AJSLP

Research Article

Evaluation of Parent- and Speech-Language Pathologist–Delivered Multiple Oppositions Intervention for Children With Phonological Impairment: A Multiple-Baseline Design Study

Eleanor Sugden,[a,b] Elise Baker,[a] A. Lynn Williams,[c] Natalie Munro,[a] and Carol M. Trivette[d]

Purpose: Evidence for the multiple oppositions intervention approach indicates it should be delivered 3 times weekly; however, this high dose frequency is not provided by many speech-language pathologists worldwide. This study investigated whether parents could be involved in delivering phonological intervention to fulfill this intensity shortfall.
Method: Five children with moderate-to-severe phonological impairment aged 3;3–5;11 (years;months) and 1 of their parents participated in this study using a multiple-baseline across participants design. Participants attended one 60-min clinic-based session per week for 8 weeks, and parents completed home practice 2 times per week over this period after receiving training. Parents also attended a 60-min training session prior to commencing intervention.
Results: All children showed a treatment effect to treated words. Three of the 5 children demonstrated a large effect size for generalization to nontreatment words, with 1 child demonstrating a moderate effect and 1 child demonstrating no effect. However, all children showed qualitative changes to their speech system. Three of the 5 children experienced significant changes to communicative participation. Measures of treatment fidelity indicated that parents were able to competently deliver the intervention both within the clinic and at home.
Conclusions: Combined parent- and speech-language pathologist–delivered multiple oppositions intervention is effective for some children with moderate-to-severe phonological impairment. The findings indicate that parents can be trained to competently and confidently deliver phonological intervention. Further evidence is needed to identify optimal child and parent characteristics most suited to this modified service delivery approach.
Supplemental Material: https://doi.org/10.23641/asha.10565885

Speech sound disorders (SSD) are a frequent condition of early childhood, with the most common type being a phonological impairment (Dodd, 2014). Children with phonological impairment have difficulty learning the phonological system of the ambient language, which results in pattern-based speech errors affecting entire classes or features of sounds. These children face an increased risk of literacy difficulties, poor educational outcomes, bullying, and low self-esteem compared to their typically developing peers (McCormack, Harrison, McLeod, & McAllister, 2011). Research has shown that the effects of SSD are not limited to the child but can extend to the family as well, with parents having described the experience of having a child with SSD as a "battle"

[a]Discipline of Speech Pathology, The University of Sydney, New South Wales, Australia
[b]School of Psychological Sciences and Health, University of Strathclyde, Glasgow, United Kingdom
[c]Department of Audiology and Speech-Language Pathology, East Tennessee State University, Johnson City
[d]Department of Early Childhood Education, East Tennessee State University, Johnson City
Correspondence to Eleanor Sugden: eleanor.sugden@strath.ac.uk

Editor-in-Chief: Julie Barkmeier-Kraemer
Editor: Mary Fagan
Received October 20, 2018
Revision received February 25, 2019
Accepted August 12, 2019
https://doi.org/10.1044/2019_AJSLP-18-0248

Disclosure: *A. Lynn Williams developed the multiple oppositions intervention approach; however, she received no royalties from the use of this approach within the study reported in this article. The other authors declared that no competing interests existed at the time of publication.*

(McCormack, McAllister, McLeod, & Harrison, 2012, p. 141). Fortunately, several evidence-based intervention approaches for treating phonological impairment exist (Baker & McLeod, 2011). One component of intervention important for outcomes is intervention intensity (Baker, 2012).

Intervention Intensity

Intervention intensity comprises dose form, dose, dose frequency, total intervention duration, and cumulative intervention intensity (Warren, Fey, & Yoder, 2007). *Dose form* refers to the activity or task in which the active ingredients or elements of an intervention are provided, which are delivered at a particular *dose*. For SSD interventions, dose is usually conceptualized as the number of trials or teaching moments a child is given to practice a goal (e.g., 100 trials to produce treatment words) in a session. These sessions are delivered at a particular *dose frequency* (e.g., two times weekly) over a period of time (i.e., over a *total intervention duration,* such as 12 weeks or for a total of 25 sessions). *Cumulative intervention intensity* is a product of these parameters and provides a general indicator of overall intensity. The research base for treating phonological impairment includes studies that have typically delivered intervention two to three times per week, in sessions containing 100 production trials, for 3–46 months (Sugden, Baker, Munro, Williams, & Trivette, 2018b). Although the principles of evidence-based practice would suggest that speech-language pathologists (SLPs) should strive to deliver intervention at the intensity described in the research evidence (e.g., Kaderavek & Justice, 2010), this may not be feasible for many SLPs worldwide.

Surveys of United States–based SLPs who provide intervention to children with SSD have reported that SLPs typically report providing 30–60 min of intervention per week, in sessions comprising 21–50 trials typically scheduled twice per week, for an average of 78.3 sessions over 16.0 months (Brumbaugh & Smit, 2013; Sugden, Baker, Williams, Munro, & Trivette, 2016). These results, while meeting some of the empirical recommendations regarding intervention intensity, do not align with the evidence base regarding dose. In Australia and the United Kingdom, this discrepancy between recommended practice and the realities of clinical practice is more stark. For example, SLPs in Australia have reported that they most commonly provide intervention to children with SSD once per week or one to two times per month, for an average of 22.7 sessions over 8.8 months, each comprising between 21 and 99 production trials (Sugden et al., 2018b). SLPs in the United Kingdom report providing even less intervention to these children (Hegarty, Titterington, McLeod, & Taggart, 2018). Although these results were not specific to a particular intervention approach, the discrepancies with the evidence base raise concerns about the effectiveness of phonological intervention delivered to children worldwide. Strategies are needed to overcome this intensity shortfall.

Parent Involvement in Intervention

One strategy adopted by SLPs to increase the amount of practice children receive is to involve parents in intervention by asking them to complete speech practice at home with their children (Sugden, Baker, Munro, Williams, & Trivette, 2018a). Involving parents within the intervention process has the potential to increase maintenance and generalization of targets, as families can incorporate therapeutic techniques and targets within everyday communicative contexts (Bowen & Cupples, 2004). The success of parent-delivered intervention, including home practice for SSD, relies on parents learning and using intervention strategies successfully (Roberts & Kaiser, 2011). A review of parent-implemented home therapy for speech and language disorders found that it is most successful when parents received explicit and comprehensive parent training incorporating evidence-based training and coaching strategies (Tosh, Arnott, & Scarinci, 2017). However, few research studies have explicitly sought to train parents to deliver phonological intervention (Sugden, Baker, Munro, & Williams, 2016). Of those that have, details about how parents were trained—and in what they were trained—were sparse (Sugden, Baker, Munro, et al., 2016). Further research investigating parents' competence and confidence in delivering phonological intervention after receiving comprehensive and evidence-based training is therefore needed. The inclusion of such training within intervention may address some of the perceived barriers to parent involvement in intervention, such as parents not having the skills or motivation to conduct intervention at home (Melvin, Meyer, & Scarinci, 2019; Sugden et al., 2018a; Sugden, Munro, Trivette, Baker, & Williams, 2019).

The Multiple Oppositions Intervention Approach

The multiple oppositions approach is a contrastive phonological intervention approach for treating moderate and severe phonological impairment in children (Williams, 2000a, 2000b, 2010). The approach explicitly targets the homonymy arising from collapses of contrast present within a child's speech. These collapses of contrast occur when a child produces multiple adult phonemes as a single sound, resulting in multiple words sounding the same and thereby reducing intelligibility. For example, a child who collapses /s, ʃ, ʧ, k, sk, tɹ/ to the default [t] would produce the words *sip*, *ship*, *chip*, *kip*, *skip*, and *trip* all as [tɪp], making it difficult for a listener to understand the child's intended meaning. The approach aims to induce change in a child's phonological system by targeting multiple sounds simultaneously from across a collapse. The multiple oppositions approach has empirical evidence—ranging from single-case studies to a randomized controlled trial—supporting its efficacy (e.g., Allen, 2013; Lee, 2018; Williams, 2000a). Unlike other approaches for treating phonological impairment, evidence also exists on the optimal intensity of the intervention. This research suggests that the intervention should be delivered three times per week, for a minimum

of 30 sessions, each comprising at least 50 production trials; for children with a severe phonological impairment, a minimum of 70 production trials in at least 40 sessions is needed (Allen, 2013; Williams, 2012). When considering this evidence in light of the current services provided by SLPs, the need for strategies to overcome intensity shortfalls is clear. No studies have investigated the outcomes following parent-delivered multiple oppositions intervention.

