term phonics is defined as, "an organized method of teaching children how letters relate to sounds," (Shaywitz, 2003 p. 200). Children at risk for reading failure acquire these skills more slowly (Foorman & Torgesen, 2001). "Specifically, instruction for children who have difficulties learning to read must be more *explicit* and *comprehensive*, more *intensive*, and more *supportive* than the instruction required by the majority of children," (Foorman & Torgesen, 2001, p. 206). For some students with reading disabilities, this specialized instruction is the only means to achieve reading success (Oakland, Black, Stanford, Nussbaum, & Balise, 1998).

National Reading Panel (2000) and the National Research Council (Snow, Burns, & Griffin, 1998) indicate that phonics is an important reading skill and that building phonics skills such as decoding is most effectively done through explicit, systematic instruction. McIntyre and Pickering (1995), as cited in Gillingham and Stillman (1997), described a particular model of explicit and systematic instruction that utilizes more than one of the learner's senses. This multisensory systematic approach targets basic skills and provides the student optimal learning potential (Gillingham & Stillman, 1997).

Birsch (1999) defines a multisensory approach as ". . . any learning activity that includes the use of two or more sensory modalities simultaneously to take in or express information," (p. 1). Sensory modalities targeted to enhance memory and learning includes auditory, visual, tactile, kinesthetic, smell and taste. Orton (1928) proposed utilization of these multisensory pathways to reinforce weak memory patterns. Gillingham and Stillman (1997) based their multisensory techniques for reading instruction on Orton's theory. The phrase "Orton-Gillingham approach" refers to the structured, sequential, multisensory

techniques established by Dr. Orton and Ms. Gillingham and their colleagues. Each of the following sensory components, e.g., visual, auditory, verbal and kinesthetic, is integrated in each lesson plan. Visually, symbols are seen within isolated graphemes, words in lists and sentences and then in paragraphs. Auditorily, sounds are processed within isolated phonemes, single words, along with words in sentences. Verbally, sounds are processed in isolated phonemes and also segmented in words. Kinesthetic feedback occurs with the writing of phonemes in isolation, in words, and sentences. Students, who struggle with acquisition of the alphabetic code or system necessary for reading development, benefit from reading instruction, which is multisensory, explicit and sequential (International Dyslexia Association, 2000).

However, due to a multitude of reasons, many students who need this specialized instruction do not have access to it, despite the fact that they should have equal access to this specialized instruction (Allington, 1994). One reason might include lack of trained instructors due to increased student enrollment, teacher retirement, and/or change of careers, with geographically remote areas suffering the most (Ingersoll, 1999, 2003; Darling-Hammond, 2004). As a result, many schools have turned to the use of remote technology.

Remote technology utilizes technical processes, methods or knowledge to facilitate communication that is impeded by distance. This extends the geographic reach for assessment and service delivery in remote or difficult-to-reach areas. A sample of the most current technologies includes the following: telephone, Internet video, voice over Internet, videoconferencing, podcasts, text messaging, and e-mail.

Terms for the use of remote technology include: telecommunication, telehealth, teletherapy, televisit, and telepractice. The professional organization of speech language pathologists, American Speech Language Hearing Association (ASHA), utilizes the term telepractice. Telepractice (ASHA, 2005) encompasses, "the application of telecommunications technology to deliver professional services at a distance by linking clinician to client, or clinician to clinician for assessment, intervention, and/or consultation," (ASHA, 2005, p. 1). Therefore, professionals using alternative delivery services (e.g. telehealth) must adhere to specific professional policies including the Code of Ethics, Scope of Practice, state/federal laws (e.g., licensure, HIPAA, etc.), and ASHA policy documents on professional practices.

Ashley (2002) notes that the practice of telehealth has existed in the various forms for approximately the last 40 years, but was cost prohibitive and consequently less accessible. However, 40 years ago technology was available but not necessarily accessible. The lack of accessibility of technology was specifically due to the cost of equipment resulting in limited exposure and progress with potential applications. The marked decrease in the cost of technological equipment affords an opportunity for exploration, which has the promise of making a global impact (Givens & Elangovan, 2003).

One of the positive aspects of the wide availability of technology includes the opportunity for specific empirical research addressing the use of telepractice compared to traditional methods. Research supporting the use of telepractice is vital to ensure the quality of services.

The Efficacy of Telepractice as a Viable Service Delivery Method to Address Foundational Reading Skills.

Examination of Foundational Reading Skills

Letter naming knowledge (LNK), letter sound knowledge (LSK), and decoding are three primary components of early reading. Letter naming knowledge is described by Foulin (2005) as the process by which the literacy learner acquires the name of the graphic shapes that represent each letter. Letter sound knowledge is the literacy learner's ability to connect the sounds associated with individual or combinations of graphic shapes. Decoding is the skill where combinations of letters form words and the reader blends these individual sounds together to produce the word as a whole. Acquisition of each skill is a prerequisite to becoming a successful reader.

Foulin (2005) examines the impact of letter naming knowledge on early literacy addressed in recent studies and summarizes the foremost findings. The review is organized into five sections. The first section details research supporting the predictive power of LNK and its impact on reading success. The next three sections are based on the role letter names play in literacy acquisition specific to phonological processes of print, letter sound knowledge, and phonemic sensitivity. The final section draws conclusions and offers future research questions.

The value of measuring LNK is comparable to that of a comprehensive reading evaluation in predicting future reading success (Scarborough, 1998). There is a wealth of documentation on the importance of assessing LNK, from Bond and Dykstra (1997), Chall (1983) to more recent Pennington and

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Lefly (2001). Each finding was based on large longitudinal studies, showing not only positive correlations between LNK and reading acquisition, but identifying LNK as a dominant predictor of reading acquisition in preschool. Foulin (2005) references Share, Jorm, Maclean, and Matthews (1984), findings that LNK was the best predictor of reading achievement for those entering kindergarten and the second best predictor in first grade. Further support for the predictive relationship between LNK and reading achievement is documented by Gallagher, Frith and Snowling (2000).

Research clearly supports the significance of LNK as a predictor for success in learning to read. The resulting question is what exactly this skill represents that facilitates reading development? For many years, the school of thought related to LNK was that it had no impact on learning to read. This concept was supported by research indicating that training LNK did not enhance reading ability (Ehri, 1983). Foulin (2005) proposes an alternative perspective that LNK incidentally impacts precursors or subcomponents of reading including LSK and phonemic knowledge. Further supporting this perspective is the fact that at the point when the predictive power of LNK reaches its ceiling, LSK takes over, holding the greater predictive power (Foulin, 2005). This discrete predictive power of LNK and LSK necessitates independent consideration.

An example of LNK's independent value is provided in Treiman, Tincoff, Richmond-Welty and Daylene (1996), who assert that LNK alone allows the early literacy learner to first spell with little LSK and phoneme sound knowledge. Children's inventive spellings strongly support the LNK contribution. For example, this is evident in the child's dependence on consonant letter names i.e. /b/ for "be" or /r/ for "are"**.** Frith's (1985) model of spelling development depicts an alternating progression of reading and spelling, as advances in one area elicits forward movement in the other. Generally speaking, reading and spelling are distinct entities, whose development is a result of a give and take from each other. Foulin (2005), suggests that connection between reading and spelling results from the child's ability to associate the printed letters in the word with letter names in the order they appear in a spoken word. Overall, the preliterate children's knowledge of letter names facilitates linguistic awareness and understanding of the alphabetic principle, thereby, contributing to a future reading achievement.

The next component of the foundational reading skills focuses on acquisition of letter sound knowledge (LSK). Foulin (2005) asserts LNK is a precursor for LSK development, particularly for

alphabetic languages, such as English. Adams (1990) and Ehri (1983) explain that the relationship between LNK and reading achievement is that LNK assists children in learning the letter sounds. Burgess and Lonigan (1998) and Mc Bride-Chang (1999) longitudinal kindergarten measures of initial LNK foretold the development of LSK.

The ability to obtain letter sounds from letter names promotes phoneme analysis, therefore facilitating each other's growth (Foulin, 2005). Foulin (2005) cites both, Goswami and Dyrant (1990) and Wagner and Torgessen (1987) findings that LNK and phonemic sensitivity causally related to formal reading and spelling development. Therefore, increasing child's letter naming knowledge assists letter sound knowledge development, ultimately enhancing potential formal reading and spelling development.

Share (2004) also suggests that LNK facilitates LSK, both of which are crucial to decoding. This is further supported by the fact that poor readers have difficulty learning the phoneme – grapheme correspondences impeding decoding. Foulin (2005) states that formal assistance is required in the presence of a delay in LNK by the time children enter elementary school. Intervention should also address LNK in conjunction with early literacy skills including phonemic sensitivity and LSK.

Children with speech disorders are delayed in the typical acquisition of speech sounds, therefore negatively impacting speech production. These children are also found to have an increased risk for reduced phonological awareness skills and literacy acquisition. As Foulin (2005) stated, "extracting letter sounds from letter names obviously requires a certain level of phoneme analysis skill." (p. 139). Treiman, Pennington, Shriberg, and Boada (2008) also predicted that children who struggle in learning letter sounds rely on rote memory and do not dissect segments.

Treiman et al. (2008) conducted a study to determine if children with speech disorders memorize the sound of letters versus extracting a letter sound from the letter name utilizing phonological awareness skills. An ancillary question addressed in the study is if children who develop significant reading problems learn basic letter-sound correspondences differently than those without reading problems. The study recruited a population of 5-6 year olds with an experimental group of 104 children with speech sound disorders (SSD) and a control group of 39 children with no history of speech sound disturbances. The 104 children in the experimental group (SSD group) were classified into three subgroups according to criteria delineated in Raitano, Pennington, Tunick, Boada, and Shriberg, (2004). One SSD group consisted of

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participants whose speech sound disorders from early childhood had resolved. A second SSD group consisted of participants whose speech sound disorders persisted into childhood. The final SSD group consisted of participants whose speech sound disorders persisted into childhood and who also exhibited language impairment.

For each participant, measures were taken for letter knowledge, phonological processes (rhyme judgment, elision, blending, sound matching), non-verbal intelligence, word attack, basic reading and basic spelling. The speech sound disordered (SSD) group had a statistically significant lower non-verbal IQ than the control group. In addition, socioeconomic status was higher for the control group as measured by the Hollingshead Four Factor index score. As a result of this study, Treiman et al. (2008) confirmed their previous findings (Trieman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998) that 5- and 6- year old children in the United States know many letter names and a number of letter sounds. Those children with a history of a speech sound disorder, particularly children who also display general language impairments, demonstrated a poorer performance on LNK and LSK than the controls without the history of speech sound disorder.

Treiman et al. (2008) findings revealed that the SSD group performed more poorly than the control group on the tasks requiring the letter name to be stated versus the letter sound to be stated. In addition, a difference in performance was detected when the letter sound occurred at the beginning of the letter name, i.e., /b/, sound at end of the letter name, i.e., /m/, or sound not in the letter name, i.e., /h/. Findings indicated that participants did better on tasks requiring the letter to be named versus tasks that required the letter sound to be named. Participants did better when the letters they were naming had the letter sound occurring at the beginning of the letter name, for example, /b/. A poorer performance resulted when the sound of the letter occurred at the end of the letter name, for example, /m/. The poorest performance occurred when the letter sound was not in the letter name at all, for example, /h/. This pattern of performance difficulty was found to be similar for the SSD groups and the control group. Continuing, the study indicated that letter names helped a wide range of students learn letter sounds, including those with speech sound disorders, children with language impairment, and children with low phonological awareness. Treiman et al. (2008) findings further confirmed prior research, that LNK and LSK are strong predictors for literacy development.

Levin, Shatil-Carmon, and Asif-Rave (2006) explored the question if letter names (LN) or letter sounds (LS) are easier to learn. In addition, Levin et al. (2006) explored if learning LN immediately transfer to performance on LS and vice versa along with the question of possible greater transfer: LN to LS or LS to LN. Finally, Levin et al.'s (2006) study asked if letter names and/or letter sounds facilitate word recognition. Specifically, the study asked if the order of learning letter names and sounds, after both are learned, affect word recognition.

Levin et al. (2006) recruited 123 children with a mean age of 5 years 1 month from eight pre-kindergarten's and kindergartens classes. All children were from the middle-socioeconomic status (SES) neighborhoods.   Inclusion criteria consisted of the following: Hebrew as a first language, children did not have special needs (per teacher report), parents agreed to their child's participation, children could identify at least eight letters without naming or providing a sound the letter makes, along with success on the screening procedure for both naming a letter and providing the sound. Total of 65 children out of 123 met the criteria for participation in the study.

The sample of participants was divided into two training groups: name-sound group and sound-name group, based on their performance on the screening criteria. The name–sound group consisted of 33 children (16 boys and 17 girls with a mean age of 5 years 0 months, range: 4 years 5 months to 5 years 6 months) and it underwent training first on letter names then on letter sounds and. The sound–name group, consisting of 32 children (20 boys and 12 girls with a mean age of 5 years 0 months, range: 4 years 5 months to 5 years 9 months), underwent training first on letter sounds then on letter names. The procedure consisted of the pre-test, training period one, post test one, training period two, and post test two.

Training for letters and sounds consisted of presenting each participant with a total of 32 cards: 22 representing the Hebrew alphabet (not including the last five (5) final position letters) and 10 cards with pictures of familiar objects to ensure moments of success. For the word recognition task, each child was presented a customized 16-word recognition task. The task consisted of eight word-pairs matched for the initial letter that the child could neither name nor sound out (by either phonemic or extended sound) on the screening test. Participants were asked identify the word presented verbally from the pair of words presented with the same initial letter. Lastly, following the word identification, the participant was asked to explain how they knew the words that were presented.

Levin et al. (2006) confirmed that children knew more letter names than letter sounds, as children's scores were highest on naming letters versus sounds. In relation to specific sounds, phonemic sounds refer to the several letters in Hebrew that stand for more than one letter. This compares to English where the letter "c" can be /k/ phoneme or /s/ phoneme. Extended sounds occur "because Hebrew orthography does not mark most vowels by letters, adults often map extended sounds rather than phonemic sounds onto consonantal letters (which comprise most letters in written words)," (Levin et al., 2006, p. 147). For example, the name Tamar would be spelled TMR and adults would mark /ta/, /ma/ and /r/. For specific sounds a statistical analysis (one-way ANOVA followed by Bonferroni tests) indicated significant difference with children performing better with the extended sounds and poorest with phonemic sounds. Levin et al. (2006) determined the specific scaffold for children's knowledge of letter names, followed by extended sounds and lastly by phonemic sounds. LNK did assist in acquisition of LSK without training. Given the same training procedure and the same number of exposures, children were better at connecting letter shapes with their phonemic sounds than with their names (Levin et al., 2006). This direct teaching of LSK provided bidirectional relationship between LSK and LNK: the sound a letter makes also serves as a cue for the letter name and vice versa. Levin et al. (2006) results support the notion that training on both, LSK and LNK, is valuable for future acquisition of decoding skills.

Only a limited number of words are available to pre-readers. Children utilize the visual structure of the words and the context the word is seen in to achieve independent word recognition. The limitations of this ability are rooted in memory functions. The point at which word recognition shifts from visual processing of the words to phonetic processing requires a certain level of LNK (Scott & Ehri, 1990).

Levin et al. (2006) indicated that training on LNK and LSK were both beneficial to word recognition. This idea counters the more common belief, that LSK is a better facilitator for word recognition than LNK. Word recognition was greater for words that started with trained letters than untrained letters. Ultimately, the learning of letter names and letter sounds advances word recognition and therefore literacy.

There are some "at risk" factors that warrant specific monitoring for progression within literacy development. These factors include reduced LNK and LSK in children, along with concomitant factors, such as speech sound disorders, language disorder, and both, speech sound along with language disorder.

Therefore, intervention programs that teach early literacy skills need to include instructions in both, letter names and letter sounds, as LNK and LSK have bidirectional relationship. These programs need to consider the fact that some words are easier to recognize than the others, based on the sound cue encoded within certain letter names, and incorporate this notion into the programs' scope and sequence (Levin et al., 2006).

A Review of Multisensory Explicit Treatment of Foundational Reading Skills

Juel and Minden-Cupp, (2000) examined if specific forms of instructional practices, with emphasis on different levels of sublexical structures (e.g. onsets and rimes, individual phonemes), affect children differently at various levels of reading development, along with the idea of when, how and which linguistic units and instructional strategies are best to be taught. For their study the authors first identified four first grade classrooms in two neighborhood schools in the same district with similar demographics, located in the southeastern United States. Classrooms 1 and 2 were in one school and classrooms 3 and 4 in the other school.

Each classroom had no more than 18 students, teaching assistant, and was led by a Caucasian female teacher with greater than ten years of teaching experience, five being at the schools that were participating in the study. Each teacher's profile included a "favorable" level of achievement that was based on a classroom observation and student performance specifically spelling and alphabet knowledge from the beginning to the end of the first grade. Also, considered in the teacher's profile was classroom management style, described as smooth and efficient based on classroom observations, discipline referrals and accumulated parental input. The language arts period for the classrooms consisted of 1½ hours per day, with each classroom broken down into 3 reading groups. Classroom 1 spent 20-30 minutes in a whole group word wall activity then divided up into smaller reading groups. Classroom 2 and 4 spent 90 minutes doing reading groups. Classroom 3's session was considered longer than 90 minutes as the 15 minute morning message was expanded and integrated into whole class language arts instruction. The morning message consisted of literacy skills interwoven into the following: writing the news from home, daily schedule or text teacher wrote on blackboard. Therefore, the time, structure and instructional targets of each classroom were different.

As mentioned above, classroom 1's word recognition instruction in the Juel and Minden-Cupp (2000) study, was conducted as a whole class word wall exercise, targeting the sequence of letters in words,

spelling words verbally and in writing. The reading group instruction contained virtually no phonics instructions, as word recognition development was tied to the basic word wall activity. In addition, phonemic awareness work consisted of rhyming words. The attention given to word units targeted initial consonants along with whole words. During the reading of unknown words in a text, students were cued to utilize the meaning of the text, to predict, to reread, to spell the word, or to look on the word wall. However, frequently the teacher simply told the child the word.

Classroom's 2 word recognition was targeted within the reading groups via phonics instruction throughout the year, utilizing hands on materials to target phonemic awareness and phonics. This included sorting word cards based on orthographic patterns or picture cards based on sounds. An additional focus of instruction was on how to chunk words into onset and rimes.

Classroom 3 targeted word recognition via peer coaching, which was unique to classroom three. Peer coaching consisted of having students who were better at reading helping the student having difficulty recognizing the word. The assistance consisted of students, rather than a teacher, providing clues that included rereading, sounding words out, to see if it makes sense, and looking at the word wall. There was minimal systematic phonics instruction. Phonics instruction occurred in a random pattern with the teacher utilizing a word in the morning message, a book or a chart to focus on initial consonants, long vowels, syllables, and whole words. This classroom had a large amount of writing, with modeling, dictation and individual text writing. The students at all reading levels were expected to learn the skills of word recognition and phonics in the context of reading and writing, which were the major activities in this classroom.

Classroom 4 in the Juel and Minden-Cupp (2000) study was the most phonics oriented. Each reading group instruction was also different. During the fall, the lowest reading group spent the greatest amount of time with hands on phonics activities and phonemic awareness and less on reading text. Phonics activities included writing sounds, worksheets, sorting word cards into categories based on orthographic patterns, i.e., words differing in their rimes or short vowels. Phonemic awareness instruction involved the hands-on process of sorting pictures by initial sounds. The higher-skill groups were the ones with greatest amount of time spent on reading text and least on phonics and phonemic awareness. The systematic phonics instruction of classroom four was complete in February with all reading groups then focusing on

vocabulary development, reading and discussion of the text. Initially, systematic phonics consisted of targeting initial consonants, in addition to context, to determine unknown words in the text. Gradually, as the year went on, the phonics instruction evolved to include segmenting rimes, breaking down rime units into individual phonemes, identifying rime chunks in unknown words. As the year progressed, the teacher increasingly modeled and encouraged children to sound out and blend individual letters to recognize a word.

Three assessments were conducted throughout the year: at the beginning of the year (in September), in the middle of the year (December), and at the end of the year (in May). At the beginning of the year all students were at the same reading level (Juel & Minden-Cupp, 2000). The assessment consisted of individually administered Book Buddies Early Literacy Screening (BBELS - an early literacy screening expanded from the one used in Book Buddies (Johnston, Invernizzi, & Juel, 1998). The BBELS assessment consisted of two parts. The first part determined early literacy understanding involved in word recognition and word recognition itself. The second part assessed the ability to read and comprehend passages. At the end of the year the analysis of covariance (ANCOVA) carried out on four different first grade classes, revealed statistically significant differences in reading skill. Classroom 4 exhibited greatest gains followed by 3, 2 and then 1.

Within Juel and Minden-Cupp's, (2000) study, the differential instruction required a knowledgeable teacher, who tailored instruction to student needs resulting in the greatest progress. Juel and Minden-Cupp (2000) cautioned that results are not derived from an experimental study, as they did not have a control group. The authors indicated the need for an expanded longitudinal study, as the results did not follow the students beyond first grade. Therefore, it is undetermined if the reading weaknesses will continue to plague students who were in the lower level reading groups.

Iversen and Tunmer (1993) examined if adding systematic instruction in phonological recoding to the Reading Recovery program, was having additional effect in reading achievements. Wilson and Daviss (1994) describes the Reading Recovery program as a one to one tutoring, serving the lowest-achieving first graders who are not yet exhibiting the basic reading and writing concepts. The intervention is most effective when it is available to all students who need it and is used as a supplement to good classroom teaching. The goal of the Reading Recovery program is to bring underachieving students to a grade or

above grade level of reading. Iverson and Tumner (1993) hypothesized that those children selected for the Reading Recovery program, should exhibit reduced phonological processing skills, specifically phonological awareness and phonological recoding. Phonological recoding (decoding) is the ability to translate letters and clusters of letters into phonological forms and to use this knowledge to decode new words. This skill is among the best predictors of reading achievement and poor phonological processing skills are a common deficit found in virtually all poor readers (see Badian, 1994; Juel, 1988; Snowling, Goulandris & Defty, 1996; Stanovich & Siegel, 1994; Vellutino, Scanlon, Sipay, Small, Pratt, Chen & Denckla, 1996). Iversen and Tunmer (1993) further hypothesized that progress in the Reading Recovery program would be strongly related to the development of phonological awareness and phonological recording skills.

Iversen and Tunmer (1993) participants were first graders from 30 schools in 13 school districts in Rhode Island, with a mean age of 6 years 2 months, identified as requiring extra reading support at the end of Kindergarten. The protocol for determining the need for extra support consisted of utilizing the following: the Metropolitan Achievement Test results (standardized test administered to kindergarten children in March of that year), a personal battery of tests given by the certified reading specialist at each school along with referrals from the kindergarten teacher. At the beginning of the first grade, the lowest ranking students from each school were administered the Diagnostic Survey (Clay, 1985) and the Dolch Word Recognition Test (Dolch, 1939). The group of students who performed at the lowest levels was divided into three subgroups of 32 students each: The standard Reading Recovery group, a modified Reading Recovery group and a standard intervention group. The Reading Recovery group followed the standard Reading Recovery program. The modified Reading Recovery group received explicit training in phonological recoding skills in addition to the standard program. The standard intervention group served as the control group and received small group (6-7 students) out of class reading support, focusing on supplemental or replacement basal reader, along with the writing process. The teachers of the three intervention groups were experienced reading specialists with master's degrees in reading (Iversen & Tunmer, 1993).

The standard Reading Recovery program consists of 7 components, one of which is a letter identification task that continues until the participant's mastery of this task. The next step is word analysis

activities targeting participant's errors within the lesson. In the modified Reading Recovery program, after the student could identify 35 of the 54 alphabet characters, explicit instruction transitioned from letter identification to letter-phoneme patterns. For example, children manipulated magnetic letters to create, segment and construct new words that exhibit the same letter- phoneme patterns.

Iversen and Tunmer (1993) wanted to see if adding systematic instruction in phonological recoding to the Reading Recovery program made the program more effective. The authors would determine the success of the program based on discharge criteria including the students' posttest performance and the total number of sessions for the students to reached grade level or above. In addition, acquired independence with strategies which assisted with more difficult material; reading at average or above average levels for that class; and consultation with the classroom teacher were determining factors.

Iversen and Tunmer (1993) results indicated that Reading Recovery groups performed at the level of standard intervention group and often were markedly better on phonological awareness measures (phoneme segmentation and phoneme deletion). The researchers noted that the most significant finding in the study was the average number of sessions to reach the discharge criteria. "The difference in the mean number of lessons to discontinuation was highly significant, $t(62) = 5.70$, $p < .001$, and indicates that the standard Reading Recovery program was 37% less efficient than the modified Reading Recovery program," (Iversen & Tunmer, 1993, p. 120) The implications of this study strongly suggest that including the systematic instruction in phonological recoding will result in a shorter remediation period. The participants in the Reading Recovery groups learned more quickly, when systematic instruction was added to the program to facilitate their awareness of the correspondences between elements of written and spoken language.

Another systematic instruction is Alphabetic phonics, a non-graded, multisensory curriculum, based on the of Orton-Gillingham approach to teaching reading. The Orton-Gillingham methodology utilizes phonetics and emphasizes visual, auditory and kinesthetic learning styles targeting the structure of language and gradually moving towards reading. Alphabetic phonetics teaches the structure of the English language, reading, handwriting, spelling, verbal and written expression and comprehension, by utilizing visual, auditory, and kinesthetic learning. Alphabetic Phonics specifically addresses the letter names and letter sounds along with letter sequencing.

