

Research Report

Treating children with expressive phonological disorders: does phonological awareness therapy work in the clinic?

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Abstract

Background: Recent research has shown that phonological awareness therapy can improve speech production in children with expressive phonological disorders. This approach may be appealing to clinicians as the therapy may also benefit the children's general phonological abilities and lead to gains in their literacy skills.

Aims: To examine the effectiveness of phonological awareness therapy under conditions more similar to those prevailing in many speech and language therapy clinics. Children were treated in small groups and less intensive therapy was offered than in previous studies.

Methods & Procedures: Twenty children were randomly assigned to treated and untreated groups. A pre-/post-test design was used to monitor their progress in phonological awareness, literacy and speech production. Children were treated in groups of three. They received 12 hours of therapy.

Outcomes & Results: Comparisons of the groups showed that the treated group made significantly greater gains in phonological awareness. However, differences between the groups in the measures of literacy and speech production were smaller and non-significant. Considerable variation was detected in the response of individual children to the therapy.

Conclusions: The results show the effectiveness of phonological awareness therapy in benefiting children's general phonological skills. However, the

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comparison of these and previous findings suggest that children may require more therapy than is often available if literacy and speech production are also to benefit. Further research is required to confirm the duration and intensity of therapy required. Until such information is available, clinicians might want to take a cautious approach and combine therapies that target phonological awareness with more traditional approaches, that target speech production more directly.

Keywords: expressive phonological disorders, phonological awareness, literacy, speech production.

Introduction

Children with expressive phonological problems are common and conspicuous because of their disordered speech production. Gierut (1998) suggests that about 10% of children are affected and says that they dominate the caseloads of speech and language therapists (SLTs) working in schools. Although these children are normally referred for speech and language therapy because of their disordered speech they are not a homogeneous group. Some have problems that are wholly or primarily in the production of speech sounds; others have more general deficits in phonology. The latter have poor knowledge of the sounds of words and this may affect their language generally and their reading and spelling in particular. There appears to be little agreement among authors on what to call these groups of children and the inconsistent terminology is unsatisfactory. Gierut refers to the two disorders as phonetic and phonemic respectively. Nathan *et al.* (2004) refer to them as children with speech and children with speech and language difficulties. In their study, the former differed from normally developing controls only on measures of output phonology while the latter had more extensive problems on tests of language and phonology including measures of phonological awareness. Gillon (2000), who compared different forms of therapy, refers to the children in her study as having spoken language impairment (confusingly abbreviated to SLI) despite the fact that they had poor phonological awareness prior to treatment. In the present study, we recruited children similar to those studied by Gillon. In this study, we refer to them as having an expressive phonological disorder. This term is potentially misleading as their problems are more general than it implies. Nevertheless, it has the virtue of identifying the primary cause of the children's referral for therapy and their most obvious target for treatment.

This heterogeneity may mean that clinicians are uncertain about the best way to treat individual children. Hesketh *et al.* (2000) are among those who have suggested that different approaches to therapy may be required. Those children with good phonological skills may only need therapy to improve their articulation. Those with poor phonological skills may require a different approach. Training in phonological awareness helps children's reading (Lundberg *et al.* 1988, Hatcher *et al.* 1994) and it is plausible that this approach may benefit children with general phonological problems and thereby improve their speech. This possibility has been reflected by a shift in the forms of treatment used. Gierut (1998) suggests that a traditional reliance on articulation has given way to more mixed approaches that include tasks designed to improve the children's underlying knowledge of phonology.

In a survey of clinicians in the UK, Joffe and Pring (in preparation) found that a majority adopted an eclectic approach to treating these children. They used auditory and articulatory activities as well as tasks to improve knowledge of phonology. This approach is a pragmatic response to the uncertainty about which treatment to use and is supported by research findings that show it to be effective. Lancaster (1991) compared therapy given by clinicians or by parents under the instruction of clinicians with an untreated control group. The therapy included a range of tasks that aimed to both improve articulatory and motor skills and enhance phonological knowledge. Both groups of treated children improved significantly more than those who were not treated. Almost and Rosenbaum (1998) took a similar approach. Therapy was given twice weekly for 4 months. Training with minimal pairs was used to teach contrasts and was followed by traditional articulation therapy. Again, the treated group made significantly greater progress than the untreated group. The latter were subsequently treated and caught up substantially with the treated group.

