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Research Report

Teaching phoneme awareness to pre-literate children with speech disorder: a randomized controlled trial

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Abstract

Background: Awareness of individual phonemes in words is a late-acquired level of phonological awareness that usually develops in the early school years. It is generally agreed to have a close relationship with early literacy development, but its role in speech change is less well understood. Speech and language therapy for children with speech disorder involves tasks that appear, either implicitly or explicitly, to require a phonemic level of awareness. However, children typically attend for intervention at a pre-school, pre-literate stage, i.e. before they would be expected to have developed the relevant phoneme segmentation and manipulation skills.

Aims: To investigate whether it is possible to teach phoneme awareness skills to pre-literate children with speech disorder.

Methods & Procedures: In a randomized controlled trial design 42 children with speech disorder, aged 4;0–4;6, were allocated to either a phonological awareness or a language stimulation programme. Children were assessed on four measures of phoneme awareness (alliteration awareness, phoneme isolation, word segmentation and phoneme addition/deletion) immediately before and after the programme and categorized as 'improved' or 'not improved' according to predetermined criteria. Fisher's Exact test was used to compare outcome in the two groups.

Outcomes & Results: Significantly more children improved in the phonological awareness group than in the language stimulation group for three out of the four measures (all except alliteration awareness). However, for the two most advanced tasks (segmentation and addition/deletion) only a small minority of children showed improvement. A marked improvement in Phoneme Isolation was made by the majority of children in the phonological awareness group.

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Conclusions: It is possible to teach some advanced phoneme awareness skills to some pre-literate children. Phoneme Isolation was the most easily learned and is a skill that appears very relevant to speech and language therapy. However, phoneme addition, deletion and word segmentation showed relatively limited improvement and only in a small number of cognitively able and older children. Whereas isolation of word initial consonants appears to be a skill that can be triggered at 4;0–4;6 by relevant activities, most children in the study were not cognitively ready for more advanced, abstract phoneme manipulation tasks. This raises questions about how speech and language therapists should tackle many common errors and the age at which we should aim to develop or draw on phoneme awareness to stimulate speech change.

Keywords: phoneme awareness, speech disorder, intervention.

What this paper adds

Phonemic awareness skills (involving identification and manipulation of individual phonemes within a word) usually develop alongside exposure to early literacy. Many therapy tasks for children with speech disorders require such an awareness of phonemes in different word and syllable positions. However, intervention for speech disorder is frequently delivered to pre-school, pre-literate children, raising the question of the extent to which they can engage with therapy tasks. This study shows that isolation of word-initial phonemes is a skill which can be triggered by targeted activities in many children aged 4;0–4;6. More demanding tasks of word segmentation and phoneme addition and deletion were acquired by only a minority of children even after participation in a focused teaching programme. Speech and Language Therapists need to be aware of the typical age of acquisition of different phoneme awareness skills, and of the metaphonological demands of specific therapy tasks.

Introduction

Children with speech problems are an important part of the Speech and Language Therapist's caseload. In the UK, these children are typically receiving Speech and Language Therapy (SLT) for the speech difficulty at approximately 4 years, sometimes earlier. In many cases therapy will begin in the pre-school year before children have formal experience of reading instruction or direct phonic work.

It is possible to take a number of different approaches to therapy for a speech problem. For example, an articulatory (Hesketh *et al.* 2000b, Williams and Stephens 2004), metaphonological (Howell and Dean 1994) or psycholinguistic (Stackhouse and Wells 2001) framework may be chosen. However, whatever the underlying rationale, SLT will involve attention to sounds in words. Whether the child is being asked to repeat, to self-correct or to make judgements about speech, the focus of attention is a sound or range of sounds which may be presented in a variety of syllable positions. To override consciously the typical patterns of speech impairment, such as word final consonant deletion, reduction of clusters or the

systematic substitution of one (class of) sound for another, requires the addition, deletion or manipulation of individual phonemes within a word.

This ability to pay attention to the internal sound structure of words, as opposed to their meaning comes under the umbrella term of phonological awareness (PA). Research on PA tells us that it is not a unitary skill, but a complex developmental ability in which children are gradually able to make finer distinctions within words, from large units (syllables and rimes), to smaller (awareness of individual phonemes within a word) (Wood and Terrell 1998, Burt *et al.* 1999, Carroll *et al.* 2003). The latter is specifically referred to as phoneme or phonemic awareness and is the level referred to in the speech change examples above. Within the phonemic level itself there are different grades of difficulty; recognition tasks are easier than manipulation (e.g. phoneme addition or deletion) and single consonant word-initial onsets are easier to handle than consonants in clusters or non-initial positions (Anthony and Francis 2005).

The gradual refinement of phonological awareness takes place in the typically developing child over a number of years. Some implicit sensitivity to word structure can be demonstrated in very young children. For example, Ballem and Plunkett (2005) show differential behavioural reactions to correct and incorrect productions of both familiar and recently learned words in children just 14 months of age. However, conscious ability to reflect on word structure comes much later in the immediate pre-school and early school years. Carroll *et al.* (2003) plotted progress in children from (group average) age 3 years 10 months to 4 years 9 months. The percentage of children who performed above chance on rime matching rose from 24 to 66% over this time period while the percentage for initial phoneme matching rose from 3 to 51%. Performance on a phoneme deletion task (*'what is "hat" without the /h/?*) was extremely low even at the last assessment; most children were unable to understand the task. Thus at the age when they present for therapy, children would typically be at quite an early pre-phonemic stage of phonological awareness. We would not expect them to be consciously sensitive to word final consonants, the presence of one sound as opposed to another, or the elements of a consonant cluster.