This Study

In this study, we investigated the efficacy of parent-delivered multiple oppositions intervention for children with phonological impairment. In light of the discrepancy between clinical practice and the evidence base regarding intervention intensity for children with phonological impairment, we adapted the multiple oppositions intervention approach to fit the service delivery models currently used by SLPs in Australia. To do this, one session was delivered per week in the clinic (reflecting current service delivery practices) with two sessions per week delivered by a trained parent at home. In this way, children received the evidence-based intensity of three sessions of multiple oppositions intervention per week. In addition to measuring the impact of intervention on children's speech accuracy, this study aimed to investigate the impact of parent- and SLP-delivered multiple oppositions intervention on the communicative participation of children with phonological impairment. Given the research indicating poor communicative participation for children with SSD (McCormack et al., 2011), it is imperative that research considers the functional outcomes of intervention on children's lives. The research questions were as follows:

- Does parent- and SLP-delivered multiple oppositions intervention lead to an improvement in the speech accuracy and communicative participation of children (3;0–5;11 [years;months]) with a moderate or severe phonological impairment?
- Given training, can parents of children (aged 3;0–5;11) with a phonological impairment deliver multiple oppositions intervention (a) at specified intensities, (b) competently (i.e., using accurate instruction and feedback), and (c) with confidence?

Method

This research received ethical approval from The University of Sydney (Protocol 2016/390). The trial was prospectively registered on the Australian New Zealand Clinical Trials Registry (ACTRN12616000849493).

Participants

Five parent–child dyads participated in this study. Participants were recruited using several strategies, including advertising the study to local SLPs, posting information about the study on social media sites dedicated to speech-language pathology, and contacting families who had previously participated in our research. Inclusion criteria for the child participants were as follows: (a) at least six sounds in error across two or three manner categories of consonant production, resulting in a phonological impairment appropriate to treat using the multiple oppositions intervention approach; (b) aged 3;0–5;11 at time of enrollment into the study; (c) normal hearing bilaterally, as measured by a pure-tone hearing screener at 500, 1000, 2000, and 4000 Hz at 20 dB; (d) receptive vocabulary above the 16th percentile, as measured by the Peabody Picture Vocabulary Test–Fourth Edition (Dunn & Dunn, 2007); (e) normal oral structure and function (Robbins & Klee, 1987); (f) English as strongest or equally strongest language, by parent report; (g) no other concomitant developmental diagnoses; and (h) willingness to participate. Parents were required to meet the following inclusion criteria: (a) willing to attend weekly intervention sessions and complete home practice between sessions, given training, and (b) functional level of English. Table 1 summarizes participant details. A measure of the participants' socioeconomic status is provided within the table. Child participants were invited to select their own pseudonyms, which are used henceforth. All but one child participant had previously received speech and/or language intervention services; however, none had received intervention using the multiple oppositions approach. Participants were asked to cease accessing other speech pathology intervention services between the initial assessment and immediate follow-up assessment. Only one participant was receiving services in the month preceding their involvement in the study; they ceased accessing that service during the period of our study. One child received one intervention session from a private SLP unconnected to the research between the immediate and final follow-up assessment points; no other participants accessed intervention services until after the final follow-up assessment.

Experimental Design

A single-case nonconcurrent multiple-baseline across participants design was used in this study. Participants were randomly allocated to receive three, four, five, or six baseline probes (Kratochwill et al., 2010). The intervention was replicated across five participants.

Procedure

The first author (a qualified SLP) conducted the eligibility and initial assessments, baseline, and all intervention sessions. The first author was trained in the delivery of multiple oppositions intervention by the third author, who developed the approach.

Eligibility and Initial Assessment

In addition to the measures used to determine eligibility, a range of speech, language, emergent literacy, and communicative participation assessments was administered. Tests are listed in Table 2, along with each child's

Table 1. Participant details and treatment targets.

Child[a]	Age (years;months)	Gender	Parent[a]	Child demographics and medical, social, and developmental history	Targets and example word set
Princess	5;5	F	Rose (mother)	Youngest of three children with a family history of SSD Monolingual English-speaking family Princess attends preschool 3 days per week, and Rose is not in paid employment. IRSAD[b] decile = 4	[d] ~ [ʃ, f, ʤ, st] Dough ~ *show*, *foe*, *Joe*, *stow*
Thomas	3;3	M	Clara (mother)	Only child with a family history of dyslexia Thomas previously had bilateral grommets, has had his adenoids removed, and had difficulties feeding. Monolingual English-speaking family Thomas attends formal care 3 days per week, and Clara is employed part-time. IRSAD decile = 10	[d] ~ [g, ʤ, st] Dane ~ *gain*, *Jane*, *stain*
Owen	5;11	M	Rory (father)	Oldest of two children with no family history of communication difficulties Punjabi is spoken at home; however, father reports that he speaks in English to Owen. Owen attends school 5 days per week, and Rory is employed full-time. IRSAD decile = 5	[d] ~ [z, g, sk] D ~ *Zee*[c], *ghee*, *ski*
Marshall	4;4	M	Donna (mother)	Youngest of three children with a family history of SSD and dyslexia Marshall attends preschool 4 days per week, and Donna is employed full-time. IRSAD decile = 10	[d] ~ [k, ʃ, ʤ, st] Deep ~ *keep*, *sheep*, *Jeep*, *steep*
Gracie	3;9	F	Amy (mother)	Youngest of three children with a family history of SSD Gracie attends preschool 2 days per week, and Amy is not in paid employment. Monolingual English-speaking family IRSAD decile = 10	[d] ~ [g, ʧ, st] Dane ~ *gain*, *chain*, *stain*

Note. F = female; SSD = speech sound disorder; M = male.

[a]Pseudonyms are used for all children and their parents. [b]Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD; Australian Bureau of Statistics, 2011), a measure of socioeconomic status. Lower deciles indicate regions with relatively greater disadvantage and less advantage. [c]Note that, in Australian English, the final letter of the alphabet is pronounced "zed." Thus, this was a nonsense word for this participant.

results. The children's speech was also assessed using (a) the Polysyllable Preschool Test (a single-word test comprising 30 polysyllabic words; Baker, 2013b), (b) the Phonological Assessment of Collapses of Contrast (a single-word test comprising rhyming words developed to identify collapses of contrast; Baker, 2013a), (c) a stimulability assessment (Powell & Miccio, 1996), and (d) a connected speech sample. Summaries of the children's speech systems are presented in Supplemental Material S1. All assessment sessions were video- and audio-recorded and were conducted in a quiet therapy room at The University of Sydney's speech-language pathology clinic.

Target Selection

Phoneme collapses present in each child's phonological system were identified based on the child's performance on single-word assessments and subsequent analysis using the Children's Independent and Relational Phonological Analysis (CHIRPA; Baker, 2017). The largest phoneme collapse was chosen to target in intervention. Three to four target phonemes were selected from this collapse, following the principles of maximal classification and maximal distinction (see Williams, 2000b). Details of each child's targets and an example word set are presented in Table 1. Further information about target selection is available in Supplemental Material S2.

Baseline Phase and Generalization Probes

Baseline probe sessions were conducted once per week prior to the commencement of intervention, either at the university's speech-language pathology clinic, at the participant's home, or via Adobe Connect. The child's final baseline probe was conducted at the beginning of the first intervention session (parent training session). Generalization probes were conducted at the beginning of each clinic-based intervention session. Baseline and generalization probes contained 10 nontreatment words starting with each of a child's target phonemes (for a total of 30–40 words, depending on each child's number of targets), plus two nontreatment words starting with each of the

Table 2. Children's initial assessment results.

Assessment	Princess	Thomas	Owen	Marshall	Gracie
Peabody Picture Vocabulary Test–Fourth Edition (Dunn & Dunn, 2007)					
Standard score (percentile)	102 (55th)	138 (99th)	105 (63rd)	98 (45th)	107 (68th)
Interpretation	WNL	> Average	WNL	WNL	WNL
Test for Auditory Comprehension of Language–Fourth Edition (Carrow-Woolfolk, 2014)					
Grammatical Morphemes subtest					
Scaled score (percentile)	6 (9th)	15 (95th)	8 (25th)	8 (25th)	13 (84th)
Interpretation	< Average	Superior	Average	Average	> Average
Elaborated Phrases and Sentences subtest					
Scaled score (percentile)	6 (9th)	13 (84th)	7 (16th)	7 (16th)	10 (50th)
Interpretation	< Average	> Average	< Average	< Average	Average
Comprehensive Test of Phonological Processing–Second Edition (CTOPP-2; Wagner et al., 2013)					
Phonological Awareness Composite					
Sum of scaled scores	16	—[a]	20	*Discontinued: no score recorded*	—[a]
Interpretation	Poor	—	< Average	—	—
Diagnostic Evaluation of Articulation and Phonology (DEAP; Dodd et al., 2002)					
Phonological Assessment					
PCC[b]	61.0	53.2	39.7	29.1	52.5
Inconsistency Assessment[c]					
% Inconsistent	—	12	24	16	—
Interpretation	—	Consistent	Consistent	Consistent	—
Focus on the Outcomes of Communication Under Six (Thomas-Stonnell et al., 2012)[d]					
Total score	255	204	228	179	215
Intelligibility in Context Scale (McLeod et al., 2012)[e]					
Average total score	3.43	2.86	3.57	2.86	3.0

Note. WNL = within normal limits.