Research has shown that children with expressive phonological problems may have poor phonological awareness and may experience literacy problems. Bird *et al.* (1995) showed that these children were behind controls on literacy and phonological awareness. Those with severe deficits and/or deficits that continued into the school years were especially at risk for reading problems. Larrivee and Catts (1999) and Hesketh *et al.* (2000) also found that these children were behind controls on phonological awareness and the former found that they were behind in reading a year later. The heterogeneity of the children was again evident. Larrivee and Catts divided their children into good and poor readers and found that the latter had more severely impaired speech and poor phonological awareness. Hesketh *et al.* note that the range of phonological awareness scores in the groups was similar despite the overall difference in their scores. These results are consistent with a relationship between speech, phonology and reading, but also show that reading ability and phonological awareness vary in children with expressive phonological problems. Nathan *et al.* (2004) followed up their children with speech and with speech and language disorders examining their reading and spelling abilities 2 years later. The speech and language group were significantly behind the speech only and control groups on reading and spelling and 68% were more than one standard deviation below the mean score of the controls. Reading problems were also found in the speech only group, however. Nearly half of these children were also below this level.

Hesketh *et al.* (2000) compared groups of children who received articulatory or phonological awareness therapy with a control group. Both treated groups improved more than controls. The articulatory approach was more specific in its effect. Children in this group did better on words that contained the processes on which they had been trained. However, no difference was found between the groups on phonological awareness or on the overall percentage of consonants correct. This result might be explained if, as suggested, some children need articulatory and others need phonological awareness therapy. Since children were randomly assigned, it would follow that each group would contain children who might or might not benefit from the particular therapy that they received. Those with good phonological awareness may be better placed to benefit from articulatory therapy while those with poor awareness require phonological awareness therapy. This pattern was not found. Hesketh *et al.* examined the progress of children with good and poor phonological awareness and found that the former made more progress in both groups.

Contrasting results were obtained by Gillon (2000) who also compared phonological awareness and articulatory therapy. Children receiving the former fared significantly better on measures of phonological awareness and reading and did equally well in speech production. They continued to be significantly more advanced at a follow up 11 months later (Gillon 2002). These are very striking findings. They warrant further research and replication by other researchers. If correct, they show that the use of phonological awareness therapy is preferable, not only because it can improve speech but because it benefits literacy. The link between phonological awareness and literacy is well established in children with normal language development and teaching phonological awareness has been shown to improve reading skills (Lundberg *et al.* 1988, Hatcher *et al.* 1994). Similar findings are available on children with language problems. Warrick *et al.* (1993) showed that language delayed children could benefit from phonological awareness training and were ahead of controls in reading a year later. Van Kleeck *et al.* (1998) also found that children with speech and/or language disorders could benefit from phonological awareness training.

The contrast between the findings of Gillon and of Hesketh *et al.* is puzzling. Therapy in the Gillon study consisted of a range of activities that are widely used to promote phonological awareness. Hesketh *et al.* used similar activities but combined them with exercises from Metaphon (Dean *et al.* 1995) and use of minimal pairs. Gillon treated older children (5–7) than Hesketh *et al.* (3.5–5.0). In view of the findings in Bird *et al.* it is likely that the children treated by Gillon were more severe and at greater risk of reading failure. Phonological awareness therapy may be more appropriate for these children than for the younger and more varied groups of children treated by Hesketh *et al.* Gillon also gave more therapy than Hesketh *et al.* (20 versus 10 sessions). A recent large-scale trial of speech and language therapy (Glogowska *et al.* 2000) found that children received a mean of only 6 hours therapy per year in the UK. This suggests that the above studies offered more therapy than may generally be available to these children. The present study sought to replicate Gillon's results for phonological awareness therapy using a treatment regime that may be more consistent with the resources available in UK clinics. Children were seen in small groups and were offered 8 weekly sessions (12 hours) of therapy.

Methods

Participants

Children were recruited to the study through referrals from speech and language therapists. They were between 5 and 7 years of age and had speech and language difficulties of a predominantly expressive phonological nature. All had received a speech and language therapy assessment, and direct or indirect intervention, before being referred to the study. They were attending mainstream schools where they had completed at least one term. Therapists were asked not to refer children with marked receptive language problems, general developmental delay, cognitive difficulties, articulatory dyspraxia or hearing problems. All the children were monolingual English speakers.