A related issue is that of children's internal lexical phonological representations. As children acquire words, information about their structure is stored as phonological representations and this information is linked to the semantic (and eventually orthographic) data associated with that lexical item. The accuracy of these representations is important for word recognition and production as well as for the mapping between phonemes and graphemes which is a key process in learning to read and spell (Stothard *et al.* 1996). Sénéchal *et al.* (2004) describe a process of restructuring of stored phonological representations, gradually adding detail by incorporating more segmental information, which may be driven either by the acquisition of phonologically similar words which have to be differentiated, or by increasing familiarity with the item (Metsala 1999). Thus, the gradual refinement of phonological representations (from large- to small-unit detail) follows the same pattern as the development of metalinguistic PA skills. However, the findings of Ballem and Plunkett (2005) suggest that the information may already exist and what develops is a child's ability to make use of it. The detail of the phonological representations may exceed a young child's metalinguistic ability to recognize and manipulate that detail, i.e. implicit and explicit processing levels may differ (Treiman *et al.* 1995). For example, normally speaking children may produce correctly

word-final consonants or consonant clusters which they are unable to count, identify or alter as a conscious, non-automatic task.

What do we know about the phonological awareness and representations of children with speech problems? Almost all pertinent studies have shown that, as a group, children with speech disorder perform worse than their peers on PA tasks, though the group results mask considerable variability (Bird and Bishop 1992, Hesketh *et al.* 2000a, Rvachew *et al.* 2003). The nature of the association and the direction of any causality remain the subject of debate. Webster and Plante (1992, 1995) showed speech intelligibility to be a predictor of PA performance and argue that the relationship between speech output and PA is one way, with output phonology being a causal factor in the development of PA. From this viewpoint, it would be necessary to improve speech output in order to stimulate gains in PA. However, SLT generally takes an opposing approach, invoking PA distinctions in order to stimulate speech change. Most research into children with speech disorder has concentrated on phonological awareness rather than underlying phonological representations. However, researchers have recently begun to try to separate out the two areas and to investigate the relationship between them. Sutherland and Gillon (2005) devised a series of receptive-based tasks that tapped phonological representations by requiring children to make judgements about word accuracy. Performance on these was compared with traditional phonological awareness tasks where reference to internal lexical representations is not necessarily involved. They demonstrated a moderate correlation between the two areas of knowledge and found that children with speech disorder were more likely than typically developing peers to have difficulty with representation as well as awareness tasks.

Phonological awareness is important both in speech and in learning to read and spell. Its contribution to early literacy development is almost universally accepted and the essential inclusion of phonics in literacy strategy has recently been re-emphasized in the UK with the advice that systematic direct teaching of phonics should be in place from 5 years (Rose 2006). Before this, awareness of rhyme and alliteration are encouraged in the Foundation and Year 1 curricula (i.e. with children of 3 and 4 years of age in the UK system). It is widely believed that, beyond a certain stage, the development of literacy and of PA may be symbiotic. For example, awareness at the level of the individual phoneme (other than simple onset identification) is thought to be one of the later developing PA skills not generally present in pre-literate children (Gombert 1996, Dodd and Gillon 2001) but it usually develops rapidly (particularly in languages with consistent phoneme–grapheme correspondence) once literacy instruction begins (Anthony and Francis 2005).

The role of phonological and specifically phoneme awareness in speech development and speech change is far less well understood than its role in literacy. Because of the recognition of the importance of PA to literacy and the evidence that many speech-disordered children are poor at it, recent trends have been towards increasing the emphasis on explicit PA work in SLT (Dodd and Gillon 2001). However, there is little guidance in the literature on the age at which it is appropriate, little reference in therapy texts to the expected development of PA in normally speaking children and, as yet, little evidence about the effect PA work might have on speech output (Hesketh 2001, Stackhouse *et al.* 2002); though see Gillon (2005) for some early findings.

To sum up so far:

- Phonological awareness is a multilevel ability in which phoneme awareness develops in the later stages. It is closely linked to literacy development but its role in speech development and speech change is less clear.
- Speech-disordered children have, as a group, poor phonological awareness.
- Speech work in SLT involves identifying and manipulating phonemes, and recent trends have encouraged more explicit use of PA approaches either as a spur to speech development or as a preventative measure against literacy problems.
- However, such work is taking place at an age at which normally speaking children do not usually demonstrate this phonemic level of awareness.

A number of immediate issues are apparent. We need to know more about the relationship between phonological awareness and lexical phonological representations. We need to understand what level of metaphonological awareness is necessary in order to *change* speech output patterns and to update phonological representations. And we need to investigate the ability of pre-school children with speech disorder to engage with phoneme awareness tasks of the kind implicitly required in SLT, i.e. are 4-year-old children simply not cognitively ready for phoneme awareness, or could it be triggered by SLT-type tasks in the way that it is more normally triggered by literacy a year or so later? This study focuses on the latter area.

What research evidence is there for the ability of typically developing young children to participate in phonemic awareness assessment and intervention? Wood and Terrell (1998) found evidence for developing phoneme level awareness in pre-school, pre-literate children even without intervention. Twenty-five per cent of participants in their study, aged 3;10–4;10, were able to carry out complex tasks such as phoneme deletion. Hulme *et al.* (2005) investigated phoneme awareness in children aged 4;4–5;6 (mean age=4;11). There was some ability to segment initial and final phonemes from nonsense syllables for phonemes where the child did not have letter–sound correspondence knowledge, showing that letter sound knowledge is not a prerequisite for developing phoneme awareness. The ability was more frequent in older children. These studies suggest that a minority of typically developing children do show phoneme awareness below 5 years and without literacy experience.

A number of studies specifically investigating children with speech and/or language disorder also suggest that it is possible to develop PA, sometimes to the level of phonemic awareness, below the age of 5 years (Warrick *et al.* 1993, Major and Bernhardt 1998, Adams *et al.* 2000). Again, these studies show the development of advanced phoneme awareness skills in a minority of the participants or to a very limited level. Laing and Espeland (2005) showed in a small-scale study that 4-year-old children with language and/or speech problems improved in initial phoneme matching ability following group instruction. Intra-group variability was not reported. Most recently Gillon (2005) provided intervention to pre-school children with speech disorder aged 3–5 years targeting speech intelligibility, phoneme awareness and letter knowledge. The PA work in this intervention was seen as necessary for future literacy rather than current speech progress. Children did improve in phoneme matching beyond the level of typically developing peers and significantly more of them had a good outcome on the Preschool and Primary Inventory of Phonological Awareness (PIPA) (Dodd *et al.* 2000) than in a control group whose intervention was not PA focused. The treated children continued to

show very low scores on the Word Segmentation subtest, therefore they had not grasped the most demanding phoneme manipulation task; however, their progress reflects the nature of the intervention which emphasized early phoneme awareness such as isolation of the first sound in words, rather than more complex skills.

