International Journal of Language & Communication Disorders
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713393930

Early literacy achievement of children with a history of speech problems

Anne Hesketh [a]
[a] School of Education, University of Manchester, Manchester, UK

Online Publication Date: 01 October 2004
To cite this Article: Hesketh, Anne (2004) 'Early literacy achievement of children with a history of speech problems', International Journal of Language & Communication Disorders, 39:4, 453 - 468
To link to this article: DOI: 10.1080/13682820410001686013
URL: http://dx.doi.org/10.1080/13682820410001686013

INT. J. LANG. COMM. DIS., OCTOBER–DECEMBER 2004,
VOL. 39, NO. 4, 453–468

Early literacy achievement of children with a history of speech problems

Anne Hesketh

School of Education, University of Manchester, Manchester, UK

(*Received 5 March 2003; accepted 20 February 2004*)

Abstract

Background: There are conflicting reports in the research literature of the literacy outcome of children with speech disorder. The link between phonological awareness and literacy in typically developing and literacy delayed children is well established, but there is less research specifically into children with an isolated speech disorder (i.e. with age-appropriate language skills). There is a clinical need for clarification on their likely outcome as a group and for a means of predicting those individuals who might need support in literacy development.

Aims: To assess literacy and phonological awareness skills at age 6;6–7;6 years in children with a history of speech disorder, and to identify factors in their early profile that were predictive of later achievement.

Methods & Procedures: Thirty-five children who had participated in an earlier therapy research study agreed to further assessment of their speech, language and literacy abilities. The children had originally been recruited between the ages of 3;6 and 5;0 years as having a moderate-to-severe speech disorder, and there were measures at that time of their non-verbal, language, phonological output and phonological awareness abilities. Follow-up assessments of phonological awareness, speech and early literacy were undertaken.

Outcomes & Results: As a group, the children had made good progress in speech and showed phonological awareness and literacy development at an age-appropriate level. However, a small number of children had phonological awareness and literacy delay. Phonological awareness at 3;6–5;0 years was the best predictor of literacy achievement.

Conclusions: Speech and language therapists can be confident about the early literacy achievement of most children with isolated speech disorder, but should undertake assessment of phonological awareness to identify those children whose phonological awareness skills after speech intervention continue to be low.

Address correspondence to: Anne Hesketh, Human Communication and Deafness, School of Education, University of Manchester, Oxford Road, Manchester M13 9PL, UK; e-mail: anne.hesketh@man.ac.uk

International Journal of Language & Communication Disorders
ISSN 1368-2822 print/ISSN 1460-6984 online © 2004 Royal College of Speech & Language Therapists
http://www.tandf.co.uk/journals
DOI: 10.1080/13682820410001686013

Introduction

Psycholinguistic and educational research has established a link between phonological awareness (PA) and early literacy development in both normally developing children and children with developmental problems of language or literacy. It has been suggested that children with output phonological (speech) problems might have a deficit of PA that underlies their speech problem and which may also put them at risk for future literacy difficulties, although the research evidence is as yet inconclusive. To move towards better-informed practice, it is necessary to clarify whether or which speech-disordered children go on to have more difficulty in acquiring literacy skills than their normally speaking peers.

Phonological awareness in children with speech disorder

Most of the research in this area has demonstrated that speech-disordered children as a group show poor PA performance as compared with normally speaking controls (Bird and Bishop 1992, Webster and Plante 1992, Bird *et al.* 1995, Stackhouse *et al.* 1997); however, there is considerable within-group intersubject variability. Bird *et al.* (1995) and Hesketh *et al.* (2000a) find a wide range of metaphonological ability in both typical and atypical speakers; there are examples of severely speech-disordered children who have good PA and of normal speakers with poor metaphonological skills. Findings might depend on the overall language profile of the speech-disordered children. For example, Leitao *et al.* (1997) found that all their participants with a language impairment had difficulties with phonological processing, while many of their purely speech-impaired children performed at normal levels.

Literacy development in children with speech disorder

There is widespread acceptance of the importance of PA in the development of literacy and also of its role in reading failure, although the literature suggests the relationship is complicated (Goswami and Bryant 1990, Stothard *et al.* 1996, Snowling and Nation 1997). It is less clear whether the same PA skills underlie speech development, and whether speech-disordered children are therefore at risk for problems in literacy acquisition. Larivee and Catts (1999) suggest that since orthography represents the sounds of speech (less directly in English than in some other languages), it might be expected that any children with speech problems would be at risk for early reading achievement. This superficial level of relationship would presumably predict that only those with persisting speech problems at the time of learning to read and spell would have problems in the area. On the other hand, a deeper explanation to do with underlying PA skills would predict literacy difficulties even in those whose speech has resolved (assuming the PA problems persist). It must also be remembered that speech disorder, although it may exist as a 'pure' condition in some children, is frequently accompanied by a broader language impairment, which is itself associated with literacy problems. Bird *et al.* (1995) found their 'pure' speech disorder subgroup not only showed metaphonological impairment, but also was worse than matched normally speaking controls on literacy measures (particularly spelling). Similarly, Clarke-Klein and Hodson

(1995) found spelling difficulties in speech-disordered children when the effects of their accompanying language difficulties had been partialled out. However, other studies have found that purely speech-disordered children are not at risk for later literacy or academic problems (Bishop and Adams 1990, Webster and Plante 1992, Catts 1993), unlike children with broader language impairment. Snowling *et al.* (2000), following up the Bishop and Adams (1990) group at 15 years of age, confirmed that those who had had isolated impairments of expressive phonology had a good literacy outcome (although less good than age and Performance IQ-matched controls). As with PA ability, there is a high degree of variability in the literacy performance of children with speech and language problems (Snowling 2000) and one needs to try to understand this variation to provide appropriate, individually matched support.

