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Intensive Phonological Training With Articulation—An Intervention Study to Boost Pupils' Word Decoding in Grade 1

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The aim of this study is to examine how a structured intensive training period with a phonological multisensory reading training method, at the end of Grade 1, can develop pupils' ability to connect phonemes with the corresponding graphemes as well as their ability to decode. A total of 38 pupils in Grade 1 from four elementary schools participated in this randomized controlled trial (RCT) study. Of the 38 pupils 19 were randomly assigned to be part of the intervention group, the other 19 were included in the control group. The intervention involved 30 minutes of intensive training on a total of 20 sessions. The control group participated in regular reading lessons in the classroom. The study included pre- and posttesting of phonological awareness, letter knowledge, and decoding. The result shows that intensive phonological awareness training with articulation, during 20 sessions spread over 4–5 weeks, stimulates pupils' decoding ability in a positive direction.

Keywords: RCT; multisensory reading training; reading difficulties; early intervention

Many pupils learn to read regardless of the method they encounter in school. For those pupils who are at risk of encountering reading and writing difficulties, the arrangement and methodology are crucial. For decades it has been known that it is possible to prevent reading difficulties by structured phonological awareness training in preschool (Lundberg et al., 1988; Snow et al., 1998). Early intervention has shown to be effective both in terms of preventing reading and writing difficulties and when training pupils who are struggling with their reading (National Reading Panel, 2000; Vellutino et al., 1996). Research shows the importance of preventative efforts already in the early school years for pupils who have difficulty learning to read (SBU, 2014). Individualized and high-quality extra support must be inserted already in year 1 for those pupils who are identified with reading and writing difficulties and thus might require special education. The reason for early intervention is to prevent incorrect reading strategies from the start, and in that way reduce the risk of the pupil losing motivation

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and confidence in their literacy learning ability (Elbro & Petersen, 2004; Høien & Lundberg, 2000, 2013). When a child is learning to read according to the alphabetic principle, phonological awareness is of critical importance. It is well known that phonological awareness can predict early reading (Bradley & Bryant, 1983; Melby Lervåg et al., 2012). The child needs to understand that words are divided into phonemes represented by graphemes. Generally, the development of phonological awareness occurs spontaneously in children at the age of 4–5. However, some children have difficulties perceiving and distinguishing forms of language and their phonological awareness does not develop spontaneously. These children are at risk of developing reading and writing difficulties without extra support (Melby Lervåg et al., 2012).

Previous studies in early reading instruction emphasize the importance of well-structured interventions (Reutzel & Cooter, 2012; Wolff, 2011). The material used in the present study consists of well-structured instructions to develop phonemic awareness of the connection between phonemes and graphemes as well as decoding ability. The present study has been conducted with pupils at the end of Grade 1 in elementary school. All pupils have spent a year at school, with ordinary teaching, without learning to read and were considered at risk of developing reading difficulties. We examined the effects of a structured intervention using the FonoMix program which contains phonological training with articulation. This teaching material has been used in a previous study (Fälth et al., 2017) that took place over a whole school year. The novelty of this study is that the training program was used as an intensive training method for 5–6 weeks instead of the whole year as it is intended for.

MULTISENSORY READING TRAINING

Lindamood Phoneme Sequencing Program (LiPS) for Reading, Spelling and Speech is a program that has been developed over 40 years ago and was then named ADD, Auditory Discrimination in Depth Program (Lindamood & Lindamood, 1998). The program has since been revised on four occasions, most recently in 2011. LiPS is a multisensory and intensive program for children in need of explicit and systematic training in phonological awareness. The program is specially designed for children with reading difficulties and children at risk of reading and writing difficulties. In multisensory reading training, several senses are used. It has shown to be effective for both children learning to read and children with reading and writing difficulties. Children with reading and writing difficulties often lack phonological and orthographic lexicons. They have difficulties understanding the connection between phonemes and graphemes as they are abstract entities that are difficult to identify. This contributes to the difficulty of associating phonemes to the correct graphemes. The confusion of letters can be a consequence of such difficulty. Functional reading requires that correspondence between phoneme and grapheme is automatic. Multisensory reading training can contribute to automation taking place at a faster rate (Høien & Lundberg, 2000). By using several senses, the child develops the ability to distinguish phonemes in spoken language. LiPS (Lindamood & Lindamood, 1998) is based on the fact that the child learns to identify phonemes with the help of mouth images, and eventually read the sounds on their own.