In summary, conscious phonemic awareness is a skill which is not demonstrated by most normally speaking children until they begin literacy work, yet this skill is being required of children with speech problems in their therapy at a pre-school stage. It is not yet clear whether the majority of children do not demonstrate phonemic awareness at age 4 because it is beyond them cognitively or because it is a skill which requires explicit development and is usually triggered by literacy learning. However, there is some evidence that early awareness of phonemes can be achieved in some children other than via literacy exposure, through focused teaching. Additionally, it is not known whether phonemic awareness needs to be addressed explicitly in therapy, or whether the implicit requirement for phoneme awareness present in many typical SLT tasks is sufficient to trigger its development. If explicit work is necessary to develop it, then such work would be an important component of therapy for young speech-disordered children, but we do not yet know the age at which it could be achieved. This study investigates whether a focused programme could promote the development of advanced phoneme awareness skills, of the kind proposed as necessary for conscious speech change, in pre-school, preliterate children with speech disorder.

Methods

Research objective

The principal objective of the study was to investigate whether specific training would enable pre-literate children aged 4;0–4;6 with speech problems to develop awareness of individual speech sounds in words (phoneme awareness).

Design

The study was a randomized controlled trial in which participants were allocated to either an experimental group (receiving a PA programme culminating in phoneme awareness tasks) or a control group (taking part in a general language stimulation programme). The null hypothesis predicted that specific training would not enable development of phoneme awareness and that there would be no post-intervention difference between the success rate of the two groups on phoneme awareness tasks.

Participants

Following approval by the appropriate Research Ethics committee, Speech and Language Therapy services in the North West of England were asked to refer children with speech problems who were aged 4 years to 4 years 6 months. Children were identified over a period of 18 months; 76 referrals were received in total, all of whom had parental consent for inclusion and all of whom underwent criterion assessment. Forty-two children met the following inclusion criteria and were entered into the study:

- Standard score below 85 on the Edinburgh Articulation Test (EAT) (Anthony *et al.* 1971).
- Language abilities within 1 standard deviation (SD) of the norm or better on the Linguistic Concepts subtest of the CELF-Preschool (Wiig *et al.* 1992) NB, six children were included who had a Linguistic Concepts standard score of six (slightly outside the 1 SD criterion). Four of these were randomized to the phonological awareness and two to the language group.
- Non-verbal abilities within 1 SD of the norm or better on the Pattern Construction and Picture Similarities subtests of the British Ability Scales II (BAS II) (Elliott 1996).
- Able to read and spell only none to two words on the BAS II Word Reading and Spelling subtests (Elliott 1996).
- Unable to carry out phoneme addition or deletion tasks (other than simple onset identification) above chance level (measured by a Phoneme Addition and Deletion task designed for the study).
- English as their first language.
- No known hearing impairment.
- No apparent structural or neurological problem affecting speech production.
- Not yet attending reception class.
- Prepared not to attend speech and language therapy sessions during participation in the research (participation could be flexibly arranged around SLT episodes of care).

The speech-related inclusion criteria were broad and were likely to encompass children with a range of causes and patterns of speech disorder. In this way they reflect the general clinic population, but with the requirement for normal range language and cognitive abilities.

Children who were included in the study received the following assessment regime:

Assessment 1 (immediately before participation in the programme):

- Phoneme Addition and Deletion task (administered as part of the criterion assessment).
- Primary and Pre-school Inventory of Phonological Awareness (PIPA) (Dodd *et al.* 2000). The three subtests of alliteration awareness, phoneme isolation and phoneme segmentation are reported here as outcome measures for the intervention.
- The *Bus Story* (Renfrew 1997) scored for information.
- Metaphon Screening Assessment (Dean *et al.* 1990) (a single-word speech assessment).
- BAS Word Reading and Spelling subtests (Elliott 1996) (administered as part of the criterion assessment).

Assessment 2 (immediately post-participation in the programme):

- Phoneme Addition and Phoneme Deletion task.
- PIPA (three subtests as listed above).
- The *Bus Story.*
- Metaphon Screening Assessment.
- BAS Word Reading and Spelling subtests.

Assessment 1 was carried out before randomization to prevent any bias arising from knowledge of group status of the subject. Assessment 2 was carried out by an assessor not involved in the intervention and blind to the participants' group allocation for the same reason. Spoken responses were recorded at the time of the administration of the tests by a high quality mini-disc recorder (Sony MZ-N707, NET MD Walkman) and microphone (Sony ECM-MS907). Transcription of the Metaphon Screening Assessment was carried out by a qualified Speech and Language Therapist and percentage consonants correct (PCC) calculated. An independent transcription and PCC calculation was carried out on a sample of 20% to check the reliability of the scoring (97–100% agreement on whether phonemes were correct or incorrect).

Allocation to groups

Following Assessment 1 the participants were randomly assigned to either the intervention or the control group. As referrals were received over a period of time, a block randomization procedure was used, with separate randomization of males and females according to computer-generated random numbers, administered by the research secretary. Allocations were held in sealed envelopes by the research secretary and opened in the presence of the research assistant when Assessment 1 was complete. Of the 42 children who met the criteria for inclusion, 22 were assigned to the Phonological Awareness (PA) group and 20 to the Language Stimulation (LS) group. Group characteristics on the inclusion criteria are summarized in table 1. All children who entered the study completed their assigned programmes and were available for outcome assessment. At entry to the programmes, there was no difference between the two groups on severity of speech disorder as measured by PCC, but the Language Stimulation group had a significantly lower *Bus Story* Information score (independent samples *t*-test; $t=2.19$, p (two-tailed)<0.05).