Implications for intervention

Within both the teaching and speech and language therapy professions, interest has grown in the remediation or prevention of reading difficulties through the development of children's PA skills. Research into children with identified reading difficulties but *normal* speech and language development has shown that speech and language therapists can have a positive effect on the reading skills of such children (Gillon and Dodd 1997, Rivers and Lombardino 1998). Gillon (2000, 2002) has also shown that PA intervention can have a positive and lasting effect on the PA and literacy development of speech-disordered children who are already demonstrating literacy difficulties. These results, along with others reported above, appear to have been extrapolated to a widespread belief that children with output phonological disorders *do* have delayed PA skills which are a potential cause of future literacy problems. A strong clinical interpretation might be that metaphonological work should therefore form part of speech and language therapy for *all* speech-disordered children (Hodson 1994, Jenkins and Bowen 1994) and that speech and language therapists should work on delayed PA even in children who are no longer demonstrating speech and language problems. However, given that not all speech-disordered children have a delay in PA and that the relationship of speech disorder to literacy problems has not been accurately established, this may not be an efficient use of therapist time.

Prediction of literacy achievement

As referral rates to speech and language therapy continue to rise, unmatched as yet by an increase in the size of the profession (Enderby and Petheram 1998), it is essential that services are directed towards those who need and can benefit from them, and that the most efficient service possible is provided. A means of predicting which *preschool* children with speech disorder will go on to have literacy difficulties, and who would therefore be likely to benefit from specific and continued intervention is urgently needed, but has proved elusive.

Larivee and Catts (1999) assessed kindergarten children with speech problems and typically developing controls on a range of speech, language and PA measures, following up their reading achievement 1 year later. Poor reading at the second assessment was associated with poor performance on PA, on language skills and on at least one measure of speech at the earlier kindergarten testing point. The speech

task that required children to repeat multisyllabic and non-words was a better predictor than single-word accuracy, indicating the need to look beyond the production of single words as the typical speech assessment format. Larivee and Catts' children were aged between 5;8 and 7;3 years at the first assessment so were already moving into literacy. Even in a group with persisting speech problems at this age, almost half the children (40%) had good early reading achievement. Children are typically treated for speech disorder at an earlier age in UK clinics and there needs to be a way of predicting at this earlier stage which of them will need support for literacy.

Earlier baselines are provided by two recent studies. Stackhouse (2000) reported longitudinal data on children with speech and language difficulties from age 4;6 to 6;6 years. Although there were differences in the speech and language profiles of good and poor readers/spellers at 6;6, it was not possible to distinguish these two groups on any of the measures taken at the earliest assessment point (including non-word repetition and other PA tasks). Gallagher *et al.* (2000) compared children with poor and typical literacy at 6 years on a range of non-verbal, language and cognitive tasks which had been assessed at 45 months, i.e. at an age when children would typically be receiving intervention for a speech problem in the UK. They state that the literacy-delayed group had a history of significantly slower speech and language development and that both speech and language skills predicted individual differences in literacy outcome. However, in their regression analysis, the 'speech' factor included two tasks of non-word repetition, a measure which is emerging as an important predictor of persisting language and literacy difficulties in many studies (Dollaghan and Campbell 1998, Larivee and Catts 1999, Weismer *et al.* 2000, Conti-Ramsden and Hesketh 2003). Speech performance as measured by The Edinburgh Articulation Test (EAT; Anthony *et al.* 1971) did *not* differentiate the good and poor literacy groups on a direct comparison, and Gallagher *et al.* acknowledge that non-word repetition is likely to have been the important factor.

The current study follows up a cohort of school-age children with a history of speech problems. They were participants in a previous study (Hesketh *et al.* 2000b) that compared approaches to speech and language therapy for children with phonological output problems. There are measures of their non-verbal, language, phonological output and PA abilities before and after 10 weeks of intervention. The current study aimed to assess the children's literacy and phonological skills at age 6;6–7;6 and to compare these to earlier patterns of phonological awareness and output to ascertain which factors in their early profile were predictive of later achievement.

Methods

Subjects

Of 61 children who had participated in an earlier therapy research study (Hesketh *et al.* 2000b), 35 agreed to further assessment of their speech, language and literacy abilities. The children had originally been recruited between the ages of 3;6 and 5;0 years as having a moderate-to-severe speech disorder and had received 10 sessions of speech and language therapy following approaches that emphasized either production practice or metaphonological awareness. The original inclusion criteria, in addition to a speech disorder, were as follows:

- 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 six children in the current study achieved a score of less than 85 on their original assessment, and only one of these fell below 80).
- Score of 6 (for children aged 3;6–4;3) or 7 (for children aged 4;3–5;0) on Raven's (1976) Coloured Progressive Matrices. This criterion was based on Raven's extrapolated norms for ages 3;6–5;0.
- Normal hearing as shown by their last hearing test.
- No structural or motor problems apparent on oral examination.
- English as a first language.

