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TREATMENT INTENSITY OF SPEECH INTERVENTION  
VIA TELEPRACTICE FOR CHILDREN WITH SPEECH  
SOUND DISORDERS: A SYSTEMATIC REVIEW

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## Structured Abstract

**Clinical Question:** In speech intervention via telepractice for preschool and school-age children with speech sound disorders (SSD), is treatment intensity similar to or different from that of traditional in-person therapy for optimal treatment results?

**Method:** Systematic Review

**Study Sources:** PubMed, Education Resources Information Center (ERIC), MEDLINE Complete, CINAHL Complete, PsycInfo, ASHAWire, Cochrane Library

**Search Terms:** telepractice OR telehealth OR telerehabilitation OR telemedicine OR telecare OR telespeech AND speech OR articulation OR phonolog\* AND interven\* OR treat\* OR therap\* AND child\*

**Number of Included Studies:** 5

### Primary Results:

1. Speech intervention via telepractice and in-person methods required similar treatment intensity for children with SSD.
2. In telepractice service, children with SSD benefited from biweekly 20- to 40-minute interventions for at least 12–18 weeks.
3. A dose of 75–100 productions per session has been adopted in speech intervention via telepractice; however, this dose was based on limited studies.

**Conclusions:** Research evidence for the optimal treatment intensity delivered via telepractice for children with SSD is still limited. In telepractice service, children with SSD benefited from speech intervention when they received 20- to 40-minute therapy twice a week for at least 12–18 weeks with an average dose of 75–100 productions per session. Such treatment intensity was similar to that of traditional in-person methods for this population. Continued research to investigate treatment intensity via the telepractice service delivery model is warranted to make a more informed clinical decision in this area.

# Treatment Intensity of Speech Intervention via Telepractice for Children With Speech Sound Disorders: A Systematic Review

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## Clinical Scenario

Don, a speech-language pathologist (SLP), has been working with children with speech and/or language impairments for the past 7 years in a school located in a larger urban city in the United States. During the COVID-19 pandemic, Don needed to use an alternative service delivery model to continue to treat children with SSD in his caseload. During a brief search of the American Speech-Language-Hearing Association (ASHA) website, Don found the ASHA's SLP Service Delivery Considerations in Health Care During Coronavirus/COVID-19 (2021), which suggested that telepractice is a viable option to continue therapy services for children in need. With support from his director, Don attended ASHA continuing education webinars to learn how to implement telepractice. First, he obtained an informed consent form for telepractice and a Family Educational Rights and Privacy Act (FERPA) of 1974 disclosure form from the parents. Then, he shared information about a K–12 relief fund with the parents who needed support to access the necessary resources (e.g., computer, adequate bandwidth, Health Insurance Portability and Accountability Act [HIPAA] of 1996 compliant video conference platform). Don successfully delivered a few trial sessions via telepractice using a commercially available telepractice platform. Children and their caregivers were able to follow directions to operate telepractice technology, and caregivers were willing to continue intervention with their children at home. Don was excited to resume therapy service via a telehealth online communication system.

Before shifting most of his cases to the telepractice service delivery model, Don wondered which treatment intensity would be sufficient to obtain progress when using telepractice for therapy and whether such treatment intensity is similar to or different from that of traditional

in-person methods. Because Don was already familiar with reviews on treatment intensity in traditional in-person methods, he planned to search telepractice research to analyze treatment intensity for children with SSD to find whether treatment intensity would be similar between these two service delivery models.

## Background Information

SLPs need to determine treatment intensity to optimize therapy effects for individual clients before implementing speech-language services. Based on a medical model, Warren et al. (2007) defined five variables essential for capturing treatment intensity: dose, dose form, dose frequency, total intervention duration, and cumulative intervention intensity. *Dose* refers to the number of practice trials or teaching episodes per session (e.g., 30 trials per therapy session) and *dose form* refers to the activity during intervention (e.g., sound production). *Dose frequency* is defined as the number of treatment sessions provided per day or per week (e.g., once a week). *Total intervention duration* refers to the total time period over which a specific therapy occurs (e.g., 15 weeks). Finally, *cumulative intervention intensity* is defined as the product of three measures of treatment intensity including dose, dose frequency, and total intervention duration.

