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Esther Ottow-Henning & Brigitta Keij

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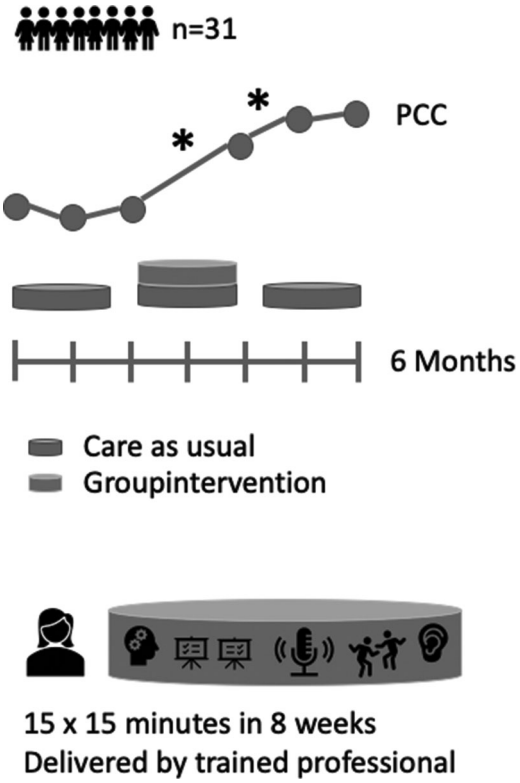
Does group intervention make a difference for the speech sound development of Dutch pre-school children with Developmental Language Disorder?

ESTHER OTTOW-HENNING & BRIGITTA KEIJ

Research Department, Royal Dutch Auris Group, Rotterdam, The Netherlands

Abstract

Purpose: In the Netherlands, children (2;0–5;0) with (presumed) severe DLD attend special treatment groups. In these groups, speech sound disorders (SSDs) are usually treated in individual therapy. The aim of this study is to examine the efficacy of an added phonological group intervention.
Method: Parallel to individual therapy, these children received a group intervention from trained childcare professionals. A within-subject multiple-baseline design was chosen to compare children's development before and after the intervention. Children tested at all six time points were included in the intervention study ($n = 31$, age range: 28–46 months).
Result: Of the children attending the selected groups, 77% have an SSD. The participating children demonstrate with a severe SSD based on their caregivers' report of their intelligibility at baseline. Their phonological production skills increased from a mean Percentage Consonants Correct (PCC) of 42–57% after the intervention compared to no significant increase during the measurements before the intervention.
Conclusion: We conclude that childcare professionals without a specific background in speech-language pathology can effectively be trained to deliver a phonological group intervention to children with (presumed) severe DLD and SSD. Moreover, these children make a clinically relevant increase in their phonological production skills due to the phonological group intervention.



Correspondence: Brigitta Keij, Research Department, Royal Dutch Auris Group, Ammanplein 2, 3031 RT Rotterdam, The Netherlands. E-mail: b.keij@auris.nl

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Keywords: *speech sound development; phonological development; group intervention; Developmental Language Disorder; early intervention; Speech Sound Disorder*

Introduction

The acquisition of the phoneme inventory of a language is essential to the acquisition of other domains of the language, such as the lexicon (Stoel-Gammon, 2011). Moreover, the phoneme inventory of a child affects the amount of words the child can produce intelligibly. Stimulating phonological development through interventions is therefore essential. Approximately half of the children diagnosed with Developmental Language Disorder (DLD) are also diagnosed with Speech Sound Disorder (SSD) (Tyler, 2002).

In the Netherlands, SSDs are often exclusively treated by speech-language pathologists in individual therapy sessions. This is also the case in the special treatment groups where this study is conducted. The aim of the current study is to examine the efficacy of additional support for speech sound development in special treatment groups through an added phonological group intervention provided by trained childcare professionals.

Background

Developmental language disorder (DLD)

DLD (formerly described as Specific Language Impairment or SLI) is a disorder that is defined in the DSM-5 (American Psychiatric Association, 2013) by four criteria, namely (i) difficulties in the acquisition and use of language across modalities are persistent and due to deficits in comprehension or production; (ii) language abilities are substantially and quantifiably below those expected for age, resulting in functional limitations; (iii) the onset of symptoms is in the early developmental period and (iv) the difficulties are not attributable to hearing or other sensory impairments, motor dysfunction, or any other medical or neurological reason and are not better explained by intellectual disability or global developmental delay.

It is estimated that about 7.5% of children around 5 years of age have DLD of which more boys than girls are diagnosed with DLD (Norbury et al., 2016; Tomblin et al., 1997). Children with DLD form a heterogeneous group and consequently, there is little consensus on the exact characteristics of DLD (cf. Bishop, Snowling, Thompson, Greenhalgh, & CATALISE consortium, 2016). Sometimes, DLD is only diagnosed in children without sensory, neurological or emotional problems and with normal intelligence (e.g. Conti-Ramsden & Durkin, 2017; Leonard, 1998). However, a multidisciplinary consensus study revealed that the majority of children with DLD also have problems in motor skills, attention, reading, social interaction and behaviour (Bishop et al., 2016). In other words, for diagnosis the language difficulties should not be attributable to these factors, but in practice these types of problems often co-occur in children with language difficulties. Children with DLD usually are late talkers, meaning that the onset of early language development is relatively late (cf. Weismer, 2013). Nevertheless, Ellis Weismer (2007) showed that being a late talker does not predict whether the child will develop DLD. Instead, the comprehension scores of late talkers at 30 months are the strongest predictor of their production scores at 66 months. Therefore, in the Netherlands we speak of presumed DLD until about age 5, without an official diagnosis.

In the Netherlands, children who are diagnosed with (presumed) severe DLD, i.e. scoring 1.5 SD or more below the norm on standardised tests for two or more language domains, can be referred to special treatment groups. Children that attend these groups are between 2 and 5 years of age. At the Royal Dutch Auris Group, they attend a group two to three days per week, for six hours per day. These groups consist of maximally eight children and each group is led by two childcare professionals. During (one of) their days attending the group, children receive individual treatment for 15–60 min a week targeting mainly phonology and morphosyntax from a speech-language pathologist. The speech-language pathologist also coaches the childcare professionals and caregivers in using communication enhancing strategies and creating a rich environment for language learning. Children also receive support from a clinical psychologist or a remedial educationalist and some of them receive treatment from a paediatric physiotherapist. The caregivers of the child are supported by a parent or family counsellor.