In addition, data were available from the previous study on the following:

- Percentage consonants correct (PCC) (Shriberg and Kwiatkowski 1982) on a picture-naming task both before and after therapy.
- Percentage change in PCC across the pre- and post-therapy measures (i.e. improvement in speech following therapy).
- Phonological awareness as measured by a metaphonological abilities battery (MAB) devised for the study. The MAB consisted of five subtests: rhyme matching, word onset matching, blending, word onset segmentation and matching, and consonant deletion. However, the consonant deletion task was too difficult for almost all the children and suffered from floor effects, so all results reported here are only from the first four subtests. Each subtest had 10 items and all responses were by picture selection to avoid problems of interpreting the spoken responses of speech-disordered children. MAB results were also available pre- and post-therapy.

For the current study, it was planned to reassess the participants between the ages of 6;6 and 7;6. Two of the children reported here were unable to attend for reassessment until slightly after the upper age limit (7;7 and 7;9, respectively). Assessment was by the following measures:

- Phonological Assessment Battery (PhAB) (Frederickson *et al.* 1997). Results are reported for the following subtests: alliteration (the child identifies the two words out of three which start with same sound); rhyme (the child identifies the two words out of three which rhyme); spoonerisms (the child replaces or exchanges sounds at the beginning of words); non-word reading test (the child reads aloud non-words); digit-naming speed (the child names a series of digits written on a card); and fluency tests (the child produces as many words as they can, organized by semantic category, alliteration and rhyme). Data on picture-naming speed were not available for all children and are not reported.
- British Ability Scales II (BAS II) (Elliot 1996) word reading and spelling subtests;
- Picture-naming task to assess speech production; there were 70 words including 170–175 consonants (depending on local accent). Performance was measured by PCC.
- British Picture Vocabulary Scales (Dunn *et al.* 1982).

Details of the participants are given in table 1.

Children were assessed in school or at home, according to parental choice, and the assessments were carried out in one session. Picture-naming responses were transcribed live and tape recorded for later checking using a Sony Walkman Professional WM-D6C recorder and Beyerdynamic M58 microphone. Nine of the tapes (25%) were retranscribed by another speech and language therapist and phonetic transcriptions were compared. Agreement on a correct/incorrect judgment on each of the consonant phonemes ranged from 92.4 to 100% (average 97.4%). Exact transcription of error productions often differed, but there was very high agreement about which were and were not correct.

Results

General observations

Almost all the children had made good progress in speech, including some of the most severely affected on original identification, with the mean PCC now over 90%. Only two children continued to show a PCC score below 80; they were both among the most severely affected on original inclusion. BPVS scores were within 1 SD of the mean, except in the case of one child (standard score 73). Her BPVS standard score was considerably worse than on assessment 1 (when her score was 90), although all her other results were close to or above the mean. It is likely that this was an unreliable single test score. For literacy at a single-word level (as measured by the BAS II word reading and spelling subtests), the group average was also normal, again masking wide-ranging individual performances. There were a few exceptionally good readers and spellers (with SS up to 145) but only one subtest score fell 2 SDs below the mean.

Table 2 shows a summary of standard scores of the PhAB and BAS II subtests. Results are discussed in relation to (1) the children's current PA skills, (2) their current literacy skills and (3) the interaction between the two.

Issues relating to the children's current PA

What were the phonological awareness skills, at age 6;6–7;6 years, of children with a history of speech impairment?

Group average standard scores for all PhAB subtests were well within 1 SD of the mean, although visual inspection of individual scores shows a wide range of performance. Range was reduced in the alliteration subtest, which suffers from ceiling effects with the maximum standard score capped at 104. Five children had more than one subtest score that was more than 1 SD below the mean (and three

Table 1. Details of participants

	Gender		Age (months)	Speech production: PCC	BPVS standard score
Participants ($n=35$)	24 M	mean	83.26	91.20	102.49
	11 F	range	78–93	59.30–98.28	73–122
		SD	3.77	7.21	11.40

Table 2. Summary of standard scores on PhAB and BAS literacy subtests

		PhAb subtest standard scores								Literacy subtest standard scores	
		Alliteration	Rhyme	Spoonerisms	Non-word reading	Digit-naming speed	Fluency; alliteration	Fluency; rhyme	Fluency; semantic	BAS II reading	BAS II spelling
Participants ($n=35$)	mean	98.46	105.51	104.40	101.37	96.31	106.89	106.14	101.54	106.63	107.40
	range	76–104	69–131	76–131	69–131	69–126	69–131	72–131	76–131	71–145	67–145
	SD	7.70	13.63	13.32	14.79	14.49	14.00	17.55	12.11	19.97	18.30

of these children did appear to have PA as an area of weakness with at least half of their subtest scores more than 1 SD below the standardization mean). A normal distribution curve predicts 16% of the population being more than 1 SD below the mean, so these five children (14% of the group of 35) would be expected in a normal population distribution. However, two of them had more than one subtest standard score below 70, i.e. 2 SD below the mean. For these five children, non-word reading and rhyme were the most vulnerable subtests. Four children showed a low standard score (below 85) on rhyme and all five had problems with non-word reading.