Twenty-eight children were referred and underwent further assessment. They were required to score above the 25th percentile on the Ravens Coloured Progressive Matrices (Raven *et al.* 1986) and above the 10th percentile on the British

Picture Vocabulary Test (BPVS; Dunn *et al.* 1982) and the sentence structure subtest of the Clinical Evaluation of Language Fundamentals (CELF; Semel *et al.* 1995). These were used to exclude children with poor non-verbal skills and with very impaired receptive language skills. They were required to score below the 10th percentile on at least one subtest of the Phonological Abilities Test (PAT; Muter *et al.* 1997) indicating some difficulty with phonological processing and to show difficulty with at least one of the processes tested on the South Tyneside Assessment of Phonology (STAP; Armstrong and Ainley 1988).

Eight children were unsuitable for the study. Two were reported by parents to have a hearing problem and one did not fulfil the receptive language criteria. Three children had phonological skills in excess of the selection criteria. Two further children were excluded by parental choice.

Design

A between-groups pre-/post-test design was used. Assessments of phonological awareness, literacy and speech were carried out before and after therapy.

The 20 children who qualified for entry to the study were assessed and randomly assigned to treatment or to no treatment. The resulting groups did not differ on any of the tests used to select children for the study. One child in the treated group was unable to attend several of the therapy sessions and had to be excluded. The control group were not seen during the intervention period and did not receive any other speech and language therapy.

Practical difficulties meant that fully blind assessment could not be used. However, pre- and post-therapy assessments were conducted by different clinicians. As a result, the post-therapy assessor was unaware of a child's performance before therapy.

Treatment

Treated children attended 8 weekly 1½-hour sessions of therapy. The therapy sessions took place in community clinics. The treated group were subdivided into three groups of three. Allocation to these subgroups was geographical so that children could attend the clinic closest to their homes. The first two authors who are speech and language therapists provided the treatment.

The therapy programme was based on the Gillon Phonological Awareness Training Programme (Gillon 2000). Its aim is to develop phoneme awareness and grapheme/phoneme knowledge rather than correct speech production. It does this through a range of activities that involve segmenting and blending sounds. Tasks that required children to identify the number of syllables in a word were used. A category of items was selected and children thought of an item from it and worked out how many syllables or 'beats' were in the word. Rhyming identification and production tasks were tested in odd one out and pair games and children were asked to produce rhyming words for target items. Phoneme identity and phoneme segmentation and blending tasks encouraged awareness of the phoneme as a phonological unit. Children were asked to identify initial and final sounds of words and to generate examples of items that shared these sounds. They were also asked to blend sounds and to say the resulting word. Initially words with a consonant vowel

(CV) or vowel consonant (VC) structure were used. As the children's skills developed, words with more complex structures were used. Phoneme manipulation tasks were used to develop children's awareness of similarities and differences between words at the phonemic level.

Steps were taken to link sounds to the written forms of words. Written as well as spoken words were provided during the activities. Pictures had their name written on them and children were given help to write words they generated on a white board. They were encouraged to use letter sounds rather than names throughout. Activities were undertaken to increase awareness of grapheme to phoneme correspondences. Children played games that involved identifying the sound a letter made and finding a letter to correspond to a sound. Letter and sound sequence games were also played.

To support the development of speech production, corrective feedback was given when errors occurred. Cues were given to help children correct mispronounced sounds and they were given opportunities to attempt more accurate productions of words they mispronounced. Specific phonological processes that children had problems with were targeted during the therapy activities. For example, a child that was fronting velar sounds to alveolar ones would be given opportunities to segment words that contained both velar and alveolar sounds, e.g. 'cap'/'tap'.

Not all the activities in the programme were included each week. Usually there were four to five activities per week each lasting about 15 minutes. A break was included in each session.

The use of a group format meant that tasks had to be adapted to the needs of different children within the group. This was achieved by presenting tasks at different levels of difficulty. For example, a rhyme detection task might be presented in the following ways (from hardest to easiest):

- Child asked to identify which two picture names rhymed.
- Child asked to think whether ends of words sounded the same.
- Therapist said names emphasizing the rhyming part of the words.
- Therapist identified the rhyme and asked if words sounded the same.
- Therapist identified if words rhymed or not.