[a]Not assessed using the CTOPP-2 as under the age of 4 years at the time of initial assessment. [b]Percent consonants correct. [c]On the basis of their performance on the single-word speech assessments, three participants were assessed using the DEAP Inconsistency subtest. [d]Parent-reported measure to evaluate change in communicative participation in preschool children. [e]Parent-reported measure of how well children are understood by a range of listeners. Higher scores (maximum 5) indicate that the child is more easily understood.

nontreated phonemes from a child's target collapse. Baseline probes additionally contained the child's treatment words so that any changes in pretreatment production of these words could be monitored. Consequently, baseline probes varied in length from 51 to 86 words, and generalization probes varied in length from 36 to 66 words. Probe items were presented randomly to the child and elicited using delayed imitation (3- to 5-s delay, in which the clinician held up three fingers and asked the child to say the word only when all of the fingers had been put down).

Intervention

Children received nine 60-min university clinic-based intervention sessions using the multiple oppositions approach over 9 weeks. The first of these sessions was a dedicated parent training session. Further information is provided under the Parent Training section below. The subsequent eight sessions focused on the multiple oppositions approach, with intervention delivered by both the SLP and the parent.

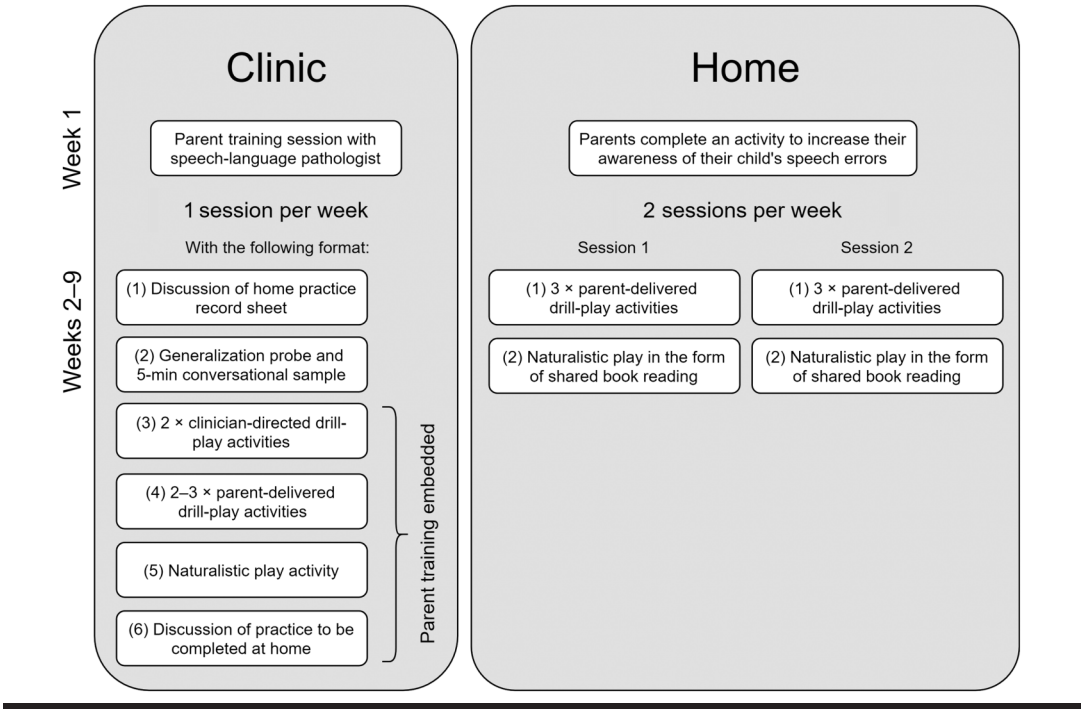
All children commenced intervention at Phase 1 of multiple oppositions and progressed through subsequent phases upon meeting predetermined criteria regarding production accuracy across two treatment sets, as outlined in the treatment paradigm (see Figure 1 in Williams, 2000a, for the criteria to move between phases). Information about each phase, definitions of treatment sets and word sets, and an example treatment script for Phase 2, Step 1 of multiple oppositions intervention are provided in Supplemental Material S2.

Figure 1 depicts the structure of the intervention phase. Naturalistic play activities (Part 5 of the clinic-based sessions in Weeks 2–9) incorporated strategically selected toys containing the child's target phonemes to provide multiple opportunities for the child to hear and produce the targets in conversation. These activities were child directed and followed a time-based, rather than dose-based, criterion with each activity lasting an average of 6 min 21 s.

Home practice. Parents were asked to complete home practice twice per week. Further information about these sessions is shown in Figure 1. Details about how the multiple oppositions approach was adapted for delivery by parents at home are provided in Supplemental Material S2. Parents were provided with all required resources.

Parent training. In the parent training session, the SLP provided and discussed information sheets about (a) communication and the difference between speech and language; (b) children's typical speech and language development; (c) an overview of SSD, with a focus on phonological impairment; (d) intervention for phonological impairment; (e) the multiple oppositions approach; (f) parent training; and (g) an outline of the clinic-based sessions and expectations for home. In response to research suggesting that untrained adults may have difficulty perceiving children's speech errors (Munson, Johnson, & Edwards, 2012), parents were provided with a list of 10–15 words

Figure 1. Structure of the intervention phase.



starting with their child's target sounds at the end of this session. Parents were requested to listen to and note down how their child produced these words in everyday conversation throughout the week.

During the subsequent clinic-based intervention sessions, parents were trained using multiple strategies (Dunst & Trivette, 2009) according to five principles outlined by Rush and Shelden (2011). Namely, training incorporated (a) joint planning, (b) observation, (c) action, (d) reflection, and (e) feedback. The integration of these principles within training is outlined in Supplemental Material S3. A key feature of the training was the use of structured observation sheets. Parents were provided with a checklist to rate the SLP's delivery of key elements of the intervention; the SLP used the same checklist to rate each parent's delivery of the intervention. Ratings were then compared. These observation checklists were used each time a child entered a new phase or step of intervention. By structuring parents' observation in this way, it was expected that the key elements of intervention would become salient to the parents. The observation sheets also provided clear opportunities to guide feedback.

Resources. When the child entered a new phase or step of multiple oppositions intervention, parents were provided with an information sheet describing the phase, the key elements, and an example script to use during intervention. At the end of each clinic-based session, parents were provided with two sheets. The first of these was a session summary sheet, in which parents were encouraged to write a brief summary of the session and their plans for home practice. The second sheet (a home practice record sheet) was to be completed at home throughout the week: On this sheet, parents were asked to list when they completed home practice, to record how many activities were conducted (to enable calculation of intervention intensity), and to reflect on their delivery of intervention at home.

Intervention tailoring. Single-case experimental design research affords a focus on the individual child. Children respond differently to intervention and may require individually tailored teaching moments to achieve success (Shriberg & Kwiatkowski, 1987). In this study, all children received multiple oppositions intervention, as outlined above and in Supplemental Material S2. However, this intervention was tailored as necessary (while adhering to the principles of multiple oppositions intervention) to suit individual learning needs. A summary of the tailoring is summarized in the Results section (see Supplemental Material S4 for details).

Follow-Up Assessments

One week after the final clinic-based intervention session, children were reassessed with the same speech assessments used in the initial assessment, the generalization probe, the Focus on the Outcomes of Communication Under Six (FOCUS; Thomas-Stonnell et al., 2012), and the Intelligibility in Context Scale (ICS; McLeod, Harrison, & McCormack, 2012). Four weeks following this immediate follow-up assessment, the children's speech was assessed again using the same assessments (final follow-up). All follow-up assessments (except for one child's immediate

follow-up assessment) were conducted by a trained research assistant (D. G.), who was a qualified SLP blinded to the child's treatment targets. Due to scheduling restrictions, one child's immediate follow-up assessment was conducted by the first author.