Several studies have examined the effects of LiPS programs on children learning to read (Fälth et al., 2017; Lindamood & Lindamood, 1998; Torgesen et al., 2001). Positive effects have been shown in terms of phonological awareness, decoding, and reading ability at the word level. In an intervention study by Torgersen et al. (2001), 60 pupils, 8–10 years old with decoding difficulties, participated. The study compared two different training

programs, ADD and Embedded Phonics (EP). The pupils in the intervention group received one-to-one tuition, twice a day for 50 minutes, over a period of 8 weeks. In the ADD training program, phonological training was included by using the structured, multisensory, and articulatory coupling of the phoneme to grapheme. In the EP training program, phonological training was combined with reading meaningful texts. Both programs showed good effects despite their differences. This, according to Torgesen et al. (2001), indicates that the details in the different programs are not the most important. They suggest that it is the phonological basis of the programs together with the phonology that is linked to the written language, combined with systematic and intensive training, which is the most important.

In a previous study by Fälth et al. (2017) the effects of phonological training with articulation on phonological awareness and reading skills were studied on pupils in preschool classes. The result showed that phonological training with articulation using nine letter–sound combinations had positive effects. The results also showed that the intervention group, which systematically received phonological training with articulation for almost 1 year, improved on all tests included in the study. These results are in line with those from other studies using phonological training with articulation (McIntyre et al., 2008; Torgesen et al., 2001) The results from the longitudinal intervention in the study by Fälth et al. (2017) tended to be stable at a follow-up measurement 6 months later.

Training with articulation has also been used in a study by Wolff (2011) with pupils in Grade 3 using Reading and Fluency Training Based on Phonemic Awareness. The program was conducted daily on a one-to-one basis for a period of 12 weeks. Immediately after, and 1 year after the intervention ended, the effects of the intensive training were tested. The multisensory reading training was supplemented by explicit reading flow training combined with reading comprehension strategies. Positive effects were also demonstrated in this intervention where intensive reading training proved successful with good results for decoding, spelling, reading comprehension, and reading speed. The intervention group performed better on all tests compared to the control group (Wolff, 2011).

In the present study, the participants are a year older (cf. Fälth et al., 2017) and have attended elementary school for almost a year. The phonological training with articulation was now used as an intensive boost for 4 weeks toward the end of the school year. The arrangement of the intervention included a month of intensive training. This is considerably shorter than previous research with LiPS and similar programs, which normally includes training for a semester or a year. The aim of this study is to examine how a structured intensive training period with a phonological multisensory reading training method, at the end of Grade 1, can develop pupils' ability to connect phonemes with the corresponding graphemes and apply this when decoding.

MULTISENSORY METHODOLOGY—FONOMIX

FonoMix, the method used in this study, is a phonological multisensory methodology for teaching reading. It connects the visual, auditory, and kinesthetic senses and concretizes the relationship between phonemes and graphemes (Löwenbrand-Jansson, 2018). The method is based on the same pedagogical foundation as LiPS (Lindamood & Lindamood, 1998; Torgesen et al., 2001) and has a structured and systematic approach that focuses on strengthening the connection between phonemes and graphemes. The method focuses on recurring moments where the mouth image/phoneme is pronounced and connected to the corresponding grapheme. This is to automate the phoneme's connection to the grapheme, a phonological strategy, which is

central to effective learning to decode words when reading. Like LiPS (Lindamood & Lindamood, 1998), mouth images are used as visual support to identify and remember how the mouth shapes phonemes in different ways. They illustrate the otherwise elusive phonemes which are the smallest units of sound distinguishing words from each other. The mouth images are named based on how the mouth is formed, for example, the phoneme / a / has been named gap mouth because the mouth gapes to produce the phoneme in the speech. The material includes 14 consonant mouths that visually show whether the phoneme is made with tongue, teeth, or lips. The four vocal mouths have drawn faces so that pupils can more efficiently distinguish between vowels and consonants. Each mouth image is introduced with the help of a story that is read aloud to the pupils. The mouth images are set up in a specific order as they are introduced to the pupils. This helps them to produce and remember the different phonemes. When the pupils are analyzing the words, the teacher says the word and displays the number of sounds with his/her fingertips against the chin in the reading direction, from the left to the right. The pupil studies his/her mouth in a mirror. Curlicues are linked to the pictures to form a written word below the mouth of the picture, for example, *sun*. Simultaneously, the teacher shows a picture of a sun and inserts it into a sentence: "The sun is shining and it is hot outside." It is important for the understanding that the word occurs in a context. The teacher's guide to this material states that the training should last for a whole school year and that it can be done both individually and in groups. Within the framework of this study, the pupils were taught in groups of six to seven pupils for 5–6 weeks.