During a day at a special treatment group, explicit attention is paid to language acquisition and as frequent as possible. For example, in order to actively expand their vocabulary, children play language games with the childcare professionals as a group. These group interventions mostly focus on lexical development and pragmatics. However, many of these children also have speech sound problems. Children with speech sound problems are treated individually by speech-language pathologists. Hence, the phonological development of children with DLD is also not registered on a group level, but only on an individual level. Consequently, there is a lack of insight into the speech sound problems that children with DLD may experience on a group level. Additionally, within these treatment groups there is an ambition to implement group intervention to increase the dose of therapy and target speech sound

Table I. Order of acquisition of Dutch consonants.

Age	Onset	Coda
1;3–1;8	/p/ /t/ /m/ /n/ /j/	/p/
1;9–1;11	/k/	/k/
2;0–2;2	/s/ /x/ /h/	/t/ /s/ /x/
2;3–2;5	/b/ /f/ /ʋ/	/m/ /n/
2;6–2;8	/l/ /r/	
2;9–2;11	/d/	
unknown		/l/ /r/ /f/ /ŋ/

problems more efficiently. In the restricted time for individual treatment per child the speech-language pathologists (have to) work on other treatment goals besides phonology, such as morphosyntactic goals, thus the individual treatment time for phonology might be insufficient for children with DLD and an SSD.

Speech sound disorder (SSD)

In typical language development, children start babbling around the age of six months (Oller, 1980). Somewhat later, canonical babbling is characterised by consonant-vowel sequences and is shaped by the segment inventory of the language that the child is learning (De Boysson-Bardies & Vihman, 1991). Children between 2 and 3 years of age are usually able to produce all vowels, almost all of the consonants of their language(s) and some of the consonant clusters, if present in their language(s) (Stoel-Gammon, 2011). Children tend to acquire the phonemes of their language(s) in a universal order (e.g. Ingram & List, 1987; cf. Fikkert, 2007; Dunbar & Idsardi, 2012). Beers (1995) examined the order of acquisition in Dutch. The order of acquisition of Dutch consonants is listed in Table I (adapted from Beers, 2003, p. 248). Appendix contains more background information on the phonological characteristics of Standard Dutch (The Netherlands).

During the process of acquiring the phonemes of the language, children substitute or omit phonemes and tend to reduce consonant clusters (Beers, 2003). For example, children that have not yet acquired fricatives will produce them as stops. These substitutions and omissions disappear as the phonological knowledge of the child increases. However, some children continue to have problems in their phonological development and, consequently, can be diagnosed with SSD.

Children who are diagnosed with SSD are usually treated in individual speech therapy sessions. Individual speech therapy has proven to be effective (Broomfield & Dodd, 2011; Hesketh, Adams, Nightingale, & Hall, 2000; Law, Garrett, & Nye, 2003). Broomfield and Dodd (2011) showed that children displayed significantly more progress after six months of treatment than after six months without any intervention. No difference in effectiveness was found between interventions by speech-language pathologists on the one hand and trained assistants on the other hand (Boyle, McCartney, Forbes, &

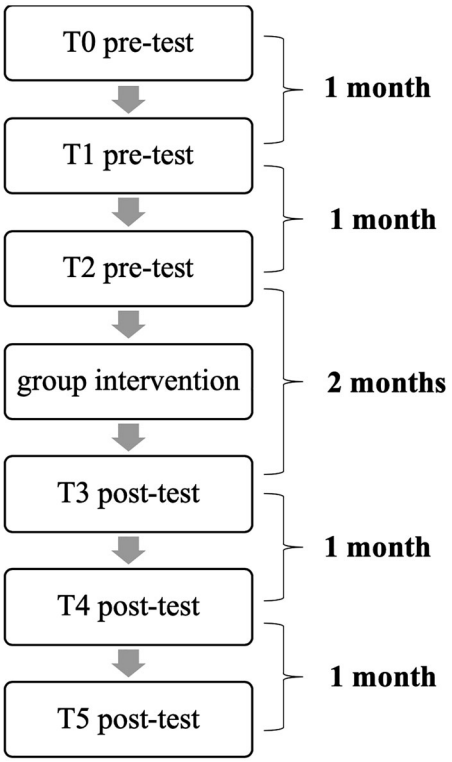

Figure 1. Design of the study.

O'Hare, 2007). However, there is no consensus on the effectiveness of specific interventions (cf. Hesketh et al., 2000). There are indications that interventions such as cycles approach (Hodson & Paden, 1991) or contrast therapy, which focus on error patterns, are effective for children with phonological delay and consistent deviant phonological disorder (Dodd, 2013). Contrast therapy focuses on the contrastive features of phonemes. Children are confronted with minimal pairs in order to raise awareness of the contrasts between different phonemes, and with that, different words. As a result, children will reorganise their phonological system and will acquire new phonemes or phoneme categories. The cycles approach as described by Hodson and Paden (1991) also focusses on error patterns and aims to influence the sound system as a whole.

DLD and SSD

The prevalence of SSD in children who are diagnosed with DLD is estimated within a range from 9% to 77%, although most studies estimate that between 40% and 60% of children with DLD also display problems in their phonological development (Tyler, 2002). We know that children who are diagnosed with expressive DLD usually have a smaller phonemic inventory and produce fewer consonants correctly (which is reflected in the Percentage Consonants Correct, PCC) than typically developing children (Roberts, Rescorla, Giroux, & Stevens, 1998). However, the coding system of the DSM-5 explicitly differentiates between SSD only, SSD and

Table II. Participant characteristics at T0 ($n = 31$: 21 male).

	n	min.	max.	mean	SD
Age (in months)	31	28	46	39	4.5
IQ	23	78	116	95.7	10.9
Sentence comprehension	31	55	118	78.2	17.7
Word comprehension	27	61	130	90.7	14.4
Sentence production	30	55	93	73.2	9.2
Word production	31	55	104	68.2	15.7

language disorders, and SSD and other pervasive disorders (Waring & Knight, 2013). In this study we examine children with SSD, which in accordance with the DSM-5 can consist of both articulation and phonological-based disorders, as well as a language disorder, which in correspondence with the DSM-5 comprises both expressive language disorder and mixed receptive-expressive disorder (Waring & Knight, 2013).