Parent Confidence

Parents' knowledge and confidence in managing their child's SSD were measured at both the initial assessment and immediate follow-up assessment using questions adapted from a scale developed by Millard, Edwards, and Cook (2009) to measure a parent's knowledge and confidence in managing their child's stuttering. The term *stuttering* was changed to *speech* or *speech sounds*. This questionnaire contained nine visual analogue scales, each 10 cm long, on which parents were asked to place a mark in response to questions such as "how confident are you in your knowledge of how to respond when your child is using incorrect speech sounds?" Parents' ratings were measured in millimeters, yielding a score from 0 to 100, with higher scores reflecting more knowledge and confidence.

Fidelity of Implementation

Fidelity refers to the degree to which an intervention is delivered in accordance with the "gold standard" implementation (Kaderavek & Justice, 2010, p. 369). Measuring intervention fidelity involves determining "adherence" to an intervention protocol, which includes adherence to the intervention content (e.g., activities and teaching moments) and adherence to the prescribed intervention intensity (adherence to dosage; Carroll et al., 2007).

Adherence to content was measured using a checklist for 20% of the SLP-delivered activities and 20% of parent-delivered clinic-based activities for each child. Activities were randomly selected from across the intervention block and rated by the first author and a trained research assistant (D. G.). Example checklist items included use of picture cards, use of gestures, requests for imitative or spontaneous child production (aligned with the current step and/or phase of intervention), and provision of linguistic feedback in the consequent event of a teaching moment. Parents were also provided with a voice recorder and asked to audio-record four randomly selected multiple oppositions activities completed at home. These four activities were also rated for fidelity using the same checklist by the same raters.

Adherence to dosage was measured using data collected in clinic-based sessions. For home-based sessions, parents reported how often they completed activities and how many treatment sets were provided in each home-based session.

Data Analysis

Baseline and generalization probe data were graphed for visual inspection for each participant. First, baselines were analyzed for stability, and then changes in level, trend, and variability of generalization probe and treatment data were examined (Byiers, Reichle, & Symons, 2012; Lane & Gast, 2014). Following this, the immediacy of effect, overlap, and consistency of data between and across phases were identified (Kratochwill et al., 2010). Standard mean difference, a measure of effect size, was calculated following procedures outlined by Gierut, Morrisette, and Dickinson (2015). These calculations used individual generalization probe scores from across the intervention phase and the immediate follow-up assessment and a pooled standard deviation in the baseline phase. A pooled standard deviation was used due to the low variability inherent in stable baselines.

For other measures, including the ICS, the FOCUS, and parent confidence scales, scores from the initial assessment were compared with scores from the immediate and final follow-up assessments. Changes in FOCUS scores for the child's communicative participation were interpreted in accordance with the manual (Thomas-Stonell et al., 2012, p. 9), that is, a change of ≤ 9 indicates *not likely a meaningful clinical change*, a difference between 10 and 15 indicates *possibly meaningful clinical change*, and a difference of ≥ 16 indicates *significant clinical change*.

Reliability of Transcription

Inter- and intrajudge reliability of broad transcription was calculated by the trained research assistant (D. G.) and the first author. Based on 20% of single-word assessment data, interjudge reliability was 90.5%, and intrajudge reliability was 92.8%. Inter- and intrajudge transcription reliability values for 20% of treatment data were both 92.5%. For 20% of baseline and generalization probes, interjudge transcription reliability was 92.3%, and intrajudge transcription reliability was 95.1%.

Results

Table 3 presents a summary of the children's and parents' outcomes following the intervention. Participants' treatment and generalization probe data are shown in Figures 2 and 3. All participants showed an immediate increase in accuracy of some targets in treatment words upon commencing intervention (as shown in Figure 2). Participants had varied patterns of generalization (as shown in Figure 3). Results for each child are presented separately in order to increase baseline length (three baseline probes for Princess, four for Thomas and Owen, five for Marshall, and six for Gracie). More details about the children's postintervention speech systems are provided in Supplemental Material S1.

For all children, the first treatment session involved parent training, and no direct speech intervention was provided to the children. In Session 2, children commenced Phase 1 of multiple oppositions intervention. Treatment data are not routinely collected in Phase 1, as the focus is on familiarity rather than accuracy. Children commenced Phase 2, Step 1 in Session 3. Treatment data were collected in Phases 2 and 3 and are presented below.

Table 3. Summary of intervention outcomes.

Child	Change in PCC[a] scores from initial assessment to final follow-up assessment (scores)	Effect size[b]	Change in FOCUS[c] scores from initial assessment to final follow-up assessment (scores from initial, immediate follow-up, and final follow-up assessments)	Change in ICS[d] scores from initial assessment to final follow-up assessment (scores from initial, immediate follow-up, and final follow-up assessments)	Change in parent confidence scores (pre- and postintervention scores)
Princess	2.1 (61.0–63.1)	3.81 (medium)	51 significant clinical change (255, 265, and 306)	0.28 (3.43, 3.43, and 3.71)	53.5 (36.5 and 90.0)
Thomas	21.3 (53.2–74.5)	60.34 (large)	100 significant clinical change (204, 273, and 304)	1.14 (2.86, 3.86, and 4.0)	40.7 (34.8 and 75.5)
Owen	4.3 (39.7–44.0)	28.10 (large)	2 not likely a meaningful clinical change (228, 241, and 230)	No change (3.57, 3.14, and 3.57)	6.0 (55.8 and 61.8)
Marshall	4.9 (29.1–34.0)	0.59 (no effect)	– 37 not likely a meaningful clinical change (179, 134, and 142)	No change (2.86, 3.0, and 2.86)	7.4 (44.5 and 51.9)
Gracie	31.9 (52.5–84.4)	32.02 (large)	89 significant clinical change (215, 282, and 304)	1.0 (3.0, 4.0, and 4.0)	43.4 (37.1 and 80.5)

[a]Percent consonants correct. [b]Effect sizes (standard mean difference) calculated using procedures described in Gierut et al. (2015). Interpretations are based on data presented in that article. [c]Focus on Outcomes of Communication Under Six (Thomas-Stonell et al., 2012). Interpretations are based on guidelines from the manual. [d]Intelligibility in Context Scale (McLeod et al., 2012).

Princess

Baseline and Intervention Phases

Baselines for all four of Princess's target phonemes, in both treated and nontreated words, were stable at 0% accuracy. Accuracy of three of her four target phonemes in treated words improved immediately upon beginning production-based intervention in Phase 2, Step 1. She commenced Phase 3 in Session 9. Princess showed some generalization of targets to untreated words during the intervention phase from Session 6 (see Figure 3A, Probe 8).

Follow-Up Phase

Princess's generalization to nontreated words was not maintained (see Figure 3). She showed an increase in her phonetic inventory in both word-initial and word-final positions at the immediate and final follow-up assessments (see Supplemental Material S1 for details). These added phonemes were part of her initial collapse, indicating some system-wide change had occurred. Table 3 summarizes her performance at the follow-up assessments, which includes effect size (medium), change in FOCUS score (*significant clinical change*), and change in ICS score (+0.28). Princess's percent consonants correct (PCC) increased by 2.1%.

Intervention Intensity

Information about the number of teaching moments and production trials provided in structured multiple oppositions activities is presented in Table 4. Princess's mother reported completing practice at home for an average of 2.85 times per week (range: 1–5), equating to an average dose of 62 teaching moments per home-based practice session.

