

# Targeting phonological representations can help in the early stages of reading in a non-dominant language

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It is not known whether children who are struggling with reading in a non-dominant language will respond better to a phonological intervention or to one that addresses oral proficiency. Multilingual seven-to nine-year-olds showing reading difficulty in a non-dominant language, English, were given a three-week intervention in phonological skills or in language proficiency and were compared with two control groups (one with reading difficulties and one with no reading difficulties) who received a non-language based intervention. The group receiving the explicit phonological instructions showed significantly better gain in reading and spelling measures than the language proficiency and reading difficulties control group, but did not reach the levels of the noreading-difficulty group. The phonological intervention was particularly effective for children with the lowest single-word reading scores. We suggest that the intervention helped to catalyse the fine-tuning of the phonological domain, making phonological representations optimally available for decoding, phonological manipulations and literacy development.

Over the last two decades an impressive array of studies has shown that there is a close and continuous link between phonological skills and reading development. Intervening at the level of phonological skills changes reading outcomes for children struggling to read in their first language (Byrne and Fielding-Barnsley, 1990; Hatcher, Hulme & Ellis, 1994; Iversen & Tunmer, 1993; Torgesen & Davis, 1996; Vandervelden & Siegel, 1997). The training effects have been impressive across a wide range of ability groups. Vandervelden and Siegel (1997) showed, for example, that phonological intervention helped both the low-ability group to improve and the high-ability group to move ahead faster and generalise to wider reading of novel words. The dynamics of successful phonological skills training may work in two ways: first, through giving children ‘useable insights’ about the internal structure of words and the mapping of sound units onto letter strings (Byrne, 1998); and second, through helping the restructuring of representations in the phonological domain (phonological representations are the cognitive delineation of the characteristic sound patterns and phonology in a language) to allow access to more

finely-parsed units of sound which in turn helps in better word decoding (Snowling, 2000).

Our understanding of the nature of phonological representations is in its infancy, though monolingual research across languages clearly suggests the strong influence of linguistic characteristics on the detailing of representations (Cossu, Shankweiler, Liberman, Tola & Katz, 1988; Goswami, Gombert & de Barrera, 1998; Lundberg, Frost & Peterson, 1988). In a Czech-English cross-linguistic study, for example, Caravolas and Bruck (1993) found that Czech four-, five- and seven-year-old children outperformed age-matched English children on an initial sound isolation task using simple ('sal') and complex ('sla') onsets. The differences become clear when the linguistic characteristics of the two languages are explored. Czech has a far greater number of complex onset clusters when compared to English (258:31), and this seems to differentiate phonological representations for onsets to a far greater degree in Czech children.

Moving to the more complex, mixed-language phonological domain of bilinguals and multilinguals, we know even less about how the phonological domain changes as new languages are learnt and reading instructions progress. The limited research in the field suggests that the specific mix of languages influences the phonological domain in unique ways. Costa, Cutler and Sebastian-Galles (1998) studied college students who were sequential bilinguals using the phonemic inventory of the native and the later learned languages. Performance with both the native language stimuli (Spanish, where the number of consonants is four times the number of vowels) *and* the foreign language stimuli (Dutch, where the vowel and consonant repertoires are similar in size) was in conformity with the distributional patterns predicted from the *native* phonemic repertoire. These findings suggest that the native language repertoire may be the base system and can have carry over effects on the processing of subsequent languages. In other words, listening to later learned languages appears to be conditioned by native language experience (*ibid.*). Similar transfer effects from the dominant to the non-dominant language have been reported in orthography to phonology mapping strategies from first to later learned scripts (Koda, 1990; Rickard Liow & Poon, 1998) and have been remedied through phonological interventions (Cheung, 1999). The conclusion cannot be drawn, however, that the non-dominant language plays no role in structuring the phonological domain. According to a contrastivity hypothesis the unique and novel phonological units of the non-dominant language will gain primacy in the phonological domain. Bruck and Genesee (1995) reported some support for this hypothesis when they found that English-speaking children, learning to read in French, showed increased syllable level awareness as well as onset-rime awareness when compared to English monolinguals learning to read in their native language only. The predominance of syllables in French seemed to have promoted syllable awareness in the bilingual group.