Assessments

The assessments differed from some of those used by Gillon. They were chosen because they were used in the clinics in which the study took place and because they are likely to be more familiar to therapists in the UK. Assessments tested the three main areas in which children were expected to progress. The PAT was used to assess phonological awareness. Literacy skills were assessed with the Wechsler Objective Reading Dimension (WORD; Weschler, 1993) and the Non-Word Decoding Test (Snowling *et al.* 1996). Speech production was assessed with the STAP.

The PAT has seven subtests. The subsections are rhyme detection, rhyme production, word syllable completion, word phoneme completion, initial phoneme deletion, final phoneme deletion and letter knowledge. Spoken responses were scored right if said correctly or if an error was consistent with a process in the child's speech. Raw scores for each subsection were calculated and converted into

percentile scores (>10, 10, 25, 50, 75) to identify areas in which children had difficulties. In the statistical analysis the total raw score on the test was used.

The WORD tests a child's reading of single words, writing of letters, sounds and spoken words and their reading comprehension. Only the former parts of the test were used as the reading comprehension test was found to be too difficult for most of the children and resulted in very low scores. The single word reading and writing tests were discontinued if a child got six consecutive items incorrect. In the reading test, items were scored correct if they were correctly articulated, or if an error was consistent with a process in the child's speech. Raw scores from the WORD were used in the analysis as the assessment is only standardized for children aged 6 and above.

The Non-Word Decoding Test requires a child to read aloud 39 non-words of between one and five syllables. Testing was discontinued if a child got five consecutive items wrong or if they were visibly distressed by their inability to do the assessment. No corrective feedback was given on any of the literacy tests.

The STAP asks children to name a range of items. Most have one or two syllables. When a child had difficulty, they were given the first sound as a cue. If this failed they were provided with a forced alternative. These methods ensured that a child could access their motor programme. The percentage consonants correct metric (PCC; Shriberg and Kwiatkowski 1982) was used in the analysis. The test has 185 consonants. For individual children, this total was reduced by the occasional omissions or shortening of items. Their score was the percentage of this reduced total that was correct.

The STAP was transcribed during testing and recorded. The recordings were used to check the transcription and the reliability of the scoring. Four tapes were randomly selected and transcribed by the clinician who had not conducted the assessment. Percentage agreement on these tapes was 95.75%.

Results

Scores on each of the assessments were analysed with a two factor mixed analysis of variance in which the groups were a between subject variable and the time of testing a within subject variable.

Mean scores on the PAT are shown in Table 1. The analysis revealed a significant main effect of time ($F(1,17)=42.72, p<0.001$) and a significant interaction of groups by time ($F(1,17)=10.78, p<0.01$). The former reflects the improvement of all the children over time. The latter shows that the treated group improved significantly more than the untreated group as seen in table 1.

Table 1. Scores on the Phonological Abilities Test before and after therapy

	Before therapy		After therapy	
	Mean	SD	Mean	SD
Treated group	40.67	14.46	63.00	11.15
Untreated group	45.30	15.58	52.70	12.51

Table 2. Number of subtests on the Phonological Abilities Test where children were below the 10th percentile

		Number of subtests on which children were below 10th percentile		
		0	<3	3-7
Treated group	pre-therapy	0	5	4
	post-therapy	5	4	0
Untreated group	pre-therapy	0	5	5
	post-therapy	0	6	4

Table 3. Reading and spelling scores on Wechsler Objective Reading Dimension before and after therapy

	Before therapy		After therapy	
	Mean	SD	Mean	SD
Reading				
Treated group	5.67	4.92	8.89	6.57
Untreated group	6.70	4.06	9.80	4.83
Spelling				
Treated group	6.56	3.75	9.44	4.25
Untreated group	8.70	4.08	11.10	4.38

Table 4. Scores on non-word reading before and after therapy

	Before therapy		After therapy	
	Mean	SD	Mean	SD
Treated group	1.67	2.74	3.11	5.84
Untreated group	1.60	2.76	1.60	3.10

This treatment effect is also apparent when individual subtests are examined. Table 2 indicates the number of subtests on which children's scores were at or below the 10th percentile before and after therapy.