METHOD

Participants

Thirty-eight pupils in Grade 1 from four Swedish elementary schools participated in the study. All pupils had received regular school-based reading instruction for almost a year before the intervention. All the pupils involved in the study (n = 159) were screened with a word decoding test (Fälth et al., 2017). The test was conducted individually. The task was for the pupil to read as many words as possible correctly in 1 minute from a list consisting of 144 words. The pupils (n = 38) who had a result below the 25th percentile on this test were asked and agreed to participate in the study. When this study started, all pupils were in Grade 1 and the average age of the pupils was 7.7 years old.

Pupils (n = 38) were randomly assigned to either an intervention group or a control group. There were 19 pupils in each group with a relatively even gender distribution despite it not being taken into account during the draw. There were 11 girls and 8 boys in the intervention group, whereof 5 had Swedish as a second language. The control group consisted of 10 boys and 9 girls, whereof 3 had Swedish as a second language.

Instruments

Phonological Awareness. The test was conducted in groups of 10–12 pupils and measured the ability to identify phonemes at the beginning, middle, and end of common words as well as the ability to combine phonemes into words. The maximum score for the test was 26.

Word Decoding. The test measured decoding ability (i.e., sight word reading) and was performed individually with the test leader. The test consisted of a list of 144 common words that gradually increased in length and difficulty. The pupil was asked to read as many words as possible in 1 minute and the test leader noted the number of correctly read words. By observing the pupil reading individual words, the test leader was able to assess the pupil's decoding strategy. The purpose of using single word tests is to avoid pupils taking advantage of the context where they guess rather than read the words. Reported test–retest reliability for children aged 6–9 years at this test was .97. The maximum score for the test was 144.

Nonword Reading. The task was to read as many nonwords as possible from a list in 1 minute. Reported test–retest reliability for children aged 6–9 years at this test was .90. The maximum score for the test was 84.

Procedure

All tests were administered by the authors. The test leaders were carefully instructed to follow the same test procedures that were provided in the test manual. The word decoding and nonword reading tests were administered in a one-to-one setting while the phonological awareness test was carried out in groups of six to seven pupils answering the questions individually.

The pupils in the intervention group received intensive training with the phonological multisensory reading learning method FonoMix (Löwenbrand-Jansson, 2018). The intervention was conducted over a period of 5 weeks at the end of Year 1 in elementary school. The intervention was carried out for 30 minutes on a total of 20 lessons divided into 4 lessons per week. 18 out of the 19 pupils completed all 20 lessons. One pupil, due to illness, participated in only 18 of the 20 lessons. Each lesson was jointly planned by the intervention leaders and the exercises followed a structured manual (Löwenbrand-Jansson, 2018).

The intervention was conducted in groups of six to seven pupils in a well-known environment. The same classroom was used during all sessions. At each session, all pupils were placed on chairs in a semicircle in front of the whiteboard. Consideration was given to the pupils' regular class schedules. The sessions have mostly been conducted at the same time every day during which the comparison group was taking part in regular reading in the classroom. This was to prevent the intervention group feeling excluded from the regular classroom teaching and thus avoid a negative impact on their motivation. The teachers (n = 4) responsible for each intervention group work as special education teachers and were well-known to the pupils.

Statistical Analysis

We analyzed data from participants in the two conditions using repeated-measures analysis of variance (ANOVA) for measures administered at pretest and posttest. A 2 × 2 repeated measures ANOVA was performed with group and test session as independent variables. An overview of the effects of the intervention on reading skills is presented in Table 1. Cohen's d (1988) was used to estimate the effects of the intervention program. Cohen's d was calculated as the ratio of the change score, and the standard deviation of the mean score of the follow-up and the pretest in the pooled sample. There were no missing data in the data set.