The Dyslexia Training Program (DTP), a remedial reading program based on the systematic multisensory methods of reading instruction originating with Orton Gillinham's (OG) is widely utilized. However, as Oakland et al. (1998) state, "relatively little research has been conducted to validate the effectiveness of the Orton-Gillingham approach and its adaptations," (p 3). Therefore, the purpose of Oakland et al. (1998) study was to answer specific questions: Do students with dyslexia differ in the amount of progress they make in reading and spelling development, receiving the DTP through either the teacher-directed or the videotaped method? Do dyslexic students, receiving the DTP, make significantly greater progress in reading and spelling achievement over the years compared to similar students receiving other instructional programs?

The DTP's complete two-year program consists of 350 one-hour sessions with a comprehensive scope and hierarchical sequence beginning with the basics of letter recognition, letter sound correspondences and concluding with complex levels of linguistic knowledge. Intervention addressing reading comprehension is initiated when the student obtains a minimal level of accuracy and automaticity determined through a criterion referenced measures administered at 7 intervals throughout the program. It was designed to allow a teacher who has not been trained extensively in dyslexia to monitor the program. The instructional content consists of both the video and live versions of the DTP.

The study contained a total of forty eight participants diagnosed with dyslexia by two different assessment facilities in Texas. The experimental group for the study consisted of twenty two students (3 girls and 19 boys) who were diagnosed with dyslexia by the Texas Scottish Rite Hospital for Children (TSRHC). The control group consisted of twenty six students (4 girls and 22 boys) who were diagnosed with dyslexia at the Austin Neurological Clinic located at the University of Texas's Learning Abilities Center. The experimental group was further divided into two groups: 12 students were receiving the video version as the main method of instruction with the teacher only there to redirect attention and respond to questions, and 10 students received directed instruction of the same content by a certified dyslexia therapist.

All students were administered the Wechsler Intelligence Scale for Children-Revised (WISC-R). The full scale IQ scores were above 90, with standard scores below 90 on the Wide Range Achievement Test – Revised (WRAT-R); all students demonstrated a standard score discrepancy between the WISC-R

full scale IQ and the word recognition subtest of at least 15 points. In addition, students had normal or corrected vision, and passed pure tone hearing screening. Students were excluded if they had emotional disturbances, were non-native English speakers, and had focal brain lesions (acquired or congenital). Participants in the control group were matched to the experimental group for intelligence, reading achievement, gender, age, grade and socioeconomic status.

Oakland et al. (1998) utilized repeated measures analysis of variance to determine the differences between the DTP teachers driven versus DTP video driven. Results were specific to the following measures: reading comprehension, word recognition, monosyllabic phonological decoding skills, polysyllabic phonological decoding skills and spelling. The results for the phonological decoding skills (monosyllabic, polysyllabic), reading comprehension and word recognition measures indicate that both groups made significant progress in reading comprehension and word recognition. The groups did not differ significantly in the volume of progress. None of the effects related to spelling were significant.

In order to determine the overall success of the DTP program, Oakland et al. (1998) compared the performance of both DTP groups to the control group for reading comprehension, word recognition, monosyllabic phonological decoding skills, polysyllabic phonological decoding skills and spelling. At the end of one year, the DTP groups performed lower than the control group. However, the DTP group made significant progress in reading comprehension after completion of two years and the control group did not. The monosyllabic decoding skills for both groups made marked, comparable development over the 2 years. The polysyllabic decoding skills of the DTP group were initially lower than the control group for decoding polysyllabic nonsense words. Later measures indicated the DTP group performed significantly higher than the control group on decoding polysyllabic nonsense words. Spelling measures indicated no significant improvement over the two years for either group.

Oakland et al. (1998) concluded from their results that the Dyslexia Training Program was effective in the facilitation of the dyslexic student's reading development. The authors also determined that results from both, direct teaching with DTP and video presented DTP, yielded similar results. Their findings indicate significant gains in phonological decoding skills (monosyllabic, polysyllabic), word recognition and reading comprehension by the student's in the DTP which supports the efficacy of sequential, explicit multisensory instruction specific to Alphabetic Phonics.

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A Review of Telepractice Studies in Speech Language Pathology: Treatment

Mashima, Birkmire-Peters, Syms, Holtel, Burgess, and Peters, (2003) conducted a study comparing a remote delivery of voice therapy to a traditional treatment service delivery at Speech Pathology Clinic at Tripler Army Medical Center (TAMC) in Honolulu, Hawaii. The remote service delivery was conducted on the premises of the outpatient facility through the use of a Real-time video monitoring system. The traditional treatment service delivery was also conducted at on the premise with a one to one face to face session.

Mashima et al. (2003) participants included a total of 72 patients with voice disorders referred to the TAMC speech pathology clinic. The final group of patients consisted of 34 males and 38 females with a mean age of 45, who were then matched according to diagnostic category and randomly assigned into traditional and remote/video groups. Twenty-eight patients were in the traditional group and 23 in the remote treatment group. Prior to initiation of individual treatment, baseline data was gathered for the four components to be measured, which included: perceptual judgments of vocal quality, acoustic analysis, patient satisfaction and fiber optic laryngoscopy. The speech language pathologist acquired baseline information for the first three components by completion of a case history form, a voice self-rating and acoustic analysis of voice samples utilizing a Visi-pitch II along with audio voice sample. Baseline measures for the final component were obtained as participants received a laryngoscopic evaluation by an otolaryngologist.

In a traditional treatment group the intervention occurred face to face, while in remote treatment method the clinician was in an adjacent room interacting via real time audio-video monitoring system. Treatment methods and facilitating techniques were the same for both, the traditional and remote groups. Modifications of the clinics established a treatment protocol was required due to the nature of the remote treatment. Therefore, for both groups written handouts for diagrams, vocal exercises supplemented oral instructions and laryngeal manipulation techniques were excluded.

Boone (1974) established guidelines for discharge from voice therapy and this protocol was applied as the guidelines for discharge from voice therapy in this study. The protocol stated that one or more of the following five criteria were needed, such as: the laryngeal lesion has improved (laryngoscopic examination), overall vocal quality sounds better in most settings, voice feels better, no improvement in

voice, or termination of voice therapy without clinician's permission. The post treatment data on three of the four data components (perceptual judgments of vocal quality, acoustic analysis, and fiber optic laryngoscopy) was collected upon discharge from therapy and analyzed by two certified speech language pathologists who did not participate in the initial evaluation or treatment sessions.

Mashima et al.'s (2003) results for the perceptual judgment of vocal quality indicated post treatment samples were rated better than pretreatment samples for 90% of the participants. Between the two treatment groups (traditional and remote) there was no difference in the perceptual ratings. Voice therapy was as effective a therapy for improving vocal quality delivered remotely as it was traditionally.

The acoustic analysis was completed for 47 out of the 51 participants for jitter and shimmer. Jitter is an acoustical measure indicating the pitch variation in the voice, resulting in a rough sound with measures over 1.0%. Prior to treatment 77% of the traditional group and 52% of the remote group had jitter measures greater than 1.0 %. Post treatment measures showed that 96% of the participants in the traditional group and 90% of the remote group had jitter measures of less than 1.0%. A two-way analysis of variance of the jitter measures showed no difference between the groups (conventional and remote). Shimmer is the acoustical analysis of the frequent back and forth changes, i.e., soft to loud (amplitude) in the voice with disorder measures above 0.5 dB. Prior to treatment 73% of the traditional group and 76% of the remote group had shimmer measures above 0.5 dB. Post treatment measures showed that 62% of the participants in the traditional group and 43% of the remote group had shimmer measures below 0.5 dB. A two-way analysis of variance of the shimmer measures between the traditional and remote groups showed no differences between the groups.

Patient satisfaction surveys were completed by 49 of the participants on the perceived voice improvement along with the process and outcome of voice therapy. An analysis of voice improvement, based on the surveys, showed no difference between the groups. On the Likert scale questionnaire, with 1 being "not at all" and 6 being the maximum improvement the mean for both groups was 5.24 indicating the average patient for both groups felt voices improved markedly with voice therapy (Mashima et al. 2003). Patient satisfaction surveys related to the process and outcome were based on a five-point scale with 1 being a positive response and 5 a negative response. The mean ratings on the ten statements were 1 to 1.68,

indicative of patients' satisfaction. Sixteen comments specific to the telehealth method were also positive in nature.

The final component for analysis was the laryngoscopic examination. Overall, 82% of the participants were rated as better, with no differences between the two groups. These results indicated that a remote service delivery (in house) was comparable to traditional face-to-face service delivery.

Mashima et al. (2003) pointed out, that a potential road block to this alternative service delivery may be the patient's receptiveness. Alternately, in support of remote treatment, Mashima et al. (2003) note that service to remote locations is possible. In addition, telehealth would allow access to treatment for patient's homebound secondary to physical disabilities, allowing them to be seen in their home environment. Furthermore, for the treating clinician reducing travel time in turn maximizes contact time with the patient, and for the facility using the telepractice method, it maximizes the income. Ultimately, services are successfully provided at lower cost.

The potential impact of telepractice within the field of treatment of speech and language disorders is immense. However, the task of continued investigation of efficacy for a variety of treatments is also immense. This study laid foundations to the benefit and potential success of telepractice. Mashima et al. (2003) planned to expand their telepractice investigation to determine its "technical acceptability, operational effectiveness and clinical appropriateness" (p.438).

While Mashima et al. (2003) proposed the use of video conferencing as a treatment service delivery option, Wilson, Onslow and Lincoln (2004) examined the use of low tech telepractice, the telephone, to deliver a modified version of Lidcombe Program of Early Stuttering Intervention. Wilson et al. (2004) interviewed speech language pathologist servicing patients in secluded areas of Australia. They found that speech language pathology services were not commonly accessible to all, and that the overall quality of service was at times problematic. A central goal of the study was to provide broad accessibility of speech language services and as Australia's infrastructure did not have the adequate support for the majority of the households, telephones were chosen as the mode of telehealth delivery.

The methods for the study included strict adherence to the Lidcombe Program treatment manual. This intervention program "is a parent-administered, non-programmed, behavioral treatment for early stuttering implemented in two stages." (Wilson et al., 2004, p 81). Allowances were made, in order to

adapt the program appropriately to include telephone service delivery. These adaptations that are not the typical delivery method for the Lidcombe program included the following: replacement of clinic visits with telephone consultation, quick access via phone between scheduled appointments as needed, frequent recordings of daily speaking situations to replace face to face interaction, parent-provider agreement on the severity ratings, recorded parental intervention sessions for the clinician to provide feedback, and minimal interaction between the child and provider over the phone (Wilson et al. 2004). The main source of service delivery was video training materials for the parents.

      Participants were referred from generalist speech language pathologist at the Australian Stuttering Research Centre, The University of Sydney or specialist speech language pathologist at the Stuttering Unit, Bankstown Health Service in Sydney. Selection criteria included the following: a diagnosed stutter by two speech pathologists, between 2 and 6 years old at the start of the study, stutter for at least 6 months, no stuttering treatment at least 2 months prior to the initiation of the Lidcombe Program, geographically isolated from participating in weekly Lidcombe Program treatment, and informed parental consent. Eighteen families were initially identified, with the final count of five families who completed the treatment phase. Attrition was due to several factors, including relocation, non-compliance, child lack of motivation, family death, and serious illness.

      Baseline and post treatment data was collected via video or audio taped speech samples and was analyzed for two components: the overall percentage of stuttered speech and the number of syllables spoken per minute. Baseline samples were collected three times in the two months prior to the treatment. Post treatment data was collected seven times over a 12 month period (considered an active maintenance period) after treatment. Participants were unaware when speech samples were recorded. Each participant was recorded for 10 minutes in three different contexts: speaking to family member at home, speaking to family or non-family member away from home and finally a recording taken in variety of home situations.

      A total of 122 speech sample tapes were presented to a speech language pathologist who was not involved in the study and specialized in fluency treatment. Ten percent of the samples were then randomly presented and rated by another speech language pathologist to determine inter-rater reliability of the results. Both measures, e.g., percent stuttered speech and syllables per minute for both assessments, were highly correlated suggesting reliable results (Wilson et al. 2004).

The overall efficiency of treatment was determined by the number of weeks to reach the completion of stage one, number of consultations until reaching stage two, duration of consultation, measure of total consultation time and a stuttering fluency/severity questionnaire. Length of completion and consultation data was gathered from times noted in medical record. The parent questionnaire addressed opinions related to severity and frequency of stuttering and was taken at the completion of the treatment, and six and twelve months post treatment.

Wilson et al. (2004) interpreted preliminary data on speech fluency progress as beneficial, as four out of five participants made progress. At 12 months post treatment, two children had less than 1.0% of stuttered speech per minute and two had less than 2.0% stuttered speech per minute. Wilson et al. (2004) note that noncompliance of the parents negatively impacted overall progress for the children scoring in the less than 2.0% of stuttered speech. The final child, however, "had a clinically significant relapse" (Wilson et al., 2004 p. 88).

Data on the overall efficiency of treatment revealed that all the components of teletherapy required a more extended duration of treatment versus the traditional therapy time frame. This is reported as an area for further research examining the potential factors that affected the duration of treatment. The impinging factors should be rectified, if possible, along with determination of the overall cost/benefit ratio. For example, as cited in Winslow et al. (2004), Jones, Onslow, Harrison and Packman, (2000) indicated a potential relationship between pretreatment stuttered speech percentage and duration of therapy. Wilson et al. (2004), also indicated that there was one treating clinician whose implementation of therapy may have been longer than the standard version.

Wilson et al. (2004) noted high attrition rates with 5 of the 13 participants dropping out. Of those 5, four were unwilling to commit to the necessary repeated recordings given the modifications for teletherapy. The agreement to commit to repeated recordings should be a consideration for participation criteria. The overall imbalance in service necessitates continued investigation of telehealth viability.

A Review of Telepractice Studies in Speech Language Pathology: Evaluation

Theodoros, Hill, Russell, Ward and Wootton, (2008) conducted a study with, "the aim to determine the validity and reliability of assessing acquired aphasia using standardized language assessment via an Internet-based videoconferencing system," (p.553). The participants were recruited from facilities in

Brisbane, Australia offering aphasia treatment including rehabilitations, aphasia support groups and university speech clinics. There were a total of 32 participants including 22 males and 10 females with an age range of 21 to 80 years old. One participant suffered a traumatic brain injury and the others all experienced a cerebrovascular accident (CVA). Participants were excluded from the study if they had any history of speech language disturbance prior to the presenting event, a history of posttraumatic amnesia, positive history of alcohol abuse, and significant uncorrected visual or hearing impairment.

Each participant was assessed face to face (FTF) and online internet based video conferencing system simultaneously by two speech language pathologists (SLP); one clinician lead the assessment and one clinician was silently rating performance. The SLP's had no prior knowledge of the severity of the participant's aphasia. Theodoros et al. (2008) randomly assigned the SLPs and participants to either FTF or online internet based system to address test bias. The participants were assessed with the commonly used standardized aphasia tests including: the Boston Naming Test (BNT) and the short form of the Boston Diagnostic Aphasia Examination 3rd edition (BDAE-3).

The online assessment was carried out via a PC based real time videoconferencing with the SLP's computer at the University of Queensland and a computer for the participant at a laboratory within a local metropolitan hospital (Theodoros et al. 2008). The participants were seated in close proximity to the computer in order to use the touch screen. Earphones were utilized to hear information and a microphone to record responses. These measures were in place to prevent any inconsistencies due to internet speed latencies and assist in obtaining an accurate rating of performance. In addition, two web cameras were utilized one for the videoconference link and a second for video clips required in the assessment.

Theodoros et al. (2008) established inter and intra-rater reliability for the online assessment by having 5 randomly chosen video recordings rated initially and four weeks later by a total of four SLPs. Two of the SLPs were involved in the study. The other two experienced SLPs were not involved in the study. Theodoros et al. (2008) used Landis and Koch scale to assess the strength of agreement between the raters. The ratings are as follows: <0.4 = poor; 0.41-0.6 = moderate; 0.61-0.80 = good; 0.81-1.00 = very good. The strength of agreement of .81-1.00 for the intra class coefficients (ICC) was indicative of a very good agreement rating.

In total, there were three components specific to participants that were measured. First, the test scores themselves were analyzed. Next, a diagnosis for type of aphasia was examined. Finally, the results of a patient satisfaction questionnaire were compiled for analysis (Theodoros et al. 2008).

The FTF assessments were conducted according to the stated test protocols. During the FTF assessment, the online SLP had the telerehabilitation system for video and audio recordings from which assessments were scored. Twenty four subtests from the BDAE 3 along with the BNT were analyzed under each testing condition (FTF or online internet based) via the Wilcoxon signed ranks test of difference. A stringent alpha level of .01 was applied in determining significant differences between the FTF and online scores. In order to determine the strength of agreement between FTF and online assessments, quadratic weighted kappa coefficients were determined. The percentage of the exact agreement between assessments was utilized to determine the diagnosed aphasia type. The patient satisfaction questionnaire results were analyzed descriptively.

The results revealed no significant difference between the 24 subtests of the BDAE or BNT in the FTF versus the online environment. Moderate to very good agreement between the two assessors was delineated for the 24 subtests of the BDAE, BNT and seven rating scales (Theodoros et al. 2008). The authors documented 90.6% strength of agreement between the two assessors in their diagnosis for the type of aphasia.

The questionnaire was completed by 15 of the 16 participants with results indicating 100% participants indicating that they were at least satisfied with the online assessment. The video and audio quality was rated as good or excellent by 80% of the participants. The cohort agreed they were comfortable and confident with the results of the online process with 93% agreement. The entire cohort indicated they would participate again, with 80% expressing equal satisfaction with the FTF or online assessment. The online process was rated more convenient by 60% of participants (Theodoros et al. 2008).

Although future consideration for the ability to participate with online assessments should be the potential effect the aphasia type and severities poses on the participants, this research provided a basis for the development of telerehabilitation as an alternative mode of service delivery for persons with aphasia (Theodoros et al. 2008).

Hill, Theodoros, Russell and Ward, (2009) investigated refining the telerehabilitation system used in the 2006 study (Hill, Theodoros, Russell, Cahill, Ward & Clark, 2006) and re-evaluating this new system with a modified research design to determine validity and reliability of the assessment completed for adults with acquired dysarthria.

The study consisted of 24 participants, recruited from local hospitals speech pathology departments who acquired neurological impairment with diagnosed residual dysarthria. The neurological impairment resulted from traumatic brain injury (45.83%), cerebrovascular accident (45.83%), one progressive neurological disorder and one with a brain tumor. The ages of the participants ranged from 16 to 78 years old with 62.5% [sic] male and 37.5% [sic] female. The average time post onset was 6 months to 11 years.

Hill et al. (2009) study participants were not required to have any experience with computers or telerehabilitation systems. Criteria for exclusion consisted of a prior language impairment, severe coexisting speech disorder, i.e. apraxia, or severe coexisting aphasia. Additional excluding factors included the following: a history of posttraumatic amnesia, positive history of alcohol abuse, and significant uncorrected visual or hearing impairment.

The speech language pathologists (SPLs) in Hill et al. (2009) had no prior contact with the patients and did not know the level of severity of dysarthria. Their range of years of experience was 2 years to 10 years after graduation. The SLPs primary clientele was adults who had a neurogenic based communication disorder, with special training in assessment tools for neurogenic base communication disorders along with the use of the telerehabilitation system.

Each participant in Hill et al. (2009) was assessed face-to-face (FTF) and online simultaneously by two SLPs, with one leading the assessment and one rating the performance. Hill et al. (2009) randomly assigned the SLPs and participants to either FTF or online internet-based session to address test bias. The patients were assessed on five components. The first was an informal oral motor assessment, with a 5-point rating scale (1 no impairment and 5 severe), and laryngeal function, rated as yes or no. The second was an informal perceptual speech assessment to rate vocal quality, vocal continuity, pitch range, pitch and loudness in speech, nasality, articulatory precision and speech intelligibility. Third component was the standardized measure, the Assessment of Intelligibility of Dysarthric Speech (ASSIDS), where samples were analyzed by independent listeners who did not know the assessment environment. For inter- and intra-

rater reliability, 20% of the samples were re-rated. The fourth component was the diagnosed type of dysarthria and the final component was a patient satisfaction questionnaire.   The percentage of exact agreement was measured for the diagnosed dysarthria type. The patient satisfaction questionnaire analysis was conducted descriptively.

The results yielded the following: strong agreement for the first component of oral motor and perceptual ratings scales, the ASSIDS agreement and the CER was above 95% with no significant difference between the two environments measured by a t test. For the diagnosis of dysarthria, percentage of agreement was 66.67%, with the inter-rater reliability for the FTF and the telerehabilitation ranging from good to very good.

Inter rater reliability in the FTF environment for the ASSIDS sentence intelligibility and CER was high (ICCs of .94 and 1.0) and comparable to the telerehabilitation environment (ICCs of .87 and 1.0). Patient satisfaction questionnaire was completed by 11 eligible and responding participants. Results showed that the majority of the participants (10/11) rated quality of video/audio as good or excellent; comfortable or very happy with telerehabilitation assessment session; satisfied or very satisfied with overall satisfaction; all confident with results; all would participate again; and 8/11 equally satisfied with delivery methods. However, only 4/11 felt it would be more convenient, 5/11 felt it would not be more convenient with the final 2 indicating they have no internet access. Findings within the patient questionnaire yielded satisfying results.

A Review of Telepractice Studies in Education

McCullough (2001) examined the limits and potential benefits for utilizing telehealth service delivery within a community to meet the needs of preschool population with disabilities. The study took place as a part of a European project called the Applications in Telemedicine Taking Rapid Advantage of Cable Television (ATTRACT) as part of the South and East Belfast Health and Social Services Trust (SEBT).

The participants of the study were chosen based on specified criteria that considered diagnosis, geographic location, age, parental cooperation, and access to a tele-network. The study participants consisted of three preschool students with Down's syndrome and one student with Cornelia de Lange syndrome. The three children, attending the Mencap nursery school, received one televisit and one home

visit per week. The child in the mainstream nursery school received one home televisit per week. The equipment consisted of fully interactive audio-visual interface appropriate for both the home and clinic setting.

Data was collected three times (pretrial, trial and post trial stages) via a survey designed to investigate participants' satisfaction, the reliability of the audio-visual system, along with quality and functionality. The survey was constructed as a Likert five point scale, answering yes/no questions or providing written comments. The survey instrument was given to the parent/caregiver and the speech language pathologist. The response rate was high at 89% [sic].

The value of the five point Likert scale was as follows: five was the most favorable and one was the least favorable. The scale generated data from both the parent/caregiver and speech language pathologist. The reliability of the results was supported by the three repeated survey administrations. Compilation of the survey results revealed favorability for the ease of setting up the system with the mean of 4.7 for parents and 4.4 for therapists. The ability to observe parent and child interactions was reported as positive factor by the therapist with a mean of 5.0. In turn, the parents reported ability to observe the interactions of therapist and child with a mean of 4.7. In addition, when parents were asked if they felt there was improvement in their child's language skills, their responses had a mean rating of 4.7, with 5 being greatly improved. McCullough (2001) reports, that therapist ratings also suggested substantial gains in communication, but no mean score was reported. The post trial survey addressed more comprehensive questions related to attitudes and function of the system itself. The findings revealed that parents felt the system afforded them the opportunity to develop their skills, feel a part of the therapy program, and improved their knowledge base of child language development.

McCullough (2001) suggested that this study supported the use of remote technology as a legitimate and effective treatment option for special needs children. McCullough also stressed that positive findings of effectiveness of the study relate to the ability of the parents to participate and interact with their child and the therapist, which lead to an overall increase in their confidence to be effective language facilitators. As a result, they were able to participate more cohesively in the study.

McCullough (2001) does not specify any weaknesses within the study. However, there are several issues that can be identified as limitations beginning with the small number of participants and the

fact that they were not randomly selected. The scope and sequence of the treatment program was not specified as well. Some data appeared missing, such as the therapists post trial mean score from the post trial survey. This study attempted to examine the potential benefits of remote technology and hints at the possibility of viability, but such conclusions are guarded due to the study's limitations.

Sulzbacher, Mas, Larson, and Shurtleff (2004) examined the usefulness of telehealth conferencing technology to support consultation in rural schools and clinics in the Pacific Northwest. Funding for the study was generated by the Washington State Community Child Health Access Project (WSCCHAP) whose goal was to provide a means for better services for children with special health needs within four communities, whose populations' profiles consist of people economically disadvantaged, culturally diverse, and located in isolated rural areas. The consultation consisted of comprehensive team meetings with staff and outside specialists, which allowed comprehensive planning and avoided miscommunications.

Interactive video teleconferencing (IVTC) sites were selected initially based on the WSCCHAP existing sites, but were expanded when the state of Washington provided necessary equipment to every school district. The teleconference equipment was placed in rooms in which privacy and freedom from interruption could be maximized. Specialists were available from the Children's Hospital and Regional Medical Center (CHRMC) and the clinic at the University of Washington.

The data was collected from March 1997 to May 2000 with 668 pediatric consultations in outpatient clinics and 108 via interactive video teleconferencing (IVTC). The data was derived from patient satisfaction survey instrument collected from patients, local providers and consultants. Data was compared from the onsite consultations to the IVTC consultations. In addition, site coordinators were surveyed via the phone to ascertain their level of satisfaction.