The programmes

Children in both arms of the study received 20 individual 30-min sessions, given two to three times weekly by one of two researchers (authors E. D. and V. N.). For the majority of children, participation in the study was no longer than 10 weeks, including initial and post-programme assessments. Assessment and intervention were carried out either at home or school according to parental preference. It was made clear to parents that the programmes did not constitute speech and language therapy and activities were not tailored to any child's individual communication profile.

In the Phonological Awareness (intervention) programme children participated in tasks progressing from syllable to phoneme awareness. The first four sessions targeted syllable and rhyme awareness; thereafter the focus was on individual phonemes beginning with word onsets and building up to the manipulation of individual phonemes at the beginning or end of words, including addition and deletion within clusters. The Language Stimulation (control) programme was linked to nursery and reception curricula, aiming to develop children's language abilities. Sessions focused on listening comprehension, print awareness, expression of feelings, developing vocabulary and general knowledge of concepts like animals, means of transportation, seasons, days of the week. The content of both programmes is summarized in table 2.

Table 1. Group characteristics at entry to study (plus PCC and Bus Story post-programme scores)

		Age (months)	Gender	Pattern construction SS*	Picture similarities SS*	CELF linguistic concepts SS**	PCC	Bus Story information RS	PCC at final assessment	Bus Story information RS at final assessment
PA group	mean	50.77	17 M	55.41	53.45	8.86	49.73	18.64	*59.32*	*21.38*
(*n*=22)	range	48–55	5 F	28–70	46–62	6–13	17–85	3–34	*26–91*	*7–36*
	SD	2.35		9.56	4.51	2.03	15.67	7.64	*16.81*	*8.46*
LS group	mean	51.05	17 M	48.8	52.20	8.40	49.98	14.05	*56.24*	*21.06*
(*n*=20)	range	48–55	3 F	28–70	43–67	6–10	12–87	1–21	*24–83*	*11–40*
	SD	2.19		10.94	5.64	1.31	18.57	5.70	*15.49*	*7.03*

*Average standard score on the BAS subtests is 50; ±1 SD=40–60.
**Average standard score on the CELF and PIPA subtests is 10; ±1 SD=7–13.

Table 2. Summary of programmes

Sessions		Content
	Phonological awareness	Language stimulation
1	Syllable level (e.g. clapping, blending, segmenting)	listening comprehension (story reading and discussion)
2	Rhyme level (e.g. rhyme completion, judgement, matching)	vocabulary/cognitive development (identification/classification of animals)
3		
4		language development (finish and then narrate a story, sequence card story)
5	Phoneme level: introduction of consonant sound–picture links	vocabulary/cognitive development (identification/classification of means of transport)
6		
7	Identification of initial sound in CV, CVC and CVCC words	'things that go together' puzzle
8		print awareness (read a story and discuss the basic concepts about print. Make a new story based on these concepts)
9	Identification of final sound in VC, CVC and CCVC words	
10		'what's wrong' game
11	Introduction of vowel sound–picture links. Word blending and segmenting of VC, CV and CVC words	listening comprehension (story reading and listening comprehension tasks)
12		vocabulary/cognitive development (discussion of the four seasons, classification of winter/summer clothes)
13	Identification of initial and final clusters	
14		personal/emotional development through expression of feelings (discussing happy/sad situations and their relevant experience)
15		opposites (discussion on big/small, heavy/light)
16	Focus on initial and final phoneme addition in VC, CV and CVC words (using sound pictures and bricks representing the sounds)	writing (make a card, write greetings, write a letter)
17		listening comprehension (story reading and listening comprehension tasks)
18	Focus on initial and final phoneme deletion in CVC, CCVC and CVCC words (using sound pictures and bricks representing the sounds)	opposites (discussion on short/long, thick/thin and recap of others)
19		vocabulary/cognitive development (days of the week, discussion and relevant activities)
20	Recap on phoneme addition/deletion using only bricks	

Outcome measures

Ability to manipulate phonemes was measured by three PIPA subtests and by the Phoneme Addition and Deletion task (PAD).

PIPA

The PIPA consists of six subtests of which three were chosen as outcome measures. (Of the other three, Syllable Awareness and Rhyme Awareness did not measure at the level of the phoneme and Letter Knowledge required a level of literacy not yet

acquired by our participants.) The Alliteration Awareness subtest of the PIPA consists of 12 items in an odd-one-out format. The tester says aloud the names of four pictured items and the child selects the one that 'does not belong'. In the Phoneme Isolation subtest (again, 12 items) the tester says aloud the name of a pictured object and the child has to provide the initial phoneme of the spoken word. The child is therefore required, as in Alliteration Awareness, to segment off the initial phoneme of a word, but does not need to retain more than one word in memory, compare segments across words or understand the nature of an odd one out task. In the Phoneme Segmentation subtest children listen to a word spoken by the tester and have to segment the whole word into its constituent phonemes. There are 12 items in total but the subtest is discontinued after three failing responses.

PAD

Designing a task of phoneme manipulation which was reflective of the demands of SLT, within the cognitive capacity of 4;0–4;6-year-old children and short enough to be clinically feasible proved to be challenging. The task could not involve a spoken response since the children's limited speech sound systems precluded accurate interpretation of failed items. Nor could it involve sound linkage pictures because the LS group would not have experience with these. Initial versions proved unsatisfactory and the task had to be modified. The first eight children to complete the study were therefore not assessed on the final test format and results for the PAD at Assessment 3 are presented for 34 children only. Our final version of this assessment used picture stimuli to introduce a word and bricks to represent its phonemes. The task consisted of 40 items in total; 20 addition and 20 deletion. Half the items involved formation of or deleting from consonant clusters. Scores of 14/40 and over were regarded as significantly above chance performance; at the beginning of intervention, none could perform above chance level on this task. Examples and instructions for the PAD are given in appendix A.