Thomas

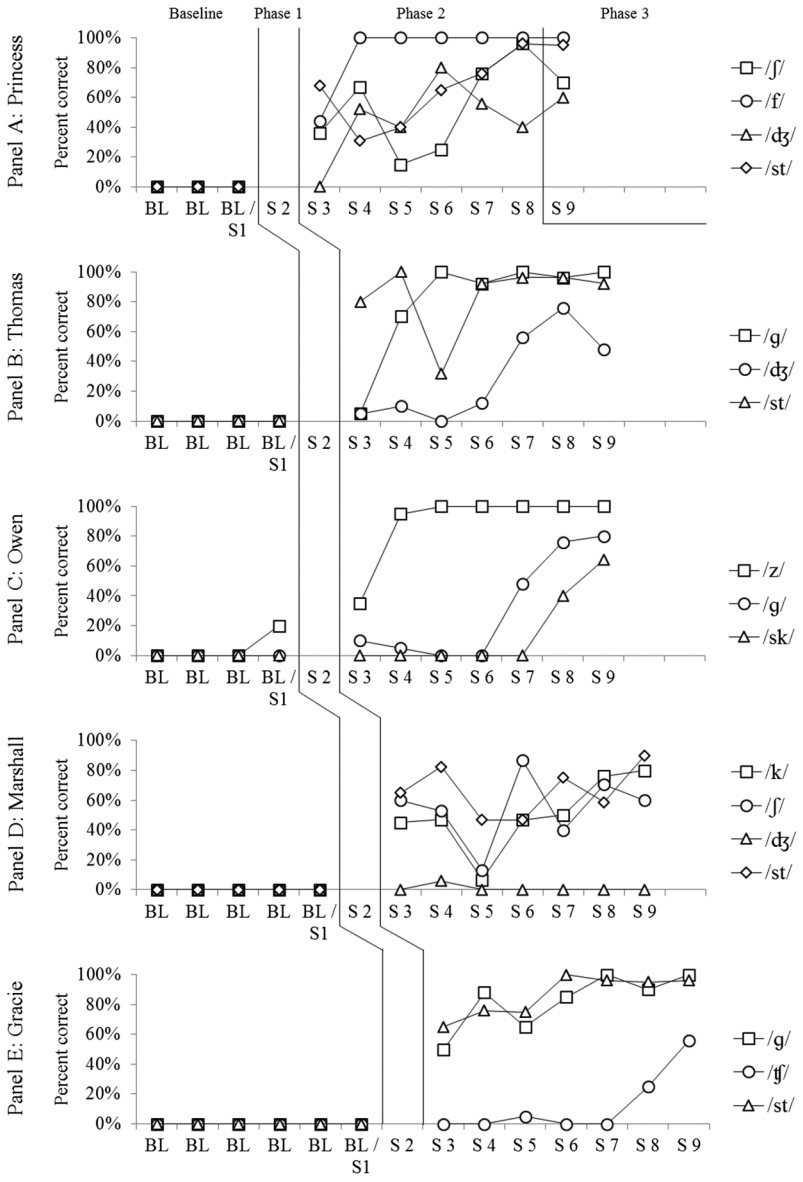
Baseline and Intervention Phases

As shown in Figure 2, Thomas's production of targets in treated words remained stable at 0% accuracy across four baselines. His production of targets in nontreated words was stable at 0% for two targets (/g/ and /st/), with minor variability (up to 10% accuracy) for his third target (/dʒ/; see Figure 3). Thomas showed an immediate treatment effect for target words starting with /st/ (see Figure 2). Accuracy of these treatment words reduced upon commencing Step 2 of Phase 2 in Session 5, but then remained level, with high accuracy, throughout the remaining treatment sessions. His accuracy of treated words starting with /g/ improved in Session 4, with an upward trend and minimal variability in accuracy. Accuracy of treated words starting with /dʒ/ improved in Session 6 and then showed an increase in accuracy with some variability. Regarding generalization to nontreatment words, Thomas showed an upward trend in accuracy for all targets (see Figure 3).

Follow-Up Phase

At the initial and final follow-up, Thomas's accuracy of all targets in nontreated words was at or above 80% accuracy. His posttreatment phonetic inventory was expanded, including /dʒ/ and a wider range of consonant clusters (see Supplemental Material S1 for details). Table 3 summarizes Thomas's performance at the follow-up assessments, which includes effect size (large), change in FOCUS

Figure 2. Children's treatment data.



BL = baseline; S = intervention session

score (*significant clinical change*), and change in ICS score (+1.14). Thomas's PCC increased by 21.3%.

Intervention Intensity

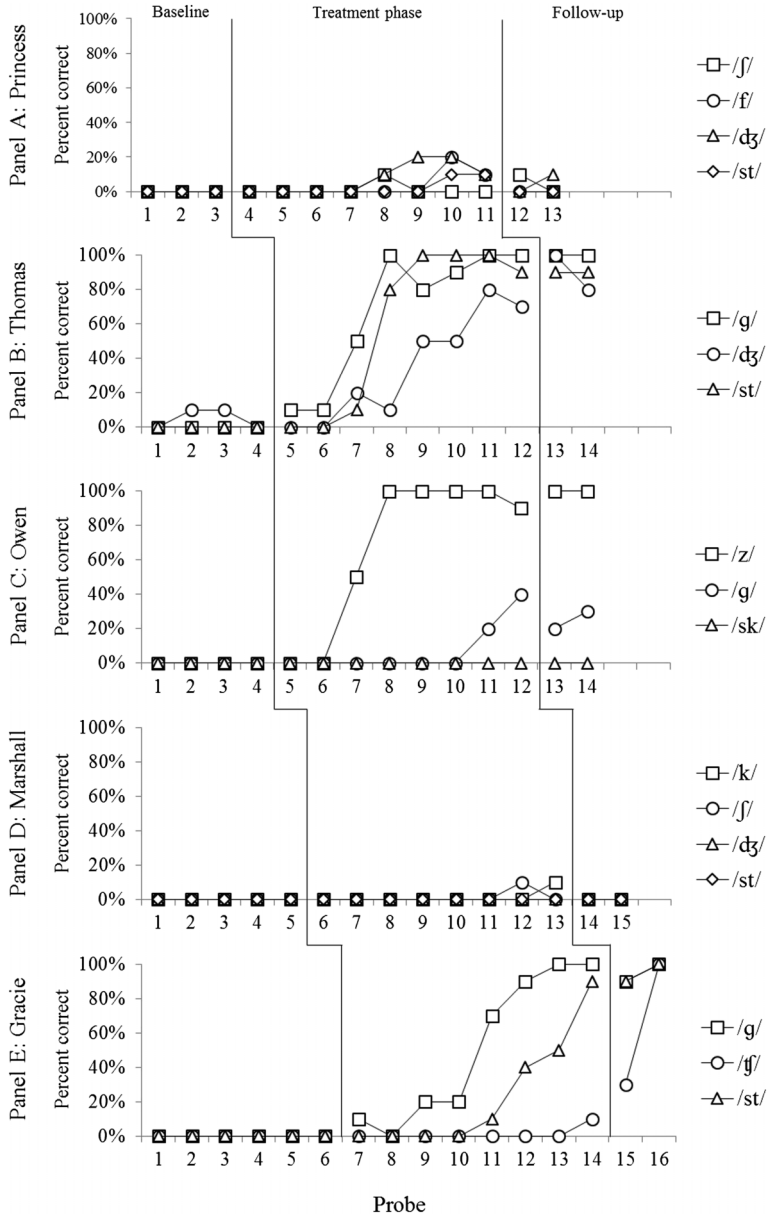
Table 4 shows the number of teaching moments and trials Thomas received over Phase 2 of multiple oppositions intervention. His mother reported initial difficulty completing the prescribed 1.5 treatment sets in a single session at home, partly due to Thomas's variable attention levels. Thomas's mother independently modified the frequency and intended dose of each home practice session to facilitate participation and learning for Thomas. His mother reported completing home practice for an average of five times per week (range: 3–7), equating to an average dose of 30.4 teaching moments per home-based session.

Owen

Baseline and Intervention Phases

As shown in Figure 2, Owen's production of targets in treated words remained stable at 0% accuracy for /g/ and /sk/ across four baselines, with 20% accuracy for /z/ in the final baseline. His production of targets in nontreated words was stable at 0% for all targets (see Figure 3). Owen

Figure 3. Children's generalization data (to nontreatment words).



demonstrated an immediate treatment effect for treated words starting with /z/, which quickly stabilized to 100% accuracy with no variability for the remainder of the treatment period (see Figure 2). Owen's accuracy of treatment words starting with /g/ steadily increased from Session 7, with his accuracy of /sk/ increasing from Session 8. He remained in Step 1 of Phase 2 for both of these targets for the duration of intervention. Owen showed rapid generalization to nontreatment words starting with /z/, with some generalization to nontreatment words starting with /g/ from the eighth clinic-based session. No generalization to nontreatment words starting with /sk/ was observed (see Figure 3).

Follow-Up Phase

Owen maintained 100% generalization to nontreatment words starting with /z/ at the initial and final follow-up assessments. He showed some generalization to nontreatment words starting with /g/ but demonstrated no generalization of /sk/ to nontreatment words. Owen's PCC increased (by 4.3%), and he added new phones and contrasts (e.g., more voicing contrasts) to his phonetic inventory postintervention (see Supplemental Material S1 for details). Table 3 summarizes Owen's performance at the immediate and final follow-up assessments, which includes effect size (large), FOCUS score (*not likely a meaningful clinical change*), and ICS score (+0.0).

Table 4. Dose received in structured multiple oppositions intervention activities from Session 3 to Session 9.