Results indicated that IVTC specialists and patients were "as satisfied" (Sulzbacher et al., 2004, p.37) with consultations as on site participants. The telephone survey of the onsite coordinators indicated that the majority of participants were somewhat to very satisfied with the IVTC judging it as an effective tool. Sulzbacher et.al (2004) suggests that IVTC is being particularly useful for consultation with rural schools with exceptional special needs students

Sulzbacher et al. (2004) indicated that remote technology research has been conducted via patient/provider satisfaction surveys and future studies need to expand to target specific objective outcome

data. Authors also noted specific benefits of remote technology to the school districts, families and patients, as it allows families who live in remote locations or where transportation is limited to have a follow up visit. These visits benefit families by providing an opportunity to consult with specialized teachers in the areas of autism, Asperger's Disorder and ADHD.

Sulzbacher et al. (2004) noted that the strength of the study is in establishing groundwork for the effectiveness of utilizing remote video conferencing to provide needed consultation for rural schools. However, this study presented with multiple weaknesses related to its methodology and data analysis. The specific satisfaction questionnaires were not provided. The data was analyzed via percentages related to the referral patterns. Still, no data was delineated related to the questionnaires. Therefore, while the information appears to support overall purpose of the study, these limitations inhibited confirmation.

A growing body of literature indicates positive outcomes for the use of telepractice as a service delivery. Table 1 details the studies discussed above along with additional studies which support the efficacy of telepractice.

Table 1. Efficacy studies and Outcomes in Speech Language Pathology and Education.

Telepractice Studies in Speech Language Pathology	Disorder/Action	Outcomes
Shenker & Tetnowski, 2012	Stuttering/Treatment	Successful results
Boisvert, Andrianopoulos, Kurland & Boscardin, 2012	Autism Spectrum Disorder (ASD)/Treatment	Successful results
Mashima, Birkmire-Peters, Syms, Holtel, Burgess, and Peters, (2003)	Voice/Treatment	Successful results
Wilson, Onslow and Lincoln (2004)	Fluency/Treatment	Successful results
Theodoros, Hill, Russell, Ward and Wootton, (2008)	Aphasia/Assessement	Successful results
Hill, Theodoros, Russell and Ward, (2009)	Dysarthria/Assessment	Successful results
Machalicek, W., O'Reilly, Rispoli, Davis, Lang, Franco & Chan, 2010	Autism/Treatment	Successful results
Gibson, Pennington, Stenhoff, & Hopper, 2009	ASD/Treatment	Successful results
Telepractice Studies in Education	**Disorder/Action**	**Outcomes**
McCullough (2001)	Children Disabilities/Treatment	Successful results
Sulzbacher, Mas, Larson, and Shurtleff (2004)	Children Disabilities/Consultation	Successful results

As seen from the literature reviewed above, there is a growing body of evidence supporting the use of telepractice as a viable means of service delivery. These studies have addressed the diagnosis and treatment of certain disorders including fluency, aphasia, ASD etc. via telepractice. However, there are no studies that speak to the efficacy of telepractice specifically addressing all the foundational literacy skills in addressed in this study.

All of the studies examined in the literature provide foundational support for the following: (1) importance of letter naming knowledge and letter sound knowledge as foundational literacy skills and decoding; (2) importance of multisensory explicit teaching of reading skills for children in particular those with deficits; and (3) validity of telepractice studies to provide intervention to individuals with specific needs who do not have regular access to the practitioners. The importance of having experienced trained teacher and/or speech language pathologist is also supported. Each study distinctly recognizes the immense potential given efficacy of successful treatment. However, the study designs are limiting, which inhibits solid validity of conclusions. The studies do provide positive support the importance of foundational reading skills, multisensory explicit teaching of reading skills and use of telepractice as a beneficial mode of service delivery and recommend continued investigation to expand documented efficacy.

Challenge, Objective and Intent

Problem Statement

In today's society, some barriers exist between the mission of speech language pathologists to provide access and specialized instruction to consumers and the disparate distribution of speech language services (ASHA, 2005). This restricted access, or an inability to access services, is a result of a myriad of factors including: lack of clinicians, deficiency of facilities in geographic areas, and transportation issues (ASHA, 2004e). The scarcity of experienced speech language pathologists is a national concern (ASHA, 2004e). Additionally, Polovoy (2008) reported that school districts that are geographically remote with underserved populations are implementing programs utilizing technology to facilitate provision of services to students and, these programs have shown success. Therefore, remote and underserved school districts across the country increasingly are turning to telepractice to meet the communication needs of their students and finding success (Sulzbacher et al. 2004). The American Speech-Language Hearing Association (2005) recognizes that a key benefit to the use of technology is the opportunity to improve

access to services. However, one of the critical factors in the continued expansion of the delivery of services as noted by ASHA (2005) is research on the application of technology within the scope of treatment.

Research Purpose

The purpose of this study is to investigate the effectiveness of a telepractice multi-sensory reading treatment versus a traditional face-to-face multi-sensory reading treatment on foundational reading skills (letter naming, letter sound naming, decoding) of students who have been identified with a delay in these foundational reading skills.

The study was designed to answer specific research question: Is there a difference in participant's progress for multi-sensory reading treatment addressing foundational reading skills using telepractice versus traditional face-to-face setting?

Hypotheses

There are several outcomes that could be envisioned as a result of the study.

HO^1: There will be no significant differences in children's treatment outcomes for letter naming knowledge using telepractice versus traditional face-to-face setting.

If this null hypothesis is rejected, either treatment could result in better outcomes.

 HO^2: There will be no significant differences in children's treatment outcomes for letter sound knowledge using telepractice versus traditional face-to-face setting.

If this null hypothesis is rejected, either treatment could result in better outcomes.

HO^3: There will be no significant differences in children's treatment outcomes for decoding using telepractice versus traditional face-to-face setting.

If this null hypothesis is rejected, either treatment could result in better outcomes.

CHAPTER II

METHODOLOGY

<u>Research Design</u>

This study is a single subject multiple baseline (MB) across behaviors design originally introduced to the literature of applied behavioral analysis by Baer, Wolf and Risely (1968). The difference between group and single subject design is in how they demonstrate experimental control. In single subject MB across behaviors design, the subject serves as his own control, as baseline measures are collected and represented visually on a graph by the letter A1 (face-to-face) and A2 (telepractice); followed by treatment for the letter naming dependent variable, represented by the letter B1 (face-to-face) and B2 (telepractice); followed by treatment for the letter sound dependent variable, represented by the letter C1 (face-to-face) and C2 (telepractice); followed by treatment for the decoding dependent variable, represented by the letter D1 (face-to-face) and D2 (telepractice). The subject is administered all conditions of the experiment as each behavior is repeatedly measured before (baseline), during (treatment) and after intervention (post-data collection), to determine the presence of a causal inference between the independent variable (face-to-face and telepractice treatment condition) and dependent variables (letter identification, letter naming, decoding). The single subject MB across behaviors design is chosen to determine if treatment in both settings is effective. Table 2 represents the sequence, targets and criteria for each phase within the study.

In order to control for the potential influence the order in which treatment is presented might have, participants are divided into two groups with one beginning with the face-to-face treatment and the other group beginning with the telepractice treatment. Therefore, group one receives condition one followed by condition two and group two receives condition 2 followed by condition one. This counterbalanced technique minimizes the probability that of the order of treatment or other factors adversely influencing the results.

For each phase, a minimum of 3-5 data points is recommended in order to be able to allow the researcher the ability to describe the effects (Alberto & Troutman, 2006). For the purposes of this study, the minimum of 5 data points was established. Within the methodological standards for single case experimental designs, a minimum of three replications is the standard of evidence recommended (Horner et al., 2005). This criterion of three replications has been included in this study.

Table 2. Sequence, targets and criteria for each phase within the study.

Setting	Condition 1 Face-to-face	Condition 2 Telepractice
Phase A *Baseline all targeted skills*	Baseline measures (A1) Data points – *minimum of 5 data points for each dependent variable*	Baseline measures (A2) Data points - *minimum of 5 data points for each dependent variable*
Phase B *Letter Naming treatment*	Treatment (B1) Probe data collection - *minimum of 5 data points for each dependent variable with a minimum of 3 consecutive 100 percent scores*	Treatment (B2) Probe data collection - *minimum of 5 data points for each dependent variable with a minimum of 3 consecutive 100 percent scores*
Phase C *Letter Sound treatment*	Treatment (C1) Probe data collection – *minimum of 5 data points for each dependent variable with a minimum of 3 consecutive 100 percent scores*	Treatment (C2) Probe data collection – *minimum of 5 data points for each dependent variable with a minimum of 3 consecutive 100 percent scores*
Phase D *Decoding treatment*	Treatment (D1) Probe data collection – *minimum of 5 data points for each dependent variable with a minimum of 3 consecutive 100 percent scores*	Treatment (D2) Probe data collection – *minimum of 5 data points for each dependent variable with a minimum of 3 consecutive 100 percent scores*

An established systematic procedural structure assists in providing the external validity along with the fidelity for the study. As described above, the study consists of a series of ordered segments, including1) identification of behaviors (letter naming, letter sound identification, decoding; 2) informal assessment; 3) baseline data point repeated measures for both telepractice and face-to-face treatment; and 4) analysis of the data.

In this study, the targeted behaviors were foundational reading skills including letter naming knowledge (LNK), letter sound knowledge (LSN), and decoding. LNK was measured by the student's ability to state the name of the presented graphemes. LSN was measured by the student's ability to state the sound associated with the presented grapheme. Decoding was measured by the student's ability to blend individual sounds together to produce the word. An informal assessment was completed and the results generated core targeted letters. These targeted letters provided a personalized set of probes obtained from the participant's prior performance on the informal assessment set of probes. Each probe provided performance accuracy for letter naming task, letter sound correspondence task and decoding. In the baseline phase, probe tasks were completed and data was collected on all three foundational reading skills:

letter naming, letter sound identification and decoding. The treatment phase began targeting letter naming

via multi-sensory intervention, while continuing to monitor letter sound knowledge and decoding. When

the LNK probe of ten letters to name resulted in 100 percent accuracy over three consecutive sessions, the

multi-sensory intervention addressed the next target, letter sound knowledge. Once LSN for each of their

ten letter sounds were correctly identified with 100 percent accuracy for a minimum of three consecutive

sessions, the third component, decoding, was targeted via multi-sensory intervention, until it reached 100

percent correct production of targeted words for three consecutive sessions.

Participants

Participants were recruited from a private grammar school located in a diverse city north of

Boston, Massachusetts. The school consists of grades preschool through eight with an enrollment of 263.

Student enrollment by race is reported as 64 percent white, 13.1 percent black, 20.1 percent Hispanic, and

2.8 percent Asian. For reasons of privacy, the school did not allow the data on free and reduced lunch to be

published. All of the participants reside in the city where the grammar school is located. The population by

race for the city is reported as follows: 47.6% Whites, 32.1% Hispanic, 10.5% African American, 6.9%

Asian, 2.2% two or more races, .5% other race alone, .2% American Indian, .04% Native Hawaiian and

other. The median household income for the city is $39, 365 with a state median household income of

$64, 081.

At the beginning of the study, a pool of ten participants (five females and five males), ranging in

age between 5 years 5 months to 7 years 10 months of age (M= 6.5; SD=.87), was identified based on the

school's test results. The participants were recruited for this study because they represented a clear example

of the population of interest, e.g., children with documented deficiencies in the foundational reading skills

of letter naming, letter sound correspondences and decoding. In addition, participants met established

inclusionary and exclusionary criteria. Inclusion criteria included identification of a delay in foundational

reading skills determined by the schools' current protocols, including combinations of: Developmental

Reading Assessment (DRA), Dynamic Indicators of Basic Early Literacy Skills (DIBELS), the Dolch

assessment and teacher recommendation, documenting below grade level reading skills within the alphabet

stage of reading development. Participants may perform within age appropriate range for certain sections or

subtests but judgments of deficiencies are based on comprehensive examination of performance on the schools protocols.

DRA assessment for level and accuracy is based on the child's ability to read an unseen text at an independent reading level. A child's independent level is reached when performance measures at 95-100 percent accuracy. The DRA on grade level expectations for the beginning of the kindergarten is level A or 1, and for the beginning of First Grade is level 4 to 10. All of the participants' DRA levels fell within the expected range as reported with the exception of participant 6 and 9 whose score fell below the guidelines. With regard to the accuracy scores, 8/10 fell below the expected range with 2/10 falling within the expected range.

The DIBELS is designed to assess the following early literacy skills: phonemic awareness, alphabetic principle, accuracy, fluency, vocabulary and comprehension. Measures of phonological awareness and the alphabetic principle were specific to foundational reading skills targeted in this study. Phonological awareness subtests (initial sounds fluency= ISF and phonemic segmentation fluency=PSF) and the alphabetic principle (letter naming=LN and nonsense word fluency=NWF) were part of the schools identification protocol. ISF assesses the child's skill at identifying and producing the initial sound of a given word. PSF assesses a child's ability to produce the individual sounds in a given word. LN assesses the child's ability to name as many of upper and lower case letters presented. NWF assesses the child's knowledge of letter sound correspondences and ability blend letters together to form unfamiliar "nonsense words." Benchmarks are based on local norms, each measure has a specific score range and depending on a participants score performance their status is listed as "at risk," "some risk," and "low risk." "At risk" indicates difficulty achieving early literacy benchmark performing in the lowest 20 percent range. "Some risk" represents 20-40 percent range and "low risk" is above the 40 percent range. Not all the participants were administered the full test as per the test guidelines for age and grade. NA or not administered notes these specific omissions in Table 3. Seven out of the seven students administered the ISF fell within at risk category. Three of the three students administered the PSF yielded scores indicative of an established skill in accordance to DIBELS guidelines. All of the ten students fell within at risk category for the letter naming subtests and three of the three students administered the NWF fell within risk category.

The Dolch assessment determines accuracy with high frequency sight words that make up between 50-75 percent of all print in English. Explicit teaching of these words is required as the majority do not follow the "regular," rules of English. Children are shown a flashcard with the Dolch word to read and this continues until a specific level is completed. There are five levels: pre-primer, primer, first grade, second grade, third grade. A baseline performance is determined by administration of the pre-primer list and continues until performance falls below sixty percent accuracy on a grade level list. All of the participants were assessed at the lowest level, i.e., the pre-primer level. Seven out of ten participant scores fell below the expected range. Participant 6 fell just above the ceiling at 65%.

All of the reading assessments administered assisted in the determination of appropriate early literacy development. Teacher recommendations were based on the test findings along with consultation with the prior year's teacher. All of the children were recommended for reading support. Table 3 represents each participant and qualifying assessment information.

Additional criteria included English as the primary language of all participants, generally good health with no medication being taken, as well as meeting the criteria established by the American Speech Language Association (2010) for telepractice candidacy. Informed parental or guardian consent was obtained via written permission for all participants (appendix A). The informed consent included general guidelines designed to assist in determining those who are most appropriate for participating in such a study design, such as the ability to attend to the session via teleconference, follow directions, adequate hearing and vision, intelligible speech, physical capability (sit for period time, manipulate tasks as necessary) and parental or guardian consent to participate.

In addition, hearing and vision was screened by the school nurse within 30 days of the beginning of the school year in accordance with the school age Massachusetts state regulations. ASHA (2013) procedures and standards were followed for audiometric screening and tympanometry. Frequencies assessed were 1000 Hz, 2000 Hz and 4000 Hz at 20 dB HL and was completed monaurally with earphones. Tympanometry was also completed in both ears with a screening failed if maximum compliance (peak pressure) occurs at less than -150 daPa, static compliance is less than.2ml, typanometric configuration is flat and/or ear canal volume is inappropriate. A screening is failed when one stimulus is missed at any level. All participants passed the hearing screening and a review school health records did not indicate a

36

history of otitis media. The Massachusetts guidelines for a vision screening required a Linear Distance

(monocularly assessed) and Near (binocularly assessed) Visual Acuity Critical Line Standard of 20/30 for

ages 48 months through grade 12. All participants passed the vision screening and review of school health

records revealed all prior screenings were passed.

Table 3. Participant qualifying assessment information

Name	CA	DRA Level	DRA Accuracy	DIBELS ISF	DIBELS PSF	DIBELS LN	DIBELS NWF	Dolch	Teacher Recom
P1	6-8	6 wnl	93-below	NA	E	LR	SR	77.5%	YES
P2	7-9	4 wnl	94-below	NA	E	SR	LR	37.5%	YES
P3	6-10	1 wnl	100-wnl	SR	NA	SR	NA	7.5%	YES
P4	5-6	1 wnl	80-below	SR	NA	LR	NA	2.5%	YES
P5	6-1	1 wnl	100-wnl	SR	NA	LR	NA	17.5%	YES
P6	6-3	3 below	93-below	NA	E	LR	SR	65%	YES
P7	5-7	A wnl	70-below	AR	NA	SR	NA	2.5%	YES
P8	5-5	1 wnl	88-below	SR	NA	SR	NA	5%	YES
P9	7-10	3 below	82-below	AR	NA	SR	NA	75%	YES
P10	6-11	A wnl	70-below	AR	NA	LR	NA	0%	YES

AR=at risk, SR=some risk, LR=low risk, E=established, NA=not applicable

Exclusionary criteria included the following: diagnosed speech sound disorder, significant

uncorrected visual or hearing impairment, primary diagnosis of cognitive, behavioral, emotional or

neurological deficits and not meeting the criteria established by the American Speech Language

Association (2010) for telepractice candidacy. The American Speech Language Association (2010)

exclusion criteria include participants, who need hands-on guidance, have attention, hearing (including

history of recurrent ear infections), vision, or cognitive deficits that limit their ability to communicate or

interact with the clinician from a distance via technology.

Participation in this study was voluntary and therefore participants were at liberty to discontinue at

any time with no repercussions. Each participant's parents/guardians were provided with a consent form

(Appendix A) that explained all the information about the nature of treatment in order to make an informed

decision regarding participation in this study. This included a description of what participation entails,

including any known risks, inconveniences or discomforts that may occur while participating in

intervention. This consent form (two copies) was signed by a parent, with one copy retained by the

investigator and one by the participant's parents. Services were provided by the primary investigator, with

no fee for services. This study was approved by the University of Massachusetts Institutional Review

Board (IRB) on September 28, 2012. The approval is documented in Appendix B.

Setting

The study took place at school during the school day. Treatment was conducted in a quiet room within the school, i.e., resource room, library, science lab. The telepractice sessions took place in the library, which was the largest room with adjacent smaller room at one end and a partitioned section at the other. The library was well lit with acoustically beneficial items including rugs, cork boards and curtains. The participant was seated at a table in the center of the room toward the back wall. The science lab was used for greater than 95% of the face-to-face sessions with the resource room as the alternate. These rooms were well lit with large windows and lacked the acoustically beneficial items of the library. The researcher and the participant were the only people present in the room during the sessions. One of the doors to the room was left ajar with the other doors closed.

For the initial and final assessments, the student and clinician were face-to-face. For the baseline and intervention phases of the study, sessions alternated between a face-to-face session and videoconference sessions. Specifically, participants assigned to group one began with a face-to-face session with the next session conducted via videoconference session, while the participants assigned to group two began with the videoconference session and had the next session face-to-faces. This alternating pattern continues throughout the baseline and intervention phases. The potential influence of the order of sessions was addressed by the counter balancing technique of dividing participants into two groups, with each group beginning with a different setting. The time of each participant's scheduled session was consistent throughout data collection. For example, a participant scheduled for a morning session was consistently seen in the morning and a student scheduled in the afternoon was consistently seen in the afternoon.

For a face-to face treatment the student was sitting at a table facing the clinician. The videoconference sessions were conducted via Face Time. Face Time is a software application, which allows a person to make video calls with face-to-face capability on the Internet. The participant utilized an iPad 2 to Face Time with the researcher, and the researcher utilized an iPhone 4 to Face Time with the participant. For the videoconference multisensory treatment the student was sitting at the table in the center of the room toward the back wall. The researcher is located at a remote distance and utilizing a technology to teleconference with the student.

Spanish is part of the school's curriculum for all grades. The curriculum for 5 of the participants did not specifically instruct students on the names of Spanish letters, the Spanish letter sounds or decoding of Spanish words. Instruction did consist of thematic units exploring the cultural aspects of the language. For example, one unit consisted of lessons related to Spanish music along with the musical instruments of Spanish origin (castanets, maracas etc.). Additional units consisted of thematic lessons targeting the following: Spanish food, holidays and clothing. The curriculum for 3 of the participants did include instruction on the names of Spanish letters, the Spanish letter sounds along with thematic units addressing the individual (feelings, senses, family members, traditions) and the community (market, money, comparisons, food, restaurants). It is a common thought that dual language instruction may impact detrimental effect on a students abilities learning to read in this case, English. However, recent studies (Bialystok, 1997, Rafferty, 1986) have demonstrated that the study of a second language benefits academics including English. It is recognized that this dual instruction needs to be noted for its potential impact.

Equipment/Training

The following equipment was utilized to accomplish the telepractice portion of the study: Face Time - a video chat application developed by Apple. Face Time was used by the student on an iPad2 connected through the school's email address to the investigator, utilizing an iPhone 4 and connected via cell phone number. All participants had prior training on the proper care and use of the iPad2 through the schools computer program. Prior to initiation of the telepractice session, the participants were trained in positioning of the iPad2 along with the procedure on how to "call" the investigator through the equipment, for obtaining a successful connection. All participants showed good mastery in the use of the equipment. The iPad2 and the iPhone 4 have 5-megapixel iSight camera with VGA-quality photos and video capabilities of up to 30 frames per second. The probe for each treatment sessions was videotaped with a Kodak full HD 1080p with HD-resolution, 5-megapixel photo captured, built in USB arm and electronic image stabilization. The computer used for playing You Tube videos and letter prompts during treatment sessions was an HP Pavilion g7. For the telepractice sessions, the upright camera was positioned on the left side of the researcher: this location was chosen for easy access to the camera by the researcher in case there was a necessity to manipulate it, i.e., changing the angle in order to make the sessions more interactive.

<center>**Variables**</center>

<center>**Independent Variables**</center>

The independent variables in this study are the alternating treatment conditions in which the multisensory reading treatment was delivered. Condition one was the face-to-face service delivery and condition two was the telepractice service delivery. For each service delivery condition, data was collected to ascertain the effect it had on performance accuracy and progress as a result of treatment.

<center>**Dependent Variables**</center>

The dependent variables were the participant outcomes as shown in Table 2. Three outcomes per participant were generated for the specific literacy skills such as letter naming, letter sounds and decoding. At the beginning of each session, individualized probes were administered to yield baseline data followed by treatment data.

<center>**Procedure**</center>

<center>**Informal Assessment**</center>

The informal test measures utilized to determined current performance level for the three dependent variables included 1) letter identification, 2) letter sound correspondences, and 3) decoding. These informal measures were used to identify ten letters (eight consonants and two vowels) to serve as core prompts. The assessments, as detailed below, consisted of a letter naming tasks, along with a combination assessment of letter naming and letter sound identification. Results of the informal measures were then utilized as described below to generate words to decode with performance level determined by accuracy at baseline.

The first informal assessment of letter naming accuracy consisted of an 8x10 paper with 8 rows containing 13 lower case letters in "comic sans" font, with each letter randomly repeated four times (Appendix B). Only one row at a time was visible to the participant, with the other rows covered with a blank sheet of paper. The participant was told to begin naming the first letter at the top left hand corner of the paper and continuing across the row. The investigator directed the participant to each letter, cued by pointing to the letter and the statement, "tell me the letter name." At the end of each row, the participant was directed to continue to the next row, ending with the final letter on the paper. Responses were scored as

<center>40</center>

correct or incorrect. A response form was kept to compile data and to account for the participant's responses. A sample response form is included in Appendix C.

For the second informal assessment letter sound accuracy was measured, as the participant was provided with a single lower case letter in "comic sans" font placed in the center of an index card. The investigator directed the participant to look at the card accompanied by the statement, "tell me the sound the letter makes." There were a total of 26 cards presented randomly over four trials. Responses were scored as correct or incorrect. A sample response form is included as Appendix C.

A total of ten core letters (two vowels, eight consonants) were used for this experiment. Five of the letters, one vowel and four consonants for the set were randomly chosen from the pool of letters identified by the participant with 100% accuracy for both the letter name and letter sound. The other five letters, one vowel and four consonants to complete the set were randomly chosen from the pool of letters that the participant demonstrated 0% identification accuracy for both the letter name and letter sound. If the number of letters with 0% accuracy did not provide enough letters necessary to complete the set, additional letters (vowel or consonants) were randomly selected from the pool of letters identified with 25% accuracy. If the sample continued to require additional letters, letters were randomly selected from the pool of letters with 50% accuracy. These ten letters (5 known and 5 unknown) served as the basis for the letter naming, letter sound and decoding components of the study.

From these ten letters, two vowels and eight consonants, a total of ten words to decode were generated. The words included five real words and five nonsense words. The structures of the words were in the form of VC (vowel consonant) or CVC (consonant vowel consonant). Appendix G details each individual participants completed probes.