Within this population, what earlier factors best predicted phonological awareness ability at age 6;6–7;6 years?

There is no single summary score for the PhAB which was the PA measure in this study. On inspection of the correlation matrix shown in table 3, rhyme, spoonerisms and rhyme fluency were the subtests that had the largest number of significant correlations (at the 0.01 level) with other PhAB subtests. (Alliteration was excluded due to its ceiling effects.) Rhyme was selected as the representative subtest for PA ability as having the highest strength of correlations.

First, it was hypothesized that the type of therapy the children had received in the earlier study would have an effect on current PA, since one therapy approach had emphasized metaphonological awareness of speech sounds (and so might be predicted to improve PA) while the other focused on production practice. The two therapy groups had shown comparable PA abilities at age 3;6–5;0 before receiving intervention, as measured by the MAB ($n=35$, $t=1.347$, p [two-tailed] $=0.187$). The current PA data from the PhAB were skewed by some low rhyme scores, therefore non-parametric statistics were used for this comparison. There was no significant difference in PhAB rhyme subtest standard scores between the metaphonologically and production-based therapy groups from the previous study ($n=35$, $U=128.00$, p [one-tailed] $=0.21$).

Second, a number of parameters were identified as possible predictor variables for a multiple regression analysis, based on theoretical and clinical prediction. Because of the relatively small number of participants in this study, only the most

Table 3. Correlations among PhAB subtests (excluding alliteration) at age 6;6–7;6

	Rhyme	Spoonerisms	Non-word reading	Digit-naming speed	Alliteration fluency	Rhyme fluency
Rhyme						
Spoonerisms	0.655					
	$p<0.01$					
Non-word reading	0.657	0.658				
	$p<0.01$	$p<0.01$				
Digit-naming speed	0.568	0.378	0.614			
	$p<0.01$	$p=0.03$	$p<0.01$			
Alliteration fluency	0.309	0.470	0.376	0.291		
	$p=0.07$	$p<0.01$	$p=0.03$	$p=0.09$		
Rhyme fluency	0.525	0.604	0.396	0.395	0.654	
	$p<0.01$	$p<0.01$	$p=0.02$	$p=0.02$	$p<0.01$	
Semantic fluency	0.326	0.391	0.238	0.141	0.627	0.478
	$p=0.06$	$p=0.02$	$p=0.17$	$p=0.42$	$p<0.01$	$p<0.01$

relevant predictors could be entered. The variables considered for inclusion were MAB performance, BPVS and speech severity. MAB and BPVS were selected for theoretical reasons; both earlier PA performance and language ability would be expected to show a relationship with the later measure. Speech severity was identified as a measure of clinical interest. Initial correlations were carried out to select the most appropriate MAB and speech measures (table 4). Metaphonological ability *post*-therapy was chosen because its relationship with rhyme standard score ($n=35$, $r=0.631$, p [two-tailed] <0.01) was stronger than that between rhyme and metaphonological ability *pre*-therapy ($r=0.381$, p [two-tailed] $=0.02$). Speech severity as measured by PCC either before or after therapy was not significantly related (pre-therapy $r=-0.151$, p [two-tailed] $=0.39$; post-therapy $r=0.035$, p [two-tailed] $=0.84$). Speech improvement, however (PCC percentage change following therapy), did show a somewhat stronger relationship ($r=0.351$, p [two-tailed] $=0.04$). The BPVS standard score at entry into the earlier study did not show a significant correlation with the PhAB rhyme subtest ($r=0.255$, $p=0.14$). There was therefore no indication that it would be useful to include BPVS in the model and the regression analysis proceeded, entering only MAB post-therapy and then PCC percentage change as predictor variables and the PhAB rhyme subtest standard score as the dependent variable. After the first step, the model summary was as follows: F 1,33 $=21.795$, $p<0.01$, $R^2=0.398$, adjusted $R^2=0.379$. The addition of the speech change score to the model did not significantly improve its ability to predict the rhyme score (F change $=0.237$, $p=0.63$, $R^2=0.402$, adjusted $R^2=0.365$). Of the information collected on these children, the best predictor of their phonological awareness at age 6;06–7;06 was their phonological awareness post-therapy in the earlier study and none of the other available information interacted with that performance in a way that significantly improved the model.

Issues relating to current literacy achievements

What was the literacy outcome at age 6;6–7;6 years of children with a history of speech impairment?

Group standard scores on the BAS reading and spelling subtests are shown in table 2. As with their PhAB scores, these children performed, as a group, within the normal range on the early literacy subtests. There were some individual exceptional performance at both the top and bottom of the range. Four children showed

Table 4. Correlations between variables from earlier study and PA and literacy measures at 6;6–7;6

	MAB pre-therapy	MAB post-therapy	PCC pre-therapy	PCC post-therapy	PCC change	BPVS pre-therapy
PhAB rhyme subtest standard score	0.381 $p=0.02$	0.631 $p<0.01$	−0.151 $p=0.39$	0.035 $p=0.84$	0.351 $p=0.04$	0.255 $p=0.14$
BAS II word-reading standard score	0.573 $p<0.01$	0.725 $p<0.01$	−0.108 $p=0.54$	0.102 $p=0.56$	0.413 $p=0.01$	0.432 $p=0.01$
BAS II word spelling standard score	0.457 $p=0.01$	0.572 $p<0.01$	−0.143 $p=0.41$	0.029 $p=0.87$	0.339 $p=0.05$	0.478 $p<0.01$

literacy scores more than 1 SD below the mean (all four showing difficulty in both reading and spelling; again, within the number predicted by a normal population distribution). Three of these were the children who were identified as having a weakness in the area of phonological awareness. Only one literacy score from all 35 children fell more than 2 SD below the mean.