Table 1 shows an exhaustive summary of all currently available reviews reporting treatment intensity in in-person contexts for children with SSD; however, not all treatment intensity measures that Warren et al. (2007) defined were offered. Baker and McLeod (2011)2011 made an initial attempt to provide a narrative review of speech intervention studies for children with SSD. This review involved 132 studies published from 1979 to 2009 that included children ages 1–10 years with phonological impairments, delays,

or disorders who received speech therapy in a one-to-one individual setting and/or group setting. A wide variation in the outcome measures (e.g., percentage of consonants correct, percentage of probe accuracy, size of phonetic and/or phonemic inventories) was reported across the 132 studies. Because their review did not focus on treatment intensity, only session length, dose frequency, and total intervention duration were reported. Session length was typically between 30 and 60 minutes and dose frequency was two to three times per week. Total intervention duration ranged from 3–18 months.

Williams (2012) there is a need to address the question of whether resources are being applied in an optimal manner. As a consequence, there has been a call to look within interventions to examine parameters that may contribute to intervention outcomes; specifically the intensity of intervention (dose, frequency, duration, and cumulative intervention intensity reviewed treatment intensity variables in three intervention studies that used phonological approaches (e.g., multiple opposition and/or minimal pair). Of the 3- to 7-year-old children with moderate to severe SSD ( $n = 22$ ), 18 children in studies 1 and 2 had an average of 17–20 therapy sessions per treatment condition, whereas four children in study 3 received an average of 4–5 sessions per treatment condition. Session length (30 minutes) and dose frequency (twice a week) were identical for all three studies, but dose varied from 46 to 82. The author concluded that (1) greater intensity yielded greater treatment outcomes, (2) intensity changed as intervention progressed, and (3) treatment intensity differed based on severity of the SSD. Williams (2012) recommended a minimum dose of 50 trials and a minimum number of 30 sessions for effective phonological therapy. In particular, for children who have severe SSD, a minimum of 70 trials per session for 40 sessions was recommended. In another study, Zeng et al. (2012) reviewed 20 randomized controlled trials to identify the relationship between dosage in interventions for treating phonology (9 studies), other domains of language such as syntax (10 studies), and vocabulary (7 studies) for children with developmental speech and language disorders. In terms of phonological intervention, the authors summarized the average session length (35 minutes), dose frequency (2.1 times per week), intervention duration (13 weeks), and the number of sessions (19 sessions). The authors concluded that with the current data, only descriptive data could be

provided, and it was not possible to make recommendations about optimal dosage.

Kaipa and Peterson (2016) reviewed seven speech intervention studies that compared different intensities of a specific intervention for speech disorders including SSD, dysarthria, acquired apraxia of speech, and childhood apraxia of speech. Only one study for SSD was included in this review (Allen, 2013) where dose frequency and total intervention duration were systematically manipulated. The authors found that higher treatment intensity (three times a week for 8 weeks) was favorable over lower treatment intensity (once a week for 24 weeks) for treating children with SSD. Recently, Sugden et al. (2018) reviewed 206 intervention research articles including 34 randomized controlled trials, 14 nonrandomized controlled trials, 28 quasi-experimental group designs, 67 single-case experimental designs, and 63 case studies. The authors reported that therapy in most published studies employed 30- to 60-minute sessions comprising a 50–100 production dose per session—two to three times a week.

In summary, the current literature review on speech therapy of in-person contexts revealed that the optimal treatment dose for children with SSD is 50–100 productions per session. The average session duration is 30 minutes, the average dose frequency is twice a week, and the average number of sessions is 24–34 sessions. Although total intervention duration varies, the average is 8–14 weeks.

The five reviews (Baker & McLeod, 2011; Kaipa & Peterson, 2016; Sugden et al., 2018; Williams, 2012; Zeng et al., 2012) helped Don obtain information on treatment intensity of in-person speech therapy, but these reviews have some limitations. First, except for one (Kaipa & Peterson, 2016) most reviews primarily described each study in regard to various intervention characteristics but did not engage in a critical appraisal or an evaluation of the process of each study. Although these reviews could be considered as a scope review whose aim is to summarize research findings and identify research gaps (Arksey & O'Malley, 2005), it would be beneficial if these reviews made a critical appraisal of each individual study so that readers are fully aware of the strengths and weaknesses of each study. Second, in addition to treatment intensity, the criterion for success is an important element to be set in clinical practice (e.g., 80% accuracy using probes). However, most reviews did not address the criterion for success except for Williams (2012). Among the three studies included in Williams's review, only one study mentioned the criterion for success: "Each

child received a maximum of 21 half-hourly treatment sessions. . .if they met the generalization criterion of 50% accuracy” (p. 457). Finally, some treatment intensity variables were not reported in these reviews. If any study did not report an element of treatment intensity, Don thought a note on which intensity measure was missing would be beneficial to readers. Therefore, when he searched the literature on treatment intensity of telepractice for children with SSD to answer his clinical question, Don kept in mind to incorporate these aspects in his systematic review.

