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Phonological awareness therapy and articulatory training approaches for children with phonological disorders: a comparative outcome study

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Abstract

Sixty-one children, aged 3;6–5;0, with developmental phonological disorders (PD) participated in a study comparing the effects of metaphonologically (MET) or articulation-based (ART) therapy. Maturational effects were controlled for by the inclusion of 59 normally speaking control children of the same age range. Measures of phonological (speech) output and phonological awareness were taken before and after therapy for all subjects and at 3 months post-therapy for PD children. Results showed that PD children improved significantly in both phonological output and awareness skills across the intervention period compared with control children, but that there was no significant difference on the awareness measure between ART and MET groups. ART and MET groups differed from each other on one measure of speech improvement only, with the ART group making more change than the MET group on individual probe scores. Follow-up measures for both therapy groups indicated that there was little difference between the groups on phonological awareness change or speech development 3 months after intervention, though there was a trend for MET children to continue to make more long-term change than the ART group on one output measure. Additional analysis showed that there were generally few significant implications for outcome between PD children with good initial phonological awareness skills and those who initially had poor phonological awareness skills.

Keywords: Phonological disorders, phonological awareness, articulation, therapy, outcome.

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Introduction

Recent literature has explored the hypothesis that children with developmental phonological disorders (PD) may have a deficit of phonological awareness (or metaphonological ability) which is associated with the speech output problem and potential future literacy difficulties (Stackhouse and Wells 1997). This hypothesis is supported by group studies of PD children showing poor performance on phonological awareness tasks compared with normally speaking controls (Bird and Bishop 1992, Webster and Plante 1992, Bird *et al.* 1995, Stackhouse *et al.* 1997, Major and Bernhardt 1998).

However, these papers do not claim that all PD children have metaphonological deficits. In fact, they have indicated the existence in PD children of a wide range of metaphonological ability that overlaps to a large extent with the range shown by their normally speaking peers. An additional factor is that PD may often be accompanied by general language impairment, which is in turn associated with poor or delayed phonological awareness and with later literacy problems. It may be the case that children with good metaphonological skills are those with a relatively pure (Leitao *et al.* 1997) or less complex (Stackhouse *et al.* 1997) speech output problem, but this needs further investigation. The status of the relationship between PD and phonological awareness therefore remains unclear.

The phonological awareness hypothesis has fostered therapeutic techniques based on raising phonological awareness in young speech disordered children which have become popular among speech and language therapists (Hodson 1994, Jenkins and Bowen 1994). Howell and Dean (1994) argue that focusing on phonological awareness is an appropriate intervention strategy for PD, even though it is recognized that 'there is no clear evidence about the direction of any causal relationship' (Waters *et al.* 1995: 51). Given the variety of profiles of phonological awareness and speech output described in the literature, it becomes difficult to justify blanket inclusion of phonological awareness intervention. Speech and language therapists know from their experience with individual children that different manifestations of phonological disorder may respond best to different forms of therapy, thus metaphonological work is not seen as the new panacea for all phonologically impaired children; it is more likely that it will be the most effective therapy approach for a subgroup of this population and that other techniques such as articulation training may be more effective for another subgroup. However, a reliable method of identification of these subgroups has not yet been achieved.

Phonological awareness training has been a welcome innovative addition to the therapeutic toolkit, but it is also important that all new interventions should be evaluated and applied efficiently to those children who will benefit from them. Results of clinical research so far have shown positive effects of intervention for speech disorders in general (Gierut 1998, Law *et al.* 1998). For example, group studies show positive effects of minimal contrast therapy (Lancaster 1991, Almost and Rosenbaum 1998) and the Metaphon programme (Reid *et al.* 1996). However, Gierut's review (1998) found that comparative efficiency of treatment regimens for PD children (in contrast to efficacy) had been relatively unresearched, as has the optimal timing of intervention (Bowen and Cupples 1999) and the subcomponents of the therapy process (Fey 1999). Overall, there is little research specifically on phonological awareness therapy (with the exception of initial data on Metaphon; Reid *et al.* 1996), nor yet into its efficiency in comparison with other treatment regimens.

The principle objective of this study was to investigate the effects of phonological awareness therapy for children with phonological disorder by comparing specific outcomes (improvements in speech output and enhanced phonological awareness ability) of this intervention with that of another intervention in common use: an articulatory approach. Additional objectives were to compare experimentally the two intervention approaches in relation to initial phonological awareness status and to identify the within-subjects factors which best predict the amount of speech change made by children during therapy.