Within this group, what earlier factors best predicted literacy development at age 6;6–7;6 years?

A multiple regression analysis was carried out to investigate the predictive power of variables assessed in the previous study. With the small numbers in this study, only a small number of variables could be entered. Research strongly suggests that PA would be a relevant predictor variable so MAB score from immediately post-therapy in the earlier study was entered first. It was clear from a preliminary examination of a correlation matrix (table 4) that there was no useful association with speech severity pre- or post-therapy. Change in PCC (i.e. speech improvement) correlated better and could, in practice, be useful clinically as a predictor after period of therapy. Research also suggests language ability as a factor in literacy development and so BPVS standard score was included. However, it is acknowledged that since all these children were selected to be within 1 SD of the mean on BPVS anyway, it was less likely that it would be a strong predictor. The multiple regression analysis was carried out, entering MAB as step 1 and entering BPVS and change in PCC stepwise at step 2.

For reading, the MAB score resulted in a prediction of reading performance significantly greater than chance (F 1,33 = 36.667, $p < 0.01$, $R^2 = 0.526$, adjusted $R^2 = 0.512$) but the addition of BPVS and PCC change in step 2 did not lead to further significant improvements in prediction (F change = 0.507, $p = 0.607$, $R^2 = 0.541$, adjusted $R^2 = 0.497$). As with PA, one parameter was identified that predicts over half of the variance in reading scores, i.e. MAB performance immediately following the earlier period of therapy.

For spelling, a similar although weaker pattern was observed with MAB significantly predicting spelling performance (F 1,33 = 16.031, $p < 0.001$, $R^2 = 0.327$, adjusted $R^2 = 0.307$), but the addition of PCC change and BPVS score yielding no further significant improvement to the model (F change = 1.562, $p = 0.226$, $R^2 = 0.389$, adjusted $R^2 = 0.329$).

This relationship between early PA performance in the preliterate speech-disordered children at age 3;06–5;00 years and their literacy achievements aged 6;06–7;06 was further investigated via categorical performance. In the original study (Hesketh *et al.* 2000b), children had been classified as good or poor at PA in comparison with a typically developing group of 59 age-matched children. Poor PA was defined as performance within the bottom quartile range of the age-matched controls. In the current study, children were classified as having good or poor literacy outcome, with poor literacy defined as both BAS II word reading and spelling standard scores below 85. Of the 27 children originally classified as having good PA, all but one went on to have a good literacy outcome. Of the eight children originally classified as having poor PA, five went on to have good and three to have a poor literacy outcome (Fisher's exact test, d.f. = 1, $p = 0.03$). Literacy achievement in relation to early PA ability is shown in figure 1.

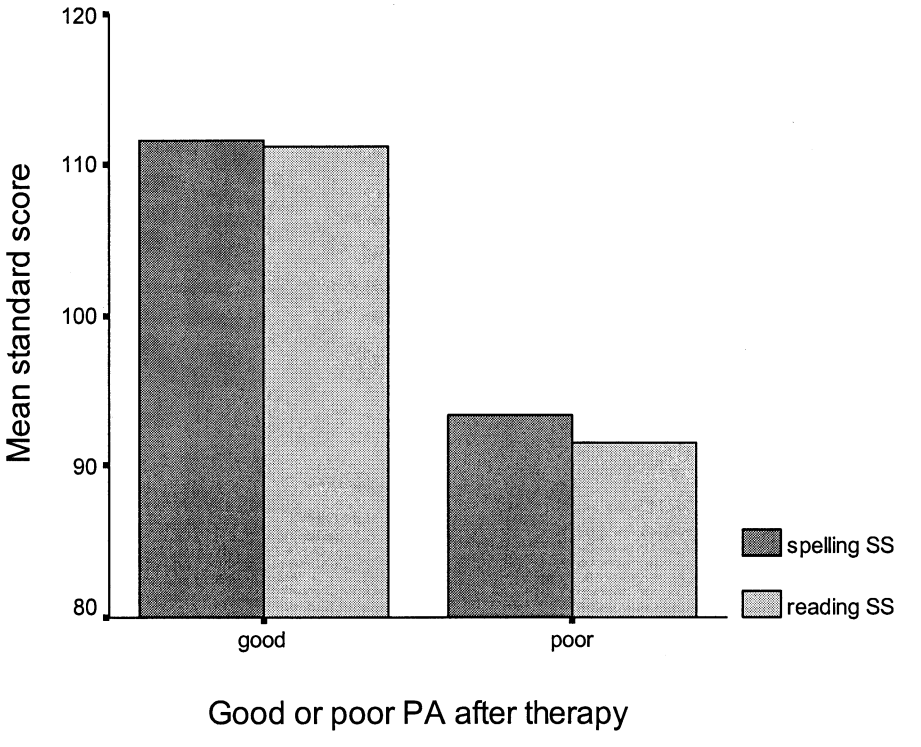

Figure 1. Mean standard scores on BAS II word-reading and spelling subtests for children classified by earlier phonological awareness abilities.