In the Netherlands young children who encounter problems in their speech and/or language development initially receive treatment from a speech-language pathologist in a private practice. If the problems are more severe or complex, and they meet the criteria described above, they can be referred to a special treatment group. In these special treatment groups for children with DLD, all children who also have an SSD receive individual speech-language therapy sessions once, sometimes, twice a week. Based on professional experience of the first author and other speech-language pathologists who work in the special treatment groups, the cycles approach described by Hodson and Paden (1991) is used most often. Added to that are elements of contrast therapy (Barlow & Gierut, 2002; Dodd, 2013) and PROMPT (Chumpelik, 1984), and specific interventions to increase phonological awareness (Howell & Dean, 1991) are deployed.

However, these individual sessions are not limited to interventions targeting the speech sound development of the children; instead, attention is also paid to other linguistic domains. In addition, their progress in language development is measured during these sessions. As a result, the individual treatments targeting speech sound development may lack a structured approach and the required intensity for effectiveness. This possible lack of a structured approach for phonological treatment is problematic, as phonological problems affect language development in other domains as well. Being unable to produce words intelligibly impedes effective and successful communication. Furthermore, having a solid phonological system is a prerequisite to several aspects of language development, such as expansion of the lexicon of a child (Stoel-Gammon, 2011).

The aim of the current study is to examine the efficacy of an added group intervention targeting speech sound development. As we expect a larger proportion of children in the special treatment groups to be diagnosed with (severe) SSD than in the general population, an added group intervention in these treatment groups may be an efficient and effective means to intervene in the speech sound development of children with DLD. The current study was performed by the research department of the Royal Dutch Auris Group, a Dutch organisation that provides special treatment groups for children with DLD.

Method

Design

This study was reviewed by a local Medical Review and Ethics Committee (MREC) and was judged not to be subject to the Medical Research Involving Human Subjects Act (WMO in the Netherlands: registration number MO17-026). To examine the efficacy of an added group intervention targeting the acquisition of speech sounds, a combination of a single-subject and multiple-baseline design was used. The design incorporated measures taken at intervals over six months. Three measures were taken pre-intervention: baseline (T0), one month past baseline and before the intervention (T1), and directly before the intervention (T2). The next measurement was taken directly after the two-month intervention period (T3). Two more post-intervention measures were taken one month (T4) and two months (T5) after the end of the intervention. The design of the study is illustrated in Figure 1.

Between T0-T2 and T3, the direct effect of the intervention is measured. Previous research showed that the effect of phonological intervention is not always measurable immediately after the intervention (Dodd, 2013; Hodson & Paden, 1991). Therefore, the delayed effect of the intervention was measured between T2 and T3-T5.

Participants

Ten out of the 30 special treatment groups of the Royal Dutch Auris Group participated in this study. In each group two childcare professionals (21 in total) and one speech-language pathologist (eight in total) were involved. Each special treatment group has place for 8 children. The children for this study were selected based on the following criteria:

(1) The speech-language pathologist of the treatment group diagnosed the child with SSD based on observation and/or articulatory assessment.
(2) The child was able to participate in the test sessions in such a way that the gathered data are representative of their phonological skills. The child had to be able to complete the naming tasks, naming at least 75% of the target words.
(3) The child had a maximum age of 4;0 years (48 months) during the baseline measurement.
(4) The participant's caregiver(s) had provided written informed consent.

The speech-language pathologists selected 54 children (37 male) with SSD and informed consent from

Table III. Test material per test session.

	T0	T1	T2	T3	T4	T5
ICS	✓					
Metaphon screening	✓	✓	✓	✓	✓	✓
NAO VW	✓	✓	✓	✓	✓	✓

their groups. For nine of these children it was not possible to complete all tasks for measurement 0 ($n = 45$), but we can report on the severity of their SSD. During the six-month study duration 14 children left the treatment groups, because they enrolled in Kindergarten during the study. It is common in the Netherlands to start Kindergarten as soon as children turn 4 years old. The results from all six measurements of the intervention study are therefore based on 31 children (21 male). Demographic and previous assessment data were extracted from the records of our organisation. These records include information on age, IQ and performance on language tests covering several linguistic domains. The performance on the language tests provide more insight into the severity of and variation in language difficulties, and together with age and IQ are summarised in Table II.

Language skills were measured using the following instruments:

(1) Schlichting Test voor Taalbegrip [Schlichting Test of Language Comprehension] (Schlichting & Spelberg, 2010a).
(2) Peabody Picture Vocabulary Test III-NL (Schlichting, 2005).
(3) Schlichting Test voor Taalproductie, Sentence production [Schlichting Test for Productive Language] (Schlichting & Spelberg, 2010b).
(4) Schlichting Test voor Taalproductie, Word production [Schlichting Test for Productive Language] (Schlichting & Spelberg, 2010b).

These are standardised, normed tests for measuring language development in Dutch. The scores on these tests are normalised similar to IQ scores: all language tests have an average score of 100 with a standard deviation of 15.

Materials

Test material

The test material used to measure the children's speech sound development consisted of the following instruments:

(1) **Dutch Intelligibility in Context Scale (ICS-NL)** (Doornik van-van der Zee & Terband, 2013)
The ICS is a parental report instrument. On a scale from 1 to 5, caregivers indicate to what extent they feel their child is intelligible. They also indicate to what extent their child is intelligible to persons other than themselves, such as other family members, nursery schoolteachers and the child's peers.
(2) **Metaphon screening** (Leijdekker-Brinkman, 2002)
The Metaphon screening is a picture naming task used by speech-language pathologists in order to examine the phonological system of a child. Each phoneme that is part of the Dutch phonological system occurs twice in initial position and twice in final position. The Metaphon screening involves a total of 42 items.
(3) **Nederlands Articulatie Onderzoek Verwervingsvolgorde (NAO VW) [Dutch Articulatory Test of Order of Acquisition]** (LOGO-Art, 2012)
The NAO VW is a picture naming task arranged in sections according to age. Each section tests whether the phonemes that are acquired by 75% of children of a norm group in the specified age range have been mastered. In the current study, the part of NAO VW that is designed for 3-year old children was used, which comprised a total of 39 items.