Methodology

Subjects

Speech and Language Therapy (SLT) services in the North West of England were asked to refer children who were aged 3;06–5;0 years and known to have phonological disorder for which they had not yet received any therapy. Sixty-one children were recruited who met the following inclusion criteria:

- Standard score of 85 or below on the Edinburgh Articulation Test (EAT) (Anthony *et al.* 1971).
- Standard score of 7 or above on the Sentence Structure subtest of the Preschool Clinical Evaluation of Language Fundamentals (CELF) (Wiig *et al.* 1992).
- Standard score of 70 or above on the British Picture Vocabulary Scale (BPVS) (Dunn *et al.* 1982); (only seven children had BPVS in the range 84–70; 54 were within 1 SD of the mean).
- Score of 6 (for children aged 3;6–4;3) or 7 (4;4–5;0) on Ravens Coloured Progressive Matrices (RCPM) (Raven 1976).
- Normal hearing as shown by their last hearing test.
- No structural or motor speech problems apparent on oral examination.
- English as a first language.

No further restrictions were imposed within the category of phonological disorder; these children are likely to represent a range of abilities in the different aspects of the speech processing system. Following the severity ratings described by Shriberg and Kwiatkowski (1982), on the basis of their PCC score (see below) 39 of the children would be classified as severe, 20 as moderate–severe and two as moderate. Given this severity range it is not surprising that most children showed a range of processes in their output. The most frequently chosen as the therapy target was fricative stopping.

To establish norms for the acquisition of phonological awareness 33 children, age range 3;6–5;0 and considered of normal academic and linguistic ability by their teachers were recruited from three schools in socio-economically contrasting local areas. These children completed a metaphonological abilities battery (MAB) devised by the experimenters to represent increasing levels of difficulty in the development of metaphonological abilities. This consisted of five subtests: rhyme matching, word initial matching, blending phonemes, word initial segmentation/matching and consonant deletion (Appendix 1). Test items were named for the child to control for vocabulary and no spoken output was required. Each subtest contained five practice items and 10 test items, giving a total score out of 50. Task scores were summed to yield a single metaphonological awareness score and the children were grouped into younger (3;6–4;3, $n=17$) and older (4;4–5;0, $n=16$) age bands. For each age band, scores within the lower quartile range of the normally developing children were classed as 'poor' and scores above this as 'good'. This range of scores was later used to group PD children into 'good' and 'poor' groups on the MAB. These 33 children then took no further part in the main study. Since the commencement of this study, standardized assessments of phonological processing have been published (Frederickson *et al.* 1997, Muter *et al.* 1997). However, there was (and remains) no available assessment appropriate for children at the lower end of the age range (from 3;6 years).

Fifty-nine normally speaking control children aged between 3;6 and 5;0 were recruited to control for amount of improvement in speech and phonological awareness which might be expected through normal development during a period of intervention. Criteria for inclusion as a speech control subject were:

- a standard score > 85 on the EAT;
- RCPM and BPVS score as for the PD group;
- no known hearing problems; and
- English as a first language.

Details of the PD children and normal controls are given in table 1.

Assessment

All PD and control children received:

- Assessment 1 (A1): a detailed investigation the week before therapy commenced, including Metaphon Screening Assessment (MSA; Dean *et al.* 1990), which was modified for length, imitation of consonants, an individual probe measure (see below) and the metaphonological abilities battery (MAB), and
- Assessment 2 (A2): a post-therapy session where the baseline speech and metaphonological measures (MSA, probe and MAB) were repeated. In the case of control children, assessment 2 took place 12 weeks after assessment 1, with no intervening contact.

PD children only received:

- Assessment 3 (A3): 3 month post-therapy re-test of the speech assessments (EAT, MSA and probe).

Responses were recorded onto audiotape using a SONY Walkman Professional

Table 1. Subject details at assessment 1

		Age (months)	BPVS standard score	RCPM raw score	EAT standard score
PD children	mean	48.13	96.30	10.59	69.05
($n=61$)	range	24	45	12	36
	SD	5.72	9.52	3.07	9.57
Normally speaking children	mean	50.65	102.83	10.72	113.03
($n=59$)	range	17	48	13	64
	SD	3.86	10.34	3.08	14.29

WM-D6C and a Beyerdynamic M58 professional microphone. Responses were transcribed live and checked later from the audiotape.

The percentage consonants correct metric (PCC) (Shriberg and Kwiatkowski 1982) scored speech output from the MSA (a potential total corpus of 89 words including 241 consonants). Correctly produced consonants were scored as 1, errors (such as deletion, substitution and distortions) as 0. If a child did not say or used a shortened version of a word, the relevant number of consonants was deducted from the 241 total. The PCC was therefore calculated out of the total number of consonants in the words attempted by the child rather than the potential total number present in the test material. Severity ratings at assessment 1 are shown in table 3.