While further research is needed to fully understand the role that age and sequence of language acquisition have on the development of the mixed-language phonological domain, studies with non-monolingual groups have begun to replicate the predictive value of phonological skills in ascertaining reading outcomes (Geva, 2000; Gomez & Reason, 1999). Investigating cross-language transfer Durgunoğlu and others found strong associations between phonological awareness in the dominant spoken language (Spanish) and the reading of words and nonwords in a second reading language (English) among pre-schoolers (Durgunoğlu, Nagy & Hancin-Bhatt, 1993). Dominant language phonological awareness was found to be a significant predictor of the variance seen in word recognition scores both within the language and across languages, to the low-proficiency

second language, English. Difficulties in later learning of a second language may also be explained through problems in learning – especially in the phonological domain – of the first language, an argument proposed by the Linguistic Coding Deficit Hypothesis (Sparks, Ganshow, Javorsky, Pohlman & Patton, 1992; Sparks, 1995). Similar first language difficulties with phonology have been postulated in case studies of Japanese second and fourth-graders referred with reading difficulties in English (Kubota, 1999).

A logical extension of these findings is that phonological interventions should help children who struggle in the early stages of reading development in a non-dominant language. There are several pointers that strengthen the argument for phonological interventions with children struggling to read in a non-dominant language. Poor readers in a non-dominant language typically seem to read for decoding of single words rather than for links between information units in the text, thus limiting comprehension of what is read (Jimenez, Garcia & Pearson, 1994). Klinger and Vaughn (1996) addressed the issue of poor reading skills among a seventh and eighth-grade Spanish-English bilingual group using a comprehension-focused intervention. While a large group of students showed significant attainments in reading comprehension, those with decoding skill levels less than Grade 3 showed a poor response to the programme, making a case for alternative interventions for readers in the beginning stages of reading development in the non-dominant language. Indication that phonological interventions could foster reading skills in this group of children comes from anecdotal data about response to treatment in studies that were primarily focused on monolingual samples (the Byrne & Fielding-Barnsley group interventions, cited in Byrne, 1998; Vandervelden & Siegel, 1997). For example, in an intervention focusing on phonemic segmentation using English words, the positive training outcomes led Vandervelden and Siegel (1997) to suggest that the limited oral proficiency of children with English as Second Language (ESL) does not reduce learning from the phonological intervention.

We were particularly curious about how a phonological intervention would work for a group who had received several years of conventional whole-word teaching. The prominence of phonemic training in English intervention studies has been tied to the understanding that mastery of the alphabetic principle requires competence with phoneme-letter linkages. Some who have worked on English interventions using onsets, rimes and syllables have argued that the larger units are perceptually more stable and a useful first step to understanding the sub-lexical structure (Gillon & Dodd, 1997; Lindamond & Lindamond, 1975; Tunmer, 1994). The characteristics of the phonological domain of children with a syllable timed language like Kannada as the dominant language and English as a non-dominant language, remains unclear. A small body of Indian research shows phoneme-level awareness is slower to develop in this sample (Prakash & Rekha, 1993; Prakash, Rekha, Nigam & Karanth, 1993), suggesting that the phoneme may not be the best point of entry for an intervention. The use of syllable-level activities as well in the intervention that is reported here was therefore planned, not only because of its perceptual stability, but also because of the primacy of the syllable in the dominant spoken language of the sample under study.