The ICS was only performed during the first pretest (T0) to provide an estimation of the severity of the SSD of the participating children. The Metaphon screening and the NAO VW were administered during all six test sessions. We included two picture naming tasks to increase the power and reliability of the results. The test protocol is summarised in Table III.

Training the childcare professionals and speech-language pathologists

The intervention was performed by the childcare professionals that lead the special treatment groups. The childcare professionals and speech-language pathologists were trained by a speech-language pathologist, who is also a psychologist and the first author of this publication. The training comprised of two hours of self-study and a two-hour session with the trainer. The self-study part contained background information on SSD and interventions in general, and videos of the specific group intervention which is examined in this study with observation-assignments and questions. During the live session, the self-study assignments were discussed, and the participants practiced with the therapeutic strategies and with the materials. In addition, there were protocols with detailed descriptions of the intervention sessions and therapeutic strategies provided to the childcare professionals. The therapeutic strategies are provided in English in Supplemental Material A. During the intervention period, the childcare professionals were supported by the speech-language pathologists. In one out of every three sessions the speech-language pathologist was present to observe if each element of the intervention was executed according to the training and to provide feedback to the childcare professionals. The childcare professionals also kept track of the intervention process in a log.

Table IV. Target consonants during the intervention in chronological order.

Session	Phoneme	Place	Manner	Voicing	Position	Process
1,2,3	/n-/	Alveolar	Nasal	Voiced	Onset	Consonant deletion, lateralisation, *h*-sation
4,5,6	/-k/	Velar	Plosive	Voiceless	Coda	Fronting
7,8,9	/st-/	Alveolar	Fricative and plosive	Voiceless	Coda	Cluster reduction, stopping
10,11,12	/-f/	Labiodental	Fricative	Voiceless	Coda	Stopping
13,14,15	/l-/	Alveolar	Lateral	Voiced	Onset	Gliding

Intervention material

The intervention consisted of 15 different sessions. The sessions were developed by the same person that trained the child care professionals and speech-language pathologists, based on evidence for the effectiveness of phonological interventions (Hodson & Paden, 1991) and contrast therapy (Barlow & Gierut, 2002; Dodd, 2013). The aim of the sessions was to help children discover differences and similarities between phonemes and consequently, to stimulate children to reorganise their phonological system. Each session focussed on a single consonant or consonant cluster, which was either in onset or in coda position. The consonants were selected based on their order of acquisition and the phonological processes that they are commonly part of. Furthermore, the selected consonants differed in place and manner of articulation, in voicing and in syllable position. The targets were not chosen based on the needs of each individual child but were selected in a way that different aspects of learning sounds were included, and most children would benefit from the support for the target sounds or through possible transfer effects. The following phonemes were selected for intervention:

(1) /n-/ is normally acquired between 1;3 and 1;8 years old (Beers, 2003). Being relatively easy to acquire, /n/ is often chosen as one of the first targets in intervention settings (Hodson & Paden, 1991).
(2) /-k/ is often problematic for children with SSD. If the child does not yet produce /k/, final /k/ is best targeted before initial /k/ in intervention (Hodson & Paden, 1991).
(3) /-f/ sometimes fails to be acquired even after interventions targeting /s/. Hodson and Paden (1991) usually target /f/ in the second remediation cycle.
(4) /l-/ is acquired relatively late. However, Hodson and Paden (1991) argue that /l/ and /r/ should be targeted early during the intervention, as younger children are more willing to attempt to produce these sounds than older children.
(5) In addition, the consonant cluster /st-/ was selected. The cluster /st-/ targets not only cluster reduction, but also stopping. By practicing the difference between words as *stop* "stop" and *top* "summit", children learn to use a fricative instead of a stop in words as *sop* "soapy water" (Hodson & Paden, 1991). Since the development of consonant clusters differs from the development of singleton segments, the cluster productions were analysed separately from the segment productions.

The selected consonants and their corresponding characteristics and phonological processes are summarised in Table IV.

Each session consisted of the following activities in the following order:

(1) **Introduction of the target phoneme**
The childcare professional describes the target phoneme and its characteristics to the children. For example, when /-f/ is introduced, it is illustrated that /f/ is produced by the teeth softly on the lips while blowing. The child can feel the blowing air on his hand.
(2) **Auditory bombardment**
The childcare professional reads twenty short words that contain the target phoneme in the target position. To keep the children focussed, a puppet is introduced that has a name that starts with the target phoneme. The words are read to the puppet. If the attention of the children starts to decrease, "the puppet" grabs their attention by saying, for example: "I hear a lot of words starting with /l-/, let's do some more"!
(3) **Auditory discrimination game**
The childcare professional shows the children pictures of two words that form a minimal pair. One of the words includes the target phoneme. The other word contrasts the targeted phoneme. For example, in the session targeting /-k/, the contrast between net /nɛt/ "net" and *nek* /nɛk/ "neck" is shown. Each child is given a word (either *net* or *nek*) and is asked to place an object next to the picture of the word that (s)he perceived. Feedback is given on what the child perceived and whether his/her perception matched with the word provided (i.e. whether the child placed the object at the correct picture).
(4) **Single word perception game**
Children participate in a game which focuses on one word containing the target phoneme. To illustrate, during the session targeting /n-/ each child is asked to draw a nose. The childcare professional emphasises the word *neus* /nøs/ "nose" repeatedly. Children are asked to join in with actions or gestures instead of being asked to say the target word. If they do say the target word spontaneously and the target is produced correctly, the childcare professional comments on that by saying: "I heard you use the /n-/ sound in the word nose"! If a child's pronunciation of the target word is incorrect, the childcare professional gives a correct recast of the target word.
(5) **Single word production game**
The childcare professional introduces a physical object and relates it to a target word which contains the target phoneme in a facilitating phonological context. The children play a game with the object and are encouraged to complete a sentence using the target word. For example, one of the sessions on /l-/ involved a chest of drawers. An object was hidden in one of the drawers. The children took turns in guessing in which drawer the object was,

Table V. Examples of calculating the Percentage Consonants Correct (PCC).