Outcome was treated as a dichotomous variable distinguishing whether a child had or had not improved on each of the measures. This categorical definition was preferred to a direct comparison of test scores for clinical reasons. The issue of interest was not simply whether there was a difference between the two groups, but whether the experimental group could achieve success in learning specific phoneme awareness skills. Success in learning phoneme awareness was defined as follows:

- A significant improvement in the PIPA Alliteration Awareness, Phoneme Isolation and Phoneme Segmentation subtests, such that there was no overlap in 68% confidence intervals between the pre- and post-programme standard scores.
- An improvement to an above-chance score on the PAD (participants were all at chance level on admission to the study).

Results

Table 3 shows the group results for PIPA subtests (raw score, standard score and improvement status) and for the PAD (raw score and 'above chance' status). PAD scores are for the 34 participants who completed the final version of the test. For each of the measures, Fisher's Exact test (two-sided) was used to examine differences in improvement between the groups (Fisher's exact test is recommended instead of a χ^2-test for contingency tables when cells may have a frequency of less than five).

Table 3. Group results for PIPA subtests and PAD at pre- and post-programme assessments

		PIPA alliteration awareness					PIPA phoneme isolation					PIPA phoneme segmentation					PAD (n=34)			
		Pre-		Post-			Pre-		Post-			Pre-		Post-			Pre-		Post-	
Group		RS (maximum =12)	SS	RS	SS	Imp	RS (maximum =12)	SS	RS	SS	Imp	RS (maximum =12)	SS	RS	SS	Imp	RS (maximum =40)	Above chance	RS (maximum =40)	Above chance
PA	mean	3.18	8.95	3.77	9.14		2.18	8.27	8.18	11.45		0.18	8.18	1.50	9.77		4.07		9.22	
	range	1–6	6–11	1–8	7–13	3	0–11	6–15	3.85	6–15	15	0–2	8–10	0–6	8–15	7	0–13	0	0–24	6
	SD	1.30	1.25	1.85	1.81		3.75	2.62	0–12	2.39		0.50	0.50	1.77	2.14		3.54		6.96	
LS	mean	3.25	9.00	2.90	8.25		0.40	7.05	1.60	7.15		0.00	8.00	0.00	8.00		5.08		3.06	
	range	1–5	7–11	1–5	7–10	1	0–3	6–9	0–11	4–13	5	0–0	8–8	0–0	8–8	0	1–9	0	0–8	0
	SD	1.07	1.08	0.97	1.02		0.75	0.83	3.14	2.03		0.00	0.00	0.00	0.00		2.22		2.44	

Results for the four measures can be summarized as follows:

- In Alliteration Awareness, few (only four) participants improved overall and no significant difference was shown between the groups. See figure 1 for a summary of scores for the two groups.
- More participants (20 in total) improved in Phoneme Isolation, particularly in the PA group; and the inter-group difference was significant ($p<0.01$). Figure 2 shows a summary of test scores.
- In Phoneme Segmentation, again few (seven) participants improved but all those who did had received PA intervention and a significant inter-group difference was shown ($p<0.01$). See figure 3 for a summary of scores.
- Similarly for the PAD, the few (six) children who improved to above-chance performance were all in the PA group and the inter-group difference was significant ($p=0.02$). Figure 4 shows a summary of test scores.

Although not related to the main research question, PCC and *Bus Story* Information measures were repeated at the final assessment (shown in table 1) and the two groups compared using the independent samples *t*-test. There remained no difference in speech severity: children in both groups improved their PCC and to a similar amount. In contrast, the LS group made more improvement than the PA group in their *Bus Story* Information score so that, although they performed more poorly on this measure on entry, there was no longer a significant different between the groups following the programmes.

Discussion

The results show that for three out of the four measures significantly more children improved in the PA group than in the LS group. This suggests that it is possible to

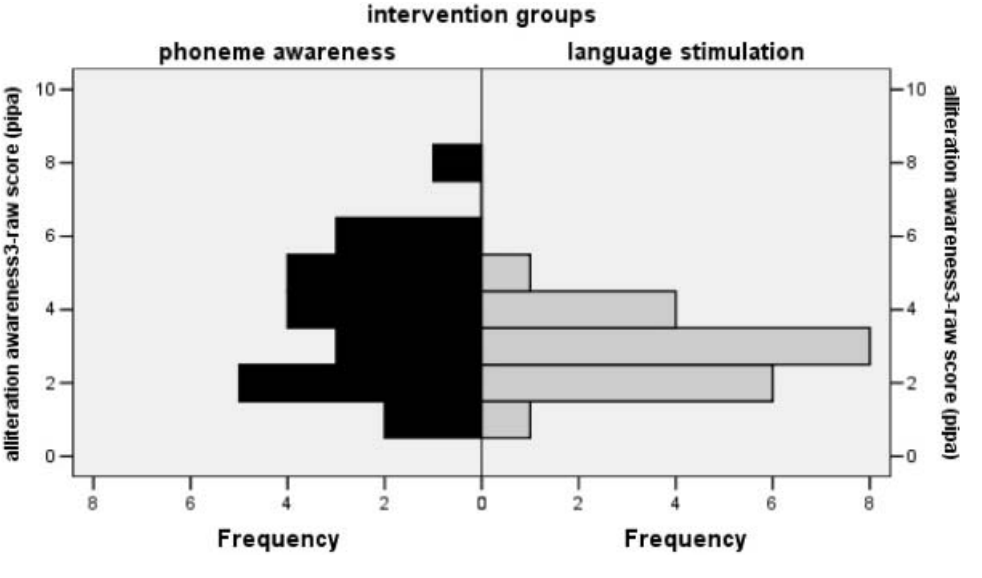

Figure 1. Distribution of scores at final assessment on the PIPA Alliteration Awareness subtest for the PA and LS groups.