## Clinical Question

Don formulated his research question using the Population Intervention Comparison Outcome (PICO) framework (Richardson et al., 1995). Don’s clinical question was: In speech intervention via telepractice for preschool and school-age children with speech sound disorders (SSD), is treatment intensity similar to or different from that of traditional in-person therapy for optimal treatment results? His clinical question followed the PICO model: (P) preschool and school-age children who are diagnosed with speech sound disorders (SSD), (I) speech therapy delivered via telepractice, (C) speech therapy delivered through in-person methods, (O) treatment intensity.

## Search for the Evidence

### Inclusion Criteria

Don included studies that met the following criteria: (1) the research must implement telepractice, (2) the population must be preschool and/or school-age children, (3) the population must have functional speech impairments without a medical diagnosis, (4) the study must measure at least one speech outcome, (5) the study must report at least one treatment intensity measure, (6) the research must be peer reviewed, and (7) the article must be available in English. He excluded articles that were expert opinions or survey reports. Articles referencing work with pediatric, adult, or geriatric populations with organic disorders or medical diagnoses were excluded.

### Search Strategy

After establishing the inclusion criteria for his research, Don searched seven databases including PubMed, Education Resources Information Center (ERIC), MEDLINE

Complete, CINAHL Complete, PsycInfo, ASHAWire, and the Cochrane Library using the following terms: telepractice OR telehealth OR telerehabilitation OR telemedicine OR telecare OR telespeech AND speech OR articulation OR phonolog\* AND interven\* OR treat\* OR therap\* AND child\*. This search generated a total of 334 citations. He excluded duplicates and the list was reduced to 169 citations. After using the inclusion criteria, the list was narrowed to 47 citations. He assessed the abstracts in detail to compare the inclusion and exclusion criteria and eliminated 40 articles. Don then completed full text reviews of the remaining seven articles. Two articles did not pass the full text analysis because one included organic or medical disorders and another did not clearly state treatment intensity. Thus, five articles were included in Don’s systematic review. Figure 1 displays Don’s selection process at each stage.

To confirm the results of his search process, Don asked his colleague Kimberly to evaluate approximately 30% of the citations ( $n = 50$ ) using the inclusion and exclusion criteria. The 50 articles were randomly chosen by using the random.org random number service. At the abstract and full text phases, inter-rater agreement between Don and Kimberly was 95%. Discrepancies were resolved through discussion between Don and Kimberly, with additional assessment by a third reviewer, and then resolved to the original decision.

## Evaluating the Evidence

### Description of Selected Studies

Table 2 presents summaries of the five studies describing participants, the number of target sounds, therapy approaches, the criterion for success, and assessment measures and treatment outcomes. The studies were published between 2003 and 2018, and a total of 49 children participated. Two studies (Lee, 2018; Pullins & Grogan-Johnson, 2017) included children with SSD without concomitant language impairments, while three studies (Grogan-Johnson et al., 2011, 2013; Jessiman, 2003) involved children with SSD and concomitant language impairments. Three studies (Grogan-Johnson et al., 2011, 2013; Pullins & Grogan-Johnson, 2017) employed control groups who received in-person intervention. Four studies (Grogan-Johnson et al., 2011, 2013; Lee, 2018; Pullins & Grogan-Johnson, 2017) focused on speech sound

intervention only, and one study (Jessiman, 2003) focused on both speech and language improvement. Only one study (Lee, 2018) reported the criterion for success.