Target word	Possible points	Produced word	Assigned points	Comment
huis /ɦœys/ "house"	2	[œys]	1	/h/ not produced
jongen /jɔŋɛ/ "boy"	2	[djɔŋɛ]	2	addition of /d/
maan /man/ "moon"	2	[mam]	1	substitution of /n/
kast /kɑst/ "cupboard"	3	[kɑts]	1	metathesis of /st/
sok /sɔk/ "sock"	2	[ʁɔk] (ʁ: lateral lisp)	1	distortion of /s/

using the word *la* /la/ "drawer." If the child produces the target sound correctly, the childcare professional comments on that by saying: "I heard you use the /l-/ sound in the word drawer"! If a child's pronunciation of the target is incorrect, the childcare professional will give a correct recast of the target-word. Children were not directly corrected on their production of sounds, but the given feedback focussed on phonological features of the target sounds.

(6) **Nursery rhyme**
The childcare professional reads a nursery rhyme that repeatedly contains the target phoneme. In the session targeting /st-/, for example, the rhyme is about *stippen*/stɪpə/ "dots" on a *step*/stɛp/ "children's scooter." After reading aloud the nursery rhyme, the childcare professional explicitly addresses the different words in the nursery rhyme that contain the target sound or points out the rhyming words. This activity aims to increase the phonological awareness of the children.

Three different sessions were developed for each target sound. In the first two sessions of a target sound, the minimal pair and the nursery rhyme are the same for consolidation purposes. For the third session a different minimal pair, with a larger contrast between the phonemes in case the minimal pair from the first two sessions was too difficult, and a different nursery rhyme to stimulate generalisation, were chosen. The auditory bombardment is the same in all three sessions. The target word and the activity in the single word perception and production games were different every session. Five out of six activities are perceptual (target sounds, minimal pairs, passive rhyming) and only one out of the six activities is productive (articulatory). The group intervention focuses more on perceptual activities than individual therapy usually does, because eliciting target sounds that are not individually selected per child asks for more tailored care, especially if the intervention is not provided by a speech-language pathologist.

Procedure

The intervention sessions were conducted in small groups of three to five children. If more than five children within a special treatment group of eight participated, the group was split in two smaller groups by the child-care professionals. One session lasted about 15 min. As the intervention consisted of three different sessions for each of the five target sounds, the children received 15 sessions in total during the intervention period of two months, which brings the frequency to two times a week. The three sessions per target sound were always presented in blocks: all three sessions for one target sound were completed before moving to the next target sound. The dosage was around 45 min per target sound in total.

During the six test sessions, the children were tested by a speech-language pathologist in a quiet room. To minimalise variation all the test sessions were executed by two speech-language pathologists connected to this study. The test sessions were recorded on video with audio for later analysis. All the elements of the tasks were performed within one session. The duration of one test session was between 15 and 30 min, depending on the attention span and motivation of the child. The order of the two picture naming tasks was alternated. In each test session, half of the children started with the Metaphon screening and continued with the NAO VW, whereas the other half of the children completed the NAO VW before the Metaphon screening. These two groups alternated as well: children either started with the Metaphon screening and ended with the NAO VW at T0, T2 and T4 or they followed this order at T1, T3 and T5. The caregiver(s) of the children filled out the ICS-NL only once, around the time of the baseline measurement (T0).

During the Metaphon screening and the NAO VW articulatory test, children named pictures and, consequently, produced target words. These target words were transcribed by five master's students in Linguistics. If the child produced a target word multiple times, the final utterance was transcribed. Two transcribers independently transcribed 10% of the samples which were used to calculate the reliability of their transcriptions on. The Intraclass Correlation Coefficient (ICC) was 0.803, which is indicative of good reliability (Koo & Li, 2016).

Analysis

The two picture naming tasks (Metaphon screening and NAO VW) were analysed by calculating the Percentage Consonants Correct (PCC). The PCC was calculated by assigning one point to each consonant that was correctly produced by the child. Additions of segments were not penalised. Omissions, substitutions, metathesis and distortions were considered incorrect and were assigned 0 points. For each target word, the total amount of assigned points was divided by the total amount of possible points. Table V shows several examples.

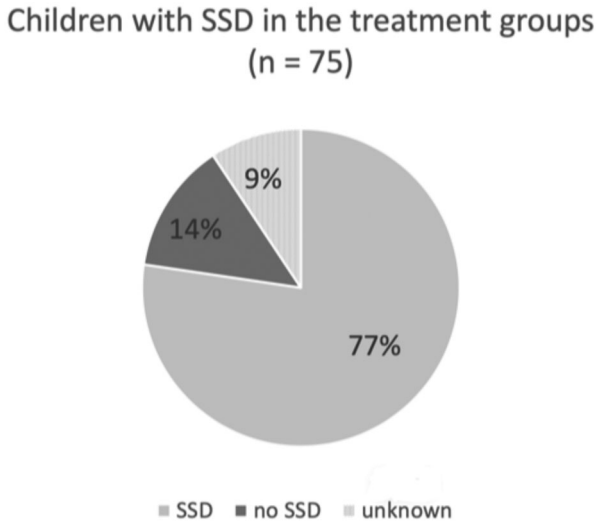

Figure 2. Prevalence of speech sound disorders (SSD) in the special treatment groups of Auris.