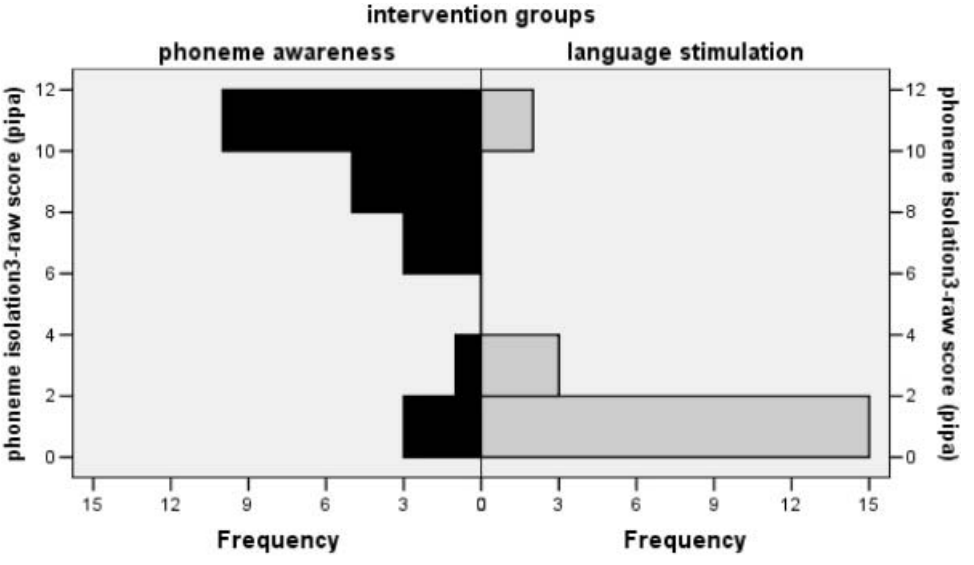

Figure 2. Distribution of scores at final assessment on the PIPA Phoneme Isolation subtest for the PA and LS groups.

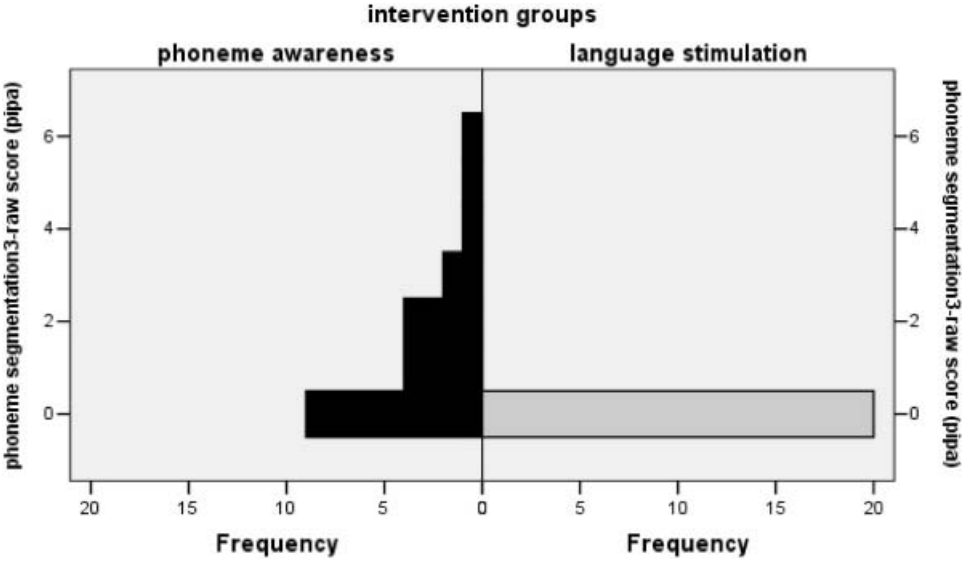

Figure 3. Distribution of scores at final assessment on the PIPA Phoneme Segmentation subtest for the PA and LS groups.

teach phoneme awareness to pre-literate children with speech disorder by means of targeted activities. However, the low number of children who did improve and the large variability in performance within the PA group indicates a need for caution in accepting this conclusion. Each measure will therefore be considered in turn, and the profiles of the high-achieving children examined.

On the PIPA Alliteration Awareness subtest at Assessment 1 the mean standard score for PA children was 8.95 and for the LS children 9.00, indicating performance

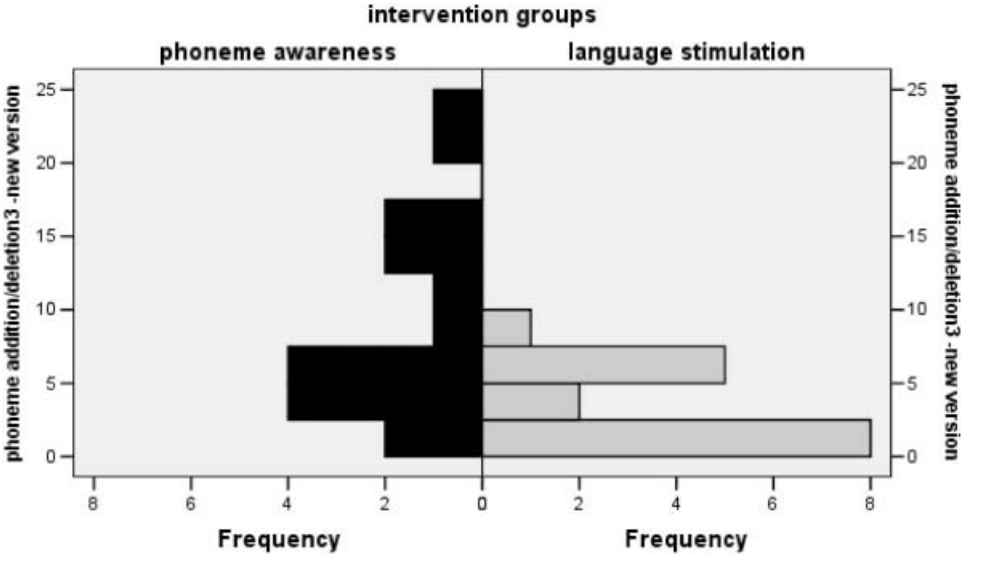

Figure 4. Distribution of scores on the Phoneme Addition and Deletion task for the PA and LS groups.