Were some preliteracy phonological awareness skills better predictors of later literacy development than others?

The raw scores on the first four subtests of the MAB undertaken in the original study, immediately after therapy for the speech disorder, were correlated with the BAS word-reading and spelling standard scores at follow-up assessment. Partial correlations, controlling for age, are shown in table 5. Significant correlations (at the 0.01 level) were obtained for both reading and spelling with all but one of the metaphonological battery tasks. There was little difference in the strength of association between rhyme matching, onset matching (e.g. 'find the one that begins with /d/') and onset segmentation and matching (e.g. 'find the one that begins with the same sound as the puppet's name'). Blending showed a weaker relationship with early literacy assessment.

Table 5. Partial correlations (controlling for age) between post-therapy metaphonological battery (MAB) and literacy subtests at age 6;6–7;6

	MAB task 1 rhyme match	MAB task 2 onset match	MAB task 3 blending	MAB task 4 segmentation and match
BAS reading	0.634	0.681	0.503	0.677
	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$
BAS spelling	0.584	0.579	0.353	0.551
	$p<0.01$	$p<0.01$	$p=0.04$	$p<0.01$

Did children who still had speech impairment differ in their literacy achievement from those whose speech difficulties had resolved?

Continuing speech impairment was defined as a PCC score of less than 90 with remaining consistent errors other than immaturities in the production of /r/, or dental and alveolar fricatives. Seven children were identified by these criteria. Non-parametric statistics were used because of the disparity of group sizes. Using a Mann–Whitney U-test, the difference in means was non-significant ($n=35$, $U=59.00$, p [two-tailed] $=0.11$). A similar pattern was shown for spelling ($U=70.50$, $p=0.26$).

Relationship between contemporaneous PA and literacy scores

What were the links between current PA and literacy skills?

Correlations (Pearson's R) between PhAB and BAS II word reading and spelling standard scores are shown in table 6. Alliteration was not included because of the ceiling effects on that subtest.

Of the PhAB subtests, non-word reading showed the strongest positive relationship with word reading and spelling scores The two subtests that involve the most prototypical PA skills (rhyme and alliteration) also correlated highly. The fluency subtests (which require children to produce lists of words which rhyme, alliterate or are from a given semantic category) did not show a significant relationship with early literacy.

Discussion

The research described here was a valuable opportunity to follow up a group of children whose history of speech disorder and related abilities was relatively well documented. It has enabled further clarification of issues for which the research literature shows contradictory results or conclusions.

Importantly, almost all the children had gone on to show both PA and literacy development within the normal range at age 6;06–7;06 years. Even using the strictest criterion for acceptable performance (within 1 SD of the mean), only four of the 35 children had scores which fell within an area of concern and only one single score fell more than 2 SD below the mean. This probably reflects the wide range of performance among typically developing children at an early stage of literacy and it would be prudent to follow up reading and writing achievement in the long term. It is rather lower than Stackhouse's (2000) finding of 25% of children with a pure speech problem going on to show literacy delay at 6;06.

Table 6. Correlations between PhAB and literacy standard scores at age 6;6–7;6

	Rhyme	Spoonerisms	Non-word reading	Digit-naming speed	Fluency; alliteration	Fluency; rhyme	Fluency; semantic
Spelling	0.654	0.700	0.898	0.572	0.326	0.329	0.263
	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$	$p=0.06$	$p=0.05$	$p=0.13$
Reading	0.724	0.562	0.887	0.711	0.292	0.276	0.159
	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$	$p=0.09$	$p=0.11$	$p=0.36$

Nevertheless, these results add to the body of evidence that suggests that one can be optimistic about the early literacy achievements of children who have a relatively isolated speech disorder and normal language skills.

Prediction of outcome

Clinically, it would be useful to identify the subgroup of speech-disordered children who *are* at risk for literacy delay. Evidence exists for school-age children (Bishop and Adams 1990, Larivee and Catts 1999), but speech and language therapists need to make decisions about preschool children as they are likely to attend for speech intervention at this stage. The potentially predictive factors examined in this study were speech severity, language abilities and phonological awareness.

There was no relationship between the severity of the speech disorder at a preliterate stage and reading or spelling at 6;06–7;06; some of the children with the most severe speech disorders before therapy are now above-average spellers. It might be that the cause of their speech problem was more to do with motor organization rather than with PA. Dodd *et al.* (1995) also suggest that the type of speech disorder is an important factor, with those children who show atypical (rather than delayed) speech development having particular literacy difficulties. Neither of these issues (cause or typicality) can be resolved in the current data, but they underline the need to look at individuals rather than group data in making predictions and planning therapy. The results appear to differ from Larivee and Catts (1999) and Gallagher *et al.* (2000), who suggest that speech production *is* related to reading outcome. However, this can be explained by the differences in the speech measure. The children here were assessed via PCC, calculated on a single-word naming task, which none of the above authors found to be predictive either. The factor that was of importance in both Larivee and Catts (1999) and Gallagher *et al.* (2000) included non-word repetition, which could be argued as a measure of PA as well as production. The results support Snowling's (2000) assertion that it is necessary to distinguish between phonological production and awareness as they are different skills.