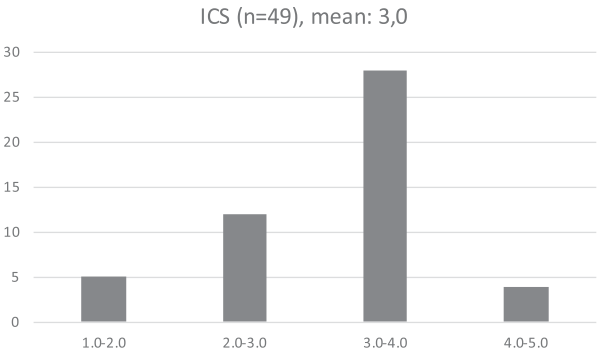

Figure 3. Severity of speech sound disorders (SSD) in the special treatment groups of Auris.

Table VI. Mean, SD and median of Percentage Consonants Correct (PCC) per measurement time point ($n = 31$).

T	Mean PCC	SD (%p)	Median PCC
0	42.2	18.0	42.9
1	40.5	18.9	43.0
2	42.5	19.5	43.4
3	51.4	20.4	57.0
4	56.6	22.6	63.0
5	57.6	21.8	63.0

To evaluate the effect of the added group intervention on the PCC, we ran a Multilevel analysis or Linear Mixed Model with test session as fixed factor, participant as random factor and pairwise comparisons using a Bonferroni correction.

Result

Out of the 75 children that attended one of the special treatment groups participating in the current study, 58 children were diagnosed with SSD by their speech-language pathologist and their caregiver(s) were asked to participate in the intervention study. According to these numbers, the prevalence of SSD in the treatment groups of Auris for children with DLD is 77%. This is shown in Figure 2.

A total of 54 of these children were self-selected by their caregiver(s) to participate in the study. The severity of SSD was determined based on results of the ICS ($n = 49$). Five children had a score between one and two (1.0–1.9), meaning that they were understood "never to rarely" due to problems in their intelligibility. Scoring between two and three (2.0–2.9), 12 children only were understood "rarely to sometimes" by their environment. Most of the children (28 out of 49) are "sometimes to usually" intelligible (between three and four: 3.0–3.9). Finally, four children were reported to "usually to always" (between four and five: 4.0–5.0) being intelligible. The distribution of the severity of SSD is shown in Figure 3.

The aim of the current study was to examine whether a group intervention targeting SSD increased the growth in speech sound production when added to the usual care. In Table VI the mean, SD and median values per test session for the intervention group ($n = 31$) are displayed. In Figure 4, the PCC-change over test sessions is visualised by means of a boxplot. We found a significant main effect of test session ($F(5,47) = 38.476$, $p = 0.000$). The results of the pairwise comparisons can be found in Table VII. For none of the pairs between T0-T2 there were significant effects of test session on the PCC. This means the PCC did not change significantly between the test sessions before the group intervention was added. However, we found significant positive effects of test session for all pairs between the test sessions T0-T2 combined with the test sessions between T3-T5. In other words, the PCCs of all test sessions after the intervention were significantly higher than the PCCs of all test sessions before the intervention. In addition, there were significant effects of test session between T3-T4 and between T3-T5, but not between T4-T5. This means that one month after the intervention had stopped there was still a significant increase in PCC, but that two months post-intervention this increase is no longer significant. To summarise, the intervention significantly affected the PCC of the participants, increasing it by over 15% in only four months' time (T2-T5).

Discussion and conclusion

It was found that 77% of the children diagnosed with (presumed) severe DLD that attend special treatment groups also have an SSD. This number is at the highest end of previous estimations, ranging between 9% and 77% (Tyler, 2002). As children attending a special treatment group have been diagnosed with (presumed) severe DLD already before the age of four, it is possible that having severe speech sound difficulties leads to an earlier detection of DLD or that the most severe subgroup of young children with (presumed)

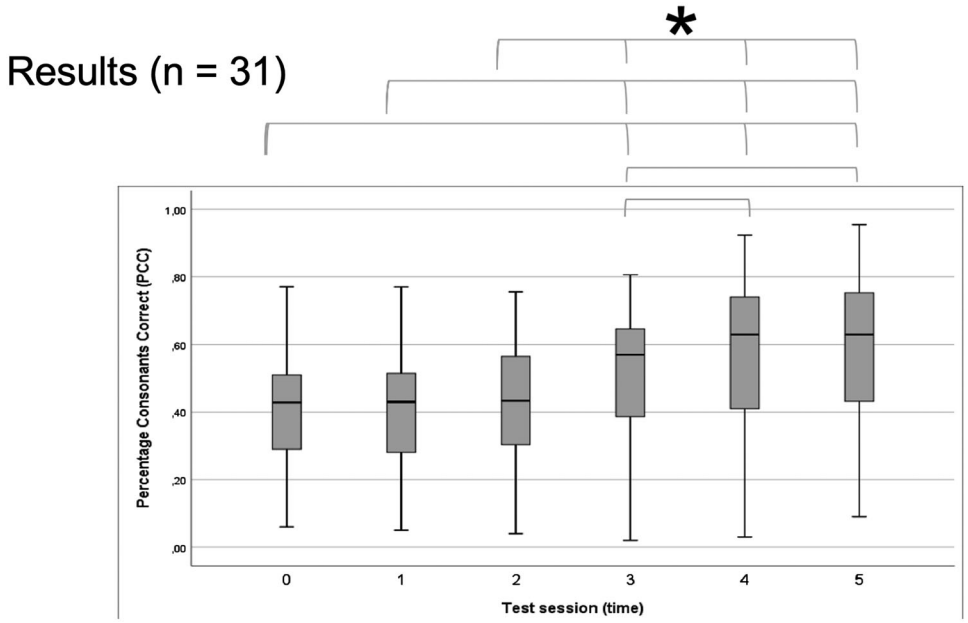

Figure 4. Boxplot of mean Percentage Consonants Correct (PCC) per measurement time point ($n = 31$).

Table VII. Mean difference and significance (* = 0.004, ** = 0.000) for pairwise comparisons (using Bonferroni correction) between test sessions.

	T1	T2	T3	T4	T5
T0	−1.7	0.3	9.2**	14.4**	15.4**
T1		2.0	10.9**	16.1**	17.1**
T2			8.9**	14.1**	15.1**
T3				5.2*	6.2**
T4					1.0

DLD overlaps greatly with the subgroup of children with both language and speech problems.