A similar analysis was conducted on the reading and spelling scores from the WORD and for Non-Word Decoding test. Scores for these tests are shown in tables 3 and 4. Significant main effects of time were found for both reading ($F(1,17)=24.30$, $p<0.01$) and spelling ($F(1,17)=26.410$, $p<0.01$). However, the interaction of group by time was not significant for either ($F<1$ in each case). As table 4 shows, the scores for non-word reading were very low. However, a significant interaction was found ($F(1,17)=11.2$, $p<0.05$) reflecting the stronger improvement in the treated group.

Table 5 gives the scores for each group on the STAP. A significant main effect of time ($F(1,17) 42.295$, $p<0.001$) was again found reflecting the improvement seen in children generally. The interaction of group by time was not significant ($F(1,17)=3.209$, $p=0.09$). As table 5 shows, the pre-therapy scores of the untreated group were higher than that of the treated group despite the random assignment of children to groups. Different initial levels of performance may contribute to

Table 5. Percentage of consonants correct scores on the South Tyneside Assessment of Phonology before and after therapy

	Before therapy		After therapy	
	Mean	SD	Mean	SD
Treated group	69.27	14.79	81.80	10.41
Untreated group	84.93	7.11	92.05	3.76

differences in the improvement shown by groups. Here the untreated group may have had less scope for improvement increasing the possibility that a group by time interaction would occur.

It should be noted that the standard deviations of the test scores are large and indicate considerable variation in both the pre- and post-therapy performance of the children on the assessments. Inspection of the data suggested that the changes made by the children also varied.

Discussion

Previous studies have shown that phonological awareness therapy can be effective when used with children with expressive phonological problems. Hesketh *et al.* (2000) found that it was as effective as traditional therapies, which target articulation more directly. Gillon (2000, 2002) went further. Her results showed that it was as effective in treating speech production and had significantly stronger effects on measures of phonological awareness and on literacy skills. Although there are inconsistencies in the results of these studies, both suggest that a phonological approach to therapy is efficacious. These results are intriguing and may convince clinicians that use of this approach to therapy with these children is advantageous. At worst, it appears that it will be no less effective than therapies that give greater emphasis to articulation; at best, it may achieve similar improvements in speech production and benefit phonological skills and literacy as well.

The present study did not seek to question these findings. Nor did it try to resolve the issue regarding the comparative effectiveness of phonological and articulatory therapies. Its purpose was essentially practical. Phonological therapy similar to that used by Gillon was compared with no therapy to ascertain whether it is effective under conditions that may be closer to those found in many speech and language therapy clinics. Less therapy time was available to each child and children were seen in small groups rather than individually. Under these circumstances, less dramatic results were obtained. Significantly greater progress was made by the treated than the untreated group on the phonological awareness measure (PAT), but findings on literacy and speech production were less convincing. The former may be thought to be an unsurprising result. Phonological awareness therapy should have its strongest effect on phonological awareness, the assessment closest in kind to the actual therapy. It should be noted, however, that the therapy trained phonological awareness generally not merely those skills needed to obtain a better score on the PAT. Moreover, the result in favour of the treated group is strongly significant. As table 2 shows, the treated group made substantial progress on all subtests of the

PAT. Indeed, three of the children were close to ceiling on the post-therapy assessment, diminishing the ability of the test to register fully their improvement.

Children in both groups improved on the reading and spelling measures of the WORD. Progress was similar in each group, however, and no advantage was found for the treated group. The treated group made significantly greater improvement than the untreated group on non-word reading. The extremely low scores on this test make interpretation of the result difficult. The small improvement by the treated group may not seem very substantial in practical terms. The alternative view might suggest that non-word reading is a difficult test for these children who are in the early stages of reading. Given the evidence that phonological awareness training is effective in enhancing reading skills (Lundberg *et al.* 1988, Hatcher *et al.* 1994), these mixed results are surprising. It is plausible that changes in phonological awareness occur more rapidly than any consequent improvement in literacy. The pre- to post-test interval in this study was 2 months; in Gillon (2000), where more therapy was offered, it was 4.5 months. Nevertheless, it must be concluded that the therapy programme was ineffective in improving literacy within the time frame of the study.