<div align="center">**Baseline Phase**</div>

A baseline performance on the three components targeted for treatment was gathered at the beginning of each 30-minute multisensory language treatment session for both the face-to-face and telepractice setting. The multisensory treatment was focused specifically on listening comprehension tasks and strategies with no components of written language. The setting for both the baseline phase and treatment phase of this study alternated between one session face to face and one session as teleconference session. The number of baseline session was determined by consistency of responses over time yielding

stable level of accuracy and providing a more reliable measure of pretreatment abilities. Responses were scored as either correct or incorrect.

The baseline phase began with the administration of the three probes generated from the informal assessment. The procedure for administration of all three probes was the same as in the informal assessment. The main difference from the informal assessment is that the probes now only targeted a ten letter set. Therefore, the letter naming probe consisted of 5 rows containing 8 lower case letters in "comic sans" font with each letter randomly repeated four times. The letter sound probe consisted of the same ten letter set randomly presented one at a time for the participant to provide the sound that corresponds to the letter. The decoding probe consisted of ten words (5 real and 5 pseudo words) presented for the participant to read. All responses were scored as correct or incorrect. Appendix D shows sample scoring forms used for data collection in the baseline and treatment phase. The baseline phase served as a controlled period, thereby replacing the control group. All tasks, e.g., letter naming, letter sound naming and decoding, utilized this set of ten known and unknown letters (eight consonants and two vowels). Baseline tasks included one for letter naming, one for letter sounds, and one for decoding.

Intervention Phase

Given the established baseline performance, the student continued participation in weekly 30 minute multi-sensory language treatment sessions alternating between a face-to-face session and a teleconference session. The same set of ten letters used within the baseline phase A were utilized within the intervention phases B, C and D. Phase B was the treatment phase which addressed letter naming until it reached the established criterion of 100% accuracy over three consecutive sessions. At this point, intervention moved to phase C, as the treatment was initiated on the second component, sound symbol correspondence. As sound symbol correspondence reached criterion of 100% over three consecutive sessions, intervention was initiated on the third component, phase D, decoding. Decoding intervention continued until 100% accuracy over three consecutive trials was achieved, concluding the data collection for this study. The repeated data collection continued through all phases for all components: letter naming, letter sound, and decoding components.

Intervention Procedures

The structure of the treatment sessions consisted of four components. Appendix E is a sample lesson targeting the skill of letter naming "b". The first component was the administration of the participant's individualized probes (Appendix E). The second component consisted of structured treatment tasks specific to targeted skill. The third component was a reinforcing treatment task of the targeted skill. The final component involved a general literacy activity, which involved the targeted skill. The strategies and tasks utilized for instruction were generated from numerous explicit, multi-sensory, structured, systematic reading programs such as: the Gillingham Manual (1997), Project Read (Enfield & Greene, 1973), RAVE-O (Wolf, 2000), and Reading with TLC (Telian & Castagnozzi, 2007). In addition, supplemental treatment activities for each of the targeted skills included Have Fun Teaching videos (2007) and an application (App) called Letter Reflex detailed below. An App is a specialized software program downloaded to mobile devices. Table 4 details materials along with explanation of the task.
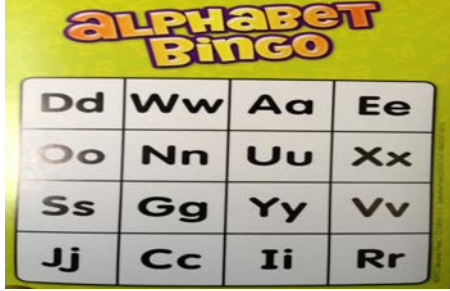
In general, Letter naming activities included the following: randomly presented graphemes for naming, Telian-Lively Letter pictures for letters, app called Letter Reflex, letter puzzle, letter naming bingo, letter games and discrimination task to find letters in chart.

Letter sound activities, specific to unknown sounds, included: Telian- Lively Letter stories, You Tube video's by Have Fun Teaching for letter sounds, letter sound games, letter sound bingo, and using key word pictures. For example, presenting the letter "o" with key word octopus picture.

Decoding activities included the use of: letter/sound identification, RAVE-O slider for word families, sliding letters activity, tapping out sounds, bingo via sound in word identification, and encoding activities include: "what says," which asks the student to write the corresponding letter to the sound that is provided.

In addition, any strategy implemented by the classroom teacher to facilitate a targeted skill was utilized within the intervention phase for that skill. For example, one strategy to assist in the decoding process was tapping out each sound in a word, finger to finger. To decode the word "bed" the participant placed thumb to index finger and say /b/, then thumb to middle finger and say /e/, next thumb to ring finger and say /d/, followed by production of the complete word.

Table 4. Sample treatment materials and explanation.

Material	Explanation
	Have Fun Teaching videos Played on YouTube, the videos target a specific letter and sound with repeated phrases, graphemes to trace along with key words paired to music. This example targets /b/: boy, ball, bounce, beat.
	Delmatian Press bingo This task was played multiple times for recognition of letters, sounds and or phoneme position (initial, medial, final).
	RAVE-O Sound SliderSound Sliders consist of a folder with lists of "sliding" initial phonemes and rhyme patterns; the card is inserted into folder and moved vertically to match sublexical units. A constant initial phoneme can also be maintained with the sublexical units moved vertically. This activity generates a list of real words and pseudowords for decoding.
	LetterReflex App This app has two parts: "Tilt it" and "Flip it". "Tilt it" requires the user to tilt the ball into the hole associated with the grapheme produced auditorially. "Flip it" requires the user, depending on the level, to visually discriminate and manipulate letters and words to match the correct orientation. Students are prompted auditorially with "swipe to make the letter --," or "swipe to make the word--."
	Telian-Lively Letters A visual character representation of a letter, cueing students to specific position of articulators required to produce the sound letter makes, along with an accompanying story to connect visual and sound production.

Validity and Reliability Measures

Internal validity asks the question if the intervention, and only the intervention, is responsible for the change in behavior, i.e. control for the events that are likely to influence the study. Threats to internal validity are of concern and the use of designs with baseline and/or treatment phases help to control threats to internal validity. As cited in Horner (2005), Neuman and McCormick state, "internal validity of a single-case design is considered acceptable if an intervention is reliably associated with higher response levels while also revealing sound experimental control" (p. 166).

In the multiple baseline design, control is established by the efforts of the investigator to remove the potential influence of extraneous variables that might affect the scores for the dependent variable. Tawney and Gast (1984) stated, "baselines will remain stable until the intervention is directly applied" (p. 232). Therefore, changes occurring in each phase arise from the systematic application of the independent variable, not some extraneous variable. Internal validity is established as the clinician collects customary baseline data across each target behavior and subsequently intervenes on one component, maintaining baseline conditions on the other components. As the first component reaches criterion, intervention is directed toward the second and then the third component.

External validity refers to the degree to which the results from a study can be generalized to other groups or settings (Gay & Airasian, 2000). In order to accomplish this, efforts were made within the study to follow Neuman and McCormick (1995) suggestions, i.e., 1) providing a rich and detailed description of the setting and the intervention, 2) detailing the measures, and 3) generalizing the results to a particular theory. Single-case research uses controlled procedures rather than control groups (Horner et al., 2005).

Reliability

Inter-rater reliability is the extent of an agreement among raters or consensus estimates. The inter-rater reliability was established by having two additional observers not affiliated with the study view video recordings of participant's probes. One observer was a certified Speech Language Pathologist who is reading certified in the state of Massachusetts with over 11 years of experience working with students learning to read. The second observer is a Reading Specialist who is reading certified in the state of Massachusetts for age's kindergarten through adults with over 12 years of experience. The specific

questions of the study and the abstract were provided to each observer. In addition, the observers were familiarized by the researcher with the scoring system for each foundational reading skill.

Twenty percent of each participant's videoed probes were randomly selected. Each observer was provided the video and individualized score sheet. An example is appendix D. Observers were instructed to score items as either correct or incorrect for letter naming, letter sounds and decoding targets. Consensus estimates of inter-rater reliability is based on the assumption that a reasonable observer should come to an exact agreement on the scoring and common interpretation. A common and simple method for computing the consensus estimate of inter-rater reliability is a simple percentage agreement. The agreement was calculated by dividing the number of scored agreements by the total number of possible agreements. The resulting number was then multiplied by 100. The percentage of agreement serves as the measure of inter-rater reliability, which indicates the extent of agreement between independent raters on the accuracy assigned to each objective in the study (Krippendorff, 1980). The present study utilized the same Landis and Koch designed scale for the strength of agreement cited and utilized in the previously discussed study by Theodoros et al. (2008). The ratings are as follows: <0.4 = poor; 0.41-0.6 = moderate; 0.61-0.80 = good; 0.81-1.00 = very good.

Statistical Analysis

Statistical analysis for this study consists of both, non- parametric analysis that included Improvement Rate Difference (IRD), Nonoverlap of All Pairs (NAP), and visual analysis of graphs. Statistical analysis is essential to ensure objective and reliable interpretation of data. To date, single case study multiple baseline design lacks a generally accepted statistical summary (Parker, Hagan-Burke, & Vannest, 2007). Traditionally, single case research design has utilized visual analysis but increasing documentation reveals the unreliable nature of visual analysis (Harbst, Ottenbacher & Harris, 1991; Ottenbacher, 1990). Therefore, data analysis for this study integrates both statistical non-parametric analysis and visual analysis, which will compare the two service delivery models (face-to-face and video conference).

Improvement Rate Data (IRD) is a simple calculation of the percent of improvement from baseline to the intervention performance (Parker, Vannest & Brown, 2009), which has been proven effective in medical research. To calculate the IRD, the improved rate percentages in the baseline are

subtracted from the improved rate percentage in the subsequent treatment phase. Improved rates for the treatment phase are defined as any data point which exceeds all data points in the baseline phase and then are divided by the total number of data points in the treatment phase (Parker et al., 2009). This results in a variable indicating the percentage of improvement from the baseline phase to the subsequent treatment phase.

Nonoverlap of All Pairs (NAP) is a nonparametric technique for measuring nonoverlap or "dominance" for two phases. NAP is defined as the percent of non-overlapping data between baseline and treatment phases. Parker & Vance (2011) state, " NAP is interpreted as the percentage of all pair wise comparisons across Phases A and B, which show improvement across phases or, more simply, the percentage of data which improves across phases." (p.312). NAP reflects the number of comparison pairs showing no overlap, divided by the total number of comparisons.

In Parker and Vannest's (2009) introduction of NAP, it is stated that NAP effect sizes (ESs) of 0-0.65, 0.66-0.92, and 0.93-1.0 corresponded to small, moderate, and large effects based on expert visual judgment. These guidelines for effect size are utilized in this study. Petersen-Brown, Karich and Symons, (2012) reported that NAP results agreed with visual analysis over 80 percent of the time in the multiple baseline design studies that were sampled. Additionally, the authors' hypothesized that NAP effect sizes are potentially higher due to the non reversal component, when targeting academic skills in multiple baseline design. NAP is appropriate for nearly all data types and distributions, including dichotomous data. NAP has good power efficiency–about 91-94% that of linear regression for "conforming" data, and greater than 100% for highly skewed, multi-modal data. Strengths of NAP are its simplicity, its reflection of visual nonoverlap, and its statistical power. Parker and Vannest's (2009) suggest NAP is a better solution than tests of Mean or even Median differences across phases. Therefore, use of NAP in conjunction with visual analysis assists to confirm findings.

The traditional analysis for single subject designs is a visual analysis within and across conditions of the study. A systematic visual analysis of the data across the components of the study is advantageous as it is not sensitive to small treatment effect. (Ramesberger and Marie, 2007; Horner et al., 2005; Tawney and Gast, 1984). Graphs, representing the data, consist of the baseline and the intervention data for each of the targeted components. During baseline and intervention conditions, the visual interpretation details level,

trend and variability in performance. The term "level" refers to the mean performance during a specific phase of the study. The mean is determined by adding up the values divided by number of items ($x = (\Sigma\ xi)\ /\ n$). Mean performance of each participant is then analyzed for the percent of change from baseline phase A to phase B. The slope is a measure of how many units go up, down or remains unchanged as a line moves to the right. A positive slope indicates and upward trend, a negative slope indicates a downward trend and a zero slope indicates no change. The trend is the direction of systematic progression (increasing or decreasing) of the dependent variable within a condition over time. Variability details the extent to which data points in a data set fluctuates around a mean or average value within or across a phase. Four measures of variability are the range, mean, variance and standard deviation.

Microsoft Excel program was utilized to plot visual analysis. A marked benefit for the single case design is that the researcher can begin graphing the measures at the onset of the treatment. The visual analysis must reveal the following four criterion standards: 1) the mean of performance is greater than the baseline performance trend; 2) the baseline phase has no overlapping data points; 3) an achievement of 100% accuracy compared to baseline and 4) all three components reached criterion. In addition, statistical analyses were also conducted using the SPSS statistical analysis software.

RESULTS

Results

Although a total of ten potential participants were sampled, only eight completed all phases of the study and were included in the analysis. One potential participant did not return the consent despite multiple attempts, and other left the school after completing only two phases. The remaining eight participants consisted of four females and four males, (Mean age 6;3, SD=.80), with the age range between 5 years 5 months to 7 years 9 months at the time the study began.

The individual results for each targeted skill, letter naming, letter sounds, and decoding is presented in the following order: mean with standard deviation, IRD, NAP and Visual analysis.

The mean is the average score followed by the standard deviation. The standard deviation is a measure of how spread out the data is. A higher standard deviation indicates data that is more widespread therefore, less reliable. A lower standard deviation results from data falling near the mean and therefore more reliable. The IRD score is a percentage of improvement from the baseline to the intervention: a higher percentage reveals the greater amount of scores in the improvement direction. The NAP score is a measure of data that improves over time with the highest potential score of 1. The effect size measures in relation to this score were previously listed. The visual analysis consisted of a mean shift and variability. The mean shift in a positive change indicates improved accuracy with a negative change denoting a decrease in accuracy. If a mean remains identical from one phase to another then there is no change. A variability score with a positive value signifies an increase in fluctuation of scores with a negative value indicating a decrease in the fluctuation of the scores. If the score was identical from one phase to the next phase, the value remained unchanged. Tables for each participant scores follow the description along with a figure of scores of accuracy across the study.

Individual Participant Results

Participant One

Participant one participated in a total of forty-two sessions with twenty one face-to-face sessions and twenty one telepractice sessions. This participant began with the face-to-face setting followed by the telepractice setting. The settings alternated to the conclusion of the study. The face-to-face condition and

the telepractice session consisted of four phases as follow: baseline (A), letter naming intervention (B), letter sound intervention (C), and decoding (D). Each phase for participant one contained the following number of sessions: phase A -5 sessions, phase B - 6 sessions, phase C- 5 sessions, and phase D-5 sessions. For condition two (telepractice), each phase contained the same number of session as face-to-face condition (see above). All the treatment for this participant occurred in the morning, with missing dates due to snow days, school closing, and one absence.

Descriptively, this participant was depicted by teachers as having difficulty remaining focused in class. Independent reports from the classroom teacher, librarian, the Spanish teacher and the Math teacher suggested that participant one required consistent redirection throughout the class time. Within the context of the study, this participant was seen in a one-to-one setting, and therefore his attention to tasks was not found to be a factor. This participant was observed to make impulsive mistakes with spontaneous self correction. These impulsive mistakes occurred specifically for letter naming tasks, particularly those that can be visually confusing (b, d, p, q, n, u).

<u>Outcome Data for Participant One</u>

<u>Letter Naming</u>. For participant one, the baseline measures (A) resulted in a face-to-face M=36.2 (SD=.447); telepractice M=36 (SD=0). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=39 (SD =1.095); telepractice M=39.33 (SD=1.632). Continuous data was collected in phases C and D with no direct intervention. For this participant, both phases C and D produced face-to-face M=40 (SD=0); telepractice M=40 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceeded the baseline. For the phase A to B, IRD was 100% for face-to-face treatment and 83% for telepractice treatment. All scores were in the direction of an improvement.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = .92 (large effect), face-to-face B-C=.75 (moderate effect); telepractice B-C=.58 (small effect), face-to-face C-D=.50 (small effect); telepractice C-D=.50 (small effect). A combined score across all phases produced a face-to-face improvement of .76 (moderate effect) and telepractice improvement of .67 (moderate effect). The intervention phase was A to B, which yielded the large effect for both settings.

Visual Analysis - The mean shifts for letter naming from phase A to B and B to C for the face-to-face and telepractice settings, were positive. In phase C to D, no mean shift change occurred in both the face-to-face and telepractice as criterion was achieved with the participant reaching 100% accuracy. Variability across phases A to B and B to C for both, face-to-face and telepractice, produced a negative value. This negative value indicated a decrease in variability across the phases. No variability occurred in phase C to D in both the face-to-face and telepractice setting. The lack of variability was due to the fact that at each phase C and D the participant achieved 100% accuracy. (Table 5 and Figure 1a)

Letter Sound. For participant one, the baseline measures (A) resulted in a face-to-face M=8.6 (SD=.547); telepractice M=8.6 (SD=.547). Phase B was a continuous data collection with no direct intervention. Participant one demonstrated a face-to-face M=9.33 (SD=.516); M=10 (SD=0) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.8 (SD =.447); telepractice M=9.8 (SD=.447). Continuous data collected in phase D produced a face-to-face M=10 (SD=0); telepractice M=10 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. Phase C was the intervention phase for letter sounds. Across phases A to C, IRD was 80% for both the face-to-face and telepractice setting. All scores were in the direction of an improvement.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .80 (moderate effect); telepractice A-B = .1 (large effect), face-to-face B-C=.73 (moderate effect); telepractice B-C=.40 (small effect), face-to-face C-D=.60 (small effect); telepractice C-D=.60 (small effect). A combined score across all phases produced a face-to-face improvement of .71 (moderate effect) and telepractice improvement of .67 (moderate effect).

Visual Analysis - Positive mean shifts occurred for participant one from phase A to B and C to D for the face-to-face and telepractice settings. This positive value indicates increases in the mean level. The mean shifts for phase B to C were positive for the face-to-face setting and negative for the telepractice setting. The negative mean shift indicates a decrease in the mean from B to C for the telepractice setting. Variability across phases A to B and C to D for both, face-to-face and telepractice, along with phase B to C face-to-face, produced a negative value. This negative value indicated a decrease in variability across the

phase. Variability for telepractice phase B to C showed positive change, indicative of an increase in variability across the phase. (Table 5 and Figure 1b)

Decoding. For participant one, the baseline measures (A) resulted in a face-to-face M=5 (SD=0); telepractice M=5.2 (SD=.447). Phase B and C were continuous data collection with no direct intervention. Phases B produced a face-to-face M=6.33 (SD=1.37); telepractice M=8 (SD=0) and phase C face-to-face M=8.2 (SD=.447); telepractice M=8.6 (SD=.894). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=9.4 (SD =.894); telepractice M=9.4 (SD=.894).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment. All of the intervention scores exceeded the baseline scores.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .83 (moderate effect); telepractice A-B = 1 (large effect), face-to-face B-C=.866 (moderate effect); telepractice B-C=.70 (moderate effect), face-to-face C-D=.866 (moderate effect); telepractice C-D=.74 (moderate effect). A combined score across all phases produced a face-to-face improvement of .853 (moderate effect) and telepractice improvement of .815 (moderate effect). Phase D was the initiation of intervention for decoding, therefore, the combined score across all phases detailed baseline through intervention yielding a moderate effect for the face-to-face and telepractice settings.

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face and telepractice settings was positive. This positive value documents increases in the mean level.

Variability for the phase A to B showed face-to-face positive change; telepractice negative change; B to C was negative for face-to-face; positive for telepractice and phase C to D; yielded a face-to-face positive change and for telepractice no change. (Table 5 and Figure 1c)

Table 5. IRD, NAP, Mean shift and Variability data for Participant One across phases and settings.

| Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B toC	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to B)	83%(A to B)				
NAP	1 Large effect	.92 Large effect	.75 Moderate effect	.58 Small effect	.50 Small effect	.60 Small effect
Mean Shift	2.8	3.33	1.0	.77	0	0
Variability	-.648	1.632	-1.095	-1.632	0	0
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	80% (A to C)	80% (A to C)				
NAP	.80 Moderate effect	1 Large effect	.73 Moderate effect	.40 Small effect	.60 Small effect	.60 Small effect
Mean Shift	.73	1.4	.47	-.2	.2	.2
Variability	-.031	-.547	-.079	.447	-.447	-.447
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	.83 Moderate effect	1 Large effect	.866 Moderate effect	.70 Moderate effect	.866 Moderate effect	.74 Moderate effect
Mean Shift	1.33	2.8	1.87	.6	1.2	.8
Variability	1.366	-.447	-.919	.894	.447	0
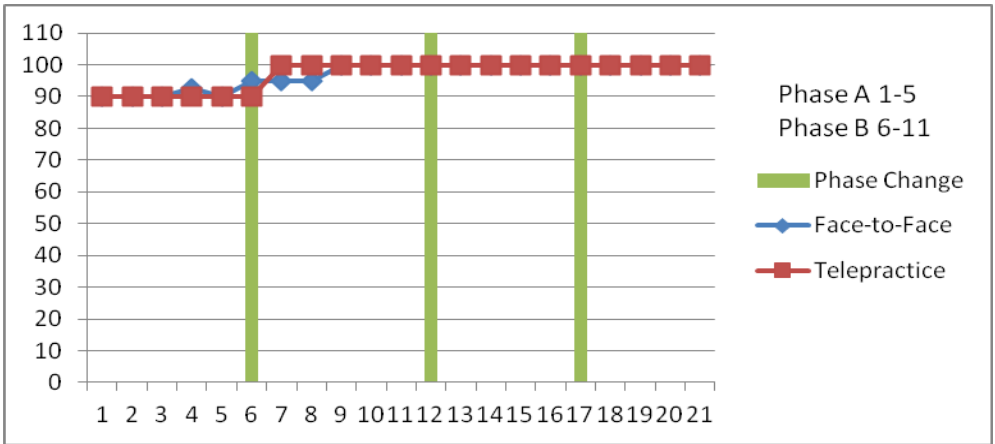
Figure 1a. Participant One Outcome Data for letter naming across the study.
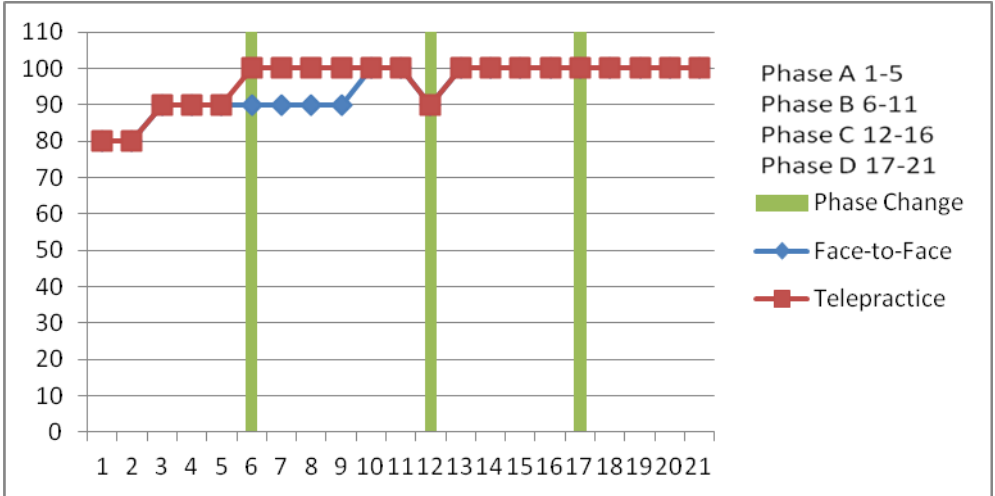

Figure 1b. Participant One Outcome Data for letter sounds across the study.
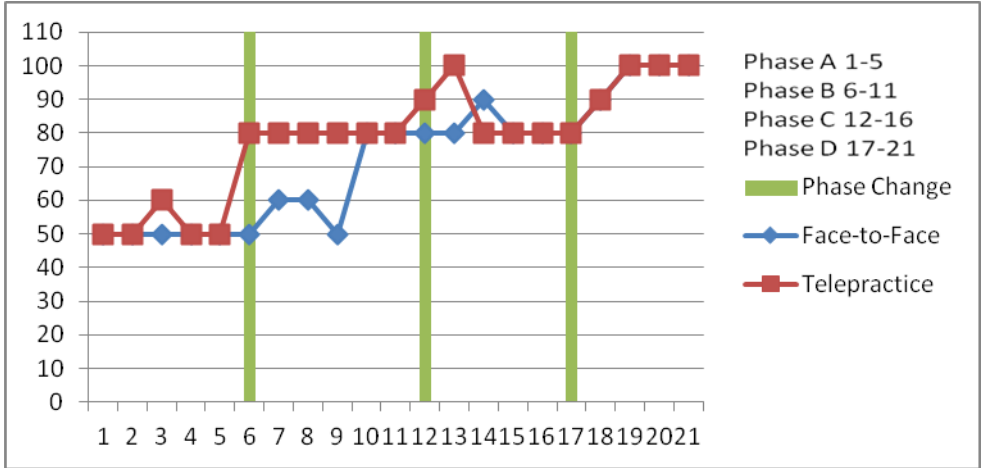
Figure 1c. Participant One Outcome Data for decoding across the study.

Participant Two

Participant two attended a total of forty-four sessions, with twenty two face-to-face sessions and twenty two telepractice sessions. This participant began with the telepractice setting followed by the face-to-face setting. The settings alternated throughout the study. For the face-to-face setting participant two completed the following number of sessions: phase A (5 sessions), phase B (5 sessions), phase C (5 sessions), and phase D (7 sessions). For the telepractice setting the same number of sessions occurred at each phase. The treatment for this participant took place in the morning, with missed sessions due to snow days and two absences.