The phonological domain is however not alone in its inputs to the reading development process. Plaut, McClelland, Seidenberg and Patterson (1996) for example state that a phonology-alone connectionist model is ‘not fully competent on its own’ (Plaut et al, 1996, p. 100). They proposed a combined model using both a ‘phonology pathway’ and a ‘semantic pathway’. Both pathways may be co-activated, but one takes precedence over the other as learning occurs. Comparisons were made of whether the phonology-alone

model or the combined model explained reading development better. In the initial stages of learning to pronounce words and nonwords, no differences were noted in the two models. But for skilled reading, the combined model was more accurate. Experimental support for the combined model has come from Nation and Snowling (1998) who predicted that children with poor semantic skills but adequate phonological skills would show difficulties with words that typically need support from semantics for recognition. The experiments used a reading age-matched design to compare nine-year-olds who have specific comprehension difficulties with a group of skilled comprehenders matched for decoding (phonological) skills, age and nonverbal ability. The sample was presented four sets of words, each set varying in word frequency and spelling regularity levels. Low comprehenders were less accurate in word recognition than the normal group across all four word sets. Differences in reading accuracy and speed were most significant for low frequency and exception words, words for which semantic support is essential for word recognition. These findings tease out the strands of processing that occur in reading. It is evident that a complete picture of single-word reading must take into account the contributions of not only the phonology domain but also the semantic domain. For children who fall behind in reading attainments in a non-dominant language, the issue of poor language proficiency makes the drawing in of the semantic domain additionally significant.

The role of semantic knowledge in a non-dominant language on reading outcomes is not fully understood. Bilingual models of language processing suggest that improved vocabulary knowledge would help improve speed of lexical access and activation of language networks (Grainger & Dijkstra, 1992; Grosjean, 1997). Improved vocabulary and lexical speed would then probably help in improved contextual cueing for reading comprehension, an association established in monolingual studies (Nation & Snowling, 1998; West & Stanovich, 1978). The strategy of depending on contextual cues appears to be most relevant and useful in the early stages of reading for the poor monolingual reader (Oakhill & Garnham, 1988). The question of whether contextual cues provide an important strategy for poor readers who are not proficient in a non-dominant language remains unclear. However, we need to explore how an intervention focused on proficiency will improve reading attainments. Identifying which type of intervention has an immediate impact on language outcomes has important implications for how children learn to read in a non-dominant language. It also has important implications for selection of appropriate interventions for those who fall behind in reading attainments in the early stages. Some practitioners may argue that an intervention that combines both phonology and proficiency may show outcomes that are superior to either one intervention alone. While we acknowledge this argument, the aim of this study was to tease out the effects of two theoretically distinguishable interventions.

This study looks at reading difficulties among multilingual children for whom English is a non-dominant language and the first script they have been exposed to. We tested the relative effectiveness of an intervention that strengthened phonological representations through phonological skills training and an intervention that focused on vocabulary building and oral proficiency. The sample had Kannada, a South Indian language, as its dominant language, while English was the first reading language. The mix of languages is particularly interesting because the non-dominant language (English) demands a more finely-parsed phonological representation than the units salient in syllabic languages (Kannada, for this sample). For brief details of the differences in English and Kannada phonology see Appendix 1. One group of researchers report phonemic skills in this

sample to be especially troublesome (Prakash & Rekha, 1993; Prakash, Rekha, Nigam & Karanth, 1993). We were particularly curious to see the outcome of a phonological intervention that focused on syllabic and sub-syllabic representations for such a group.

## Method

### *Design*

The study compared the effectiveness of two interventions (a phonological intervention and a language exposure intervention) with children who manifested reading difficulties using a standard pre- and post-test design with testing at three time periods and using two control groups. Four groups of children, three with reading difficulties and one with no reading difficulties received a ten-session intervention over three to five weeks. One of the reading-difficulties groups received a phonological intervention (the PI group), one received a language exposure intervention (the LE group), and the reading difficulties control group (the RDC group) received a non-language based intervention of craft and calligraphy training. The no-reading difficulties control group (the NRDC group), included to compare intervention outcomes with grade level performance, also received the craft and calligraphy intervention.

### *Participants*

Four schools in Bangalore, South India, offering English as the first language participated in the study.<sup>1</sup> Altogether 526 students in nine Grade 3 classes from these four schools were screened for the study. Teacher rating and performance on the Wechsler objective reading dimensions (WORD) (Rust, Golombok & Trickey, 1993) were used for grouping the children. Children were taken into the reading-difficulties groups if they had been identified as showing difficulty with reading by the class teacher, and had scored below their chronological age on either the WORD Basic Reading or the WORD Reading Comprehension tests. Children were taken into the no reading-difficulties control group if they had been identified as being at class level in reading by the class teacher, and had scored at or above their chronological age on either the WORD Basic Reading or WORD Reading Comprehension tests.