Grogan-Johnson and colleagues (2011, 2013) and Pullins and Grogan-Johnson (2017) implemented the traditional articulation approach targeting a single sound at a time. Lee (2018) employed the multiple opposition phonological approach targeting several sounds simultaneously. Jessiman (2003) did not specify the intervention method. The number of target sounds varied from one or two sounds (Grogan-Johnson et al., 2013; Jessiman, 2003) to nine sounds (Lee, 2018). Three studies (Grogan-Johnson et al., 2011, 2013; Lee, 2018) measured improvement in children's speech sound production using both standardized assessment and nonstandardized assessment. Specifically, in addition to the Goldman-Fristoe Test of Articulation (GFTA-2; Goldman & Fristoe, 2000), Grogan-Johnson et al. (2011) and Lee (2018) adopted a probe assessment and Grogan-Johnson et al. (2013) adopted listener judgment of sound accuracy. To assess children's improvement, Jessiman (2003) used an informal probe and parent questionnaire, and Pullins and Grogan-Johnson (2017) used the functional communication measures from the ASHA K-12 School National Outcome Measurement System. All five studies reported progress in children's speech outcomes during post-treatment sessions.

Table 3 shows specific information on treatment intensity including dose, session duration in minutes, dose frequency, the number of sessions, total intervention duration, and total intervention duration in minutes for each study included in this review. Cumulative treatment intensity based on Warren et al. (2007) was not obtained because of lack of dose information in some of the selected studies. Instead, total intervention duration in minutes was obtained by multiplying dose frequency times session length times total intervention duration in order to make all studies comparable. Four studies (Grogan-Johnson et al., 2011, 2013; Jessiman, 2003; Lee, 2018) incorporated 20- to 60-minute sessions twice a week and one study (Pullins & Grogan-Johnson, 2017) incorporated 6-minute sessions five times a week. The average number of sessions for Jessiman (2003), Grogan-Johnson et al. (2011), and Lee (2018) were 12, 20, and 28, respectively. Grogan-Johnson et al. (2013) had the smallest number of total sessions (i.e., 9 sessions) because the study was conducted during a 5-week summer intervention program. Pullins and Grogan-Johnson (2017) had the largest mean number of total sessions (i.e., 127.9

sessions) because they employed 6-minute sessions five times a week during a school year. Children with SSD received a minimum of 240 minutes of therapy to a maximum of 1,920 minutes of therapy.

## Study Appraisal

Don examined the quality of the evidence using the modified Critical Appraisal of Treatment Evidence framework (CATE; Dollaghan, 2007) and the five-phase model (Robey, 2004). The CATE is a rating scale commonly used in speech-language pathology to evaluate the quality of research articles. Among the 15 appraisal items, Don selected and slightly modified eight evaluation items that are relevant to the articles (see Table 4). Because the CATE was developed for appraising group studies, Don modified some appraisal items (e.g., "Was the finding statistically significant?" changed to "Did intervention lead to improved treatment outcomes?"). Whether intervention led to improved treatment outcomes was determined either quantitatively (i.e., statistical significance) for group studies or qualitatively for single subject experimental design or case studies. The qualitative results included percentage of correct sound production, percentage of nonoverlapping data, percentage of data exceeding the median, and individual-level effect size. In addition to the eight appraisal items of the CATE, Don added three review items related to treatment intensity to ensure that the studies provided accurate and sufficient information to enable replication. These items included whether the treatment intensity reported in the article was specific for SSD, how many treatment intensity measures were reported, and whether treatment intensity was reported as a fixed value or as a range of values. According to Dollaghan (2007), studies can be rated as *compelling*, *suggestive*, or *equivocal*. Studies rated as *compelling* provide incontrovertible evidence. Studies are considered *suggestive* when their evidence is open to debate. Lastly, studies are rated as *equivocal* if opposite conclusions can be made by unbiased experts.

Robey's five-phase model (2004) is also commonly used to evaluate the level of clinical evidence. Phase I studies include case studies, retrospective studies, and small before-and-after studies for exploring, specifying, and estimating a treatment effect. The purpose of Phase I is to determine whether the target treatment is suitable for further clinical trials. Phase II studies include case-control studies, small within-group studies, and small group experimental-control studies. The main aims of Phase II studies are to explore the

various dimensions of the therapeutic effect and to build the necessary foundations for conducting a clinical trial. Phase III studies include parallel-group designs having a within effect (e.g., pre- and post-therapy), or between factor (i.e., comparing experimental and control group), as well as rigorous single case research. Phase III studies involve carrying out clinical trials to measure test efficacy. Phase IV uses field studies to measure the effectiveness of the treatment of interest in a real-world setting. Finally, Phase V studies involve determining the cost and the benefits of the treatment of interest.