A similar picture was seen on the STAP. Again both groups improved. While the treated group made greater progress, the interaction of group by time approached, but did not reach significance. This may be considered a comparatively optimistic result. Other factors need to be considered, however. The interaction is close to significance despite the small sample size employed in the study. A larger sample would be likely to result in a significant result. Gillon (2000) calculated that a sample size of 36 children per group was required for 80% power on her speech production measure. This was larger than the sample required for her phonological awareness and literacy measures, as well as her own sample size and the sample size in this study. This implies that the effect size is quite small and suggests that the effects of phonological awareness therapy on speech are less robust than those on phonological awareness itself and on reading. Small effect sizes pose a problem for clinical research. They may be shown to be statistically significant by using large samples. However, clinicians may question whether relatively small changes represent clinically significant improvements. In contrast, the effect size in the present study was a large one ($d=0.85$) and a significant result would have been obtained with only a slightly larger sample size than the one used.

Interpretation of the possible group by time interaction on the STAP must also consider the somewhat higher initial scores of the untreated group. This difference was unintended (the children were randomly assigned) and was not significant. Nevertheless, it is possible that the less rapid progress made by the untreated group owed something to their more limited scope for improvement. This factor further suggests that the outcome should be treated with caution.

A final factor to be considered is the variability seen in individual children. As is often the case in treatment studies, some treated children improved strongly despite an overall failure to obtain a significant result. This was true in the literacy measures and particularly on the STAP. This may reflect the heterogeneity of the children sampled and/or the fact that some children respond more rapidly to therapy than others. The latter may be particularly likely given the brief period of therapy offered in this study. The former may suggest that better results would be obtained if more restrictive selection criteria were applied. Since this study was an attempt to assess the effectiveness of current clinical provision, it was felt inappropriate to use criteria

that might exclude many of the children who clinicians treat. The criteria used were already more restrictive than those used elsewhere. Children included were required to be in the bottom ten per cent of scores on at least one subtest of the PAT. This criterion was not used in the Hesketh *et al.* or Gillon studies so children with relatively good phonological skills may have been included. It was used here, as it appears that children with a general phonological problem are more likely to benefit from phonological awareness therapy. This said, it should be recalled that Hesketh *et al.* found that children with better phonological awareness before therapy made better progress regardless of the treatment offered.

Inspection of the data in the studies by Hesketh *et al.* and Gillon suggests that treated children showed considerable variation in their progress there too. In the latter, children were offered twenty hours of therapy. That variation is still apparent suggests that some children may require very much more therapy time than others. A further indication of the time required for training in phonological awareness to be effective comes from Gillon and Dodd (1997). Here adolescents with poor reading skills were offered phonological awareness training. Twenty hours of training was found to have stronger effects than a shorter period and more severely affected children required more training to match the improvement shown by those less severely affected.

Clinicians who are familiar with the findings in Hesketh *et al.* (2000) and Gillon (2000) may be persuaded to use phonological awareness training with children with expressive phonological problems. This study was an attempt to discover whether the therapy is effective in the more constrained conditions that may apply in speech and language therapy clinics. The findings are less dramatic. Phonological awareness improved sharply but, at least in the short term, no effect was seen on literacy and the effects on speech were uncertain. It appears clinicians who want to exploit the benefits that phonological awareness therapy offers, must offer more therapy. Clearly we require more research on the minimum duration of therapy that is required and, given the variation in the progress of children seen in this study, on the identification of those children who may need more or less therapy to benefit. Until such information is available, clinicians may be well advised to include in their therapy more traditional methods to correct specific processes in a child's speech as a means of amplifying the effects of phonological awareness training.

References

- ALMOST, D. and ROSENBAUM, P., 1998, Effectiveness of speech intervention for phonological disorders: a randomized control trial. *Developmental Medicine and Child Neurology*, **40**, 319–325.
- ARMSTRONG, S. and AINLEY, M., 1988, *South Tyneside Assessment of Phonology (STAP)* (Northumberland: STASS Publ.).
- BIRD, J., BISHOP, D. V. M. and FREEMAN, N. H., 1995, Phonological awareness and literacy development in children with expressive phonological impairments. *Journal of Speech and Hearing Research*, **38**, 446–462.
- DEAN, E. C., HOWELL, J., WATERS, D. and REID, J., 1995, Metaphon: a metalinguistic approach to the treatment of phonological disorder in children. *Clinical Linguistics and Phonetics*, **9**, 1–19.
- DUNN, L. M., DUNN, L. M., WHETTON, C. and BURLEY, J., 1997, *British Picture Vocabulary Scales*. 2nd edn. (Windsor: NFER-Nelson).
- GIERUT, J. A., 1998, Treatment efficacy: functional phonological disorders in children. *Journal of Speech, Language and Hearing Research*, **41**, S85–S100.
- GILLON, G. and DODD, B., 1997, Enhancing the phonological processing skills of children with specific reading disability. *European Journal of Disorders of Communication*, **32**, 67–90.