The BPVS score at age 3;06–5;00 years was not a good predictor of reading or spelling achievement. As a measure of language ability, it was expected to be more closely related to literacy outcome. However, there are two reasons why this relationship might not have been found. First, the children were originally selected to have BPVS scores within the normal range, thus excluding the possibility of showing the usual link between language delay and poor literacy. Second, as a language measure, the BPVS might correlate more strongly with reading comprehension than with the single-word encoding and decoding abilities assessed in this study. Larivee and Catts (1999) also found language abilities to be less closely associated with reading outcome than were PA abilities and non-word repetition.

The strongest predictor of early literacy achievement in this group of children was their PA performance immediately after a period of therapy delivered between the ages of 3;06 and 5;00. Some of the children had received therapy with a metaphonological focus and others had received production-focused intervention; both had an effect on PA performance and there was no difference between the two groups. Therefore, it was not the type of therapy that influenced outcome, but the level of PA skill after therapy regardless of what approach had been used. What

level of PA skill is of concern? These results suggest that PA skills within normal limits are a very good indication that literacy achievement will also be within normal limits. In contrast, of the children whose PA performance was in the bottom quartile of the normal sample, just under half went on to show literacy achievement more than 1 SD below the norm.

It is widely accepted that PA correlates strongly with literacy achievement: these findings add to the evidence that the same relationship holds in children with speech disorder. In addition, it has been shown that PA abilities can be assessed accurately enough in the preschool years for this relationship to be a clinically useful predictor. Although this study does not include a non-word repetition (NWR) measure, the literature suggests NWR as a valuable early marker for literacy outcome. The nature of the NWR task clearly demands segmentation and phonological processing of the stimulus and it can legitimately be regarded as a PA skill. Its identification as a *speech* skill by Larivee and Catts (1999) and Gallagher *et al.* (2000) has led to the apparent importance of speech as a literacy predictor in those papers.

Implications for intervention

We are beginning to accrue evidence to help clinical decisions about intervention and discharge for speech-disordered children. It appears that one can be confident about the early literacy achievement of many children with speech disorder but that one should concentrate attention on those whose PA skills after speech intervention continue to be low. As a predictor, PA ability is sensitive (only one child with good PA went on to have low literacy scores) and is the most specific measure currently identified (with a false-positive rate of around 50%). Since, according to the present results, only a small proportion of purely speech-disordered children did show low PA skills, the number of children who were kept on for therapy on these grounds will also be relatively small. (Of course, the general clinical population will contain children who have both speech *and* language difficulties and in this population the prevalence of PA problems is likely to be higher.)

The ability to test PA at preschool level has been questioned. Gallagher *et al.* (2000) found it difficult to assess at 45 months when children were unable to achieve scores above chance on 'tests of metaphonological ability', although they do not further specify the nature of those tests. In contrast, Hesketh *et al.* (2000a) found their early tests of rhyme and onset awareness and segmentation were possible for preschool children to complete. With the publication of the PIPA (Dodd *et al.* 2000), speech and language therapists now have a standardized assessment tool available to measure PA at a preschool stage and should be able, therefore, to make informed decisions about a child's ability.

Having identified a population of concern, there is some evidence about what can be done to help. Gillon and Dodd (1997), Rivers and Lombardino (1998) and Gillon (2000, 2002) all show that intervention based on PA work can benefit the PA and literacy outcome of school-age children. There is less evidence yet about the effect of PA work in preschool children. However, Hesketh *et al.* (2000) found that children's metaphonological abilities improved after speech intervention whether or not PA had been a specific therapy focus, suggesting that at least some PA skills are amenable to stimulation at a preschool stage.

Summary

The group of 35 children with a history of speech disorder performed at a normal level on the PhAB, and on the word reading and spelling subtests of the BAS II. The results support the established link between phonological awareness and single-word literacy skills, but it was found that as a group, purely speech-disordered children are not at increased risk of a delay in either area. Within the group there was a wide range of performance and early phonological awareness skills were the best predictor of single-word literacy outcome.

Acknowledgements

The author thanks Lauren Collins, Emma Gray, Emma Molloy and Jennifer Paterson for help in data collection, and the children and parents for their willing participation in the project. Thanks are also due to the schools who allowed the use of their space for assessment.

References

Anthony, A., Bogle, D., Ingram, T. T. S. and McIsaac, M. W., 1971, *The Edinburgh Articulation Test* (Edinburgh: Livingstone).

Bird, J. and Bishop, D., 1992, Perception and awareness of phonemes in phonologically impaired children. *European Journal of Disorders of Communication*, **27**, 289–312.

Bird, J., Bishop, D. and Freeman, N., 1995, Phonological awareness and literacy development in children with expressive phonological impairments. *Journal of Speech and Hearing Research*, **38**, 446–462.

Bishop, D. and Adams, C., 1990, A prospective study of the relationship between specific language impairment, phonological disorder and reading retardation. *Journal of Child Psychology and Psychiatry*, **31**, 1027–1050.