The severity of SSD was determined based on results of the ICS. It was found that most caregiver(s) (28 out of 49) reported understanding their child "sometimes to usually." While 17 out of the 49 children were understood "never to rarely" or "rarely to sometimes" by their environment. This could have quite an impact on the interaction between the child and others and might influence not only their direct success in interacting with others but also their self-esteem and the amount of language input they receive in the long run due to more communication breakdowns and avoidance of communicative situations.

The main research question concerned measuring the efficacy of a group intervention targeting the phonological development of children with (presumed) severe DLD and SSD. The results showed no significant increase of PCC between T0, T1 and T2. This was an unexpected result. Before, during and after the added group intervention, children continued to have individual speech therapy sessions. It was therefore expected that children would increase in their PCC even before the intervention (and show more progress after the intervention). An explanation for this lack of growth in the two months before the group intervention could be that the content of the individual therapy might not have been targeting phonology, but other language domains such as morphosyntax. Another possibility is that, even if individual therapy was targeting phonology, the dosage of individual therapy on its own is too low to accomplish growth in PCC over a short period of time (2 months).

The added group intervention had a significant positive effect on the mean PCC. The mean PCC improved directly after the intervention, although we had rather anticipated a delayed effect, which we saw as well. The mean PCC went up 8.9% during the intervention period and another 5.2% in the following month. Over the four-month period after the last pre-intervention test until the last post-intervention test the mean PCC increased by 15.1%. During the six months the children were followed, the mean PCC increased 15.4% in total.

The aim of the current study was to examine the efficacy of group intervention targeting phonological development. In a between-subjects multiple-baseline design, children diagnosed with (presumed) severe DLD and with SSD were tested by means of several measures. The design included three pre-intervention test sessions to measure the progress due to natural growth and care as usual (individual speech therapy sessions). After the intervention period, three post-intervention test measurements were administered in order to measure both the direct and the delayed effect. The results show that children benefit from a group intervention targeting phonological development, displaying an increase in overall phonological production skills during and directly after the intervention. Due to the time investment going into both the collection and analyses of speech production data, the impact of repeated measurements on

children, and challenges in matching children from the intervention group with children from control groups, we chose the current design over a design including control groups. However, due to the design of the study and the difference in improvement found before and after the intervention we are positive that the group intervention contributed to the effect found.

The results of this study also indicate that trained childcare professionals can effectively deliver a group intervention targeting phonology. They attained the necessary skills to deliver the group intervention and were able to administer the intervention according to protocol while being coached by a speech-language pathologist. In this specific clinical setting, adding a group intervention is an efficient and effective way of increasing dosage for phonological therapy. Further research is needed to find out if the increase in dosage of therapy is the main explanation for the gains in PCC or whether the increase is due to specific group aspects of the intervention, such as hearing other child models during the intervention sessions, children being more attentive or engaged during group activities, or perhaps due to a combination of these factors.

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Supplementary material

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References

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: APA.

Barlow, J.A., & Gierut, J.A. (2002). Minimal pair approaches to phonological remediation. *Seminars in Speech and Language*, 23, 57–68. doi:10.1055/s-2002-24969

Beers, M. (1995). The phonology of normally developing and language-impaired children. Dissertation: University of Amsterdam.

Beers, M. (2003). Klankproductieproblemen: een fonologische benadering. *Stem-, Spraak- en Taalpathologie*, *11*, 245–259.

Bishop, D.V.M., Snowling, M.J., Thompson, P.A., & Greenhalgh, T, & CATALISE consortium. (2016). CATALISE: A multinational and multidisciplinary Delphi consensus study. Identifying language impairments in children. *PLoS One*, *11*, e0158753 doi:10.1371/journal.pone.0158753

Boyle, J., McCartney, E., Forbes, J., & O'Hare, A. (2007). A randomised controlled trial and economic evaluation of direct versus indirect and individual versus group modes of speech and language therapy for children with primary language impairment. *Health Technology Assessment*, *11*, 1–139.

Broomfield, J., & Dodd, B. (2011). Is speech and language therapy effective for children with primary speech and language impairment? Report of a randomized control trial. *International Journal of Language & Communication Disorders*, 46, 628–640. doi:10.1111/j.1460-6984.2011.00039.x

Chumpelik, D. (1984). The PROMPT system of therapy: Theoretical framework and applications for developmental apraxia of speech. *Seminars in Speech and Language*, *5*, 139–156. doi:10.1055/s-0028-1085172

Conti-Ramsden, G., & Durkin, K. (2017). Developmental language disorder. In D. Skuse & H. Bruce (Eds.), *Child psychology and psychiatry: Frameworks for clinical training and practice* (3rd ed., pp. 307–313). Hoboken: Wiley-Blackwell.

De Boysson-Bardies, B., & Vihman, M.M. (1991). Adaptation to language: Evidence from babbling and first words in four languages. *Language*, *67*, 297–319. doi:10.1353/lan.1991.0045

Dodd, B. (2013). *Differential diagnosis and treatment of children with speech disorder* (2nd ed.). Hoboken: John Wiley & Sons.

Doornik van-van der Zee, A., & Terband, H. (2013). *Schaal voor verstaanbaarheid in de context: Nederlands, vertaling van Intelligibility in Context Scale van McLeod*, Harrison & McCormack. Utrecht: Universiteit Utrecht.

Dunbar, E., & Idsardi, W. (2012). The acquisition of phonological inventories. In J. Lidz, W. Snyder, & J. Pater (Eds.), *The Oxford handbook of developmental linguistics* (pp. 7–26). Oxford: Oxford University Press

Fikkert, P. (2007). Acquiring phonology. In P. de Lacy (Ed.), *The Cambridge handbook of phonology* (pp. 537–554). Cambridge: Cambridge University Press.

Hesketh, A., Adams, C., Nightingale, C., & Hall, R. (2000). Phonological awareness therapy and articulatory training approaches for children with phonological disorders: A comparative outcome study. *International Journal of Language & Communication Disorders*, *35*, 337–354. doi:10.1080/136828200410618

Hodson, B., & Paden, E. (1991). *Targeting intelligible speech: A phonological approach to remediation* (2nd ed.). Austin, TX: Pro-Ed.