within the normal range for both groups. However, it is relevant to note that 'normal' performance at this age constitutes a far from complete mastery of the skill. A raw score of four out of 12 is sufficient to gain the average standard score of 10, and, given four picture choices, three correct responses would be predicted by chance. The reduction in standard score for the LS children at Assessment 2 is due to two reasons. First, some children changed test standardization age bands during their time in the study, therefore an unchanged raw score would result in a lower standard score. Second, eight children did show an actual reduction in raw score at Assessment 2, mostly involving a change from three to two, i.e. it occurred in children who were performing at chance level. Eight children in the PA group showed the same pattern. Figure 1 shows clearly the considerable overlap in scores between the two groups following the programmes. Why was there so little improvement on this subtest in the PA group when they show a marked change in Phoneme Isolation, which also requires attention to word onsets? The memory load involved in listening to four words before making a response choice may have limited performance, or the availability of picture choices may have encouraged guessing. The PA programme included more activities focusing on the identification of the initial phoneme of individual words than those encouraging grouping of words by initial phoneme and even activities requiring children to categorize words by their onset usually presented those words one at a time.

In contrast, the Phoneme Isolation subtest shows more than half of the PA group making an unequivocal improvement in standard score. The PA programme included two sessions specifically on initial consonant awareness, plus another two on final consonant awareness. All later sessions (involving word segmentation, clusters and addition or deletion of phonemes) also built on and practised at least this level of awareness. Clinical SLT sessions, whatever the approach taken, will also require children to pay attention to sounds in particular word positions and so the Phoneme Isolation task seems very relevant to a clinical intervention routine. At

entry to the study, the mean standard score for both groups was in the low normal range at 8.27 and 7.05 for the PA and LS groups, respectively. However, floor effects operated here: a raw score of zero gave a standard score of seven and a raw score of one, a standard score of 8, i.e. a complete inability to do the task is within the normal range at this age. Examination of the raw scores suggests that task ability is learned as a step change rather than a gradual development; 38 children scored three or below (mostly zero) on entry while the remaining four identified between 9 and 11 initial phonemes correctly (all of whom happened to be in the PA group). The phoneme awareness programme enabled most children to master the skill of phoneme isolation, some moving from zero to a maximum score of 12. Just four children remained at a very low level, identifying three or fewer initial phonemes at Assessment 3. The LS group shows a very different picture. Eighteen out of the 20 children remain practically unable to do the task with raw scores of 0–2. The other two children have achieved the ability to isolate phonemes, both starting from zero and moving to scores of 10 and 11. Figure 2 illustrates this contrasting pattern of achievement in the two groups. Thus phoneme isolation seems to be a skill that is mastered by many children at around 4;0–4;6 years and which can be triggered by relevant phoneme awareness activities. Its mastery did not however enable success the odd-one-out Alliteration Awareness test. Gillon (2005) also showed that children with speech impairment receiving intervention improved on initial phoneme matching. Indeed, her intervention appeared to push them beyond the level of a control group of typically developing children. Gillon's task required children to select a word, from a spoken choice of three, that started with a target phoneme and seems to fall somewhere between the PIPA Alliteration Awareness and Phoneme Isolation formats in its demands.

On the Phoneme Segmentation subtest, as with Phoneme Isolation, floor effects are evident: most children of this age have not mastered the task. A raw score of two is sufficient to gain the average standard score of 10, and a score of zero gives a standard score of eight. Thirty-nine of our participants were unable to complete a single item at Assessment 1. Three children scored at a minimal level; two of these were also competent at phoneme isolation at study entry (see above). All children in the LS group remain at zero at Assessment 2. The significantly higher number of improvers in the PA group at Assessment 2 masks a continuing low level of ability overall (figure 3). The mean raw score for the PA group is only 1.5 and the maximum achieved was 6. The PA programme included two sessions specifically targeting the blending and segmenting of whole words and a further 12 sessions included segmentation work, but of phonemes at a specific syllable position rather than of a whole word. Clinical SLT sessions are more likely to focus on sounds at specific word positions than to require whole word segmentation. Segmentation of words into their constituent phonemes is a skill which is beginning to emerge in some typically developing children aged 4;0–4;6 who may be able to segment simple CVC units. Targeted intervention at this age appeared to trigger its emergence in some children in this study, bringing them to at least the mean level for their typically developing standardization sample peers.

The PAD was used as a criterion assessment therefore all children were performing at a chance level on entry to the study. As an assessment task, most children found it difficult and it was apparent that many were guessing their responses. Within the PA programme five sessions were specifically devoted to addition and deletion tasks using increasingly complex syllable structures where

possible (though many children were not able to progress at this level). The PA programme itself used sound picture cards to support the tasks and concepts whereas the assessment relied on bricks to represent individual phonemes. There are a number of different ways in which to measure addition and deletion, and a different procedure may have shown up more progress. However, we were constrained in our task choice by the need to avoid sound pictures (which were familiar to the PA but not to the LS group) and to have a response mode other than spoken output. Phoneme addition and deletion as abstract tasks in their own right are not common activities in SLT clinical work, but addition of consonants and replacement of one sound by another are intrinsic requirements of intervention for many common errors (final consonant deletion, cluster reduction, systemic substitutions such as fronting and stopping). Therapy would typically use sound pictures to support such work in pre-literate children. Clearly phoneme addition and deletion has not been mastered by most children at this age, and the LS group showed no sign of the skills emerging over the study period; their final mean raw score was slightly lower than the mean at Assessment 1. In contrast, seven children in the PA group did increase their performance above the chance level, two of whom were markedly better at the task than the rest of the group, scoring 22 and 24 out of the maximum 40 points (figure 4). Nevertheless, mean performance even in the PA group remained low. As with word segmentation, intervention appears to support some development in phoneme addition and deletion ability in some but not all children.