Recruitment was restricted to children who had been studying English as the first language in school since Grade 1, had not been introduced to any other script prior to English, had no sensory deficits, emotional problems and major health problems according to school records, reported use of at least three languages (either at home, school or neighbourhood) and rated Kannada as a dominant spoken language. In order to ensure that all children had a minimum fluency in the dominant language Kannada, only those who scored above the cut-off on a Kannada Listening Comprehension test were retained. A final intake criterion used was performance above the 25th centile on the Coloured Progressive Matrices.

The final sample of participants was thus reduced to 118 children. Of these, 90 had reading difficulties and 28 had no reading difficulties. The children with reading difficulties were assigned numbers which were then randomly allocated to the three intervention groups: phonological intervention, language exposure and control. All groups were matched for chronological age, non-verbal ability, proficiency in the dominant spoken language, basic letter-sound correspondence and number skills (see

**Table 1.** Means (and standard deviations) of the grade-level and the reading-difficulties groups at intake and *F* tests (and *p* values) of the reading-difficulties groups.

Intake measures	Grade level		Reading difficulty groups		
	NRDC (n = 28)	PI (n = 31)	LE (n = 31)	RDC (n = 28)	<i>F</i> (2,87)
Chronological age in months (sd)	97.07 (6.63)	97.45 (5.15)	99.74 (6.46)	99.74 (6.46)	2.266 (ns)
Coloured Progressive Matrices (sd)	75.89 (23.45)	76.61 (21.62)	66.29 (25.62)	66.29 (25.62)	2.057 (ns)
Kannada listening comprehension (sd)	37.32 (4.18)	38.74 (3.73)	39.13 (4.52)	39.13 (4.52)	0.990 (ns)
Letter-sound Correspondence (sd)	9.50 (1.10)	9.51 (0.68)	9.25 (0.81)	9.45 (0.81)	1.613 (ns)
Number skills (sd)	6.96 (1.83)	6.32 (1.30)	6.19 (1.92)	6.86 (1.71)	1.482 (ns)

Note: NRDC = No Reading Difficulties Control group, PI = Phonological Intervention group, LE = Language Exposure group, RDC = Reading Difficulties group.

Table 1). The two intervention groups and the reading-difficulty control group were also matched on their single word reading and reading comprehension levels (see Table 2). Details of the group's performance on the rest of the variables are also given in Table 2.

Class teachers and parents were blind to the intervention groups their children were assigned to. Trained volunteer-teachers who conducted the interventions were not aware of the pre-intervention assessment results of the children assigned to them.

### Procedure

The study was conducted in three phases (T1, T2 and T3). The children were assessed at each phase and the interventions took place between the first and second phases (i.e. between T1 and T2). At T1 the assessments on single-word reading, reading

**Table 2.** Means (and standard deviations) of the grade-level and the three reading-difficulties (RD) groups and *F* tests of the RD groups on the test battery at T1

Intake measures	Grade level		Reading-difficulties groups		
	NRDC (n = 28)	PI (n = 31)	LE (n = 31)	RDC (n = 28)	<i>F</i> value (2, 87)
Single-word reading	40.46 (4.90)	25.16 (7.64)	24.55 (7.94)	28.45 (4.43)	2.629 (ns)
Reading comprehension	21.89 (3.69)	12.32 (2.51)	12.64 (3.36)	14.07 (4.19)	2.185 (ns)
Spelling	30.11 (3.51)	23.16 (3.51)	22.65 (3.82)	23.71 (2.89)	0.710 (ns)
Phonological skills	133.14 (9.68)	95.97 (24.39)	92.84 (21.97)	103.21 (8.96)	2.145 (ns)
Nonword reading	19.57 (5.36)	11.10 (6.49)	10.13 (6.06)	13.50 (3.98)	2.730 (ns)
TROG	14.71 (2.29)	10.39 (2.33)	10.81 (2.85)	11.71 (2.19)	2.177 (ns)

comprehension, spelling, nonword reading, phonological skills and language proficiency were used as baseline information. All groups received the intervention after T1. At T2, approximately six weeks after T1, the same battery of tests was administered as post-intervention measures. In order to study the long-term impact of the interventions, the battery was administered again nine months later, at T3. Furthermore, in order to examine the specificity of intervention effects, number skills were tested at T1 and T3. Given below are the descriptions of the test battery used at each phase, the three different interventions and the selection and training of the volunteer-teachers who conducted the interventions.