Child	Average teaching moments in the clinic per week (average total trials)	Average teaching moments at home per week	Total teaching moments (total trials)	Average teaching moments per target (average trials)
Princess	85.7 (124.3)	177.1	1,840 (2,110)	460 (527.5)
Thomas	72.0 (106.4)	152.1	1,569 (1,810)	523.0 (603.3)
Owen	66.4 (103.1)	96.4	1,140 (1,397)	380.0 (465.7)
Marshall	70.9 (139.9)	97.1	1,176 (1,659)	294.0 (414.8)
Gracie	66.4 (99.6)	170.0	1,655 (1,887)	551.7 (629.0)

Note. Teaching moments may include one or more trials (see Supplemental Material S2 for more information).

Intervention Intensity

Table 4 shows the number of teaching moments and trials Owen received over Phase 2 of multiple oppositions intervention. His father reported that home practice was completed twice per week, every week, corresponding to an average dose of 48.2 teaching moments per home-based session.

Marshall

Baseline and Intervention Phases

Marshall demonstrated stable, 0% production accuracy of targets in treatment and nontreatment words over five baseline sessions (see Figures 2 and 3). Marshall showed an immediate treatment effect for treated words for three of his four targets (/k, ʃ, st/). With the exception of Session 5, in which Marshall was unwell, production of these targets in treated words showed a general trend toward increased accuracy over the intervention period (see Figure 2). Marshall demonstrated no change in accuracy for treated words starting with /ʤ/ over the intervention period. He remained in Step 1 of Phase 2 for all targets over the intervention phase. Marshall demonstrated minimal generalization of treatment targets to nontreatment words over the intervention period.

Follow-Up Phase

At the initial and final follow-up assessments, Marshall showed no generalization of treatment targets to nontreatment words (see Figure 3). He had an effect size of 0.59, indicating no treatment effect regarding generalization of target phonemes. Although this effect size falls at the lower end of the range identified by Gierut et al. (2015) as suggesting a small effect, the fact that it fell below the benchmark of 1.4, combined with findings from the visual inspection, meant that the change was deemed clinically insignificant. However, despite showing limited generalization of treatment targets, analysis of Marshall's speech revealed some system-wide change. Fricatives and velars, which had previously been absent from Marshall's phonetic inventory, were starting to emerge in both initial and final positions of words. A new voicing contrast in the initial position was also evident.

Despite these qualitative changes to Marshall's speech system, other outcomes following intervention were poor. Table 3 presents Marshall's FOCUS and ICS results, which indicate there was *not likely a meaningful clinical change* in his communicative participation. Marshall's mother reported that, though wanting to continue participating in the study, she was disappointed in the treatment effects and was experiencing increased anxiety about Marshall's speech.

Intervention Intensity

Table 4 shows the number of teaching moments and production trials provided to Marshall. Marshall's mother reported that home practice was completed for an average of 1.86 times per week (range: 1–2), corresponding to an average dose of 52.3 teaching moments per practice session at home.

Gracie

Baseline and Intervention Phases

Gracie demonstrated stable, 0% production accuracy of targets in treatment and nontreatment words over six baseline sessions (see Figures 2 and 3). Accuracy of /g/ and /st/ in treatment words showed immediate improvement in clinic-based sessions, with no overlap with baseline data and accuracy trending upward with minimal variability for the duration of the intervention period (see Figure 2). Gracie's accuracy of /ʧ/ in treated words improved in the final two treatment sessions. She did not meet the criteria to move to Step 2 of Phase 2 for this target. Gracie demonstrated generalization to nontreatment words for all of her treatment targets (see Figure 3).

Follow-Up Phase

Figure 3 shows that Gracie's generalization of treatment targets to nontreatment words continued to improve between the initial and final follow-up assessments, reaching 100% accuracy for all targets in the final follow-up assessment. Gracie's posttreatment phonetic inventory expanded to include new manner classes, places of production, and an increased range of consonant clusters, indicating large system-wide change (see Supplemental Material S1 for details). Table 3 summarizes Gracie's

performance at immediate and final follow-up assessments, which includes effect size (large), FOCUS score (*significant clinical change*), and ICS score (+1.0). Her PCC increased by 31.9%.

Intervention Intensity

Information about the number of teaching moments and production trials provided to Gracie during Sessions 3–9 is provided in Table 4. Gracie's mother reported completing the home practice more frequently than was prescribed, completing it for an average of 3.86 days per week (range: 3–5). On each of these days, an average dose of 44.1 teaching moments was provided.

Intervention Tailoring

Four children (Thomas, Owen, Marshall, and Gracie) demonstrated limited stimulability for one or more of their target sounds and were thus provided with traditional articulation intervention in isolation and consonant–vowel contexts for a total dose of 20 at the beginning of most clinic-based sessions. This dose is not included in the dosage data presented in Table 4, as it did not form part of the multiple oppositions phonological intervention. The inclusion of traditional articulation intervention in multiple oppositions intervention has empirical support (Williams, 2000a). For one participant (Princess), the teaching moment of multiple oppositions intervention was modified to better suit her speech system. Further details about intervention tailoring are provided in Supplemental Material S4.

Parent Confidence Scores

Parent confidence scores from the initial assessment and immediate follow-up assessment, as well as the change over the treatment period, are shown in Table 3. All parents reported an increase in their knowledge and confidence in managing their child's SSD; however, Owen and Marshall's parents reported the lowest change.

Fidelity of Implementation

For all participants, average adherence to content in both clinic-based and home-based sessions is provided in Table 5. Overall average adherence to dosage across the intervention period is also presented. As shown, parents' fidelity of implementation changed over the treatment phase. Comments about each parent's fidelity are provided within the table.

Discussion

Two research questions were addressed in this study: (1) Can parent- and SLP-delivered multiple oppositions intervention lead to an improvement in speech accuracy and communicative participation for children with a moderate or severe phonological impairment? and (2) Can parents deliver multiple oppositions intervention (a) at specified intensities, (b) competently, and (c) with confidence after receiving training? Overall, the findings from this study provide preliminary evidence for involving parents in the delivery of multiple oppositions intervention. In this discussion, we explore reasons for the varied responses made by the children and discuss considerations for involving parents in phonological intervention. Limitations and avenues for future research are presented.

Intervention Factors

Factors of the intervention, either individually or in combination, may explain the varied responses shown by children in this study. These include intervention intensity, the target selection procedures for multiple oppositions intervention, and the suitability of the approach for the participants in this study.

Intervention intensity is important for intervention outcomes with the multiple oppositions approach (e.g., Allen, 2013). Although this study was designed to provide a dose frequency of three times weekly, the data show that children received different dose frequencies ranging from 2.86 to six times weekly. Marshall, who showed the smallest response to intervention, received the lowest dose frequency, whereas Thomas, who had the largest effect size following intervention, received the highest dose frequency. As this variable of intensity was not experimentally manipulated in this study, we cannot draw conclusions about the role dose frequency played in intervention outcomes for these five children. We believe, however, that dose frequency may have played a role in the children's responses to intervention given previous findings about the importance of a high dose frequency in phonological intervention (Allen, 2013; Kaipa & Peterson, 2016).

Table 4 also presents information on the cumulative number of teaching moments that the children received during the intervention. As shown in the final column of this table, this cumulative dose is distributed across each of the child's targets. Multiple oppositions intervention allows for the selection of two to four targets from a child's collapse to contrast with their default (error) sound. In this study, Thomas, Owen, and Gracie—who had the largest treatment effects—each had three targets, whereas Princess and Marshall each had four. The aim of selecting multiple targets is to stimulate broad learning across the system, rather than deep learning of a single phoneme or contrast (Williams, 2000b). Further research is needed to ascertain the optimal dose and number of targets needed for the breadth and depth of phonological learning required for multiple oppositions intervention to be effective.

Finally, the multiple oppositions approach was developed for children who have a phonological impairment, and thus, the approach (like other phonological approaches) aims to target the phonological rather than the articulatory level of speech. However, this theoretical distinction, at least for productive phonological interventions, may be blurred in practice. In this study, as in previous phonological intervention research (e.g., Shriberg & Kwiatkowski,

Table 5. Average measures of implementation fidelity.