The group results, as in most research into children with speech disorder, hide a great deal of variability between individuals. Many children in the PA group did not improve greatly and the significant results were apparently influenced by the high achievement of a small number of children. It would be useful to understand what predicts a level of readiness for explicit phoneme awareness work. Four children achieved good outcomes in at least three out of four of the measures and their entry profiles were examined for common features. All four children were in the older half of the age range at 52–54 months and all had BAS subtest scores in at least the good normal range. Three out of the four had a high Pattern Construction standard *T*-score (65–70, where 50 is average). Three were already able to carry out Phoneme Isolation at the beginning of the study and two of them showed some limited word segmentation ability on entry. One of the children could read and spell one or two words from the BAS at the beginning of the study and had improved to five and six words at the end. None of the other high achievers scored on the literacy assessment. No consistent patterns of language ability or speech severity were noted. Thus the children who were good at phoneme awareness tasks at the end of this study were nearer to 4;6 than 4 years, had relatively good cognitive skills and tended to show some emerging phoneme awareness at entry. One child in the LS group also showed this pattern of good prognostic indicators but did not show high performance on the outcome measures. One further LS participant with good BAS II scores acquired the skill of phoneme isolation between Assessments 1 and 2.

Conclusion

The results show that some children who have a certain level of cognitive adequacy can be helped by targeted intervention to make marked improvements in their phoneme awareness skills. Other children, particularly if younger or cognitively less able, made less or no change, even with an intensive period of intervention.

Phoneme isolation proved to be a skill particularly responsive to the programme offered and this fits with findings for a similar task by Gillon (2005). The more advanced phoneme awareness tasks such as word segmentation and phoneme addition/deletion were grasped by very few children. The present results broadly confirm the order of acquisition of phoneme awareness skills described in the literature (Carroll *et al.* 2003, Anthony and Francis 2005) but highlight, with regard to Alliteration Awareness, the considerable potential effects of the subtleties of task requirements. The participant children showed a wide range of type and severity of speech disorder but had broadly acceptable language and cognitive abilities; our results should be generalizable to other children with this profile.

Gillon (2005) found that speech-disordered children who had received PA intervention went on to develop later phoneme and letter awareness tasks at the same rate as typically developing children. That is, some skills were not acquired during the intervention but did eventually mature at the expected rate. Gillon argues rightly that this is a positive gain (since the speech-disordered children had been delayed in PA skills prior to intervention) and one which will better prepare them for literacy development. However, the interest underlying the current study was on the skills required for speech change rather than literacy and so the lack of progress in phoneme addition and deletion remains an issue for us. Children with speech disorder commonly show omission of word final and within-word consonants, reduction of consonant clusters and systematic substitution of sounds in all word positions. Tackling any of these problems in any cognitive or linguistic framework would seem to require conscious awareness and manipulation of phonemes to a level beyond the capacity of a typical 4;0–4;6-year-old child. Therapy tasks will have to be carefully designed with much concrete support in order to enable children to engage with their speech problem. Obviously sound linkage pictures (of 'the tap says [t]' variety) are more meaningful than our abstract brick manipulation assessment and can be a valuable way of representing phonemes in an accessible way. Nevertheless, we must be aware as therapists of the demands, order and age of acquisition of phoneme awareness tasks, and sensitive to subtle differences in their demands.

Although we now have more information on what pre-literate children can and cannot acquire, we still do not know which of these conscious phoneme awareness skills is necessary in order to change speech. Indeed, since it is 'normal' not to be able to carry out these tasks at 4;0-4;6 years old and the standardization sample for our chosen assessment (the PIPA) had no problems with spoken phonological development, it has to considered whether conscious phoneme awareness is a necessary skill for speech development at all. However, we return here to the difference between implicit and explicit learning; a greater level of explicit knowledge may be required to *change* speech than is necessary for its spontaneous development. Nor do we know whether different levels of awareness are necessary depending on whether the child just needs to update entries in a automatic motor programme store, or whether underlying lexical phonological representations are underspecified. Given the intuitive relevance of phoneme isolation to common SLT tasks, its ripeness for development in pre-school children is an optimistic sign. However, we do not know whether it is most efficient to elicit it through directly targeted activities or whether it will be triggered spontaneously by immersion in SLT tasks focusing on a child's target sounds.

Where children do not acquire phoneme isolation, are they ready for active involvement in speech change? Can pre-school children be helped and shown to develop phoneme addition/deletion skills by different intervention and assessment tasks than those used in this study? If children cannot carry out phoneme addition and deletion tasks, will they be able to eradicate the processes of consonant deletion or cluster reduction? Clearly there is much still to learn about the contribution of phoneme awareness to speech change and its influence on therapy management and timing decisions.

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Appendix A: Phoneme addition and deletion task

Addition example

The child was given a picture of '*tea*', shown that the word could be segmented, and its constituent phonemes represented by two bricks. The child had to add a third brick in the appropriate word position to turn '*tea*' into '*teeth*'.

Two practice items were given at the beginning of the addition task, and feedback and explanation given as necessary. Two further practice items were given before stimuli 11–20 which involved adding a consonant to form a cluster (e.g. '*lock*' to '*block*').

Deletion example

The child was given a picture of a '*goat*', shown how it can be segmented and its phonemes represented by three bricks. The child then had to take away one of those bricks to turn the word '*goat*' into '*go*'.

Script and examples were similar to the addition task. Two practice items were given at the beginning of the deletion task and two further practice items before stimuli 11–20, which involved deleting from a consonant cluster (e.g. '*clap*' to '*cap*').

Script	Accompanying action
Here's a picture of a cup of *tea*.	present picture
Tea has two sounds, [t] [i].	set out two bricks at the same time as saying the separate phonemes
Listen again, [t] [i], *tea*	point to the two bricks separately as say the phonemes, then sweep hand across the two bricks while saying the whole word
Now here's a different word, *teeth*	show picture
We can turn *tea* into *teeth* by adding a sound	hold up an additional brick
Where would you add [θ] to turn the word *tea* into *teeth?*	indicate the three different spaces (in front of, between and after the existing two bricks) and give the additional brick to the child.
(If no response)	
We've already got [t] [i] which makes *tea*. Where should you add another sound to make *tea* into *teeth?*	Point to the two bricks again as say the sounds. Indicate the third brick as ask where to put the additional sound