Speech output was also measured using individualized probe scores that had the potential to be more sensitive to change than an overall PCC score. Once each child's target process for intervention had been established, a naming task of 20 words incorporating that process was designed. A probe scoring system was devised that could show degrees of change towards the target such as one might expect to see during the therapy process. The child's response for each target phoneme was negatively scored according to the degree of mismatch from the adult form with regards to the features of place, manner and voice. A score of –1 was given for each mismatched feature and –4 if a phoneme was omitted. Production of the adult form scored 0. The sum of the scores was calculated to give a total negative mismatch for the probe. The scoring system is described in more detail by Hall *et al.* (1998).

Intervention

PD subjects were allocated to groups receiving articulation (ART) or metaphonologically (MET)-based therapy in a semi-random fashion in order to achieve even numbers of children in each group. The two groups were comparable for severity (table 3). Each child received 10 weekly sessions of individual phonological therapy from one of the experimenters (all registered speech and language therapists). The two therapy groups were further subdivided (for the purpose of analysis only) according to initial metaphonological performance (MAB), leading to four groups:

- GART: good MAB/articulation therapy.
- GMET: good MAB/metaphonological therapy.
- PART: poor MAB/articulation therapy.
- PMET: poor MAB/metaphonological therapy.

Target processes or phonemes for intervention were selected according to individual phonemic inventories in priority order:

- stimulable but not used spontaneously;
- developmentally the next appropriate; and
- having the greatest effect on intelligibility.

Articulation therapy

Children in the articulation- or production-based therapy group participated in tasks which practised the production of phonemes or phoneme classes which assessment had shown to be problematic, but the therapy did not directly target underlying phonological knowledge. Practice tasks worked through the target sounds or groups of sounds in isolation, in simple CV or VC structures (if appropriate), in words containing the target in initial or final word position and, finally, in sentences containing such words. If the child became consistent within the therapy period at producing all his/her target sounds or eliminating the process at a sentence level, then a new target sound or process would be introduced. Inevitably, eliciting a sound from a child encourages them to attend to its features, but targets were not contrasted with the child's habitual production in minimal pair type games. Rather the emphasis was on lots of physical practice at producing the correct form of a sound or sounds.

Metaphonological therapy

Children in the metaphonological therapy group worked on both general phonological awareness tasks and on more specific awareness tasks involving their target phonemes or processes (see Appendix 2 for examples). The first four sessions involved work on rhyming, syllable clapping, alliteration, blending and segmenting games. In sessions 5–8 the phonological awareness tasks focused on the therapy targets. If the child had a particular phonological process occurring in his/her speech output, the features of that process were discussed. For example, a child who was fronting velar sounds would learn that there are front sounds and back sounds and participate in listening and judging games involving that distinction. Only in the last 2 weeks of therapy was production work involved, using contrasting sounds and minimally paired words. In these 2 weeks children were not directly corrected on their speech attempt but were given feedback commenting on phonological features of their production.

Results

Metaphonological ability and metaphonological change in therapy

Mean MAB and change in MAB are shown in table 2. At A1, normally speaking children achieved a significantly higher score on MAB than PD children (d.f. = 110.69, $t = 2.60$, p (two-tailed) < 0.05). (Levene's statistic is used throughout to test for equality of variance; where this cannot be assumed the unequal variance t-test or non-parametric statistics are used as appropriate.) There was no significant difference between the ART and MET subgroups on MAB performance at A1 (independent samples t-test, d.f. = 59, $t = 0.906$, n.s.) nor among control, ART and MET subgroups (Kruskal–Wallis d.f. = 2 ($\chi^2 = 5.792$, n.s.)).

MET subjects, ART subjects and controls were compared on the amount of change in MAB (difference between A1 and A2 scores) during therapy or an equivalent period using a one-way ANOVA. A significant difference was not shown among the three groups (d.f. = 119; $F = 2.427$, n.s.). However, it is interesting to make a broader comparison between all children who received therapy and the control group. The MET and ART groups were therefore collapsed to form one PD group which was compared with the normal controls on MAB change from A1 to A2. The PD group made more change than the controls (table 2) and this difference reached significance (d.f = 113.6; p (two-tailed) < 0.05).