After reviewing the five articles selected for review, Don rated the two studies conducted by Grogan-Johnson and colleagues (2011, 2013) as suggestive. The two studies had a control group, participants were randomly allocated between two conditions, the treatment was clearly described, and the intervention led to improved treatment outcomes. However, both studies included a small number of participants (7 children) as a group study. Furthermore, the assessors in Grogan-Johnson et al.'s (2011) study were not blind to the purpose of the studies and the intervention groups. The study also did not report the reliability of the other two progress measurements including pre- and post-targeted speech sound production levels and quarter progress report results. Grogan-Johnson et al. (2013) reported that the first author and the graduate students scored GFTA-2 separately, but the specific reliability information was not reported and reliability for another outcome measure, listener judgment, was not provided. These two studies are considered to be in Phase III because they attempted to assess the effect of telepractice using randomized controlled design.

Both studies provided treatment intensity information specific to SSD. Although Grogan-Johnson et al. (2011) reported four out of six components and Grogan-Johnson et al. (2013) reported all six components, the amount of treatment intensity in both studies had a wide range. For example, the number of sessions differed from 24 to 32 sessions and the session duration also varied from 20-minute therapy to 40-minute therapy in Grogan-Johnson et al. (2011). The amount of treatment intensity in Grogan-Johnson (2013) had a relatively limited range because the study was conducted during a 5-week summer program. One child completed eight sessions (maximum 10 sessions), three children completed nine sessions, and three children completed 10 sessions. The Grogan-Johnson (2013) study is one of two studies that reported dose information. The SLPs in the study targeted 75 productions if the child

was practicing the sound at the isolation level and 125 productions at the word or sentence level.

The examination of Lee's (2018) study based on the CATE guideline revealed that this study was a well-designed, single-case, experimental study and rated as compelling. Her study assessed participants' speech production, and assessors and participants were blind to the study goals. This study reported transcription reliability between two assessors, the experimental condition probes were randomized, and the experimental effects were replicated across participants to avoid possible threats to internal validity. This study is considered to be Phase III research because it attempted to evaluate the effectiveness of telepractice therapy using a rigorous single-case experimental design. Lee (2018) reported treatment intensity information specific to SSD. She reported all components of treatment intensity except dose. The amount of treatment intensity in Lee (2018) was reported as a fixed value rather than as a range. One child received 30-minute therapy twice a week for 12 weeks (total 24 sessions) and another child received 30-minute therapy twice a week for 16 weeks (total 32 sessions).

Jessiman's (2003) study provided equivocal evidence because it had several methodological weaknesses. This study provided information on telehealth technology and discussed the effectiveness and efficiency of speech and language services via telehealth. However, this study did not describe clearly how treatment was implemented; in addition, this study lacked randomization and control conditions and included a small participant sample. The study also did not report information on measurement reliability and validity or on blinding. The informal probes and parent questionnaires were completed to assess children's speech sound productions before, at the mid-point, and after treatment; however, Jessiman did not report descriptive information on the change in children's speech production. This study is categorized under Phase I research because it examined the therapeutic effect of telepractice as case study research. Two children in Jessiman's (2003) study received therapy twice a week for 2 months. The biggest barrier to replicate the treatment intensity in her study is that both language and speech activities were included in a 30-minute session and it was not clear how much time was spent on speech therapy. The session duration was 60 minutes for the first four sessions to help clinicians and caregivers become familiar with the telepractice setting, and the duration decreased to 30 minutes for the last eight sessions.



Pullins and Grogan-Johnson (2017) described the treatment in detail, the rationale was plausible, and their intervention led to improved treatment outcomes. Moreover, participants were representative and randomly assigned to the conditions. However, this study did not provide information on blinding and detailed participants' performance on outcome measures. The major limitation of this study was that the two groups were not comparable to each other in that they had different therapy schedules (i.e., 6 minutes five times per week in the telepractice group vs. 30 minutes once a week in the in-person group) and the total session lengths for the two groups were significantly different (601 minutes for the in-person group vs. 767 minutes for the telepractice group). It is not certain whether this study examined different service delivery models or the effects of different treatment intensity. As a result, this study was rated as equivocal. Because Pullins and Grogan-Johnson attempted to examine a modified version of speech sound therapy using a small participant sample, this study is categorized as Phase II research.