Catts, H., 1993, The relationship between speech–language impairments and reading disabilities. *Journal of Speech and Hearing Research*, **36**, 948–958.

Clarke-Klein, S. and Hodson, B., 1995, A phonologically based analysis of misspellings by third graders with disordered-phonology histories. *Journal of Speech and Hearing Research*, **38**, 839–849.

Conti-Ramsden, G. and Hesketh, A., 2003, Risk markers for SLI: a study of young language learning children. *International Journal of Language and Communication Disorders*, **38**, 251–263.

Dodd, B., Crosbie, S., McIntosh, B., Teitzel, T. and Ozanne, A., 2000, *Preschool and Primary Inventory of Phonological Awareness* (London: Psychological Corporation).

Dodd, B., Gillon, G., Oerlemans, M., Russell, T., Syrmis, M. and Wilson, H., 1995, Phonological disorder and the acquisition of literacy. In B. Dodd (ed.), *Differential Diagnosis and Treatment of Children with Speech Disorder* (London: Whurr), pp. 125–146.

Dollaghan, C. and Campbell, T. F., 1998, Nonword repetition and child language impairment. *Journal of Speech, Language and Hearing Research*, **41**, 1136–1146.

Dunn, L., Dunn, L., Whetton, C. and Pintilie, D., 1982, *British Picture Vocabulary Scale* (Windsor: NFER-Nelson).

Elliot, C., 1996, *British Ability Scales II* (Windsor: NFER-Nelson).

Enderby, P. and Petheram, B., 1998, Changes in referral to speech and language therapy. *International Journal of Language and Communication Disorders*, **33(Suppl.)**, 16–20.

Frederickson, E., Frith, U. and Reason, R., 1997, *Phonological Assessment Battery* (Windsor: NFER-Nelson).

Gallagher, A., Frith, U. and Snowling, M. J., 2000, Precursors of literacy delay among children at genetic risk of dyslexia. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, **41**, 203–213.

Gillon, G., 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., 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.

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.

Goswami, U. and Bryant, P., 1990, *Phonological Skills and Learning to Read* (Hove: LEA).

Hesketh, A., Adams, C. and Nightingale, C., 2000a, Metaphonological abilities of phonologically disordered children. *Educational Psychology*, **20**, 484–498.

Hesketh, A., Adams, C., Nightingale, C. and Hall, R., 2000b, 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.

Hodson, B., 1994, Helping individuals become intelligible, literate and articulate: the role of phonology. *Topics in Language Disorder*, **14**, 1–16.

Jenkins, R. and Bowen, L., 1994, Facilitating development of preliterate children's phonological abilities. *Topics in Language Disorder*, **14**, 26–39.

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.

Leitao, S., Hogben, J. and Fletcher, J., 1997, Phonological processing skills in speech and language impaired children. *European Journal of Disorders of Communication*, **32**, 91–111.

Raven, J. C., 1976, *Coloured Progressive Matrices* (Oxford: Oxford Psychologists Press).

Rivers, K. and Lombardino, L., 1998, Generalisation of early metalinguistic skills in a phonological decoding study with first-graders at risk for reading failure. *International Journal of Language and Communication Disorders*, **33**, 369–391.

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., 2000, Language and literacy skills: who is at risk and why? In D. V. M. Bishop and L. B. Leonard (eds), *Speech and Language Impairments in Children: Causes, Characteristics, Intervention and Outcome* (Hove: Psychology Press), pp. 245–259.

Snowling, M., Bishop, D. V. M. and Stothard, S. E., 2000, Is preschool language impairment a risk factor for dyslexia in adolescence? *Journal Of Child Psychology and Psychiatry and Allied Disciplines*, **41**, 587–600.

Snowling, M. and Nation, K., 1997, Language, phonology and learning to read. In C. Hulme and M. Snowling (eds), *Dyslexia: Biology, Cognition and Intervention* (London: Whurr), pp. 153–166.

Stackhouse, J., 2000, Barriers to literacy development in children with speech and language difficulties. In D. V. M. Bishop and L. B. Leonard (eds), *Speech and Language Impairments in Children: Causes, Characteristics, Intervention and Outcome* (Hove: Psychology Press), pp. 73–97.

Stackhouse, J., Nathan, L. and Goulandris, N., 1997, Speech processing skills in children with specific speech difficulties: phase one of a longitudinal study. *Work in progress*, **VII**, 95–119. Department of Human Communication Science, University College London.

Stothard, S., Snowling, M. and Hulme, C., 1996, Deficits in phonology but not dyslexic? *Cognitive Neuropsychology*, **13**, 641–672.

Webster, P. and Plante, A., 1992, Effects of phonological impairment on word, syllable and phoneme segmentation and reading. *Language Speech and Hearing Services in Schools*, **23**, 176–182.

Weismer, S. E., Tomblin, J. B., Zhang, X., Buckwalter, P., Chynoweth, J. G. and Jones, M., 2000, Nonword repetition performance in school-age children with and without language impairment. *Journal of Speech, Language and Hearing Research*, **43**, 865–878.

Wiig, E. H., Secord, W. and Semel, E., 1992, *Clinical Evaluation of Language Fundamentals Preschool* (San Antonio: Psychological Corporation).