TABLE 1. Results on the Reading Tests (*M, SD*) T1 and T2 (*N* = 38)

	N = 38	T1 Decoding	T2 Decoding	T1 Nonword	T2 Nonword	T1 Phon. Awar.	T2 Phon. Awar.
Mean	Intervention	19.4	30.8	10.2	15.6	17.4	22.6
	Control	19.5	23.5	9.37	11.8	17.6	19.0
Standard deviation	Intervention	7.92	9.98	3.92	5.05	2.31	2.71
	Control	8.95	9.00	4.86	3.85	4.07	5.07
Cohen's *d*	Intervention		1.18		1.16		2.07
	Control		0.45		0.54		0.30

Note. Cohen's *d* = [*M* at T2_(*M* at T1 + M at T2) / 2] / pooled *SD* for T1, T2.

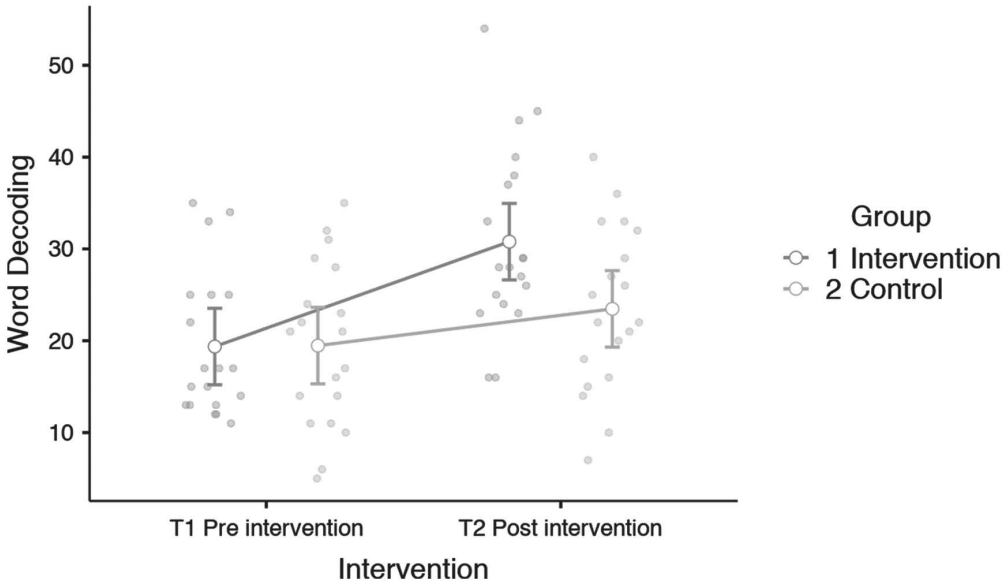

Figure 1. Results from the word decoding test for the intervention group and the control group at Test session 1 and Test session 2.

RESULTS

A 2 × 2 repeated measures ANOVA (pre- and posttest) with between group factors (intervention, control) was conducted for each of the three reading tests (word decoding, nonword reading, phonological awareness). The results showed statistically significant main effects of test session (i.e., improvements) for all measures. Table 1 shows the mean characteristics and effect sizes (Cohen's *d*) of both the intervention and control groups.

For *decoding*, there was a significant interaction between time and group, $F(1, 36) = 22.6$, $p = <.001$, $\eta^2 = .386$ (Figures 1–3).

For *nonword reading*, there was a significant interaction between time and group, $F(1, 36) = 7.1$, $p = <.001$, $\eta^2 = .165$.

For *phonological awareness*, there was a significant interaction between time and group, $F(1, 36) = 6.73$, $p = <.001$, $\eta^2 = .157$.