In summary, Don rated three out of five studies as either compelling or suggestive, supporting the effectiveness of telepractice, and two studies as equivocal because they had methodological limitations. The three studies rated as either compelling or suggestive were considered Phase III whereas the two equivocal studies were categorized as either Phase I or II research. Overall, all studies had a small number of participants (2–9 participants per group), and a majority of the studies did not include blinding or reliability and validity information on the outcome measurements. To confirm his study appraisal, Don asked his colleague Kimberly to examine the quality of the evidence in the five studies using the modified CATE framework and Robey's (2004) five-phase model. Don asked her to fill out an appraisal form of study quality (see Table 4) that included 12 questions for the five studies selected. Kimberly completed the appraisal form while being blinded to Don's appraisal. Don and Kimberly compared their appraisals and found that their agreement was 98%. Discrepancies were resolved through discussion between Don and Kimberly, with additional assessment by a third reviewer.

Four studies reported treatment intensity information specific for SSD. Three studies (Grogan-Johnson et al., 2011; Jessiman, 2003; Lee, 2018) provided therapy over a restricted duration (i.e., predetermined number of weeks) and two studies (Grogan-Johnson et al., 2011; Pullins & Grogan-Johnson, 2017) were conducted during an academic

year. Most studies reported either five or six components of treatment intensity. Dose was the component most studies did not report. Most studies implemented 20- to 40-minute therapy sessions twice a week. The total number of sessions varied between 8 and 32 sessions when the therapy was implemented twice a week.

## The Evidence-Based Decision

The primary purpose of Don's review was to obtain external evidence to answer his clinical question: In speech intervention via telepractice for preschool and school-age children with SSD, is treatment intensity similar to or different from that of traditional in-person therapy for optimal treatment results? Even though there is limited research on the optimal treatment intensity in a telepractice context for children with SSD, the available evidence suggests that traditional in-person therapy and telepractice service require similar treatment intensity for this population. According to the current literature on in-person speech intervention, children with SSD receive 24–34 therapy sessions twice a week for 30 minutes on average with 50–100 productions per session. The review of the five studies on telepractice service revealed that children with SSD benefited from intervention when they received 24–32 therapy sessions twice a week for 20–40 minutes on average with 75–100 productions per session. In addition to external scientific evidence, Don was aware that an evidence-based decision should be also based on clients' needs and preferences as well as the clinician's internal experience. Based on these three elements, Don's clinical decision was to provide speech therapy via telepractice in 30-minute, one-to-one sessions twice a week during a semester, resulting in 30 sessions. He planned to target 75–100 production episodes per session.

However, Don was aware that there are some limitations in the current literature on the intensity of treatment delivered through telepractice. First, the five telepractice studies Don reviewed provided therapy in a one-to-one format while the current reviews on treatment intensity of in-person intervention for children with SSD included both group and one-to-one therapy formats. Therefore, it may not be plausible to make a direct comparison of treatment intensity between these two delivery methods. Second, the severity of SSD was not clearly described in the telepractice studies Don reviewed. Only Lee (2018) reported that her study included two

children with severe phonological disorders. Thus, it was not clear whether children with severe SSD in Don's caseload needed the same treatment intensity compared to children with mild to moderate SSD when he delivered service via telepractice. Williams (2012) suggested different treatment intensities depending on the severity in the in-person method. Don decided to follow this guideline for children who have severe SSD. In addition to severity, it was not certain how other individual variables such as concomitant disorders, client's socioeconomic status, and/or cultural background could affect treatment intensity. Regarding this concern, Don referred to Farquharson et al.'s recent paper (2020) that explored child and therapy factors contributing to gains in speech sound production. Third, Don was also not certain how rapport with his clients would affect the intensity of therapy delivered through telepractice. No previous telepractice studies addressed the level of rapport between the clinician and client. Akamoglu et al. (2018) expressed concern that SLPs might have difficulty in building rapport with their clients in telepractice service. A couple of children in Don's caseload were relatively new. He was not sure if treatment effectiveness would differ between new and old clients via telepractice. Based on these limitations, Don decided to start using telepractice service in a one-to-one format with children with SSD who had already been in his caseload since the previous year to ensure he met the needs of the children. Fourth, Don was also aware of technological aspects during telepractice intervention. In Lee's study (2018), it was reported that one participant was dropped because of technical difficulties. Don planned to discuss optimal technology requirements with the school IT team to ensure the adequate transmission of the online connection for the best possible therapy outcomes. He also planned to share the information with caregivers of his clients. Finally, following the previous studies (Grogan-Johnson et al., 2011; Jessiman, 2003; Lee, 2018), Don planned to develop probes to evaluate the child's progress and set up the criterion of success for each child before beginning telepractice intervention. Don looked forward to exploring the effectiveness of his therapy via telepractice and planned to administer an informed satisfaction survey of caregivers' telepractice experiences.