Participant two was depicted by multiple teachers, as exhibiting a delay in processing, although this was not a formal diagnosis. The delay was described as an increase in response time, along with requests for repetitions. This unsolicited information was conveyed to the investigator by the participant's classroom teacher and learning center teacher. Within the context of the baseline and treatment sessions, the participant was observed to require additional response time, particularly when a novel task was introduced. Specific to tasks, this participant exhibited errors with visually confusing letters including: b, d, p, and q. Letter confusion errors negatively impacted performance on both, the letter naming and letter sounds task. With the decoding task, the participant two was observed to utilize a tapping strategy while decoding. This involved thumb tapping each finger, as each sound of the letter was produced, followed by a pause, and then production of the word.

Outcome Data for Participant Two

Letter Naming. For participant two, the baseline measures (A) resulted in a face-to-face M=35.2 (SD=1.788); telepractice M=34 (SD=3.391). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=39.4 (SD =1.341); telepractice M=38.6 (SD=2.190). Phase C produced a face-to-face M=40 (SD=0); telepractice M=39.6 (SD=.894) and phase D face-to-face M=40 (SD=0); telepractice M=40 (SD=0). Continuous data was collected in phases C and D with no direct intervention. Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 100% for face-to-face treatment and 80% for telepractice treatment. All scores were in the direction of an improvement.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = .88 (moderate effect), face-to-face B-C=.60 (small effect); telepractice B-C=.62 (small effect), face-to-face C-D=.50 (small effect); telepractice C-D=.60 (small effect). A combined score across all phases produced a face-to-face improvement of .69 (moderate effect) and telepractice improvement of .69 (moderate effect).

Visual Analysis - The mean shifts from phase A to B and B to C for the face-to-face and telepractice settings, along with phase C to D for telepractice, were positive. No mean shift change occurred within the face-to-face phase C to D. No change was a result of 100% accuracy rate achieved by participant two at both phase C and D. Variability across phases A to B and B to C for both, face-to-face and telepractice, along with phase C to D telepractice, produced a negative value. This negative value indicated a decrease in variability across the phases. Variability for phase C to D in the face-to-face setting was zero. The lack of variability was due to the fact that at each phase C and D the participant achieved 100% accuracy. (Table 6 and Figure 2a)

Letter Sound. For participant two, the baseline measures (A) resulted in a face-to-face M=9 (SD=0); telepractice M=7.2 (SD=.447). Phase B was a continuous data collection with no direct intervention. Participant two demonstrated a face-to-face M=9 (SD=0); 8.6 (SD .547) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.4 (SD =.894); telepractice M=9.6 (SD=.547). Continuous data collected in phase D produced a face-to-face M=10 (SD=0); telepractice M=10 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. Phase C was the intervention phase for letter sounds. Across phases A to C, IRD was 60% for face-to-face treatment and 100% for telepractice treatment. All scores were in the direction of an improvement.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .50 (small effect); telepractice A-B = .96 (large effect), face-to-face B-C=.70 (moderate effect); telepractice B-C=.88 (moderate effect), face-to-face C-D=.70 (moderate effect); telepractice C-D=.70 (moderate effect). A

combined score across all phases produced a face-to-face improvement of .63 (small effect) and telepractice improvement of .83 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. This positive value indicates increases in the mean level. Variability across phases A to B and B to C for both, face-to-face and telepractice, along with phase C to D telepractice, produced a negative value. This negative value indicated a decrease in variability across the phases. Variability was inconsistent in both settings: for the face-to-face setting a zero change was seen from A to B, a positive change from B to C and a negative change from C to D; similarly, the telepractice setting yielded a positive change from A to B, no change from B to C and negative change from C to D. (Table 6 and Figure 2b)

<u>Decoding.</u> For participant two, the baseline measures (A) resulted in a face-to-face M=4.8 (SD=.447); telepractice M=4.8 (SD=.447). Phase B and C were continuous data collection with no direct intervention. Phases B produced a face-to-face M=7.2 (SD=1.095); telepractice M=6.6 (SD=1.140) and phase C face-to-face M=7.8 (SD=.447); telepractice M=8 (SD=0). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=9 (SD =1); telepractice M=8.6 (SD=1.214).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment. All of the intervention scores exceeded the baseline scores.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = .92 (moderate effect), face-to-face B-C =.64 (small effect); telepractice B-C =.90 (moderate effect), face-to-face C-D =.83 (moderate effect); telepractice C-D=.71 (moderate effect). A combined score across all phases produced a face-to-face improvement of .83 (moderate effect) and telepractice improvement of .83 (moderate effect). Phase D was the intervention phase, therefore the combined score across all phases A to D encompassed the improvement across baseline to intervention with a moderate effect for both the face-to-face and telepractice settings.

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face and telepractice settings was positive. This positive value documents increases in the mean level.

Variability for the face-to-face and telepractice settings yielded a positive change across phases A to B and

C to D that indicated variability increased across phase. For the face-to-face and telepractice setting phase

B to C, a negative value for variability was seen indicating a decrease in variability across the phase. (Table

6 and Figure 2c)

Table 6. IRD, NAP, Mean shift and Variability data for Participant Two across phases and settings.

| Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to B)	80% (A to B)				
NAP	1 Large effect	.88 Moderate effect	.60 Small effect	.62 Small effect	.50 Small effect	.60 Small effect
Mean Shift	4.2	4.6	.6	1	0	.4
Variability	-.447	-1.201	-1.341	-1.296	0	-.894
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	60% (Ato C)	100% (A to C)				
NAP	.50 Small effect	.96 Large effect	.70 Moderate effect	.88 Moderate effect	.70 Moderate effect	.70 Moderate effect
Mean Shift	0	1.4	.4	1	.6	.4
Variability	0	1	.894	0	-.894	-.547
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	1 Large effect	.92 Moderate Effect	.64 Small Effect	.90 Moderate Effect	.83 Moderate Effect	.71 Moderate Effect
Mean Shift	2.4	1.8	.6	1.4	1.2	.86
Variability	.648	.693	-.648	-1.140	.553	1.214
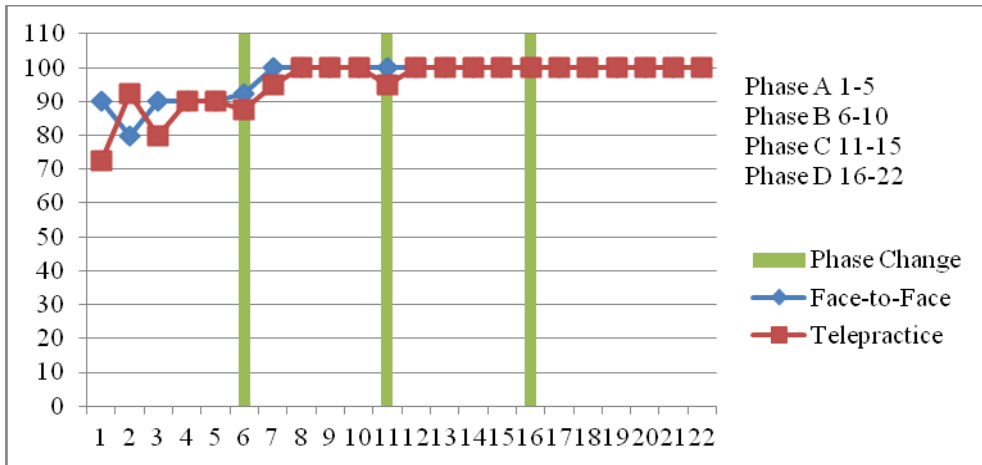
Figure 2a. Participant Two Outcome Data for letter naming across the study
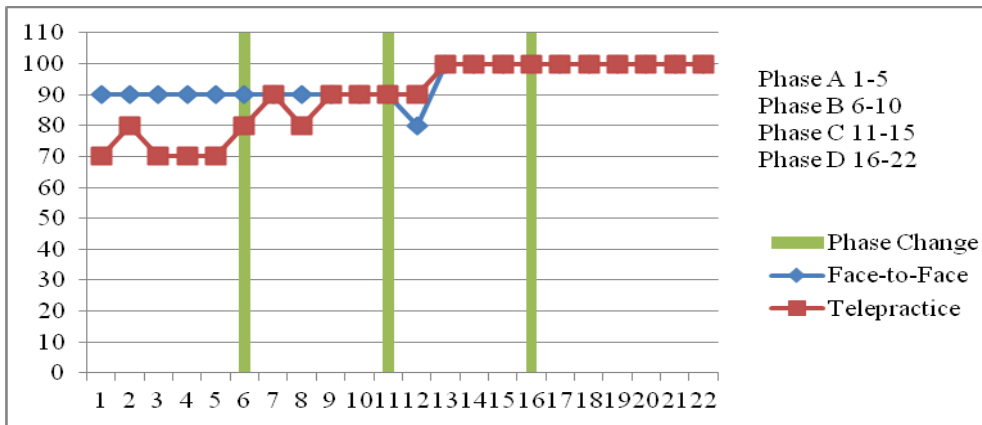

Figure 2b. Participant Two Outcome Data for letter sounds across the study
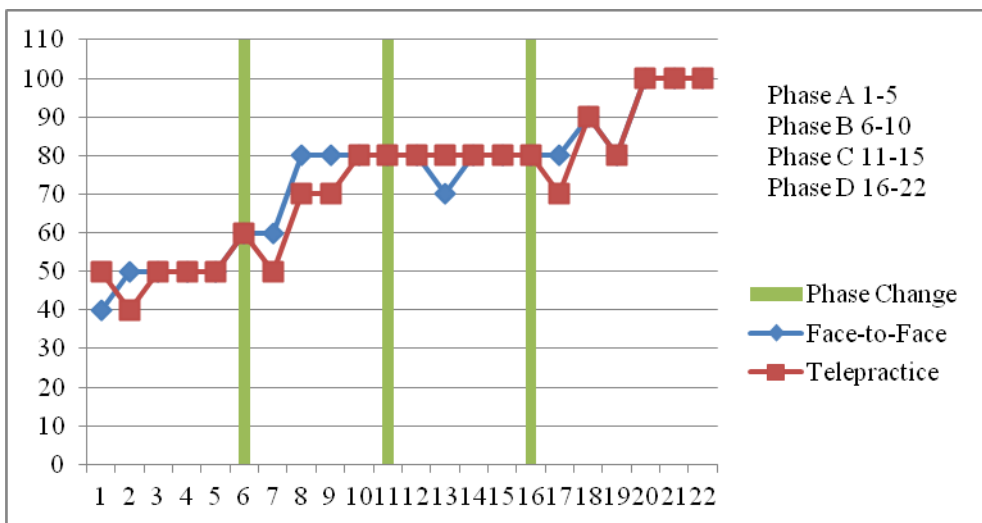
Figure 2c. Participant Two Outcome Data for decoding across the study

Participant Three

Participant three attended a total of forty-five sessions, with twenty three face-to-face sessions and twenty two telepractice sessions. This participant began with the face-to-face setting followed by the telepractice setting. The setting alternated throughout the study. For the face-to-face setting, participant three completed the following number of sessions: phase A - 5 sessions, phase B - 6 sessions, phase C - 5 sessions, and phase D - 7 sessions. For the telepractice setting, each phase contained the same number of sessions as the face-to-face setting with the exception of phase D. Phase D for the telepractice setting was completed in 6 sessions. The treatment sessions occurred in the morning, with missed treatments due to snow days and one absence due to a family vacation.

Descriptively, participant three was described by teachers as having difficulty remaining focused, immature and required consistent cues to complete the tasks. Given the context of the one-to-one setting, reported behaviors were not consistently observed. Within the context of the baseline and treatment sessions, the participant was observed to impulsively respond to prompts, along with making naming errors with visually confusing letters including b, d, p, and q. Errors from letter confusion did not extend to letter sound tasks or probe. The process of decoding within the probe task involved verbalizing each letter sound followed by a silent pause and the correct or incorrect word produced.

<u>**Outcome Data for Participant Three**</u>

<u>**Letter Naming**</u>. For participant three, the baseline measures (A) resulted in a face-to-face M=33 (SD=2.236); telepractice M=32.8 (SD=1.788). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=38.33 (SD =1.966); telepractice M=38.33 (SD=1.966). Phases C produced a face-to-face M=39.4 (SD=.894); telepractice M=39.4 (SD=.894) and phase D face-to-face M=39.71 (SD=.76); telepractice M=40 (SD=0). Continuous data was collected in phases C and D with no direct intervention.

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 80% for face-to-face setting and the telepractice setting. All scores were in the direction of an improvement.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .93 (large effect);

telepractice A-B = .96 (large effect), face-to-face B-C=.63 (small effect); telepractice B-C=.63 (small effect), face-to-face C-D=.61 (small effect); telepractice C-D=.70 (moderate effect). A combined score across all phases produced a face-to-face improvement of .72 (moderate effect) and telepractice improvement of .76 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for both the face-to-face and telepractice settings were positive. Variability across phase A to B produced a negative change in the face-to-face setting and positive change for telepractice setting. Phase B to C and C to D resulted in a negative change. (Table 7 and Figure 3a)

Letter Sound. For participant three, the baseline measures (A) resulted in a face-to-face M=6.8 (SD=.447); telepractice M=5.8 (SD=.447). Phase B, was a continuous data collection with no direct intervention. Participant three demonstrated a face-to-face M=8.83 (SD=.752); 8.33 (SD .816) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.6 (SD =.547); telepractice M=9.8 (SD=.447). Continuous data collected in phase D produced a face-to-face M=9.71 (SD=.487); telepractice M=10 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. Across baseline phase A to intervention phase C, IRD was 100% for the face-to-face and telepractice setting. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = 1 (large effect), face-to-face B-C=.78 (moderate effect); telepractice B-C=.95 (large effect), face-to-face C-D=.55 (small effect); telepractice C-D=.60 (small effect). A combined score across all phases produced a face-to-face improvement of .77 (moderate effect) and telepractice improvement of .85 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. Variability in both settings for phase A to B yielded a positive change. Phase B to C and C to D was negative for both the face-to-face and telepractice settings. (Table 7 and Figure 3b)

Decoding. For participant three, the baseline measures (A) resulted in a face-to-face M=0 (SD=0); telepractice M=0 (SD=0). Phase B and C were continuous data collection produced a face-to-face M=2.5

(SD=1.643); telepractice M=2.83 (SD=1.940) and phase C face-to-face M=5.8 (SD=.447); telepractice M=5.8 (SD=.447). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=9 (SD =1.154); telepractice M=9.5 (SD=.836).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment with all scores exceeded the baseline scores.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .91 (moderate effect); telepractice A-B = .91 (moderate effect), face-to-face B-C =1 (large effect); telepractice B-C =.98 (large effect), face-to-face C-D =1 (large effect); telepractice C-D=1 (large effect). A combined score across all phases produced a face-to-face improvement of .97 (large effect) and telepractice improvement of .97 (large effect). Participant three's combined score documented a large effect across all phases for both the face-to-face and telepractice settings.

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face and telepractice settings was positive value. Variability for the face-to-face and telepractice settings yielded a positive change across phases A to B and C to D that indicated variability increased across phase. For the face-to-face and telepractice setting phase B to C, a negative value for variability was seen indicating a decrease in variability across the phase. (Table 7 and Figure 3c)
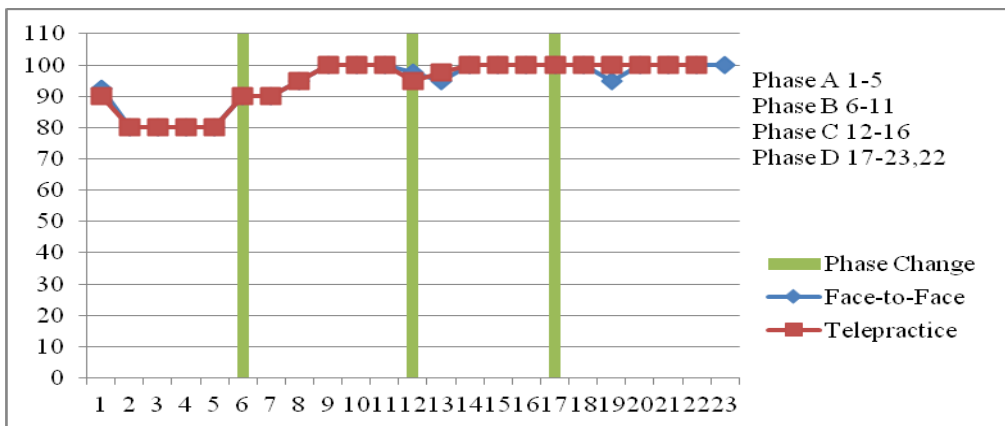
Figure 3a. Participant Three Outcome Data for letter naming across the study

Table 7. IRD, NAP, Mean shift and Variability data for Participant Three across phases and settings.

Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	80% (A to B)	80%(A to B)				
NAP	.93 Large effect	.96 Large effect	.63 Small effect	.63 Small effect	.61 Small effect	.70 Moderate effect
Mean Shift	5.33	5.53	1.07	1.07	.31	.6
Variability	-.27	.178	-1.072	-1.072	-.139	-.894
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (Ato C)	100% (A to C)				
NAP	1 Large effect	1 Large effect	.78 Moderate effect	.95 Large effect	.55 Small effect	.60 Small effect
Mean Shift	2.03	2.53	.77	1.47	.11	.2
Variability	-.27	.178	-1.072	-1.072	-.139	-.894
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	.91 Moderate effect	.91 Moderate effect	1 Large effect	.98 Large effect	1 Large Effect	1 Large effect
Mean Shift	2.5	2.83	3.3	2.97	3.2	3.7
Variability	1.643	1.940	-1.196	-1.493	.707	.389

Phase A 1-5
Phase B 6-11
Phase C 12-16
Phase D 17-23,22

Phase Change
Face-to-Face
Telepractice
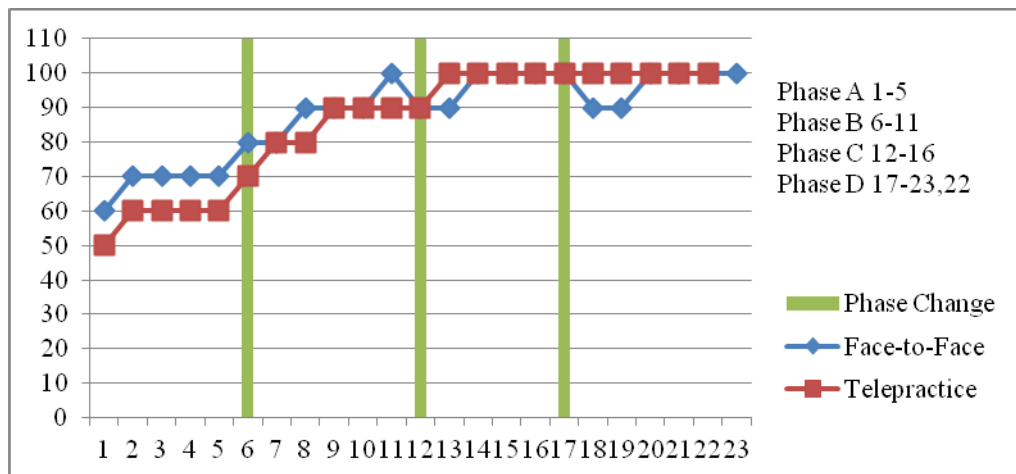
Figure 3b. Participant Three Outcome Data for letter sounds across the study
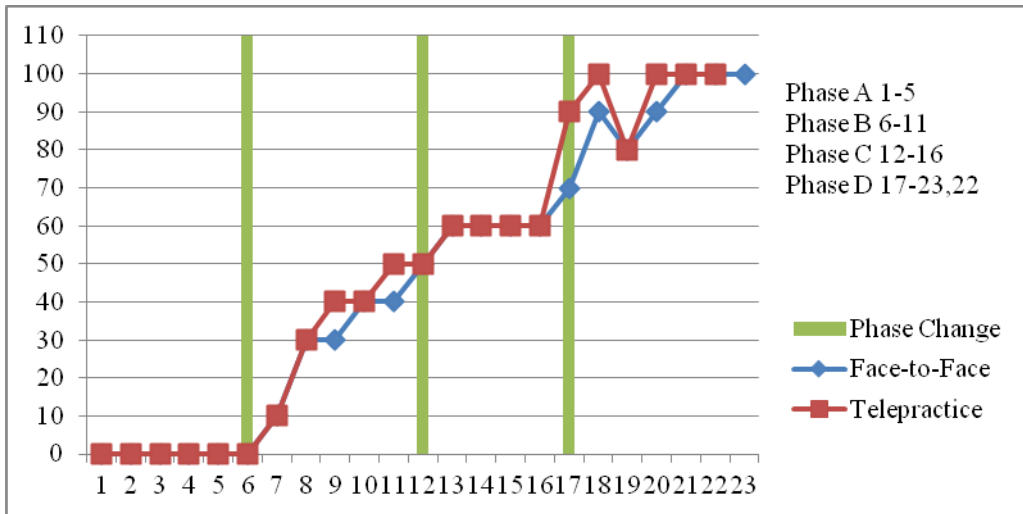
Figure 3c. Participant Three Outcome Data for decoding across the study

Participant Four

Participant four participated in a total of forty-six sessions with twenty three face-to-face sessions and twenty three telepractice sessions. This participant began with the telepractice setting followed by the face-to-face setting. The setting alternated to the conclusion of the study. Participant four completed the following number of sessions for both the face-to-face and telepractice setting: phase A (5 sessions), phase B (7 sessions), phase C (5 sessions), and phase D (6 sessions). The course of treatment for this participant occurred in the morning with days missed due to snow days along with one absence.

Descriptively, participant four was depicted by both, the learning specialist and classroom teacher, as having difficulty following classroom instruction and rules particularly with non preferred tasks. This behavior was observed in both the face-to-face and telepractice setting. Cues to remain and return to task were intermittently required. Given clear and specific structure of the sessions, the frequency of cuing decreased over the course of the study. The decoding process observed for this participant involved utilizing a tactile strategy to segment and blend. For each letter the participant touched his thumb to his index finger for the first sound, his thumb to middle finder for the second sound, and his ring finger for a third sound. He then tapped the table with the fingers while verbalizing the decoded word.

<u>Outcome Data for Participant four</u>

<u>Letter Naming</u>. For participant four, the baseline measures (A) resulted in a face-to-face M=36 (SD=0); telepractice M=34.6 (SD=1.949). The intervention phase (B) specifically targeting letter naming skills,

yielded a face-to-face M=38.57 (SD =1.902); telepractice M=38.28 (SD=1.799). Phases C produced a face-to-face M=40 (SD=0); telepractice M=40(SD=0) and phase D face-to-face M=39.67 (SD=.816); telepractice M=39.67 (SD=.816). Continuous data was collected in phases C and D with no direct intervention.

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 71% for face-to-face setting and the telepractice setting. IRD indicated that 71% of all scores were in the direction of an improvement.

Nonoverlap of All Pairs – NAP quantifies the percentage of data, which shows improvement across phases. The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .85 (moderate effect); telepractice A-B = .91 (moderate effect), face-to-face B-C=.71 (moderate effect); telepractice B-C=.78 (moderate effect), face-to-face C-D=.41 (small effect); telepractice C-D=.41 (small effect). A combined score across all phases produced a face-to-face improvement of .668 (moderate effect) and telepractice improvement of .71 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, and B to C for both the face-to-face and telepractice settings were positive. The phase C to D mean shift was negative for both the face-to-face and telepractice settings. Variability across phase A to B produced a positive change in the face-to-face setting and negative change for telepractice setting. Phase B to C yielded a negative change for both settings and C to D resulted in a positive change. (Table 8 and Figure 4a)

<u>Letter Sound</u>. For participant four, the baseline measures (A) resulted in a face-to-face M=4.6 (SD=.447); telepractice M=4 (SD=.447). Phase B, was a continuous data collection with no direct intervention. Participant four demonstrated a face-to-face M=7 (SD=1.527); 7.71 (SD 1.112) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.2 (SD =1.095); telepractice M=9.4 (SD=.894). Continuous data collected in phase D produced a face-to-face M=9.67 (SD=.816); telepractice M=9.83 (SD.408).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. Across baseline phase A to intervention phase C for the face-to-face setting, IRD was 86% and 100% for the telepractice setting. Scores reflected the percentage of scores in the direction of improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .94 (large effect); telepractice A-B = 1 (large effect), face-to-face B-C=.88 (moderate effect); telepractice B-C=.88 (moderate effect), face-to-face C-D=.61 (small effect); telepractice C-D=.63 (small effect). A combined score across all phases produced a face-to-face improvement of .81 (moderate effect) and telepractice improvement of .84 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. Variability in both settings for phase A to B yielded a positive change. Phase B to C and C to D was negative for both the face-to-face and telepractice settings. (Table 8 and Figure 4b)

Decoding. For participant four, the baseline measures (A) resulted in a face-to-face M=0 (SD=0); telepractice M=0 (SD=0). Phase B and C were continuous data collection produced a face-to-face M=1.29 (SD=1.704); telepractice M=.57 (SD=.729) and phase C face-to-face M=6.8 (SD=.836); telepractice M=5.6 (SD=1.140). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=9.5 (SD =.836); telepractice M=9.33 (SD=1.032).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment with all scores exceeded the baseline scores.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .71 (moderate effect); telepractice A-B = .64 (small effect), face-to-face B-C =1 (large effect); telepractice B-C =1 (large effect), face-to-face C-D = .98 (large effect); telepractice C-D=1 (large effect). A combined score across all phases produced a face-to-face improvement of .89 (moderate effect) and telepractice improvement of .87 (moderate effect).