	Adherence to content				
	Clinic-based intervention		Home-based intervention		
Child	SLP-delivered	Parent-delivered	Parent-delivered	Comment on parent's adherence to content at home	Adherence to dosage
Princess	92.7%	89.3%	92.0% (88.0%–96.0%)	Reduced over time. KR feedback provided for every production, but linguistic feedback provided less frequently over time.	92.5%
Thomas	95.3%	77.5%	86.7% (76.0%–96.0%)	Reduced over time. Linguistic feedback and KR provided less frequently. Antecedent event of Phase 2 modified by not pairing cards together.	92.5%
Owen	93.3%	85.3%	94.7% (92.0%–96.0%)	Increased over time.	80.0%
Marshall	93.3%	84.0%	89.3% (84.0%–96.0%)	Increased over time. Increase in provision of linguistic feedback.	80.0%
Gracie	93.3%	82.67%	88.0% (84.0%–92.0%)	Reduced over time. Linguistic feedback provided less frequently. Antecedent event of Phase 2 modified by not pairing cards together.	85.0%

Note. SLP = speech-language pathologist; KR = knowledge of results feedback, that is, feedback that tells a child whether their response was correct or incorrect.

1987), four of the five children were provided with articulatory training support to achieve the phonetic requirements of at least one of their targets. For some children, this need for additional support with phonetic learning may have reflected their age (e.g., Thomas and Gracie received phonetic training for non–age-expected affricates); however, for others (such as Marshall), it indicated a possible co-occurring difficulty with both the phonological and motor aspects of speech. For Marshall, it may be that an approach aimed at inducing change at the phonological level —such as multiple oppositions intervention—was only targeting one part of his SSD. Marshall could have benefitted from a period of intervention solely focused on the motoric aspects of his SSD before recommencing with a phonological approach (as per the case of Sabrina in the study by Williams, 2000a). For children like Marshall and Sabrina, who present with severe-to-profound SSD and meet the specified criteria for multiple oppositions intervention, it may be that more than one intervention approach or a modified approach integrating principles of both phonological and motor learning is needed.

Considerations for Involving Parents in Phonological Intervention

Learning to deliver phonological interventions is not easy, especially with multiple targets and the dense teaching moments of multiple oppositions intervention. However, we found that the parents who participated in this study were able to competently deliver this complex phonological intervention approach after receiving comprehensive and explicit training. Such a finding underscores the importance of comprehensive and ongoing training for successful parent-delivered interventions (Tosh et al., 2017). The finding that parents can competently and confidently deliver multiple oppositions intervention is encouraging for SLPs and researchers wanting to involve parents in supporting children with phonological impairment.

In this study, some parents adapted the teaching moment of multiple oppositions intervention by changing either the amount or the type of information provided in the antecedent and consequent events. The adaptations made by Thomas's and Gracie's parents (who had the lowest fidelity ratings at home) are intriguing. Although their adaptations did not appear to negatively influence outcomes, more progress may have been made without them. Alternatively, it may be that the tailoring of the teaching moment to suit the child resulted in intervention being delivered at the child's optimum challenge point and thus supported the child's phonological learning (Guadagnoli & Lee, 2004; Rvachew & Brosseau-Lapre, 2018).

It is worth considering the reasons why some parents modified the intervention approach while others did not. One possible explanation is each parent's confidence and self-efficacy regarding their ability to support their child's intervention. A qualitative study exploring parents' conception of roles in supporting their child's speech and language development identified three stages to parents' roles: being an *attender* of intervention appointments, being an *implementer* of activities prescribed by the SLP, and being an *adaptor* of their approach to communication and interaction within the home (Davies, Marshall, Marshall, & Goldbart, 2017). It may be that those parents who modified the intensity or teaching moment of intervention in this study viewed their role as an adaptor, whereas others conceived of themselves as an implementer. Parents' conceptions of their role in their child's intervention can change over time (e.g., Davies et al., 2017; Sugden et al., 2019). Research has also found that SLPs can support parents to become more actively engaged and involved in the intervention

process (Melvin et al., 2019). Strategies SLPs can use to support this engagement include building trusting relationships, establishing open communication, and working together in intervention sessions (Melvin et al., 2019). All of these elements may not have been present for all parents who participated in the current study. Alternatively, it may be that 9 weeks of intervention was insufficient to support the necessary changes to parents' confidence and self-efficacy so that they could become effective adaptors of intervention. It may also be that those parents who were "implementers," rather than "adaptors," were content with their current role and did not want support from the SLP to change their role in the intervention. Of course, parents who did not adapt may have been hesitant to do so, because they were cognizant of adhering to a research protocol.

Limitations and Directions for Future Research

First, nonconcurrent multiple-baseline designs do not provide the same level of control for threats to internal validity as concurrent multiple-baseline designs; however, the nonconcurrent design is more practical to use in an applied setting due to pragmatic difficulties commencing baselines for multiple participants simultaneously (Christ, 2007). Using predetermined baseline lengths randomized to each participant, as conducted in this study, is one strategy to overcome this limitation (Christ, 2007). Second, the study design did not allow us to determine whether the clinic-based or the parent-delivered sessions alone may have been equally effective at improving children's speech production skills. Although findings from previous research would suggest that weekly SLP-delivered sessions or parent-only-delivered intervention is less effective than the combined SLP–parent service delivery model used in this study (e.g., Allen, 2013; Lancaster, Keusch, Levin, Pring, & Martin, 2010), those studies differed from our study in terms of duration of clinic-based sessions (Allen, 2013) and the training and activities provided to parents (Lancaster et al., 2010). Further research is needed to compare the effects of multiple oppositions intervention delivery by SLPs only, parents only, or SLP plus parents.

The service delivery modification investigated in this study may not be feasible or appropriate for all families of children with phonological impairment. The five families who participated in this research were willing to commit the time required to deliver intervention at home and were competent in intervention delivery. While the results indicate that parents can be trained to deliver multiple oppositions intervention at home, SLPs wanting to apply this research to their clinical practice are encouraged to discuss parents' expectations and roles prior to implementing this service delivery model (e.g., Sugden et al., 2019). Engagement in intervention may also be influenced by family characteristics (such as socioeconomic status or a positive family history of communication disorders). We reported these characteristics descriptively but did not evaluate them further. Future research should consider possible effects on family engagement and intervention outcomes.

Finally, the intervention provided in this study was tailored to suit individual children. While reflecting typical clinical practice, this meant that the intervention—although following the same principles—was not identical across children. Intervention was also tailored by parents to suit their child. The impacts of these modifications are unknown.

Conclusions

This study arose in response to a clinical problem facing SLPs: that of service shortages and being unable to deliver sufficient intensities of intervention to children with phonological impairment. This study presents evidence that parents can be engaged to overcome this intensity shortfall with mixed effects. Additionally, the findings offer evidence that parents can competently deliver a complex phonological intervention after receiving comprehensive training. Finally, this study adds to the evidence base for the multiple oppositions approach by showing that it can efficiently promote phonological learning for some children with moderate and severe SSD in a short intervention period and lead to meaningful changes in their communicative participation.

Acknowledgments

Research reported in this publication was supported by a Speech Pathology Australia Higher Degree Research Grant awarded to Eleanor Sugden. We would like to thank the children and their families who participated in this study for providing their time and for stimulating our thinking about the nature of speech sound disorders in children and how parents can be involved in intervention. In addition, we thank Danielle Grayson for her assistance with data collection, transcription, and fidelity analysis.

ORCID iDs

- Eleanor Sugden: https://orcid.org/0000-0001-5722-3035
- Elise Baker: https://orcid.org/0000-0002-9973-5925
- Natalie Munro: https://orcid.org/0000-0002-5870-6378

References

Allen, M. M. (2013). Intervention efficacy and intensity for children with speech sound disorder. *Journal of Speech, Language, and Hearing Research, 56*(3), 865–877.

Australian Bureau of Statistics. (2011). *Socio-Economic Indexes for Areas (SEIFA)*. Retrieved from http://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa

Baker, E. (2012). Optimal intervention intensity. *International Journal of Speech-Language Pathology, 14*(5), 401–409.

Baker, E. (2013a). *Phonological Assessment of Collapses of Contrast*. Sydney, Australia: Author.

Baker, E. (2013b). *Polysyllable Preschool Test*. Sydney, Australia: Author.

Baker, E. (2017). *Children's Independent and Relational Phonological Analysis (CHIRPA): Australian English*. Sydney, Australia: Author.

Baker, E., & McLeod, S. (2011). Evidence-based practice for children with speech sound disorders: Part 1 narrative review. *Language, Speech, and Hearing Services in Schools, 42*(2), 102–139.

Bowen, C., & Cupples, L. (2004). The role of families in optimizing phonological therapy outcomes. *Child Language Teaching and Therapy, 20*(3), 245–260.

Brumbaugh, K. M., & Smit, A. B. (2013). Treating children ages 3–6 who have speech sound disorder: A survey. *Language, Speech, and Hearing Services in Schools, 44*(3), 306–319.