## Authors' Note

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**Table 1. Summary of Treatment Intensity in Face-to-Face Methods**

Source	# of SSD studies reviewed	Dose	Session length	Dose frequency	# of sessions	Total intervention duration	Cumulative intervention intensity <sup>a</sup>
Baker & McLeod (2011)	132	Not reported	30–60 min	2–3 x week	Not reported	12–72 weeks	Not reported
Williams (2012)	3	35–149	30 min	2 x week	14–21 (two studies) or 4–13 (one study) per intervention	10–11 weeks	2,455–2,499 trials (study 1 & 2) or 529 trials (study 3)
Zeng et al. (2012)	9	Not reported	35 min	2 x week	Not reported	13 weeks (ranges: 6–34)	Not reported <sup>b</sup>
Kaipa & Peterson (2016)	1 <sup>c</sup>	81	30 min	3 x week	24	8 weeks	1,944 trials
Sugden et al. (2018)	199	50–100	30–60 min	2–3 x week	43.8 (ranges: 10–105)	61.3 weeks (ranges: 1–184)	Only 5 studies reported

*Note.* <sup>a</sup>Cumulative intervention intensity was calculated by multiplying dose x dose frequency x total intervention duration. <sup>b</sup>Zeng et al. (2012) reported cumulative intervention intensity by multiplying session length x dose frequency x total intervention duration, which is different from Williams’ (2012) or Kaipa & Peterson’s (2016) definition. <sup>c</sup>Only one article in Kaipa and Peterson’s (2016) review was related to SSD.

**Table 2. Summary of Research Articles Selected for the Current Review**

Source	Participants/ treatment group	Participants/ comparison	# of target sounds	Therapy approach	Criterion for success	Assessment measures and treatment outcomes
Grogan-Johnson et al. (2011)	Telepractice: 7 children with SSD (ages 7:1–11:11)	Face-to-face practice: 6 children with SSD (ages 6:3–10:9), 3 children also had expressive language impairments	1–4 sounds	Traditional SSD intervention including auditory discrimination, sound production training, and maintenance	N/A	Students significantly improved in the standardized assessments at pretest and posttest.  GFTA-2: 72.71 at pretest → 89.00 at posttest  Target sound production: 39% accuracy at pretest → 85.65% at posttest
Grogan-Johnson et al. (2013)	Telepractice: 7 children with SSD (ages 6:4–9:9)	Face-to-face practice: 7 children with SSD (ages 7:9–10:0)	1–2 sounds	Traditional speech sound intervention including identifying target sounds and positions, ear training, production training, transfer, carryover, and maintenance	N/A	Children significantly improved in the standardized assessments and listener judgment  GFTA-2: 76.85 at pretest → 83.57 posttest  Descriptive information on listener judgment was not reported.
Jessiman (2003)	2 children (one child with mild articulation delay with mild language delay, another child with difficulties producing fricatives with mild language delay)	N/A	1–2 sounds	Articulation and language therapy  Articulation: /f/ and /str/ blend sounds  Language: understanding and use of language form	N/A	Both children made progress on the informal probes.  Parents reported satisfaction with the gains their children made and with service using the telehealth technology.  Descriptive information on the children's progress was not reported.
Lee (2018)	2 children (ages 4:10 & 6:0 years old) who were diagnosed with phonological disorders	N/A	6 or 9 sounds	Multiple opposition phonological approach based on individual child's phoneme collapse patterns using phonemic contrasts  Child A: 2 target sounds/phase for 3 phases (total 6 target sounds)  Child B: 3 target sounds/phase for 3 phases (total 9 target sounds)	At least 1 target sound for each target group reached 100% accuracy.	Child A: 0%–20% accuracy at pretest → 60%–100% at 2-week maintenance probe  GFTA-2: 2 SD below the mean at pretest → 1.5 SD below the mean at 2-month follow-up  Child B: 0% accuracy at pretest → 80%–100% accuracy at 2-week maintenance probe  GFTA-2: 2 SDs below the mean at pretest → 1 SD below the mean at 2-month follow-up