- GILLON, G. T., 2000, The efficacy of phonological awareness intervention for children with spoken language impairment. *Language, Speech and Hearing Services in Schools*, **31**, 126–141.
- GILLON, G. T., 2002, Follow-up study investigating the benefits of phonological awareness intervention for children with spoken language impairment. *International Journal of Language and Communication Disorders*, **37**, 381–400.
- GLOGOWSKA, M., ROULESTONE, S., ENDERBY, P. and PETERS, T., 2000, Randomised control trial of community based speech and language therapy in preschool children. *British Medical Journal*, **321**, 923–926.
- HATCHER, P. J., HULME, C. and ELLIS, A. W., 1994, Ameliorating early reading failure by integrating the teaching of reading and phonological skills: the phonological linkage hypothesis. *Child Development*, **65**, 41–57.
- HESKETH, A., 2001, Phonological awareness, speech impairment and literacy: the missing link. *Advances in Speech–Language Pathology*, **3**, 155–158.
- HESKETH, A., ADAMS, C., NIGHTINGALE, C. and HALL, R., 2000, Phonological awareness therapy and articulatory training approaches for children with phonological disorders: a comparative outcome study. *International Journal of Language and Communication Disorders*, **35**, 337–354.
- JOFFE, V. and PRING, T., 2005, Treating children with expressive phonological problems: a survey of clinical practice (in preparation).
- LANCASTER, G., 1991, The effectiveness of parent administered input training for children with phonological disorders. Unpublished MSc thesis, City University, London.
- LARRIVEE, L. S. and CATTS, H. W., 1999, Early reading achievement in children with expressive phonological disorders. *American Journal of Speech Language Pathology*, **8**, 118–128.
- LUNDBERG, I., OLOFSSON, A. and PETERSEN, O.-P., 1988, Effects of an extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly*, **23**, 263–284.
- MUTER, V., HULME, C. and SNOWLING, M., 1997, *The Phonological Abilities Test* (London: Psychological Corporation).
- NATHAN, L., STACKHOUSE, J., GOULANDRIS, N. and SNOWLING, M. J., 2004, The development of early literacy skills among children with speech difficulties: a test of the ‘critical age hypothesis’. *Journal of Speech, Language and Hearing Research*, **47**, 377–391.
- RAVEN, J. C., COURT, J. H. and RAVEN, J., 1986, *Raven’s Progressive Matrices and Raven’s Coloured Matrices* (London: H. K. Lewis).
- SEMEL, E., WIIG, E. H. and SECORD, W. A., 1995, *Clinical Evaluation of Language Fundamentals*. 3rd edn. (Orlando, FL: Harcourt Brace).
- SHRIBERG, L. D. and KWIATKOWSKI, J., 1982, Phonological disorders III: a procedure for assessing severity of involvement. *Journal of Speech and Hearing Disorders*, **47**, 256–270.
- SNOWLING, M., STOTHARD, S. and McLEAN, J., 1996, *Graded Nonword Reading Test* (Bury St Edmunds: Thames Valley Publ.).
- VAN KLEECK, A., GILLAM, R. B. and McFADDEN, T. U., 1998, A study of classroom-based phonological awareness training for preschoolers with speech and/or language disorders. *American Journal of Speech–Language Pathology*, **7**, 65–76.
- WARRICK, N., RUBIN, H. and ROWE-WALSH, S., 1993, Phoneme awareness in language delayed children: Comparative studies and intervention. *Annals of Dyslexia*, **43**, 153–173.
- WESCHLER, D., 1993, *Weschler Objective Reading Dimension (WORD)* (London: Psychological Corporation).