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face and telepractice settings was positive value. Variability for the face-to-face and telepractice settings yielded a positive change across phases A to B. For phase B to C, a negative change occurred for the face-to-face setting with a positive change for the telepractice setting. Finally, the phase C to D no change in variability occurred for the face-to-face setting with a negative change for the telepractice setting. (Table 8 and Figure 4c)
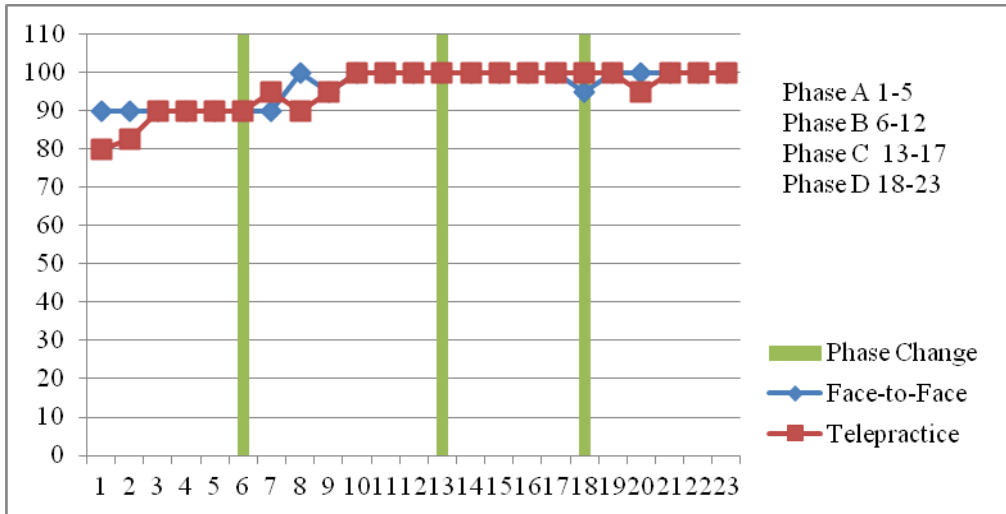
Figure 4a. Participant Four Outcome Data for letter naming across the study
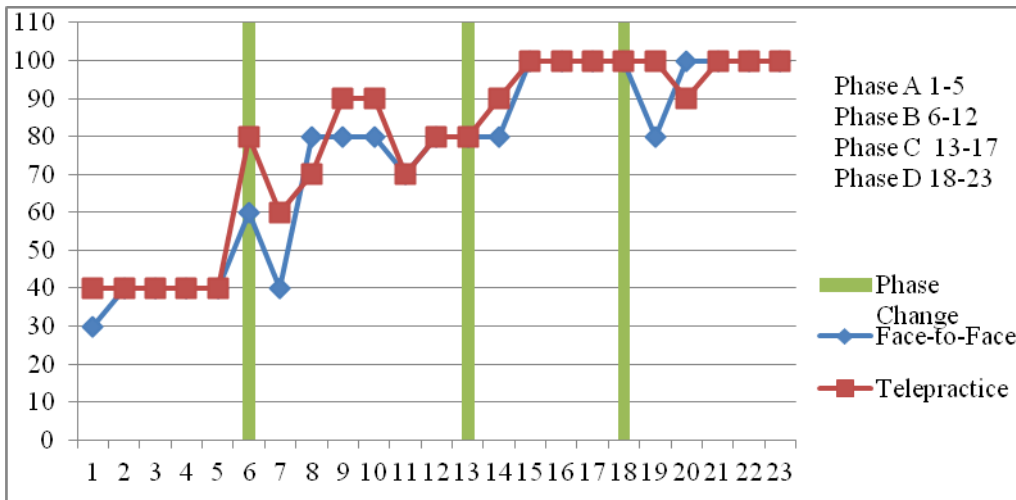
Figure 4b. Participant Four Outcome Data for letter sounds across the study
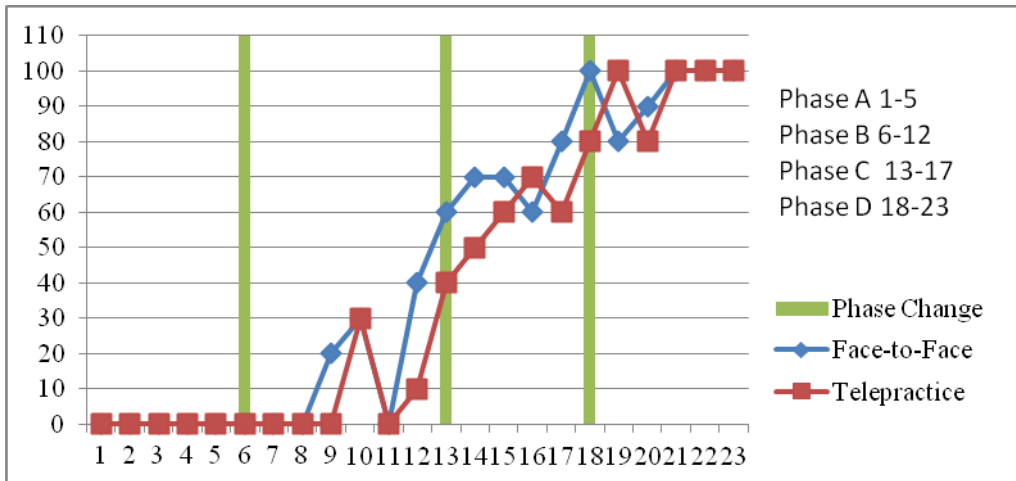
Figure 4c. Participant Four Outcome Data for decoding across the study

Table 8. IRD, NAP, Mean shift and Variability data for Participant Four across phases and settings.

Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	71% (A to B)	71%(A to B)				
NAP	.83 Moderate effect	.91 Moderate effect	.71 Moderate effect	.78 Moderate effect	.41 Small effect	.41 Small effect
Mean Shift	2.51	3.68	1.43	1.72	-.33	-.33
Variability	1.902	-.15	-1.902	-1.799	.816	.816
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	86% (Ato C)	100% (A to C)				
NAP	.94 Large effect	1 Large effect	.88 Moderate effect	.88 Moderate effect	.61 Small effect	.63 Small effect
Mean Shift	2.4	3.71	2.2	1.69	.47	.43
Variability	1.08	1.112	-.432	-.218	-.279	-.486
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	.71 Moderate effect	.64 Small effect	1 Large effect	1 Large effect	.98 Large Effect	1 Large Effect
Mean Shift	1.29	.51	5.51	5.03	2.7	3.73
Variability	1.704	.729	-.868	.411	0	-.108

Participant Five

Participant five participated in a total of forty-five sessions with twenty three face-to-face sessions and twenty two telepractice sessions. This participant began with the face-to-face setting followed by the telepractice setting. The setting alternated to the conclusion of the study. Participant five completed the following number of sessions for both the face-to-face setting: phase A - 5 sessions, phase B - 5 sessions, phase C - 5 sessions, and phase D - 8 sessions. For the telepractice setting, each phase contained the same number of sessions as the face-to-face setting with the exception of phase D. Phase D for the telepractice

setting included 7 sessions. The course of treatment for this participant occurred in the afternoon with days missed due to snow days along with one dismissal.

Descriptively, participant five was very vocal about a personal preference for the face-to-face setting. Comments included: "Can't I just see you?" and "I do better if you are next to me." Of note is the fact that in the decoding portion of the investigation, this participant initially did not even attempt to decode five of the required words. These five words contained the same vowel that this participant reported, "I don't know." This continued through the last two data points at the end of phase C (a continuous data collection phase with no decoding intervention). The decoding process observed was a finger tapping out sounds in words along with rehearsal of each, followed by the word verbalized.

Outcome Data for Participant five

Letter Naming. For participant five, the baseline measures (A) resulted in a face-to-face M=38 (SD=0); telepractice M=37.2 (SD=1.095). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=39.6 (SD =.894); telepractice M=39.4 (SD=.894). Phases C produced a face-to-face M=40 (SD=0); telepractice M=40(SD=0) and phase D face-to-face M=40 (SD=0); telepractice M=40 (SD=0). Continuous data was collected in phases C and D with no direct intervention.

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 80% for face-to-face setting and the telepractice setting. IRD indicated that 80% of all scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison was as follows: face-to-face A-B = .90 (moderate effect); telepractice A-B = .94 (large effect), face-to-face B-C=.68 (moderate effect); telepractice B-C=.70 (moderate effect), face-to-face C-D=.50 (small effect); telepractice C-D=.50 (small effect). A combined score across all phases produced a face-to-face improvement of .65 (small effect) and telepractice improvement of .70 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, and B to C for both the face-to-face and telepractice settings were positive. The phase C to D mean shift was zero for both the face-to-face and telepractice settings. Variability across phase A to B produced a positive change in the face-to-face setting and negative change for telepractice setting. Phase B to C yielded a negative change for both settings and no change for phase C to D. (Table 9 and Figure 5a)

Letter Sound. For participant five, the baseline measures (A) resulted in a face-to-face M=4.6 (SD=.447); telepractice M=4 (SD=.447). Phase B, was a continuous data collection with no direct intervention. Participant five demonstrated a face-to-face M=7 (SD=1.527); M=7.71 (SD=1.112) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.2 (SD =1.095); telepractice M=9.4 (SD=.894). Continuous data collected in phase D produced a face-to-face M=9.67 (SD=.816); telepractice M=9.83 (SD.408).

Improvement Rate Difference – The IRD across phase A to phase C for both the face-to-face setting and for the telepractice setting was 100%. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .60 (small effect); telepractice A-B = .80 (moderate effect), face-to-face B-C=.80 (moderate effect); telepractice B-C=.90 (moderate effect), face-to-face C-D=.70 (moderate effect); telepractice C-D=.70 (moderate effect). A combined score across all phases produced a face-to-face improvement of .82 (moderate effect) and telepractice improvement of .79 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. Variability in both settings for phase A to B yielded no change for the face-to-face setting and a positive change for the telepractice setting. Phase B to C was positive for both settings; C to D was negative for both the face-to-face setting and positive for the telepractice settings. (Table 9 and Figure 5b)

Decoding. For participant five, the baseline measures (A) resulted in a face-to-face M=0 (SD=0); telepractice M=.2 (SD=.447). Phase B and C were continuous data collection produced a face-to-face M=2.4 (SD=.547); telepractice M=1.8 (SD=.480) and phase C face-to-face M=5.2 (SD=1.414); telepractice M=5 (SD=1). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=8.63 (SD =1.187); telepractice M=8.57 (SD=1.397).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment with all scores exceeded the baseline scores.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = .96 (large effect), face-to-face B-C =1 (large effect); telepractice B-

C =1 (large effect), face-to-face C-D = .98 (large effect); telepractice C-D=1 (large effect). A combined

score across all phases produced a face-to-face improvement of .99 (large effect) and telepractice

improvement of .98 (large effect).

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face

and telepractice settings was positive value. Variability for the face-to-face and telepractice settings yielded

a positive change across phases A to B and B to C. For phase C to D a negative change in variability

occurred for the face-to-face setting with a positive change for the telepractice setting. (Table 9 and Figure

5c)
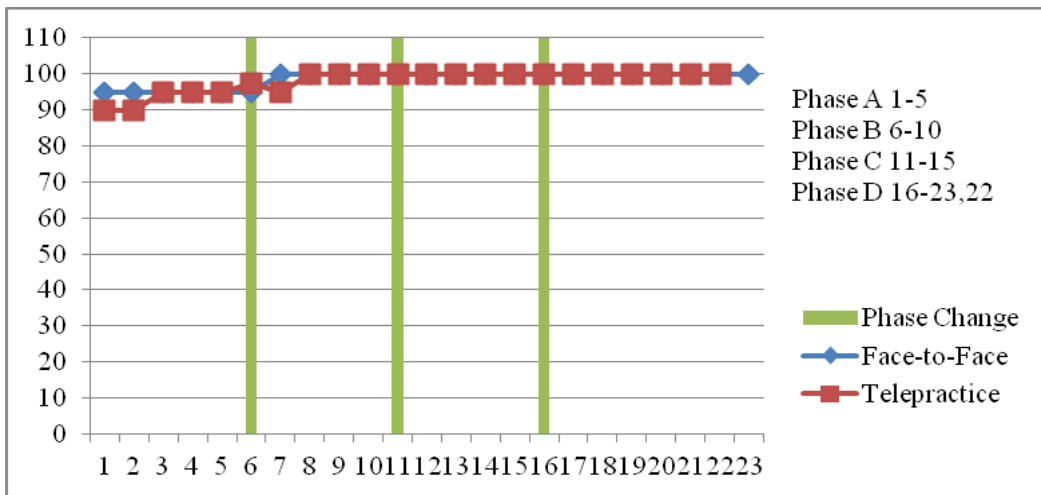
Figure 5a. Participant Five Outcome Data for letter naming across the study
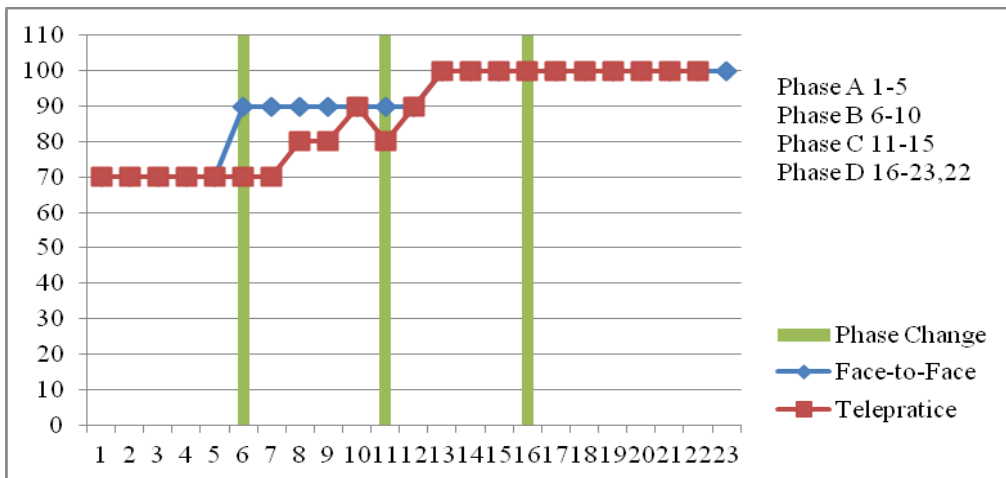
Figure 5b. Participant Five Outcome Data for letter sounds across the study

Table 9. IRD, NAP, Mean shift and Variability data for Participant Five across phases and settings.

Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	80% (A to B)	80%(A to B)				
NAP	.90 Moderate effect	.94 Large effect	.68 Moderate effect	.70 Moderate effect	.50 Small effect	.50 Small effect
Mean Shift	1.6	2.2	.4	.6	0	0
Variability	.894	-.211	.894	-.894	0	0
Letter Sounds	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (Ato C)	100% (A to C)				
NAP	.60 Small effect	.80 Moderate effect	.80 Moderate effect	.90 Moderate effect	.70 Moderate effect	.70 Moderate effect
Mean Shift	2.	.8	.6	1.6	.4	.6
Variability	0	.836	.547	.058	-.547	.503
Decoding	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	1 Large effect	.96 Large effect	1 Large effect	1 Large effect	.98 Large effect	1 Large effect
Mean Shift	2.4	1.6	2.8	3.2	3.43	3.57
Variability	.547	.033	.867	.52	-.227	.917
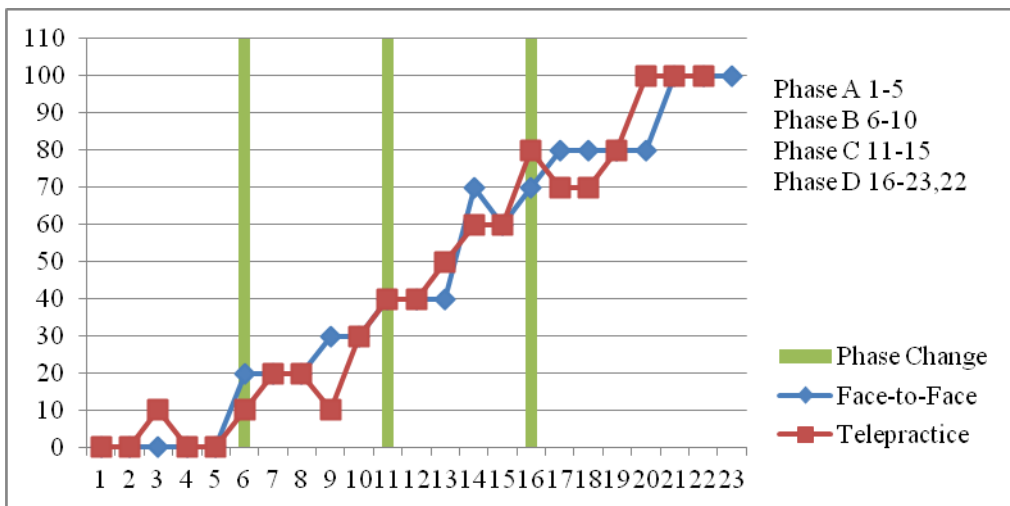
Figure 5c. Participant Five Outcome Data for decoding across the study

<center>**Participant Six**</center>

Participant six participated in a total of forty-five sessions with twenty two face-to-face sessions and twenty three telepractice sessions. This participant began with the telepractice setting followed by the face-to-face setting. The setting alternated throughout the study. Participant six completed the following number of sessions for both the face-to-face setting: phase A (5 sessions), phase B (5 sessions), phase C (6 sessions), and phase D (6 sessions). For the telepractice the same number of sessions occurred at each phase with the exception of phase D as participant six completed 7 sessions. The course of treatment for this participant occurred in the afternoon with days missed due to snow days, along several absences particularly in the month of January.

Participant six was depicted by teachers as generally having inconsistencies. In the winter months this participant was noted to have multiple absences along with tardiness. Classroom teacher reported that inconsistencies with parental schedules were judged a contributing factor along with a parental split. Participant six was easily engaged within the face-to-face setting. Within the telepractice setting, additional cues were required for the participant to set up and get started. Within the context of the baseline and treatment sessions, the participant was observed to make error with visually confusing letters, such as p, and q. The observed decoding process was supported by tapping fingers to thumb for each sound, followed by the verbalization of the word. As accuracy increased participant six' decoding became more automatic in nature.

<u>Outcome Data for Participant Six</u>

<u>Letter Naming</u>. For participant six, the baseline measures (A) resulted in a face-to-face M=32.8(SD=1.788); telepractice M=31.8 (SD=2.190). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=39.2 (SD =1.788); telepractice M=38.4 (SD=2.190). Continuous data was collected in phases C and D with no direct intervention. Phases C produced a face-to-face M=40 (SD=0); telepractice M=40(SD=0) and phase D face-to-face M=40 (SD=0); telepractice M=40 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 100% for face-to-face setting and the telepractice setting. All scores were in the direction of an improvement.

<center>73</center>

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = 1 (large effect), face-to-face B-C=.60 (small effect); telepractice B-C=.70 (moderate effect), face-to-face C-D=.50 (small effect); telepractice C-D=.50 (small effect). A combined score across all phases produced a face-to-face improvement of .68 (moderate effect) and telepractice improvement of .71 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, and B to C for both the face-to-face and telepractice settings were positive. The phase C to D mean shift was zero for both the face-to-face and telepractice settings. The zero mean shift resulted from no change in the mean from phase C to D. Variability across phase A to B and C to D was zero with no change. Phase B to C yielded a negative change for both settings. (Table 10 and Figure 6a)

Letter Sound. For participant six, the baseline measures (A) resulted in a face-to-face M=7 (SD=0); telepractice M=7 (SD=0). Phase B, was a continuous data collection with no direct intervention. Participant six demonstrated a face-to-face M=7.8 (SD=.447); M= 7.8 (SD=.447) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.17 (SD =.983); telepractice M=9 (SD=1.095). Continuous data collected in phase D produced a face-to-face M=10 (SD=0); telepractice M=10 (SD=0).

Improvement Rate Difference – The IRD across phase A to phase C for both the face-to-face setting and for the telepractice setting was 100%. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .90 (moderate effect); telepractice A-B = .90 (moderate effect), face-to-face B-C=.86 (moderate effect); telepractice B-C=.80 (moderate effect), face-to-face C-D=.75 (moderate effect); telepractice C-D=.75 (moderate effect). A combined score across all phases produced a face-to-face improvement of .83 (moderate effect) and telepractice improvement of .81 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. Variability in both the face-to-face and telepractice settings for phase A to B and B to C resulted in a positive change. Phase C to D was negative for both the face-to-face setting and positive for the telepractice settings. (Table 10 and Figure 6b)

Decoding. For participant six, the baseline measures (A) resulted in a face-to-face M=4.8 (SD=.447); telepractice M=5.2 (SD=.447). Phase B and C were continuous data collection produced a face-to-face M=5.8 (SD=.547); telepractice M=6 (SD=0) and phase C face-to-face M=7.67 (SD=.516); telepractice M=6.83 (SD=.752). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=9.17 (SD =.983); telepractice M=8.86 (SD=1.214).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment with all scores exceeded the baseline scores.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .92 (moderate effect); telepractice A-B = .90 (moderate effect), face-to-face B-C =1 (large effect); telepractice B-C =.83 (moderate effect), face-to-face C-D = .88 (moderate effect); telepractice C-D=.91 (moderate effect). A combined score across all phases produced a face-to-face improvement of .94 (large effect) and telepractice improvement of .88 (moderate effect).

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face and telepractice settings was positive value. Variability for the face-to-face setting resulted in no change for phase A to B and for the telepractice setting a negative change occurred. A positive change across phases B to C and C to D was the outcome for the face-to-face and telepractice setting. (Table 10 and Figure 6c)
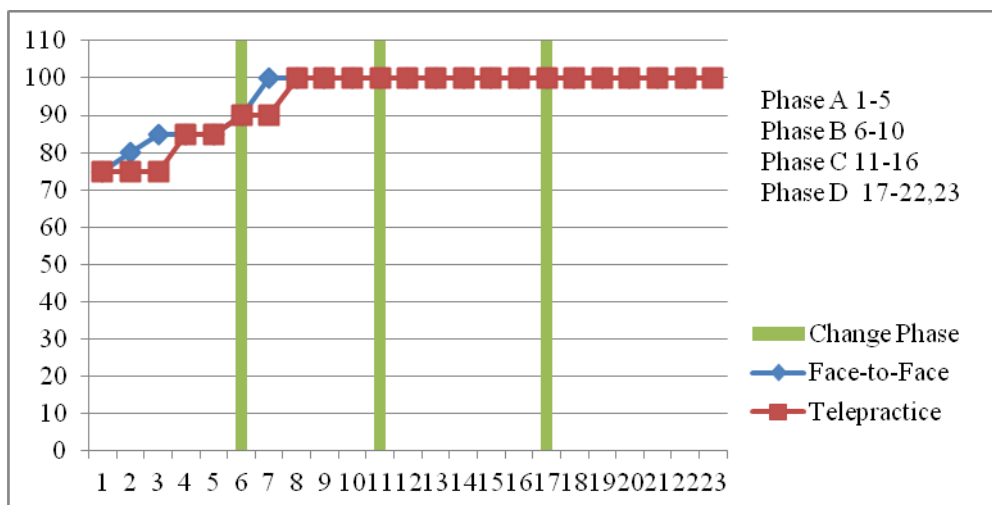
Figure 6a. Participant Six Outcome Data for letter naming across the study
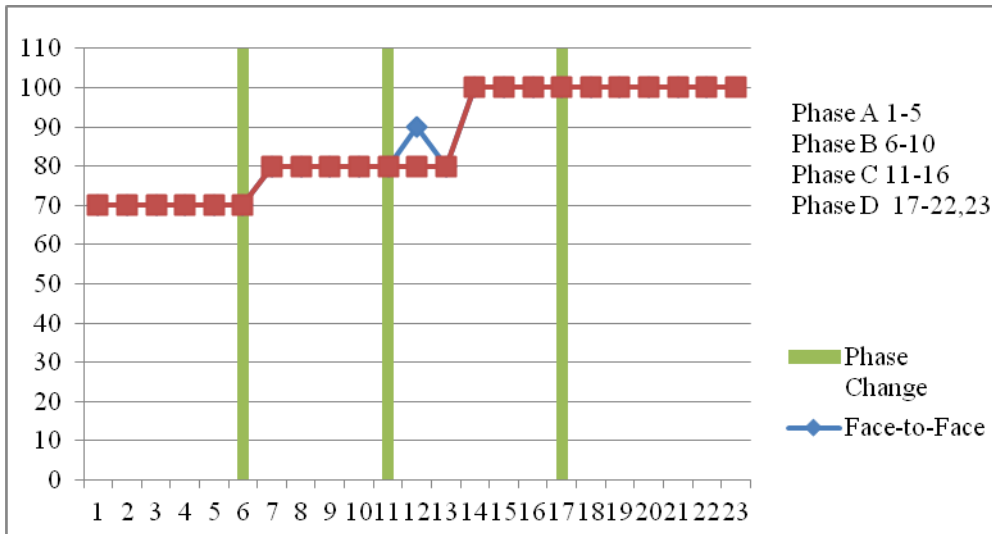
Figure 6b. Participant Six Outcome Data for letter sounds across the study
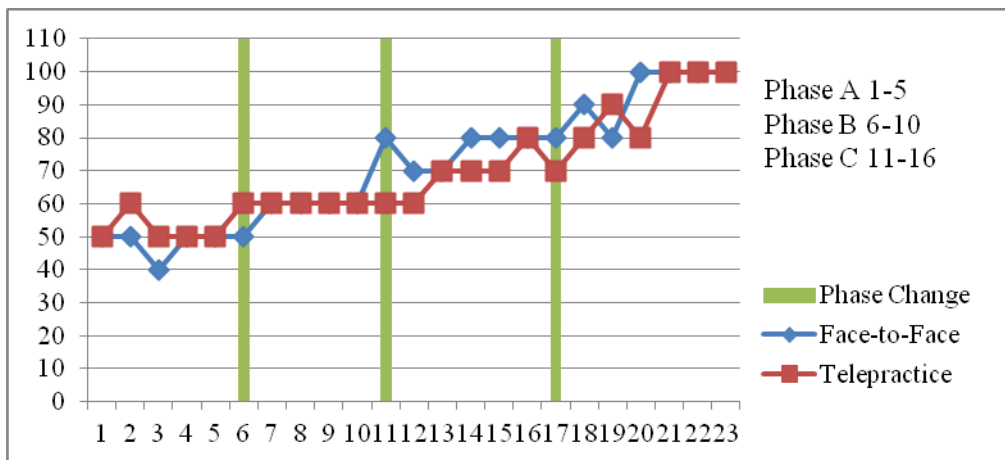
Figure 6c. Participant Six Outcome Data for decoding across the study

Participant Seven

Participant seven participated in a total of forty-seven sessions with twenty four face-to-face sessions and twenty three telepractice sessions. This participant began with the face-to-face setting followed by the telepractice setting. The setting alternated to the conclusion of the study. Participant seven completed the following number of sessions for both the face-to-face setting: phase A (5 sessions), phase B (5 sessions), phase C (7 sessions), and phase D (7 sessions). For the telepractice sessions, each phase contained the same number of sessions as the face-to-face (see above) with the exception of phase C which was completed in 6 sessions. The course of treatment for this participant occurred in the afternoon with days missed only due to snow days.