**Table 2. Summary of Research Articles Selected for the Current Review (continued)**

Source	Participants/ treatment group	Participants/ comparison	# of target sounds	Therapy approach	Criterion for success	Assessment measures and treatment outcomes
Pullins & Grogan-Johnson (2017)	9 children (ages 5:8–10:10) with speech sound impairment, no concomitant language impairment	9 children (ages 5:1–10:5) with speech sound impairment, no concomitant language impairment	2–5 sounds	Speech sound intervention  Telepractice group: 10 productions of the target sound and practice producing the target sounds using pictures of words	N/A	Using the functional communication measures from the ASHA K–12 School National Outcomes Measurement Systems, children improved from 1.11 to 6.11.

Note. SSD: Speech sound disorders; GFTA-2: Goldman-Fristoe Test of Articulation; ASHA: American Speech-Language-Hearing Association

**Table 3. Summary of Treatment Intensity in the Selected Studies**

Source	Dose (# of trials per session)	Session length	Dose frequency	# of sessions	Intervention duration	Total intervention duration
Grogan-Johnson et al. (2011)	Not reported	20 minutes (6 children) or 40 minutes (1 child)	Not reported	24–48	7 months	480 minutes (6 children) or 1,920 minutes (1 child)
Grogan-Johnson et al. (2013)	75–125	30 minutes	2 x week	8–10	5 weeks	240–300 minutes
Jessiman (2003)	Not reported	30–60 minutes	2 x week	12	2 months	480* minutes
Lee (2018)	Not reported	30 minutes	2 x week	24–32	12 or 16 weeks	720 minutes or 960 minutes
Pullins & Grogan-Johnson (2017)	75–100	6 minutes	5 x week	95–150	9 months	570–900 minutes

Note. \* The sessions included both speech sound and language therapy. It is not clear how much time was spent on the speech sound therapy.

**Table 4. Appraisal of Study Quality**

Study quality appraisal questions		Grogan-Johnson et al. (2011)	Grogan-Johnson et al. (2013)	Jessiman (2003)	Lee (2018)	Pullins & Grogan-Johnson (2017)
1	Was there a plausible rationale for the study?	Yes	Yes	Yes	Yes	Yes
2	Was there a control group or condition?	Yes	Yes	No	Yes	Partially <sup>a</sup>
3	Included randomization and sufficient number of participants per group?	No	No	No	N/A	No
4	Were methods and participants specified prospectively?	Yes	Yes	No	Yes	Yes
5	Was treatment described clearly and implemented as intended?	Yes	Yes	No	Yes	Yes
6	Was the measure valid and reliable, in principle and as employed?	Partially	Partially	No	Yes	Yes
7	Was the outcome evaluated with blinding?	No	Yes	No	Yes	No
8	Did intervention lead to improved treatment outcomes?	Yes	Yes	UR	Yes	Yes
9	Was the treatment intensity reported specific for SSD?	Yes	Yes	No	Yes	Yes
10	How many treatment intensity measures were reported? (total 6 measures)	4	6	5	5	6
11	Was the amount of treatment intensity reported as a fixed value or as a range of values?	Wide range	Wide range	Fixed	Fixed	Wide range
<b>Appraisal rating</b>		Suggestive	Suggestive	Equivocal	Compelling	Equivocal
<b>Phase of research</b>		III	III	I	III	II

*Note.* This appraisal form was adopted from two sources: 1) Dollaghan, C. A. (2007). *The handbook for evidence-based practice in communication disorders*. Paul H. Brookes Publishing and 2) Robey, R. R. (2004). A five-phase model for clinical-outcome research. *Journal of Communication Disorders*, 37(5), 401–411. <https://doi.org/10.1016/j.jcomdis.2004.04.003>

\* UR: unable to rate

<sup>a</sup> The control group received face-to-face intervention; however, the experimental group and the control group were not identical in the therapy frequency and intensity.

*Figure 1. Process to Select Relevant Research*