MAB for the PD and control groups following therapy were compared using

Table 2. Metaphonological abilities battery scores

		Assessment 1 (A1)	Assessment 2 (A2)	Changes from A1 to A2
MET group	mean	17.71	24.84	7.13
($n = 31$)	range	8–39	13–45	− 6–20
	SD	5.24	8.17	7.38
ART group	mean	19.17	25.27	6.10
($n = 30$)	range	9–38	10–46	− 8–20
	SD	7.21	8.93	6.53
PD group (MET and ART combined)	mean	18.43	25.05	6.62
($n = 61$)	range	8–39	10–46	− 8–20
	SD	6.27	8.48	6.94
Normally speaking controls	mean	21.87	26.14	4.20
($n = 59$)	range	9–40	11–40	− 10–21
	SD	8.17	8.21	5.49

the independent samples t-test. Differences between group means at this stage were no longer significant (d.f. = 118, $t = 0.71$, n.s.). Nor was there a post-therapy difference between the MAB of the ART and MET groups (d.f. = 59; $t = 0.478$; n.s.).

Speech output and speech output change

Results of speech assessments are shown in table 3. At A1, there is no significant difference in PCC between the MET and ART subgroups (independent samples t-test, d.f. = 59, $t = 1.377$, n.s.). Change scores for PCC and Probes from A1 to A2 were calculated (table 4).

Changes in PCC from A1 to A2 for ART, MET and control groups were compared using a one-way ANOVA. A significant difference was shown among group means (d.f. = 119, $F = 17.49$, $p < 0.001$) and the Sidak *post-hoc* test showed the differences to be between the ART/control and MET/control groups. There was no significant difference between ART and MET groups in PCC change.

A comparison of change in probe measures was carried out between ART and MET groups only, as there is no probe list for the control children. A t-test for independent samples showed that the difference between the means was significant (d.f. = 59, $t = 2.038$, $p < 0.05$) with the ART group making more change than MET on the probe measure.

More long-term effects of therapy were examined by comparing change in speech production between A2 and A3, or overall, between A1 and A3. Control children were not followed up beyond A2, so only PD children are considered here. Some of the PD group had received further therapy (of unknown type) from their local SLT services in between A2 and A3, which could potentially influence their performance. Therefore only those children who had not received further local therapy are considered. This exclusion reduces the numbers to 24 children in the MET and 23 in the ART group (47 PD children overall). Results for A1–3 for this 'no further therapy' (NFT) subgroup are shown in table 5.

Comparison of the NFT MET and ART groups on PCC and probe change between assessments 2 and 3 showed no significant difference between groups (PCC change d.f. = 33.93, $t = 1.04$, n.s.; probe change d.f. = 45, $t = 1.02$, n.s.). On

Table 3. PCC and probe score at assessments 1–3 for all children

		PCC			Probe		
		A1	A2	A3	A1	A2	A3
MET group ($n=31$)	mean	43.24	53.63	60.66	− 37.44	− 19.24	− 18.53
	range	23.83–62.76	24.48–87.03	26.25–90.34	− 71.0–− 15.0	− 54.0–0	− 66.0–0
	SD	11.45 (Severity: 20 severe 11 moderate–severe)	15.88	18.19	14.25	16.68	18.87
ART group ($n=30$)	mean	47.23	57.68	61.91	− 35.58	− 10.17	− 16.08
	range	25.00–72.27	27.62–90.64	27.39–95.02	− 75.0–− 15.5	− 37.0–0	− 58.5–0
	SD	11.20 (Severity: 19 severe 9 moderate–severe 2 moderate)	16.83	18.62	15.29	10.77	18.18
PD group ($n=61$)	mean	45.20	55.62	61.29	− 36.53	− 14.78	− 17.31
	range	23.83–72.27	24.48–90.64	26.25–95.02	− 75.0–− 15.0	− 54.0–0	− 60.0–0
	SD	11.41	16.34	18.26	14.68	14.70	18.41
Controls ($n=59$)	mean	85.53	88.33				
	range	64.85–98.26	73.53–98.76				
	SD	8.10	6.47				

Table 4. PCC and probe score change between assessments

		PCC			Probe		
		Change A1 to A2	Change A2 to A3	Change A1 to A3	Change A1 to A2	Change A2 to A3	Change A1 to A3
MET group	mean	10.40	5.56	16.55	18.19	− 1.54	16.96
	range	− 1.77–38.07	− 8.3–22.82	− 3.79–48.54	− 2.0–52.5	− 55.5–14.5	− 4.0–48.0
	SD	9.40	8.00	15.59	14.52	13.05	16.83
ART group	mean	10.45	3.67	14.71	25.42	− 4.80	22.78
	range	− 1.67–26.87	− 2.54–12.52	− 1.9–30.25	5.0–60.5	− 24.5–7.5	− 15.5–68.0
	SD	8.31	3.96	10.10	13.10	8.30	18.21
PD group	mean	10.42	4.64	15.65	21.75	− 3.14	19.81
	range	− 1.77–38.07	− 8.3–22.82	− 3.79–48.54	− 2.0–60.5	− 55.5–14.5	− 15.5–68.0
	SD	8.80	6.36	13.08	14.20	11.00	17.58
Controls	mean	2.95					
	range	− 5.07–15.32					
	SD	4.05					

Changes A2 to A3 and A1 to A3 results include only those cases that had not received further therapy from local services since assessment 2 (NFT subgroup).
NFT MET ($n=24$).
NFT ART ($n=23$).
NFT PD ($n=47$).