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Table 10. IRD, NAP, Mean shift and Variability data for Participant Six across phases and settings.

Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to B)	100%(A to B)				
NAP	1 Large effect	1 Large effect	.60 Small effect	.70 Moderate effect	.50 Small effect	.50 Small effect
Mean Shift	6.4	6.6	1.8	1.6	0	0
Variability	0	0	-1.788	-2.190	0	0
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to C)	100% (A to C)				
NAP	.90 Moderate effect	.90 Moderate effect	.86 Moderate effect	.80 Moderate effect	.75 Moderate effect	.75 Moderate effect
Mean Shift	.8	.8	1.37	1.2	.83	1
Variability	.447	.447	.536	.648	-.983	-1.095
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	.92 Moderate effect	.90 Moderate effect	1 Large effect	.83 Moderate effect	.88 Moderate effect	.91 Moderate effect
Mean Shift	1	.8	1.87	.83	1.5	2.03
Variability	0	-.447	.069	.752	.467	.462

Descriptively, participant seven was easily focused and quick to be ready to work. This participant frequently questioned at the beginning of each session as to if it was going to be face-to-face or telepractice. Participant seven never indicated a preference for either. Initially, across all tasks the participant did not guess if he felt he did not know the answer and just stated, "I don't know that one." As the study continued and accuracy increased, his use of this statement decreased. The letter sound /l/ was difficult for this participant due to articulation substitution /w/. This was address within the letter sound intervention. The decoding processed observed were the use of tapping out sounds with fingers on the table, sub-vocalizing repetition of sounds, and finally producing the word.

Outcome Data for Participant seven

Letter Naming. For participant seven, the baseline measures (A) resulted in a face-to-face M=32.8(SD=1.788); telepractice M=34 (SD=0). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=38.2 (SD =2.683); telepractice M=38.8 (SD=1.643). Continuous data was collected in phases C and D with no direct intervention. Phases C produced a face-to-face M=40 (SD=0); telepractice M=40(SD=0) and phase D face-to-face M=40 (SD=0); telepractice M=40 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 100% for face-to-face setting and the telepractice setting. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .94 (large effect); telepractice A-B = 1 (large effect), face-to-face B-C=.70 (moderate effect); telepractice B-C=.65 (small effect), face-to-face C-D=.50 (small effect); telepractice C-D=.58 (small effect). A combined score across all phases produced a face-to-face improvement of .69 (moderate effect) and telepractice improvement of .73 (moderate effect). Phases A to B is the baseline to intervention phase and the face-to-face setting yielded large effect and the telepractice setting.

Visual Analysis - The mean shifts from phase A to B, and B to C for both the face-to-face and telepractice settings were positive. The phase C to D mean shift was zero for both the face-to-face and telepractice settings. Variability across phase A to B was positive and phase B to C was negative for both settings. Phase C to D was zero with no change for the face-to-face setting and negative for the telepractice setting. (Table 11 and Figure 7a)

Letter Sound. For participant seven, the baseline measures (A) resulted in a face-to-face M=3.4 (SD=.894); telepractice M=4.2 (SD=.447). Phase B, was a continuous data collection with no direct intervention. Participant seven demonstrated a face-to-face M=7 (SD=0); M= 6.8 (SD=.447) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9.43 (SD =.975); telepractice M=9.17 (SD=.983). Continuous data collected in phase D produced a face-to-face M=10 (SD=0); telepractice M=10 (SD=0).

Improvement Rate Difference – The IRD across phase A to phase C for both the face-to-face setting and for the telepractice setting was 100%. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = 1 (large effect), face-to-face B-C=1 (large effect); telepractice B-C=1 (large effect), face-to-face C-D=.64 (small effect); telepractice C-D=.75 (moderate effect). A combined score across all phases produced a face-to-face improvement of .86 (moderate effect) and telepractice improvement of .90 (moderate effect). Phase C was the initiation of intervention for the letter sounds task with a large effect for face-to-face and for telepractice.

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. Variability in both the face-to-face and telepractice settings for phase A to B was negative for the face-to-face setting and no change for the telepractice setting. Phase B to C resulted in a positive change. Phase C to D yielded a negative for both the face-to-face setting and positive for the telepractice settings. (Table 11 and Figure 7b)

Decoding. For participant seven, the baseline measures (A) resulted in a face-to-face M=0 (SD=0); telepractice M=0 (SD=0). Phase B and C were continuous data collection produced a face-to-face M=.2 (SD=.447); telepractice M=.2 (SD=.447) and phase C face-to-face M=5.14 (SD=2.672); telepractice M=5.17 (SD=2.316). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=9.29 (SD =.951); telepractice M=9 (SD=1).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment with all scores exceeded the baseline scores.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .60 (small effect); telepractice A-B = .60 (small effect), face-to-face B-C =.98 (large effect); telepractice B-C =1 (large effect), face-to-face C-D = .97 (large effect); telepractice C-D=.96 (large effect). A combined score across all phases produced a face-to-face improvement of .88 (moderate effect) and telepractice improvement of .87 (moderate effect). Phase D was the initiation of intervention for the letter sounds task with large effect for face-to-face and with large effect for telepractice.

Visual Analysis - The mean shifts for decoding across phases A to B, B to C and C to D for the face-to-face and telepractice settings was positive value with exception of C to D telepractice which was a negative

value. Variability for phase A to B and B to C was positive for both the face-to-face and telepractice setting. For phase C to D both settings yielded a negative change. (Table 11 and Figure 7c)
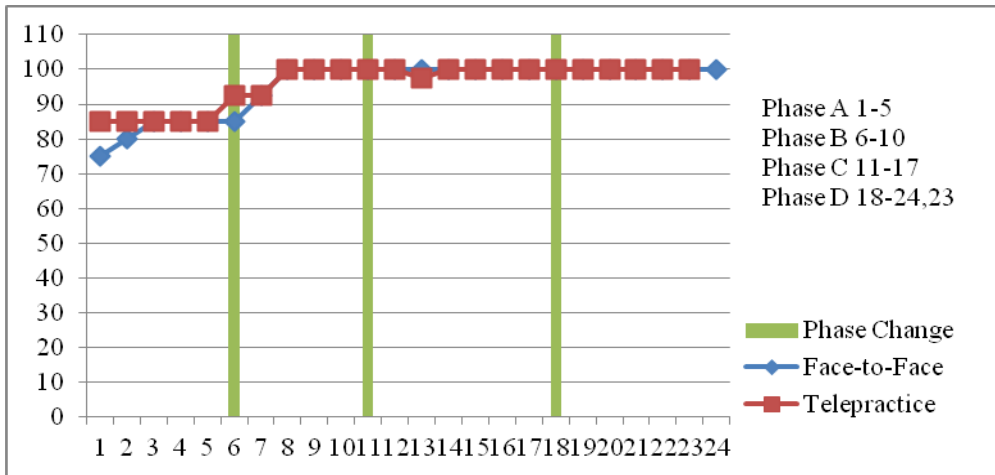
Figure 7a. Participant Seven Outcome Data for letter naming across the study
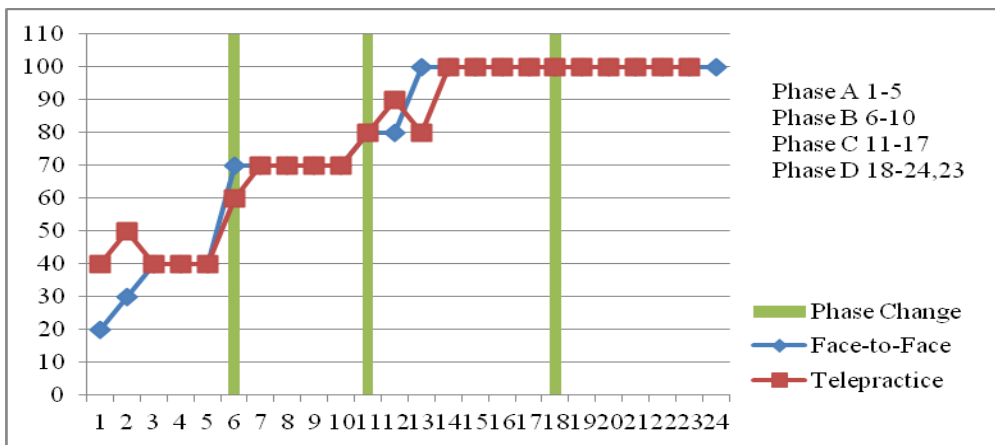
Figure 7b. Participant Seven Outcome Data for letter sounds across the study
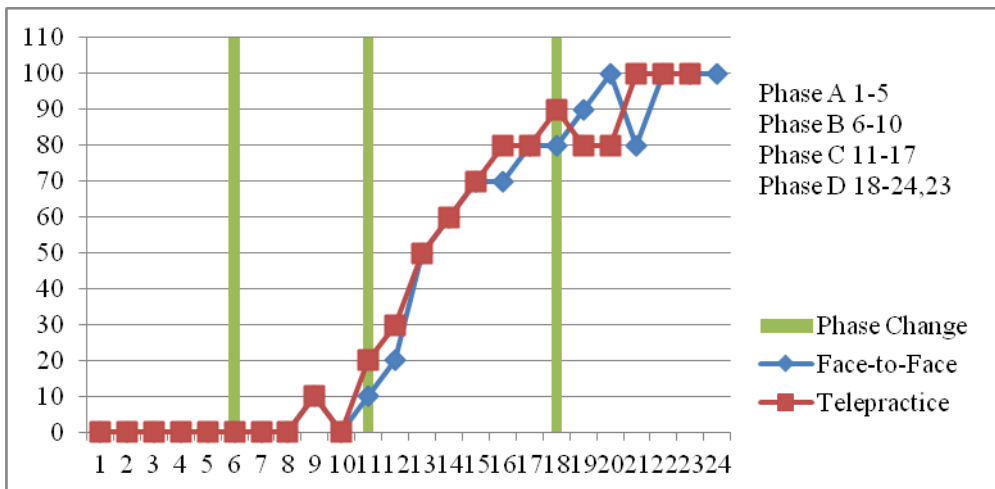
Figure 7c. Participant Seven Outcome Data for decoding across the study

Table 11. IRD, NAP, Mean shift and Variability data for Participant Seven across phases and settings.

Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to B)	100%(A to B)				
NAP	.94 Large effect	1 Large effect	.70 Moderate effect	.65 Small effect	.50 Small effect	.58 Small effect
Mean Shift	5.4	4.8	1.8	1.2	0	0
Variability	.895	1.643	-2.683	-1.235	0	-.408
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (Ato C)	100% (A to C)				
NAP	1 Large effect	1 Large effect	1 Large effect	1 Large effect	.64 Small effect	.75 Moderate effect
Mean Shift	3.6	2.6	2.43	2.37	.57	.83
Variability	-.894	0	.975	.536	-.975	-.983
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	.60 Small effect	.60 Small effect	.98 Large effect	1 Large effect	.97 Large effect	.96 Large effect
Mean Shift	.2	.2	4.94	4.97	4.15	-.17
Variability	.447	.447	2.225	1.869	-1.316	-.325

Participant Eight

Participant eight participated in a total of forty-nine sessions with twenty four face-to-face sessions and twenty five telepractice sessions. This participant began with the telepractice setting followed by the face-to-face setting. The setting alternated to the conclusion of the study. Participant eight completed the following number of sessions for both the face-to-face setting: phase A (5 sessions), phase B (6 sessions), phase C (6 sessions), and phase D (7 sessions). For the telepractice setting, the same number of sessions occurred at each phase. The course of treatment for this participant occurred in the afternoon with days missed due to snow days and one absence due to a family vacation.

Descriptively, participant eight was described by the learning specialist, librarian and teacher as being immature. This participant is the youngest of all the participants. At the beginning of this study he refused to attempt the decoding. He stated, "I can't do that." Initially with the letter naming and letter sound probes, for a number of letter names and sounds he stated, "I don't know that one." The participant was observed to make error with visually confusing letters including b, d, p, and q. In the beginning, he utilized nominal strategies to decode the word attempting only to state the sound symbol correspondence of the first letter in the word. Gradually, he demonstrated a process of stating the sound correspondence to the initial letter continuing through the word letter by letter decoding the letter sounds then blending together to decode words.

Outcome Data for Participant eight

Letter Naming. For participant eight, the baseline measures (A) resulted in a face-to-face M=32.2(SD=.447); telepractice M=31.4 (SD=.894). The intervention phase (B) specifically targeting letter naming skills, yielded a face-to-face M=37.33 (SD =3.01); telepractice M=37 (SD=3.02). Continuous data was collected in phases C and D with no direct intervention. Phases C produced a face-to-face M=39.67 (SD=.816); telepractice M=39(SD=1.67) and phase D face-to-face M=39.71 (SD=.755); telepractice M=40 (SD=0).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to B, IRD was 100% for face-to-face setting and the telepractice setting. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = 1 (large effect); telepractice A-B = 1 (large effect), face-to-face B-C=.70 (moderate effect); telepractice B-C=.70 (moderate effect), face-to-face C-D=.51 (small effect); telepractice C-D=.67 (moderate effect). A combined score across all phases produced a face-to-face improvement of .73 (moderate effect) and telepractice improvement of .78 (moderate effect). Phases A to B is the baseline to intervention phase and the face-to-face setting yielded large effect and the telepractice setting.

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for both the face-to-face and telepractice settings were positive. Variability across phase A to B was positive change and phase B to C and C to D was negative change for both settings. (Table 12 and Figure 8a)

Letter Sound. For participant eight, the baseline measures (A) resulted in a face-to-face M=5 (SD=0); telepractice M=5 (SD=0). Phase B, was a continuous data collection with no direct intervention. Participant eight demonstrated a face-to-face M=6.33 (SD=.816); M= 6 (SD=.816) for the telepractice setting. The intervention phase (C) specifically targeting letter sound correspondence skills, yielded a face-to-face M=9 (SD =1.095); telepractice M=9 (SD=1.264). Continuous data collected in phase D produced a face-to-face M=10 (SD=0); telepractice M=10 (SD=0).

Improvement Rate Difference – The IRD across phase A to phase C for both the face-to-face setting and for the telepractice setting was 100%. All scores were in the direction of an improvement.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .92 (moderate effect); telepractice A-B = .86 (moderate effect), face-to-face B-C=1 (large effect); telepractice B-C=.98 (large effect), face-to-face C-D=.75 (moderate effect); telepractice C-D=.75 (moderate effect). A combined score across all phases produced a face-to-face improvement of .88 (moderate effect) and telepractice improvement of .86 (moderate effect).

Visual Analysis - The mean shifts from phase A to B, B to C and C to D for the face-to-face and telepractice settings, were positive. Variability in both the face-to-face and telepractice settings for phase A to B and B to C was positive. Phase C to D resulted in a negative change for both the face-to-face setting and telepractice setting. (Table 12 and Figure 8b)

Decoding. For participant eight, the baseline measures (A) resulted in a face-to-face M=0 (SD=0); telepractice M=0 (SD=0). Phase B and C were continuous data collection produced a phase B a face-to-face M=0 (SD=0); telepractice M=0 (SD=0) and phase C face-to-face M=4 (SD=1.788); telepractice M=3.83 (SD=1.940). The intervention phase (D) specifically targeting decoding skills, yielded a face-to-face M=8.86 (SD =1.463); telepractice M=8.57 (SD=1.618).

Improvement Rate Difference – The IRD indicated the percent intervention scores that exceed the baseline. For the phase A to D, IRD was 100% for both the face-to-face treatment and the telepractice treatment with all scores exceeded the baseline scores.

Nonoverlap of All Pairs –The NAP score for each phase to phase comparison is as follows: face-to-face A-B = .50 (small effect); telepractice A-B = .50 (small effect), face-to-face B-C =1 (large effect); telepractice B-C =1 (large effect), face-to-face C-D = .98 (large effect); telepractice C-D=.98 (large effect). A combined

score across all phases produced a face-to-face improvement of .84 (moderate effect) and telepractice improvement of .84 (moderate effect).

Visual Analysis - The mean shifts for decoding across phases A to B yielded a no change in the means for both settings. , B to C and C to D for the face-to-face and telepractice settings was positive value. Variability for phase A to B was no change for both settings. For both the face-to-face and telepractice settings, phase B to C was positive and phase C to D yielded a negative change. (Table 12 and Figure 8c)
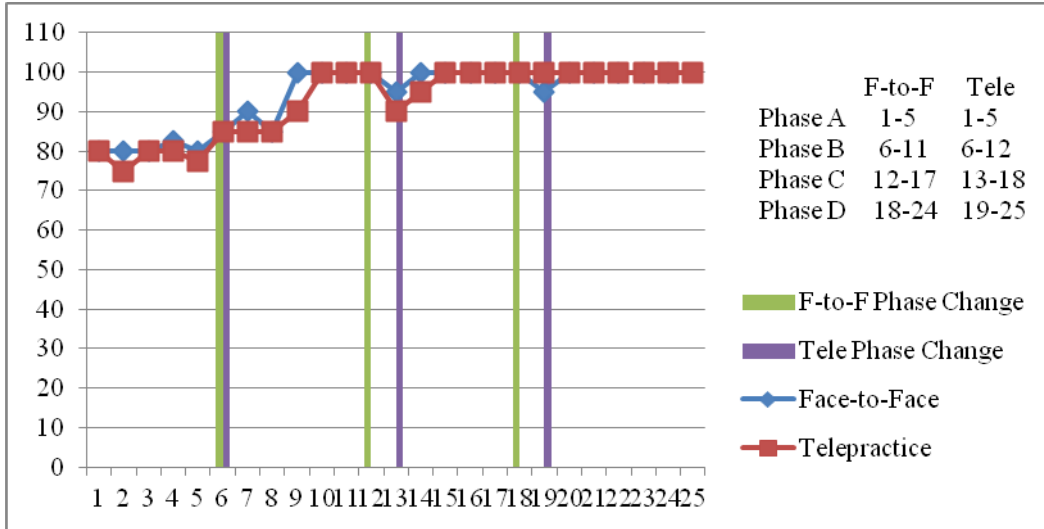
Figure 8a. Participant Eight Outcome Data for letter naming across the study
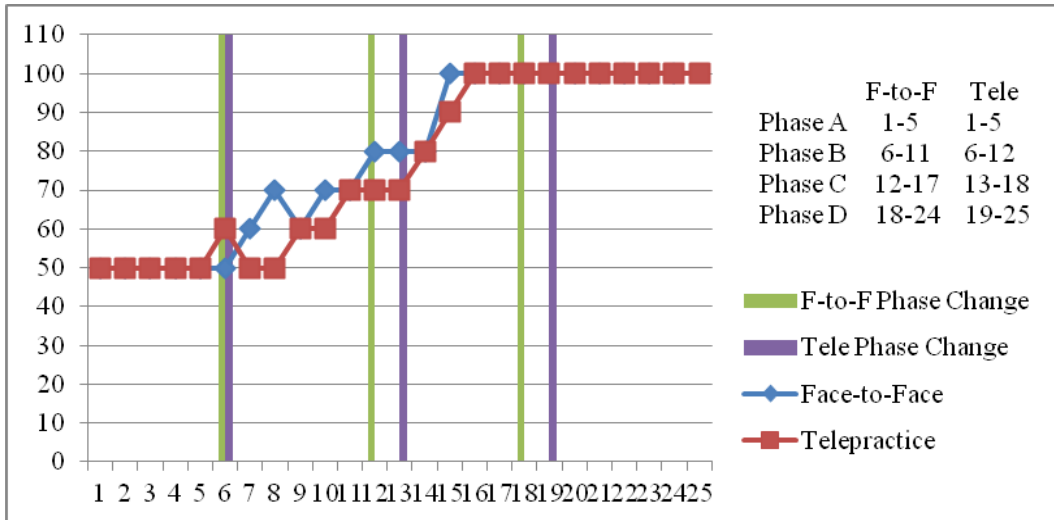
Figure 8b. Participant Eight Outcome Data for letter sounds across the study
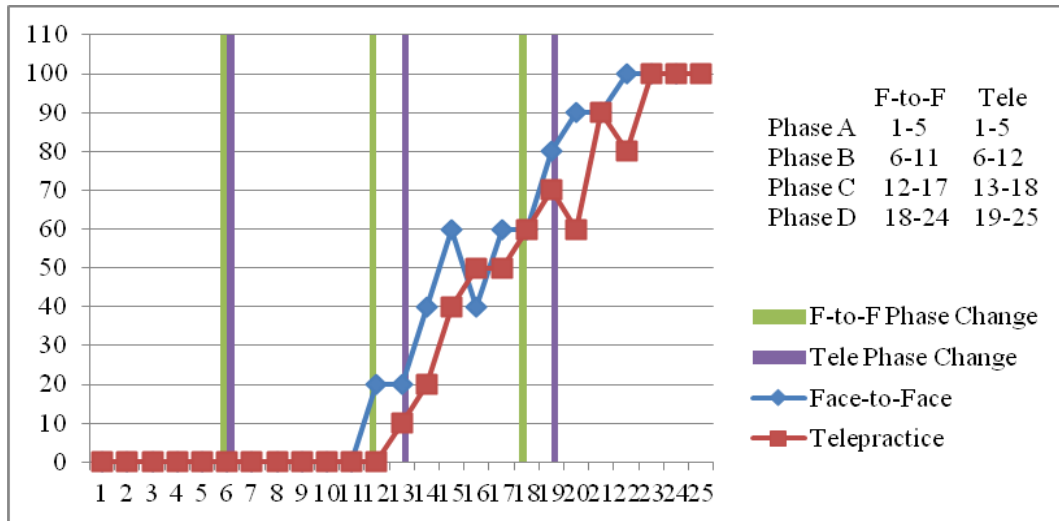
Figure 8c. Participant Eight Outcome Data for decoding across the study

Table 12. IRD, NAP, Mean shift and Variability data for Participant Eight across phases and settings.

Letter Naming	Face-to-Face	Telepractice	Face-to-Face	Telepractice	Face-to-Face	Telepractice
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to B)	100%(A to B)				
NAP	1 Large effect	1 Large effect	.70 Moderate effect	.70 Moderate effect	.51 Small effect	.67 Moderate effect
Mean Shift	5.13	5.6	2.34	2.0	.04	1
Variability	2.564	2.129	-2.195	-1.35	-.064	-1.673
Letter Sounds	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (Ato C)	100% (A to C)				
NAP	.92 Moderate effect	.86 Moderate effect	1 Large effect	.98 Large effect	.75 Moderate effect	.75 Moderate effect
Mean Shift	1.33	1	2.67	3	1	1
Variability	.816	.816	.279	.448	-1.095	-1.264
Decoding	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**	**Face-to-Face**	**Telepractice**
Phase Measure	Phase A to B	Phase A to B	Phase B to C	Phase B to C	Phase C to D	Phase C to D
IRD	100% (A to D)	100% (A to D)				
NAP	.50 Small effect	.50 Small effect	1 Large effect	1 Large effect	.98 Large effect	.98 Large effect
Mean Shift	0	0	4	3.83	6	4.74
Variability	0	0	1.788	1.940	-.325	-1.618

Group Outcome Data

Each of the individual participant's results has been detailed above. Examining the data from all

the participants creates a big picture and results in group patterns. Participants 1,3,5,7 all began the study in

the face-to-face setting with participants 2,4,6,8 initiating the study in the telepractice setting. Sessions to

complete all the targets to criterion resulted in a M=45.38 (SD=2.07); face-to-face sessions M=22.88

(SD=1.04) and telepractice sessions M=22.5 (SD=1.31). Specific patterns evolved through comprehensive

analysis of all the statistics including IRD, NAP and visual analysis. Each individual's statistical analysis

held greater legitimacy given consistency across all participants.