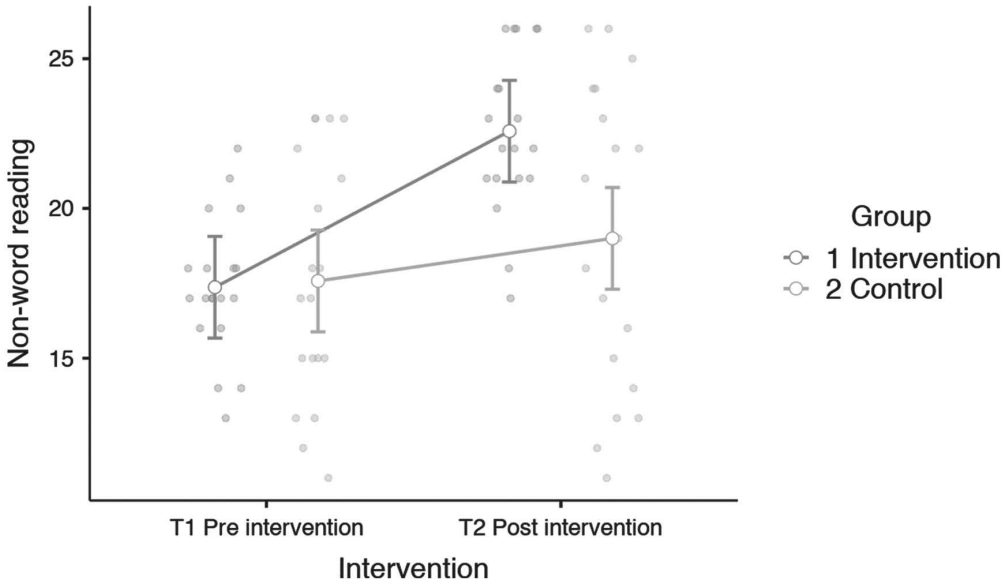

Figure 2. Results from the nonword reading test for the intervention group and the control group at Test session 1 and Test session 2.

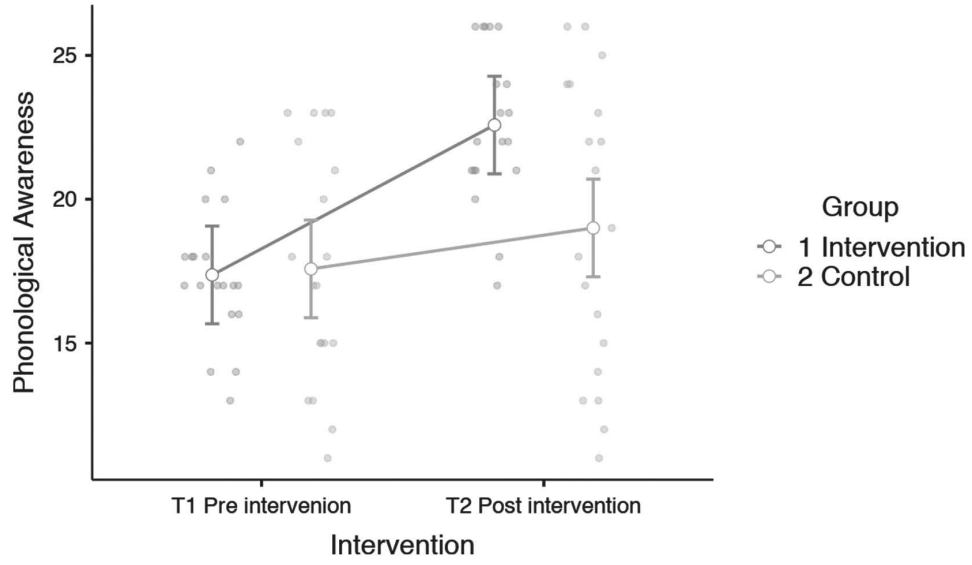

Figure 3. Results from the phonological awareness test for the intervention group and the control group at Test session 1 and Test session 2.

There were statistically significant main effects of the test session (all *ps* < .01) for all dependent variables. Furthermore, significant interactions were found between group and test session on all dependent variables (all *ps* < .05). Cohen's *d* showed that the experimental group improved more than the control group between pretest and posttest for all measures. For the experimental group, Cohen's *d* varied between 1.16 and 2.07 and for the comparison group between 0.3 and 0.54.