Table 5. PCC and probe scores at assessments 1–3 for the 'no further therapy' (NFT) subgroup

		PCC			Probe		
		A1	A2	A3	A1	A2	A3
MET group ($n=24$)	mean	44.77	55.76	61.32	− 36.44	− 17.94	− 19.48
	range	29.29–47.74	30.71–87.03	31.06–90.34	− 63.0–− 15.0	− 54.0–0	− 66.0–0
	SD	10.73	15.91	18.65	13.50	16.52	20.19
ART group ($n=23$)	mean	46.10	57.15	60.82	− 37.26	− 9.67	− 14.48
	range	25.00–72.27	27.62–90.64	27.39–95.02	− 75.0–− 15.5	− 37.0–0	− 58.5–0
	SD	11.85	18.32	19.79	15.79	11.38	17.61
PD group ($n=47$)	mean	45.43	56.44	61.07	− 36.84	− 13.89	− 17.03
	range	25.0–72.27	27.62–90.64	27.39–95.02	− 75.0–− 15.0	− 54.0–0	− 66.0–0
	SD	11.19	16.96	19.01	14.51	14.69	18.93

the probe measure, both groups showed a slight deterioration between assessments 2 and 3.

NFT MET versus ART comparisons were also carried out for the overall change from A1 to A3. The difference between group means was not significant for either PCC or probe score change (PCC change d.f. = 45, $t = 0.48$, n.s.; probe change d.f. = 45, $t = 1.14$, n.s.).

Taking all NFT children (MET and ART together), PCC change for A1 to A2 and for A2 to A3 were compared. A paired samples *t*-test showed a significant difference between the changes made over these two periods, with more progress being made during therapy (d.f. = 46, $t = 4.65$, p (two-tailed) < 0.001). The same comparison for probe change showed an even sharper distinction (d.f. = 46, $t = 9.13$, p (two-tailed) < 0.001), with deterioration in probe score during the post-therapy period. A comparison between the amount of PCC progress made by the NFT children from A2 to A3 with that made by normal controls over 3 months showed no significant difference (unequal variances *t*-test, d.f. = 74.32, $t = 1.58$, n.s.).

Table 6 shows PCC and probe change data for the four therapy subgroups derived from initial MAB scores.

These subgroups were compared using a one-way ANOVA; control data were also included for the PCC comparison only. There were no significant differences among the four therapy subgroups for probe change (d.f. = 3, $F = 2.623$, $p = 0.059$). A significant difference was shown for PCC change (d.f. = 4, $F = 9.873$, $p < 0.001$); Sidak's *post-hoc* revealed differences between the control/GART ($p < 0.001$) and control/GMET ($p < 0.001$) subgroups, with mean change in children with good MAB being greater than in control children. There were no differences in mean change between control groups and either PMET or PART children, nor within the four therapy subgroups.

Within this study is information on a number of factors that might have an effect on the progress made by PD children in therapy: therapy type, initial metaphonological ability, metaphonological change during therapy, initial speech severity, age and initial language, and cognitive abilities (as measured by the BPVS, CELF and RCPM) were all included in a correlation matrix with the change in PCC score during therapy. Correlations were markedly low (and precluded a regression analysis) and even the initial level of metaphonological ability, which appeared

Table 6. PCC, probe and change scores of the four therapy subgroups

		PCC				Probe			
		A1	A2	A3	A1 to A2 change	A1	A2	A3	A1 to A2 change
GMET	mean	43.01	54.83	61.51	11.82	− 38.43	− 19.32	− 19.07	19.11
(*n* = 22)	range	23.83–62.76	24.48–87.03	26.25–90.34	− 1.77–38.07	− 71.0–− 15.0	− 54.0–0	− 66.0–0	− 2.0–52.5
	SD	12.10	16.78	19.12	10.43	14.96	16.69	19.46	15.47
PMET	mean	43.80	50.71	58.34	6.92	− 35.00	− 19.06	− 17.06	15.94
(*n* = 9)	range	31.80–57.74	33.61–75.0	36.40–83.40	1.25–17.26	− 54.0–− 20.0	− 46.5–0	− 43.0–0	− 1.0–30.0
	SD	10.36	13.90	16.28	5.15	12.84	17.65	18.30	12.41
GART	mean	46.39	57.57	62.31	11.17	− 38.58	− 9.98	− 15.73	28.60
(*n* = 20)	range	25.0–72.27	27.62–89.58	27.39–95.02	− 1.67–26.87	− 75.0–− 15.5	− 37.0–0	− 58.5–0	6.0–60.5
	SD	11.80	18.02	20.28	8.97	15.87	12.00	20.08	13.53
PART	mean	48.92	57.90	61.10	8.99	− 29.60	− 10.55	− 16.80	19.05
(*n* = 10)	range	35.59–65.68	39.91–90.64	41.91–92.02	0.20–24.96	− 48.0–− 16.5	− 28.5–− 0.5	− 46.5–0	5.0–35.5
	SD	10.26	15.07	15.74	7.00	12.73	8.35	4.61	9.96