Inspection of the IRD data (Table 13) reveals, with few exceptions, the same IRD rate for

participant's skills in both the face-to-face and telepractice setting. The exceptions were noted in

participant two's letter sound IRD with the face-to-face setting yielding 60% and telepractice at 100%.

Table 13. Group Improvement Rate Data

Participant	One	Two	Three	Four	Five	Six	Seven	Eight
Letter Naming FTF	100	100	80	71	80	100	80	100
Letter Naming Telepractice	83	80	80	71	80	100	100	100
Letter Sound FTF	80	60	100	86	100	100	100	100
Letter Sound Telepractice	80	100	100	100	100	100	100	100
Decoding FTF	100	100	100	100	100	100	100	100
Decoding Telepractice	100	100	100	100	100	100	100	100

The NAP results for both the face-to-face and telepractice setting were examined for numerical

patterns. NAP is a measure of improvement across phases. The three phase transitions A to B, B to C and C

to D for each skill, letter naming, letter sound and decoding scores, were closely aligned for both the face-

to-face and telepractice setting. Table 14 details the NAP combined scores across all phases for each

targeted skill under each setting, analogous results are depicted.

Table 14. Group NAP combined data

Participant	One	Two	Three	Four	Five	Six	Seven	Eight
Letter Naming FTF	.76 Mod Effect	.69 Mod Effect	.72 Mod Effect	.67 Mod Effect	.65 Small Effect	.68 Mod Effect	.69 Mod Effect	.73 Mod Effect
Letter Naming Telepractice	.67 Mod Effect	.69 Mod Effect	.76 Mod Effect	.71 Mod Effect	.70 Mod Effect	.71 Mod Effect	.73 Mod Effect	.78 Mod Effect
Letter Sound FTF	.71 Mod Effect	.63 Small Effect	.77 Mod Effect	.81 Mod Effect	.82 Mod Effect	.83 Mod Effect	.86 Mod Effect	.88 Mod Effect
Letter Sound Telepractice	.67 Mod Effect	.83 Mod Effect	.85 Mod Effect	.84 Mod Effect	.79 Mod Effect	.81 Mod Effect	.90 Mod Effect	.86 Mod Effect
Decoding FTF	.85 Mod Effect	.83 Mod Effect	.97 Large Effect	.89 Mod Effect	.99 Large Effect	.94 Large Effect	.88 Mod Effect	.84 Mod Effect
Decoding Telepractice	.82 Mod Effect	.83 Mod Effect	.97 Large Effect	.87 Mod Effect	.98 Large Effect	.88 Mod Effect	.87 Mod Effect	.84 Mod Effect

Analysis of group mean shift scores revealed increases in the mean (positive value) across phases for six out of eight of the participants in both, the face-to-face and telepractice settings. Participant four did not demonstrate a positive value across all phases. The participant's results did document the same value positive or negative in the face-to-face and telepractice setting. Overall, seven out of eight participants demonstrated comparable mean shifts in both the face-to-face and telepractice settings.

Variability measures for all participants across letter naming, letter sounds, and decoding in both settings were changeable. However, a clear pattern of the similarities between the face-to-face and telepractice settings emerged. Each individual had a total of 9 phase transitions variability measures with 3 phase transitions (A-B, B-C, C-D) for 3 skills: letter naming, letter sounds and decoding for the face-to-face session. For example, given a zero change occurring in the face-to-face, a zero change also occurred for the telepractice session. This was evident for each and all the potential changes including: zero, positive and negative.

The results of multivariate procedures (MANOVA), with 4 levels of treatments and 3 levels of reading skills, yielded insignificant results: $F(4,11)= .364$, $p=.829$; Wilk's $\lambda=.883$, and $F(3,12)=.095$, $p=.962$; Wilk's $\lambda=.977$, respectively . Both the raw scores and standardized data failed to detect any differences between the two conditions (face-to-face and telepractice). Additionally, an omnibus measure

(ANOVA) computed from the standardized data failed to indicate any statistically significant difference between the two conditions: $F (1, 14) =.026$, $p=.874$. As expected, these results could be attributed to the small sample size (n = 8), as well as the parameter estimates required to detect statistical significance. However, it is this researcher's judgment that the detailed profile elicited with the single subject design along with all of the advantages detailed within this study outweighed the limited sample size.

Inter-Observer Reliability

Inter-rater reliability was established by having two additional observers, a certified Speech Language Pathologist with over 11 years of experience working with students learning to read and a Reading Specialist with over 12 years of experience with kindergarten through adults learning to read both of whom are reading certified in the state of Massachusetts score performance on targeted skills. Observations were completed as twenty percent of treatment data probes for each participant were randomly selected, viewed via video recording and individualized score sheet for each participant were completed by the raters. The percentage of agreement for this study was 85% with a range between 83% - 100%. This study utilized the Landis and Koch scale for the strength of agreement as cited in Theodoros et al. (2008). The ratings were as follows: <0.4 = poor; 0.41-0.6 = moderate; 0.61-0.80 = good; 0.81-1.00 = very good. These results are suggestive of a very good inter-rater reliability. Additional support for a strong inter-rater reliability included, Fleiss (1981) who proposed the following benchmark scale: <.40 = poor, .40 to .75=intermediate-good and more than .75= excellent; and Altman (1991) who proposed the following scale: <.20= poor, .21 to .40= fair, .41 to .60= moderate, .61 to .80=good and .81 to 1.00= very good.

While the measure falls within the high reliability range, it was still negatively affected by quality of video observations: Several of the chosen videos had excerpts of reduced quality due to several environmental factors. Examples of environmental factors included: interruptions by someone entering the room, noise from the hall, video recorder unforeseen movement and intercom/page.

CHAPTER IV

DISCUSSION

<u>**Discussion**</u>

A growing body of literature exists detailing the efficacious use of telepractice in speech language pathology and education. The literature demonstrates successful outcomes for the use of telepractice for assessment, treatment and consultation for a variety of diagnoses. Specific studies, diagnosis, action and outcomes are detailed in table 1.

Despite the growing interest in telepractice, there is paucity of studies addressing the use of telepractice in literacy intervention. Two specific studies can be cited in the area of telepractice use for literacy assessment and literacy intervention. Waite, Theodoros, Russell, and Cahill (2010) study yielded positive results for the use of telepractice to assess children's literacy skills. Waite (2010) investigated the treatment of children with a literacy disorder utilizing the Phonological Awareness for Literacy Program (PAL), which resulted in significant findings for non-word spelling and text reading accuracy along with some improvement trends on nearly all other measures.

To the best of our knowledge, the present study specifically targeting foundational reading skills via a systematic multi sensory intervention in a telepractice setting is the first completed account of the treatment outcomes.

This study investigated potential differences in the effectiveness of multi-sensory reading treatment delivered in a telepractice versus a traditional face-to-face setting, targeting the foundational reading skills (letter naming, letter sound naming and decoding) of participants who have been identified with a delay in these foundational reading skills. We hypothesized three different outcomes addressing each foundational reading skill: Null hypothesis would imply no differences in the outcomes between telepractice and traditional face-to-face treatment settings. The rejection of the null hypothesis would imply that children benefit the most from either telepractice or face-to-face sessions for each foundational skill.

Results for individual participants indicated improvement of each foundational reading skill in both, the face-to-face and telepractice settings within a similar number of sessions. Various analyses such as IRD, NAP, mean shifts and variability, indicated comparable results in both the face-to-face and

telepractice setting across all skills. These results were consistent across all participants and all targeted skills. As there were no marked difference in achievements for any participant or targeted skills through either type of service delivery, e.g., face-to-face or telepractice, we cannot reject the null hypothesis. Therefore, telepractice is a viable method to deliver multisensory reading treatment remotely: Participants in more isolated locations can get comparable benefits from treatment via telepractice, as children who receive face-to-face therapy. These findings are consistent with the literature supporting telepractice as an efficacious service delivery model as has been shown for literacy assessment (Waite et al., 2010) and phonological awareness treatment (Waite, 2010). This study adds to the literature related to the efficacy of telepractice and specifically the use of telepractice to address foundational reading skills.

Additional Observations

As intervention targeting letter naming was initiated, accuracy increased across all targeted letters. At the same time, with no direct intervention there was a marked increase in letter sound skills. This observation supports Foulin's (2005) suggestion that LNK is a precursor for LSK development, as well as Share (2004) and Treiman et al. (2008) findings that LNK facilitates LSK.

Share (2004), asserts that letter naming knowledge and letter sound knowledge are crucial to decoding as poor readers have difficulty learning the phoneme – grapheme correspondences, impeding decoding. In the present study, as the participants reached the established criterion for letter naming and letter sounds, gains in decoding skills became evident. Participants three, four, seven and eight were distinct examples.

As participants developed their decoding skills, there was evidence of different styles or processes that participants utilized. Some participants sounded out individual phonemes one by one, symbol by symbol (b----e-----d), demonstrating the ability to systematically determine the sound (phoneme) symbol (letter) relationship to read the word (The University of Oregon Center on Teaching and Learning, 2009). However, this response resulted in increased response time, resulting in less efficient, although correct decoding. Other participants demonstrated an increased response time, as they were able to look at the word and say it immediately, suggesting automaticity of the grapheme-phoneme correspondence process. It is speculated by this researcher that if the scoring for the decoding probe went beyond correct or incorrect, a more detailed profile of decoding development would have been available. Potentially, a more

90

tiered scoring system should be developed to identify specific patterns of progression toward automatic and effective decoding.

Winslow, Onslow and Lincoln (2004) research related to fluency treatment, documented a greater number of sessions required to achieve goals in the telepractice setting. This study's findings did not support a lengthier treatment period for the telepractice setting. Results were based on a comparable number of sessions for the telepractice and face-to-face settings to successfully achieve the criterion set up by the researcher.

Limitations

A clear limitation to this study is the small sample size. However, a small sample size is a characteristic of a high percentage of studies within the current body of research on the efficacy of telepractice and it may result in problems of generalization. To address this issue in future studies, researchers need to include a larger and more diverse sample, including different participants, locations and researchers, with systematic replication to establish true external validity.

In addition, single subject multiple baseline design across behaviors may be problematic for establishing the experimental control. Extensive baseline measures on the three components may produce extinction effects impacting student responses (Tawney & Gast, 1984). Specifically, the investigator must choose three target components that are independent yet responsive to the same treatment. There is an absence of statistical controls which compromises results due to potential individual differences. An example of this would be one student being more responsive than another. This absence of experimental control often inhibits acceptance for publication (Rapoff & Stark, 2007).

Advantages

The common sense methodology of single subject multiple baseline design offers several advantages that are demonstrated in this study. The cause and effect relationship can be established. The design allows the assessment of programs that teach permanent skills. The logic of repeated data collection can reliably document that the change in a phase occurs at the point of intervention and across the length of the phase (Barnett, Heinemann, Libin, Houts, Gassaway, Sen-Gupta, Resch & Brossart, 2012). The continuous measurement allows the investigator to closely monitor and delineate progress across the

learning stages along with determination if treatment effects are permanent and/or long lasting. Also, this continuous measurement affords the opportunity to detail individual variability in outcome measures.

For several reasons, the multiple baseline design is more attractive for a practicing clinician to do clinical research. The design allows a forum to examine a conceptual theory or practice. This contributes to the identification of evidence based practices. Further, the results are often more easily understood by clinicians. This leads to more clinicians completing research and expanding the literature.

Reliable and valid intervention delivered via telepractice offers numerous advantages including low cost, availability of specialized treatment delivered to a larger numbers of students, and unlimited access to treatment. As technology continues to advance and develop, the cost of audio/video devices has become more affordable and therefore accessible. Telepractice allows therapists with specialized skills to be matched to students with specific needs. In addition, the potential for online groups further expands the number of people that can be treated (Towey, 2012). In conclusion, less expensive, quality specialized treatment for a greater number of people is a growing reality as a result of telepractice.

Implications

As technology becomes less expensive and more accessible, it is increasingly integrated into education. Students have expressed that their learning is improved with the integration of technology (Speaker, 2004). Speech language pathologists need to integrate technology into their practice and tap into this expanding potential. Necessary technical skills and clinical competencies are essential for speech language pathologists to acquire for maximum benefit and to ensure competent and ethical integration for the benefit of all involved (ASHA, 2008).

Additional considerations result from the increase integration of technology, specifically telepractice. Several factors to consider include issues with investment, reimbursement, and licensure. Each of these factors impacts telepractice and its overall viability.

The establishment of consistent and comprehensive insurance reimbursement of services impacts decisions related to investment in equipment and professional development. These decisions happen at a range of levels from the individual speech pathologist all the way up through corporate health companies such as Partners Healthcare or Hallmark Health. A cost benefit analysis can assist in determination of the ultimate worth of implementation.

The expanded use of telepractice in speech language pathology and other health related fields, results in several implications regarding reimbursement. ASHA (2013) reports 15 states have required insurance providers to fund telepractice services as they do face-to-face services. Large insurance providers such as Aetna and Cigna have provided coverage since 2008. There has been sporadic coverage through Medicaid for eligible children in schools and ASHA continues to consult with state associations to facilitate understanding and growth of telepractice. Medicare currently does not cover speech language pathology services delivered via telepractice.

Another factor related to reimbursement is licensure. The nature of telepractice allows opportunities for services to be provided at a distance. If the speech language pathologist is not in the same state as the patient, is dual or multiple licenses required? In order to address these issues, ASHA encourages state licensure boards to think flexibly to reduce the obstacles.

Research related to the use of telepractice as an option for service delivery needs to continue, expand and diversify. Studies that replicate prior studies, contain larger samples, include diverse populations (adults, children, diagnosis), and involve different venues of telepractice (home, clinic, school) need to be carried out to ensure quality, reliable and valid services. As technology continues to develop, new technology needs to be investigated. Further considerations to explore include the following: the expense versus the benefit, participant profiles that demonstrate maximum benefit, participant profiles that demonstrate variable benefit and overall logistics. There is groundwork literature on the efficacy of telepractice and research needs to continue to be cultivated to ensure effective, dependable and well-founded services (assessment, intervention, consultation).

Conclusions

The purpose of this study was to investigate the effectiveness of a multi-sensory reading treatment via telepractice, versus a traditional face-to-face multi-sensory reading treatment on foundational reading skills (letter naming, letter sound naming, decoding) of students who have been identified with a delay in these foundational reading skills. The research question probed possible differences in participant's progress for multi-sensory reading treatment addressing foundational reading skills in telepractice versus traditional face-to-face setting. As analyses of the data indicate, there are no statistically significant differences between the participants' improvements via face-to-face vs. telepractice treatment delivery.

A key principle of the 2005 ASHA telepractice position statements is that the quality of telepractice services should be equal to that of services dispensed face-to-face. This study expands the literature on the efficacy of systematic multi-sensory treatment for foundational reading skills along with determining the effectiveness of teleconferencing as a service delivery. There is a continued need for further research to establish comprehensive empirical data addressing the use of telepractice compared to traditional methods. The scope of research should expand to include participants with a greater variety of disorders, severity of disorders and diversity for geographic location along with ethnicity. Research supporting the use of telepractice is vital to ensure the quality of services.

IRB-INFORMED CONSENT
Consent Form for Participation in a Research Study
University of Massachusetts Amherst

Principal Investigator: Mary Beth Hetherton
Student Researcher: Mary Beth Hetherton
Study Title: Single Subject Design Addressing Foundational Reading Skills in Alternating Environments

1. WHAT IS THIS FORM?

This form is called a Consent Form. It will give you information about the study so you can make an informed decision about participation in this research study.

This consent form will give you the information you will need to understand why this study is being done and why your child is being invited to participate. It will also describe what your child will need to do to participate and any known risks, inconveniences or discomforts that you may have while participating. We encourage you to take some time to think this over and ask questions now and at any other time. If you decide to participate, you will be asked to sign this form giving permission for your child to participate. A copy will be provided to you for your records.

2. WHO IS ELIGIBLE TO PARTICIPATE?

Inclusion in this study was determined by the following criteria: a student attending the private grammar school who has been identified with a delay in foundational reading skills (letter naming knowledge, letter sound knowledge, decoding). Identification is determined by the schools' current protocols including combinations of Pre-kindergarten screening, teacher recommendation, Developmental Reading Assessment (DRA), Dynamic Indicators of Basic Early Literacy Skills (DIBELS), and the Stanford 10.

3. WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to investigate the effectiveness of a telepractice (videoconference) multi-sensory reading instruction versus a traditional (face-to-face) multi-sensory reading instruction on foundational reading skills (letter naming, letter sounds, decoding) of a student who has been identified with a delay in these specific foundational reading skills. Telepractice is a method of service delivery that utilizes technology and equipment such as a computer, iPad, webcam and secure videoconferencing software.

4. WHERE WILL THE STUDY TAKE PLACE AND HOW LONG WILL IT LAST?

This study will take place at school during the school day. Instruction will be conducted in a room within the school (resource room, library, science lab). The face-to-face session will be conducted with the student sitting at a table and the telepractice (videoconference) multisensory instruction will take place with the student participating at an iPad and the researcher will be located at a remote distance utilizing a technology to teleconference with the student. The student will participate in 40 minute session including a brief consultation with the primary teacher. Due to the nature of the single subject design, a specific time frame is difficult to ascertain. The process will occur as follows. Initially, baseline data is established. This will be followed by the instruction phase beginning by targeting letter naming for intervention, while monitoring the other components. When the first targeted component reaches the criterion level, the sound symbol correspondence intervention will be introduced. With the second component reaching the criterion level, the third component, decoding is targeted. The length of time for each phase of the study is based on student performance.

At the conclusion of the study there is no current plan to contact the student for further participation and/or information.

5. WHAT WILL MY CHILD BE ASKED TO DO?

Your child will be given an initial informal assessment to determine a current skill level for naming letters and their sounds. Following this assessment, your child will participate in weekly individual multisensory reading instruction. These sessions target specific letter names, letter sounds and words to decode that are determined by the informal assessment. Initially, a baseline period will be conducted to determine consistent skill performance. This is followed by instructional sessions that involve one session in a traditional face-to-face format and one telepractice session. When your child reaches 100 percent accuracy for the specific letter names, letter sounds along with the words to decode; the initial informal assessment is administered to re-determine your child's skill level.

As noted above, a specific time frame from the beginning to end of the study is difficult to ascertain. Please refer to schedule noted above.

6. WHAT ARE MY BENEFITS OF BEING IN THIS STUDY?

Potential benefits to the student include gains within oral and written language skills. The potential benefits expected to accrue to the population which the student represents or to society in general includes further confirmation for the efficacy of multisensory reading instruction in both a face-to-face setting and/or a telepractice setting.

7. WHAT ARE MY RISKS OF BEING IN THIS STUDY?

There are no known risks associated with this research study.

8. HOW WILL MY PERSONAL INFORMATION BE PROTECTED?

The researchers will keep all study records in a secure location in a locked file cabinet. Research records will be labeled with a code. All electronic files (e.g., database, spreadsheet, etc.) containing identifiable information will be password protected. Any computer hosting such files will also have password protection to prevent access by unauthorized users. Only the members of the research staff will have access to the passwords. At the conclusion of this study, the researchers may publish their findings. Information will be presented in summary format and you will not be identified in any publications or presentations.

Confidentiality will be guaranteed with the exception of cases of mandated reporting such as child abuse and/or neglect.

9. WILL I RECEIVE ANY PAYMENT FOR TAKING PART IN THE STUDY?

Not required as the participant will not receive any payment.

10. WHAT IF I HAVE QUESTIONS?

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the principal investigator, Mary Beth Hetherton, M.S., CCC-SLP at 617-571-5340. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst SPHHS Local Human Subjects Review Board at (413) 545-3428 or humansubjects@ora.umass.edu.

11. CAN I STOP BEING IN THE STUDY?

You do not have to agree to allow your child to be in this study if you do not want to. If you agree to your child's participation in the study, but later change your mind, your child may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

The parent/guardian will be notified of all significant new findings during the course of the study that may affect your willingness to let your child continue.

12. WHAT IF I AM INJURED?

The University of Massachusetts does not have a program for compensating subjects for injury or complications related to human subjects' research, but the study personnel will assist the participant in getting treatment.

13. SUBJECT STATEMENT OF VOLUNTARY CONSENT

I have read this form and agree to allow my child participate in the project described above. The general purposes and particulars of the study as well as possible hazards and inconveniences have been explained to my satisfaction. I understand that I can withdraw my child at any time.

_____
Student's Name

_____   _____   _____
Parent/Guardian Signature: Print Name: Date:

By signing below I indicate that the participant has read and, to the best of my knowledge, understands the details contained in this document and has been given a copy.

_____   _____
Mary Beth Hetherton, M.S., CCC-SLP   Date:
Speech Language Pathologist
Principal Investigator

University of Massachusetts Amherst
School of Public Health and Health Sciences
Human Subjects Review Committee
(SPHHS-HSRC)

DATE: 9-28-12

TO: Mary Beth Hetherton, Dr. Pat Mercaitis, Dr. Elena Zaretsky

FROM: Elaine Puleo, Ph.D, Chair, SPHHS-HSRC

SUBJECT: The following action resulted from human subjects review of your amended proposal entitled: "Single subject design addressing foundational reading skills in alternating treatment environments"

SPHHS-HSRC file #: 11-57

Your revised protocol has been

☐ **1a**. APPROVED by the *SPHHS-HSRC* after expedited review under 45CFR46.110(b).

✓ **1b.** Administratively approved by the chair of *SPHHS-HSRC* for continuing research of previously approved protocol.

☐ **2a.** The *SPHHS-HSRC* requests the following information from the investigator before a final decision is made:

☐ **2b.** The *SPHHS-HSRC* has **NOT APPROVED** the above proposal for the following reasons:

☐ **3.** Your proposal was determined **EXEMPT** under 45CFR46.101 by the Chair of the *SPHHS-HSRC*.

Elaine Puleo, Ph.D.
Chair, SPHHS-HSRC

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g n e y r l v d h z n d x

s c n j h s s e n g h c i

h b b o y f p a i q c d q

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f m w w s j i k l e r k g

APPENDIX D

**INFORMAL ASSESSMENT OF LETTER NAMING AND LETTER SOUND KNOWLEDGE
SCORE SHEET**

Letter Names	Trial One	Trial Two	Trial Three	Trial Four	Percentage
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					
P					
Q					
R					
S					
T					
U					
V					
W					
X					
Y					
Z					

PROBE DATA COLLECTION FORM

	Letter Naming		Letter Sounds		Decoding	
Date	Accuracy	Errors	Accuracy	Errors	Accuracy	Errors

o   k   p   o   i   n   v   k

j   i   p   d   p   c   v   j

c   o   i   n   p   j   l   d

v   k   n   l   c   i   o   c

n   d   j   d   l   k   v   l

Letters   Decoding
l n c p i o j k d v z   on in pod pij lip viz kid cov zok   nol

SAMPLE LESSON PLAN

Meet/Greet

Probe Administration

Targeting Letter Naming of B

1. Write (instructor) letter upper and lower case, focus on lower case. Talk about shape connect

with visual provided and key words (bat and ball). First it is the bat then it's the ball.

2. Discrimination task finding the b's

B	g	b	b	D	F	A	o	b	i

3. Participant writes the letter ___times (different colors)

4. Participant is presented a total of 20 individual lower case letters (10 b's and 10 f's) on index

cards. The task is to sort into two piles.

5. Participant traces the Lively Letter b and then the accompanying story is told.

6. Participant says letter b ten times.

7. Participant listens to the instructor say a list of ten letters and participant raises hand when b

heard.

8. LetterReflex app for direction of b.

10. Bingo with students card containing letter b.

INDIVIDUALIZED PARTICIPANT PROBES

Participant	Letters	Decoding					
1	g, k, j, t, n, a, e, c, h, y	net	jek tag	yej jec			
		hat	gat hen	hag cah			
2	q, u, b, w, v, o, g, c, n, p	goc	bog				on
		con				qup	pun
		wuv	gob				vuc
		bun					
3	l, n, p, i, o, j, k, d, v, z	on	in				
		pod	pij				
		lip	viz				
		kid	dov				
		zok	nol				
4	a, k, g, w, p, u, h, r, c, v	wag	pup				
		gap	up				
		rug	vup				
		av	cag				
		ruc	huv				
5	a, e, c, y, h, g, n, t, k, j	net	jek				
		tag	yej				
		hat	gat				
		hen	jec			cah	
		hag					
6	o, a, j, c, g, h, n, y, p, z	jog	hap				
		con	paz				
		zap	noh				
		yag	coj				
		hon	paj				
7	f, h, s, w, o, l, n, c, p, a	cap	pal				
		on	wah				
		nap	sop				
		pop	fol				
		ac	hop				
8	g, o, z, d, p, c, a, y, s, h	had	pog	yop	soh		
		zod	cap		yad	hog	
		zap	gag				

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