DISCUSSION

In this randomized controlled trial (RCT) study, we investigated by contrasting an aligned intervention with a nonaligned intervention. The main purpose of the study was to evaluate an intervention with intensive phonological training with articulation for improving children's reading skills. The results showed that the intervention group, which systematically received phonological training with articulation, improved on the tests included in the study. These results are in line with those from other studies using phonological training with articulation (Fälth et al., 2017; McIntyre et al., 2008; Torgesen et al., 2001) where it was concluded that multisensory training contributes to an automation of the coupling when several senses are allowed to interact during learning. In the present study, intervention took place at the end of Grade 1 as an extra boost for pupils who had not yet started reading efficiently after receiving the ordinary basic reading and writing instruction during their first year in school. The broader literature on reading interventions for promoting reading development among struggling readers makes it clear that intervention programs, on average, are more effective in younger compared to older children (Lovett et al., 2017) The pupils in this study have not started to read efficiently, or do not read at an age-appropriate level, and still have to rely on phonological strategy when decoding (cf. dual-route theory) (Coltheart, 2005).

Understanding the attributes of inadequate responders also contributes to research that identifies potential intervention targets. For example, inadequate responders are known to have deficits in several cognitive and linguistic domains, including phonological awareness, vocabulary, and listening comprehension (Fletcher et al., 2011; Stage et al., 2003). Many of these domains are promising intervention targets (Lesaux et al., 2014; Torgesen et al., 2010). In this study, we target the phonological awareness domain by consolidating the connection between phonemes and graphemes to enable decoding automatically. Several researchers (Elbro & Petersen, 2004; Høien & Lundberg, 2013; Kamhi & Catts, 2012) argue that phonological awareness plays a central role in continued reading and writing development. Within the framework of the training, 14 consonants and 4 vowels were used. The results indicated that the effects of training are transferable to other letters, and sound–letter combinations, than the ones explicitly trained during the intervention. In other words, there appear to be transfer effects from the explicitly trained letter–sound combinations to other sounds and letters, which facilitates word decoding.

In this study, we compressed the FonoMix method from the intended minimum of 6 months of intervention to a 1-month intensive intervention period, including 20 sessions. The intensity, 1 hour per day for 4–5 days a week, of this intervention, and skilled instructors tailoring the pace of the program according to the pupils' needs, makes it unique to earlier studies using the FonoMix method. The results from the posttest showed that 15 pupils in the intervention group, and 4 pupils in the control group, reached the target level for decoding in Grade 1. However, the study shows that all pupils in the intervention need continued teaching to practice their decoding. Although they are now able to decode and are in what Ehri (2005) describes as the *partial alphabetic phase,* more and adequate training is crucial for continued decoding development. This is very demanding as pupils are forced to use a phonological strategy. However, as the pupils become more confident in their alphabet–phonemic decoding they will be able to manage orthographic–morphemic reading which requires less effort. Pupils who cannot read words automatically run the risk of not understanding what is being read. Early intervention to prevent these difficulties is important. In line with Ehri et al. (2001), intensive training for a

limited period in smaller groups, are factors that affect the outcome. The multisensory and structured training in phonology and the connection between phonemes and graphemes have probably also contributed to the positive development. In this case, it is in line with the conclusions made in previous intervention studies (Fälth et al., 2017; Torgesen et al., 2001; Wolff, 2011). The results indicate a gain when using multisensory training to strengthen the connection between phonemes and graphemes, which is also pointed out by Høien and Lundberg (2013). However, it is important to have a critical approach when choosing a method for teaching reading, as there is no universal method that suits all pupils.

CONCLUSIONS

Our study has contributed to strengthening previous research (Ehri et al., 2001; Gustafson et al., 2007; SBU, 2014) on the importance of phoneme and grapheme coupling as well as structured intensive reading instruction and training in smaller groups. Previous studies (Alexander et al., 2007; Atteberry & McEachin, 2016) have concluded that there is a risk of pupils losing their newly acquired reading ability during the summer break between Grades 1 and 2. Boosting pupils decoding ability at the end of Grade 1 can strengthen their reading ability and thus prevent them from having to start all over again in the autumn. The results of this study show that a relatively small effort can boost pupils' reading ability, and hopefully minimize summer reading loss. A stable and secure decoding ability ensures that reading development continues rather than taking a step back at the start of Grade 2. Additional research into how an intensive boost of pupils' decoding ability, at the end of the school year, affects the future reading development of struggling readers is recommended.

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