Howell, J., & Dean, E.C. (1991). *Treating phonological disorders in children – Metaphon: Theory to practice*. London: Whurr.

Ingram, C.P.D., & List, H. (1987). A comparison of initial consonant acquisition in English and Quiché. In K. E. Nelson & A. Kleeck van (Eds.), *Children's language* (Vol. 6, pp. 175–190). Hillsdale, NJ: Lawrence Erlbaum.

Koo, T.K., & Li, M.Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. J Chiropr Med, *15*, 155–163. doi:10.1016/j.jcm.2016.02.012

Law, J., Garrett, Z., & Nye, C. (2003). Speech and language therapy interventions for children with primary speech and language delay or disorder. *Cochrane Database Systemic Reviews*, *3*, CD004110.

Leijdekker-Brinkman, W. (2002). De Metaphonbox. *Behandeling Van Kinderen Volgens De Metaphon-Therapie*. Lisse: Swets & Zeitlinger.

Leonard, L.B. (1998). *Children with specific language impairment*. Cambridge, MA: MIT press.

LOGO-Art. (2012). *Nederlands Articulatie Onderzoek in Verwervingsvolgorde (NAO VV)*. Oldemarkt: LOGO-Art.

Norbury, C.F., Gooch, D., Wray, C., Baird, G., Charman, T., Simonoff, E., … Pickles, A. (2016). The impact of nonverbal ability on prevalence and clinical presentation of language disorder: evidence from a population study. *Journal of Child Psychology and Psychiatry*, *57*, 1247–1257. doi:10.1111/jcpp.12573

Oller, D.K. (1980). The emergence of the sound speech in infancy. In G.H. Yeni-Komshian, J.F. Kavanagh, & C.A. Ferguson (Eds.), *Child Phonology* (Vol. 1, pp. 93–112). New York: Academic Press.

Roberts, J., Rescorla, L., Giroux, J., & Stevens, L. (1998). Phonological skills of children with specific expressive language impairment (SLI-E): outcome at age 3. *Journal of Speech, Language, and Hearing Research*, *41*, 374–384. doi:10.1044/jslhr.4102.374

Schlichting, J.E.P.T., & Spelberg, H.C.L. (2010a). *Schlichting Test voor Taalbegrip*. Houten: Bohn Stafleu van Loghum.

Schlichting, J.E.P.T., & Spelberg, H.C.L. (2010b). *Schlichting Test voor Taalproductie II*. Houten: Bohn Stafleu van Loghum.

Schlichting, L. (2005). *Peabody Picture Vocabulary Test-III-NL*. Amsterdam, the Netherlands: Hartcourt Assessment BV.

Stoel-Gammon, C. (2011). Relationships between lexical and phonological development in young children. *Journal of Child Language*, *38*, 1–34. doi:10.1017/S0305000910000425

Tomblin, J.B., Records, N.L., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M. (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech, Language and Hearing Research*, *40*, 1245–1260. doi:10.1044/jslhr.4006.1245

Tyler, A.A. (2002). Language-based intervention for phonological disorders. *Seminars in Speech and Language*, *23*, 69–81. doi:10.1055/s-2002-23511

Waring, R., & Knight, R. (2013). How should children with speech sound disorders be classified? A review and critical evaluation of current classification systems. *International Journal of Language & Communication Disorders*, *48*, 25–40. doi:10.1111/j.1460-6984.2012.00195.x

Weismer, S.E. (2013). Specific language impairment. In L. Cummings (Ed.), *The Cambridge Handbook of Communication Disorders*. Cambridge: Cambridge University Press.

Weismer, S.E. (2007). Typical talkers, late talkers and children with specific language impairment: A language endowment spectrum? In R. Paul (Ed.) *Language Disorders From A Developmental Perspective* (pp. 83–101). Mahwah, NJ: Lawrence Erlbaum.

Appendix: Phonological Characteristics

Language: Standard Dutch (The Netherlands)	Language Family: Indo-European
Words	"The Dutch language is known for the fact that it can 'glue' words together to form very long words, and there is little restriction as to the number of syllables in a word." (Mennen et al., 2007, p. 406)
Syllable shapes	Onsets: C, CC, CCC; Rimes: V, VC, VCC, VCCC, VCCCC (e.g. from ei [ɛɪ] "egg" to herfst [hɛrfst] "autumn".
Tones	None
Syllable stress	Predominant prefinal syllable stress, but variable between initial and final syllable stress.
*Vowels	/i, y, u, eː, øː, oː, aː, ɪ, ɛ, ɔ, ʏ, ɑ/
*Diphthongs	/ɛi, oey, ʌu/
*Consonants	/p, b, t, d, (c), k, (g), m, n, (ɲ), ŋ, r, f, v, s, z, (ʃ), (ʒ), χ, h, ʋ, j, l/ (incl. allophones and marginal consonants)
Clusters	Two and three element consonant clusters in word-initial position, up to four element clusters in word-final position. Dutch can have many consecutive consonant phones (e.g. within composite words such as angstschreeuw ['ɑŋstsχrøʉ] "cry of fear").
Examples of phonological constraints	"Any consonant except /ŋ/ can occur in syllable initial position. Similarly, any consonant except /h/ can occur word-finally. There are some language specific restrictions on the possible combinations of consonants. For example, /h/ never occurs in syllable-initial clusters. Syllable-initial clusters never have two sonorant consonants, that is, combinations of nasals with liquids or glides (e.g. [nl]), or liquids with glides ([lj]), are not allowed in syllable-initial position. There is only a very restricted set of three element clusters. Where a syllable onset has three consonants, the first consonant is always /s/. Where a syllable ends in more than two consonants, the final consonants are always coronal /t/ and /s/ as in herfst [hɛrfst] "autumn"." (Mennen et al., 2007, p. 406)

*Mennen, I., Levelt, C., & Gerrits, E. (2007). Dutch speech acquisition. In S. McLeod (Ed.), *The international guide to speech acquisition* (pp. 327-339). Clifton Park, NY: Thomson Delmar Learning.