above to have some effect on response to therapy, showed only a weak relationship with PCC change (table 7). The only measures to show a significant relationship with PCC change were change in metaphonological scores over the same period ($R = 0.399$, p (two-tailed) < 0.01), and initial speech severity (PCC score at assessment 1, $R = 0.295$, p (two-tailed) < 0.05).

Discussion

Phonological awareness skills of PD children

The results concur with studies such as by Bird and Bishop (1992) and Major and Bernhardt (1998) in finding that PD children as a group were poorer at metaphonological tasks than a group of normally speaking children. Nevertheless, there was congruity in the range of scores for the two groups, bearing out our earlier observation and that of Leitao *et al.* (1997) that there are good speakers with poor metaphonological skills and poor speakers with good metaphonological skills. Metaphonological skills improved with therapy (either ART or MET) beyond the progress made by control children in a similar period so that, at assessment 2, there is no longer a statistically significant difference between the two groups. This goes beyond the findings of a report on the effects of the Metaphon programme (Reid *et al.* 1996) which demonstrated a degree of spontaneous development in metalinguistic skills over a similar period of 10 weeks, and raised doubts about whether changes in treated children could therefore be attributed to the therapy process. The results show, however, that the amount of change made by the therapy group was significantly greater than that made by control children.

It might have been expected that there would be therapy specific effects for ART and MET groups; that ART children might have made most progress on measures such as PCC and Probe and MET children on MAB. The results were far from being this neat and it is surprising to see that the type of therapy offered did not make a difference to overall progress. Lack of difference between the groups is not due to ceiling effects in the battery as all of the individual subtests continued to stretch the PD children (as a group) after therapy. Consonant deletion remained a challenge for most individual children, though there are indications of different patterns of performance within the groups (Hesketh *et al.* 2000). Children receiving articulatory therapy clearly received metaphonological benefit from it so, while speech and language therapy can make a difference to metaphonological skills, it does not appear that specifically metaphonological therapy is necessary to achieve this improvement. It may be that ART therapy inevitably has a metaphonological effect because of the very nature of the process of focusing on speech sounds, but if this is the case then further investigation is required to address this as an issue of comparative efficiency (Geirut 1998). It may be that there are subtle differences

Table 7. Correlation table for PCC change

	A1 PCC	MAB total at A1	MAB change A1 to A2	CELF subset SS	BPVS SS	RCPM score	Age at A1 (in months)
PCC change A1 to A2	0.295*	0.207	0.399**	0.106	0.030	− 0.095	0.156

in the effects of the two therapy approaches on different subtests of the MAB, which require more detailed analysis to determine (Adams and Hesketh 2000). The effect of phonological awareness training on phonological and reading skills in normally speaking children with reading difficulties has already been documented (Gillon and Dodd 1997, Rivers and Lombardino 1998). The potential effect of metaphonological improvement on literacy skills in PD children is a further area requiring thorough and prompt investigation.

Effects of therapy on speech production

Although this study was not primarily designed as efficacy research and does not contain an untreated PD control group, one can make a comparison between the progress made by PD children during therapy and that made by normally speaking children over the same period. Both the ART and MET therapy groups made more progress during 10 sessions of therapy than the normal speakers in that time. It should be emphasized that subject numbers were relatively small for a comparative study with a small anticipated effect size. The effect of receiving therapy, however, is robust enough to show up despite the reduction in group size that occurs when considering the ART and MET subgroups separately (unlike the metaphonological change discussed above).

Further evidence for the effect of therapy can be seen when comparing the progress made during the therapy period with change that occurs in the following 3 months (between A2 and A3). This is best examined in the subgroup of children who had no further therapy: a sharp reduction in improvement is found in their PCC score, and the group actually shows an overall deterioration in the probe score; both these differences were statistically highly significant. Whereas the PD children make much more progress than normals during their therapy period, the NFT group is not significantly different from normals in the progress it made in the 3 months following therapy. This suggests a specific training effect that diminished at the end of a short period of therapy and which may be more marked in the ART group. Further analysis of the outcome for those children who continued in therapy in comparison with the NFT group may reveal valuable information about optimal timing of interventions.