Byiers, B. J., Reichle, J., & Symons, F. J. (2012). Single-subject experimental design for evidence-based practice. *American Journal of Speech-Language Pathology, 21*(4), 397–414.

Carroll, C., Patterson, M., Wood, S., Booth, A., Rick, J., & Balain, S. (2007). A conceptual framework for implementation fidelity. *Implementation Science, 2*(1), 40.

Carrow-Woolfolk, E. (2014). *Test for Auditory Comprehension of Language–Fourth Edition (TACL-4)*. Austin, TX: Pro-Ed.

Christ, T. J. (2007). Experimental control and threats to internal validity of concurrent and nonconcurrent multiple baseline designs. *Psychology in the Schools, 44*(5), 451–459.

Davies, K. E., Marshall, J., Marshall, L. J. E., & Goldbart, J. (2017). Co-working: Parents' conception of roles in supporting their children's speech and language development. *Child Language Teaching and Therapy, 33*(2), 171–185.

Dodd, B. (2014). Differential diagnosis of pediatric speech sound disorder. *Current Developmental Disorders Reports, 1*(3), 189–196.

Dodd, B., Hua, S., Crosbie, S., Holm, A., & Ozanne, A. (2002). *Diagnostic evaluation of articulation and phonology*. London, United Kingdom: Pearson.

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test–Fourth Edition (PPVT-4)*. Minneapolis, MN: Pearson.

Dunst, C. J., & Trivette, C. M. (2009). Let's be PALS: An evidence-based approach to professional development. *Infants and Young Children, 22*(3), 164–176.

Gierut, J. A., Morrisette, M. L., & Dickinson, S. L. (2015). Effect size for single-subject design in phonological treatment. *Journal of Speech, Language, and Hearing Research, 58*(5), 1464–1481.

Guadagnoli, M. A., & Lee, T. D. (2004). Challenge point: A framework for conceptualizing the effects of various practice conditions in motor learning. *Journal of Motor Behavior, 36*(2), 212–224.

Hegarty, N., Titterington, J., McLeod, S., & Taggart, L. (2018). Intervention for children with phonological impairment: Knowledge, practices and intervention intensity in the UK. *International Journal of Language & Communication Disorders, 53,* 995–1006.

Kaderavek, J. N., & Justice, L. M. (2010). Fidelity: An essential component of evidence-based practice in speech-language pathology. *American Journal of Speech-Language Pathology, 19*(4), 369–379.

Kaipa, R., & Peterson, A. M. (2016). A systematic review of treatment intensity in speech disorders. *International Journal of Speech-Language Pathology, 18*(6), 507–520.

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). *Single-case designs technical documentation*. Retrieved from What Works Clearinghouse: https://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf

Lancaster, G., Keusch, S., Levin, A., Pring, T., & Martin, S. (2010). Treating children with phonological problems: Does an eclectic approach to therapy work? *International Journal of Language & Communication Disorders, 45,* 174–181.

Lane, J. D., & Gast, D. L. (2014). Visual analysis in single case experimental design studies: Brief review and guidelines. *Neuropsychological Rehabilitation, 24*(3–4), 445–463.

Lee, S. A. S. (2018). The treatment efficacy of multiple opposition phonological approach via telepractice for two children with severe phonological disorders in rural areas of West Texas in the USA. *Child Language Teaching and Therapy, 34*(1), 63–78.

McCormack, J., Harrison, L. J., McLeod, S., & McAllister, L. (2011). A nationally representative study of the association between communication impairment at 4–5 years and children's life activities at 7–9 years. *Journal of Speech, Language, and Hearing Research, 54*(5), 1328–1348.

McCormack, J., McAllister, L., McLeod, S., & Harrison, L. (2012). Knowing, having, doing: The battles of childhood speech impairment. *Child Language Teaching and Therapy, 28*(2), 141–157.

McLeod, S., Harrison, L., & McCormack, J. (2012). *Intelligibility in Context Scale*. Bathurst, Australia: Charles Sturt University.

Melvin, K., Meyer, C., & Scarinci, N. (2019). What does "engagement" mean in early speech pathology intervention? A qualitative systematised review. *Disability and Rehabilitation*. https://doi.org/10.1080/09638288.2018.1563640

Millard, S. K., Edwards, S., & Cook, F. M. (2009). Parent–child interaction therapy: Adding to the evidence. *International Journal of Speech-Language Pathology, 11*(1), 61–76.

Munson, B., Johnson, J. M., & Edwards, J. (2012). The role of experience in the perception of phonetic detail in children's speech: A comparison between speech-language pathologists and clinically untrained listeners. *American Journal of Speech-Language Pathology, 21*(2), 124–139.

Powell, T. W., & Miccio, A. W. (1996). Stimulability: A useful clinical tool. *Journal of Communication Disorders, 29*(4), 237–253.

Robbins, J., & Klee, T. (1987). Clinical assessment of oropharyngeal motor development in young children. *Journal of Speech and Hearing Disorders, 52,* 271–277.

Roberts, M. Y., & Kaiser, A. P. (2011). The effectiveness of parent-implemented language interventions: A meta-analysis. *American Journal of Speech-Language Pathology, 20*(3), 180–199.

Rush, D. D., & Shelden, M. L. L. (2011). *The early childhood coaching handbook*. Baltimore, MD: Brookes.

Rvachew, S., & Brosseau-Lapre, F. (2018). *Developmental phonological disorders: Foundations of clinical practice* (2nd ed.). San Diego, CA: Plural.

Shriberg, L. D., & Kwiatkowski, J. (1987). A retrospective study of spontaneous generalisation in speech-delayed children. *Language, Speech, and Hearing Services in Schools, 18,* 144–157.

Sugden, E., Baker, E., Munro, N., & Williams, A. L. (2016). Involvement of parents in intervention for childhood speech sound disorders: A review of the evidence. *International Journal of Language & Communication Disorders, 51*(6), 597–625.

Sugden, E., Baker, E., Munro, N., Williams, A. L., & Trivette, C. M. (2018a). An Australian survey of parent involvement in intervention for childhood speech sound disorders. *International Journal of Speech-Language Pathology, 20*(7), 766–778.

Sugden, E., Baker, E., Munro, N., Williams, A. L., & Trivette, C. M. (2018b). Service delivery and intervention intensity for phonology-based speech sound disorders. *International Journal of Language & Communication Disorders, 53*(4), 718–734.

Sugden, E., Baker, E., Williams, A. L., Munro, N., & Trivette, C. M. (2016, November). *An international comparison of intervention*

practices for children with speech sound disorder. Paper presented at the American Speech-Language-Hearing Association Convention, Philadelphia, PA.

Sugden, E., Munro, N., Trivette, C. M., Baker, E., & Williams, A. L. (2019). Parents' experiences of completing home practice for speech sound disorders. *Journal of Early Intervention, 41*(2), 159–181.

Thomas-Stonell, N., Robertson, B., Walker, J., Oddson, B., Washington, K., & Rosenbaum, P. (2012). *FOCUS: Focus on the outcomes of communication under six*. Toronto, Canada: Holland Bloorview Kids Rehabilitation Hospital.

Tosh, R., Arnott, W., & Scarinci, N. (2017). Parent-implemented home therapy programmes for speech and language: A systematic review. *International Journal of Language & Communication Disorders, 52*(3), 253–269.

Wagner, R., Torgesen, J. K., Rashotte, C. A., & Pearson, N. A. (2013). *Comprehensive test of phonological processing* (2nd ed.). Austin, TX: Pro-Ed.

Warren, S. F., Fey, M. E., & Yoder, P. J. (2007). Differential treatment intensity research: A missing link to creating optimally effective communication interventions. *Mental Retardation and Developmental Disabilities Research Reviews, 13*(1), 70–77.

Williams, A. L. (2000a). Multiple oppositions: Case studies of variables in phonological intervention. *American Journal of Speech-Language Pathology, 9,* 289–299.

Williams, A. L. (2000b). Multiple oppositions: Theoretical foundations for an alternative contrastive intervention approach. *American Journal of Speech-Language Pathology, 9*(4), 282–288.

Williams, A. L. (2010). Multiple oppositions intervention. In A. L. Williams, S. McLeod, & R. J. McCauley (Eds.), *Interventions for speech sound disorders in children* (pp. 73–94). Baltimore, MD: Brookes.

Williams, A. L. (2012). Intensity in phonological intervention: Is there a prescribed amount? *International Journal of Speech-Language Pathology, 14*(5), 456–461.