Striking differences between MET and ART therapies in the effect on speech change were not found. During the therapy period the two groups made the same amount of progress as measured by the PCC, although the ART group made more change on the probe measure. Between A2 and A3, in the 3 months immediately following therapy, table 4 shows that there is a trend for the MET groups to maintain a higher rate of progress on the PCC score. Although the difference does not reach statistical significance, it suggests that the effect of metaphonological therapy may be less immediate and more gradual. Whether a metaphonological approach leads to greater change than articulatory therapy in the long-term is unclear; this is a question requiring urgent investigation through longitudinal research.

Is the effect of therapy related to the phonological awareness ability of children?

Proposed above was that if not all PD children have a deficit of phonological awareness then a metaphonological approach to therapy would not be the most efficient for all. It could be hypothesized that children who do have a delay in phonological awareness might need to address this problem in therapy before being able to change their internal phonological representations in a way necessary for effecting change in spoken output. Conversely, children whose phonological awareness skills are at a normal level may not need this element to therapy, and would be most efficiently treated by an approach which gave them more opportunities to practise the production of sounds and contrasts they do not already use. This argument would predict that children with poor metaphonological skills would be best treated by metaphonological therapy, and children with good metaphonological skills would be more efficiently treated via an articulatory, production based approach.

Statistical analysis revealed no significant difference among the four therapy groups for either PCC or probe change. Table 6 shows that children with good metaphonological abilities on entry to the study appear to do better than those with poor metaphonological skills; the difference approached significance and it may be that larger group sizes are necessary to show this distinction to an acceptable level of significance. It appears that an initial average or above average level of phonological awareness allows children to benefit more from therapy, whether this therapy concentrates on either cognitive/phonological knowledge or motoric production practice.

What factors predict the amount of progress made in therapy?

The two factors that showed a positive relationship were the amount of change in metaphonological ability made during therapy and the initial severity of the speech problems, as measured by PCC at A1. Thus, metaphonological abilities appear to improve alongside speech output abilities during therapy, again regardless of whether the therapy approach directly targets this aspect. Children with milder degrees of speech impairment made more progress in therapy, but language and cognitive abilities or even age did not show a relationship with speech change. There was no evidence that older children have a better outcome, which has been an anecdotal claim for metaphonological therapy. It is clear that there are other factors affecting progress in therapy, such as motoric skills or other aspects of cognitive or metaphonological awareness, not measured by the chosen assessments or controlled for in the inclusion criteria and which should be considered for inclusion in future research.

Summary

A clear effect of the benefits of even modest amounts of speech and language therapy for children with phonological disorders has emerged from the study. Therapy has an effect on both metaphonological abilities and speech output, but there was no effect of therapy type, though this may be an artefact of small group size. Initial metaphonological readiness was not a strong predictor of outcome whereas initial speech severity is a relevant factor in prognosis. There is no evidence from this study that working on metaphonological skills is a necessary precursor for speech improvement, or that production practice is necessary for all children since the MET group made as much progress as the ART group. The study in effect raises more issues than it can answer in that what actually happens in therapy still remains poorly understood, and there is a need for controlled longitudinal research to address the complex set of factors involved in a diverse set of individual children. It is recognized that therapists are unlikely to make the clear distinctions between metaphonological and articulatory work which were necessary for this research, and that most are likely to adopt a more eclectic approach to therapy in their clinical practice. Some of the more abstract concepts such as readiness or timing of therapy that have long been held as crucial to the success of therapy (Adams *et al.* 1997) have been hinted at here in the tendency for PD children with average or above average MAB to have a better outcome and this needs further scrutiny.

Some ethical and practical issues must be overcome in setting up future research studies for PD treatment, not the least of which is teasing out the specificity of treatment regimens, but given the paucity of data on relative efficiency of therapy for these children it seems that this must now be a priority.

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Appendix 1: Metaphonological Abilities Battery

Each of the five subtests contained five practice items, during which feedback was given, and then 10 test items. Each item had a choice of three or four picture responses for the child to choose from, and the tester named all pictures for the child before a choice was made. Target pictures were randomly allocated to a position on the page.

Subtest 1: Rhyme matching

The child has to find the picture that rhymes with a puppet's name.

Set 1: rhymes for puppet 'Dan'

Target	Distractor items		
pan	spoon	cup	fork
fan	plane	bike	kite
van	house	boat	car
can	tap	vase	mug
man	girl	boy	lady

Set 2: rhymes for puppet 'Pat'

Target	Distractor items		
hat	shoe	ham	fish
cat	sock	cap	pan
mat	book	scarf	map
rat	saw	cup	race
bat	comb	bag	purse

Subtest 2: Onset matching

The child is asked to find the picture that starts with a target phoneme spoken by the tester.

Set 1

Target	Distractor items		
pipe	fan	house	kite
pan	vase	cup	fork
pig	watch	hen	key
purse	hand	ring	jug
pen	saw	car	duck

Set 2

Target	Distractor items		
chair	bike	peg	map
chain	net	key	bell
chips	cat	fish	fan
chicken	carrot	tap	pig
cherry	dog	pencil	worm

Subtest 3: Blending phonemes

The child has to find the picture of the word that is presented by the tester as a series of phonemes.

Target	Distractor items	
man	map	lady
dog	door	cat
fish	shark	fence
cup	plate	cut
spoon	spade	fork
purse	peg	bag
sword	knife	soap
baby	mummy	balloon
teapot	teddy	kettle
rabbit	rubbish	kitten

Subtest 4: Word initial segmentation and matching

The child is asked to find the picture that starts with the same sound as the puppet's name. The child is only given the whole name so must segment the word initial sound first.

Set 1: to match initial phoneme of puppet 'Tom'

Target	Distractor items		
tie	sock	pipe	hat
teddy	book	dolly	bird
table	fence	cake	shoe
tap	goat	ship	van
tent	mug	lamp	box

Set 2: to match initial phoneme of puppet 'Sam'

Target	Distractor items		
sun	fan	ball	car
saw	bee	tie	hat
sock	pen	mop	boot
sea	fork	cup	knife
settee	table	bed	mat

Subtest 5: Consonant deletion

Children have to find the picture of a word that is formed after the deletion of a consonant from a word given verbally.

Stimulus target	Distractor items		
spot	pot	cot	stripe
start	tart	go	heart
train	rain	lane	bus
black	back	sack	yellow
clap	cap	tap	cheer
snail	nail	slug	sail
stick	tick	log	sick
blocks	locks	box	trolley
swing	wing	slide	sing
ski	key	sea	sledge

Appendix 2: Examples of tasks used in metaphonological therapy

The following are examples of tasks used in the first four 'general' sessions, involving words with a wide range of structures and sounds, not specifically related to the child's individual speech pattern.

- Game with pictures of one or two syllables. Pick a picture. Give one-syllable words to a toy with a one-syllable name (Pooh), and two-syllable words to a two-syllable toy (Tigger). (Could involve therapist saying the word, or silent judgements by child.)
- Therapist says words of up to three syllables. Child taps on the table the correct number of times for the number of syllables or puts the correct number of beads on a string.

- Rhyme matching game. Child has to match a picture to a rhyming one out of a choice of three.
- Odd one out game. Can be adapted for rhyme, number of syllables or initial or final sound matching. (Therapist says the word, or silent judgement by child.)
- Therapist says a word. Child has to identify the sound card that represents the sound heard at the beginning or the end of the word.
- Child is asked to listen out for a particular sound. Therapist says lots of words. Child has to shout when s/he hears the target sound.
- Phoneme counting game. Therapist picks a picture and says the word. The word is segmented into phonemes, which are counted. The picture splits into that number of pieces to reinforce the concept. The child is encouraged to split the words along with the therapist.

The following are examples of tasks used in sessions 5–8 of the metaphonological therapy, selected according to the child's particular problem. Many can be adapted according to the ability of the child (e.g. by listening to therapist or making silent judgement; by increasing or decreasing number and closeness of distractors), or to other processes.

- Present pictures of words with a range of fricative sounds at the beginning (or end) of the word. Encourage child to judge which sound is present in the word initial (or word final) position, but do this silently. The picture is assigned to the correct sound card. (Fricative confusion.)
- Present pictures with back/front sounds. Encourage child to judge whether the word initial (or word final) sound is back/front. The back sounds are put at the back of a toy, the front ones to the front of the toy. (Fronting.)
- Present pictures that have or do not have a word final consonant. Child judges silently whether or not a sound is present at the end of the word. (Word-final consonant deletion.)
- Child is shown a picture. Therapist then says the word, either correctly or without the final sound. The child is encouraged to say whether the word was correct or not. The missing sound is then discussed and produced on the word (by therapist). (Word-final consonant deletion.)
- Listening game. Talk about single sounds/sounds that go together. Say a sound, child has to identify as cluster or single sound. Use bricks as visual cue at first. (Cluster reduction.)
- Lotto game. Take it in turns to pick a card, silently add the /s/ sound and find the correct picture. (/s/ cluster reduction.)