*The test battery.* This was administered to all groups and consisted of ten sets of tasks: Kannada language comprehension, non-verbal reasoning, letter-sound correspondence, WORD single-word reading, WORD reading comprehension, WORD spelling skills, nonword reading, TROG proficiency in the reading language, a phonological skills battery and number skills. The tests are described in greater detail in Appendix 2.

*The interventions.* The three interventions were developed specifically for this study and each was administered between T1 and T2. Each intervention was for ten sessions of contact between one teacher and a small group of between three and eight children, conducted three times a week. Each session was of 90 minutes duration. All interventions focused on or used English for communication, but the dominant language was not rejected in any of them.

*Phonological intervention.* In the absence of a model of the mixed-language phonological domain, a multiple abilities model as conceptualised in monolingual studies (e.g. Muter, Hulme, Snowling & Taylor, 1997; Yopp, 1988) was used for developing this intervention. Task diversity was based broadly on the activity framework set out by Hatcher, Hulme & Ellis (1994). Phonological activities included identification, blending, segmentation, deletion, substitution and transposition. Sub-lexical manipulations were with all word positions. All participants had to try all activities. Every session had five tasks requiring a mix of phonological abilities. This is unlike other phonological intervention programmes (Hatcher, Hulme & Ellis, 1994; Iversen & Tunmer, 1993; Lindamond & Lindamond, 1975) where phonological tasks are presented in a graded manner and the child shifts to a different category of manipulation on reaching a pre-specified level of mastery.

Phonological activities were planned both with phonemes and syllables. The intervention was predominantly aural in nature with minimal use of visual materials. The abstract sub-lexical concepts were made concrete through games. For example, children were introduced to syllables as the number of claps in a word (e.g. ba-na-na has three claps; com-for-ta-ble has four, etc.). Children received home assignments to find big words (e.g. with five claps). These words were usually low frequency, novel words that children brought back from parents and siblings. The volunteer-teachers used these words to discuss the manipulations being practised. Other phonological games included making 'silly sentences' by stringing words with similar initial phonemes into unusual sentences (e.g. 'Swinging swarms of sweets swore they saw Swathi swimming up the swelling river'), and brainstorming for words with a target sound (e.g. 'ph', 'sl').

All word lists, nonsense words and sentences used for the phonological activities were developed by the first author with the advice of six specialist teachers and one ESL teacher. Each activity was introduced by first explaining the manipulation. For example,

for a deletion activity with an initial phoneme the demonstration would start with, 'I am taking away the first sound and calling out what is left. Tell me if I am right'. This was followed by six practice items. Where necessary, the volunteer teacher introduced additional practice examples.

*Language exposure intervention.* The language exposure intervention encouraged spontaneous exploration of the non-dominant language in the presence of a language role model. The interactions were open-ended and aimed at creating opportunities for spoken language apprenticeship, contrasting with the typically teacher-led, closed-ended communications characteristic of the children's school experience. The intervention used flashcards extensively. Teachers did not assist in the segmenting of words. Instead the word on the flashcard was associated with different contexts within a session. Such a methodology was expected to help improve visual memory of the words.

Grade 2, 3 and 4 text books from Indian schools were used to identify vocabulary lists. The comprehension strategies taught in the intervention were based on research reported by Oakhill and Garnham (1988) and included questioning, predicting, identifying key elements and linking information units in the text. Each session consisted of a sequence of five activities. Starting with a teacher-led reading activity (on topics like 'Icebergs' and 'Nature'), the session proceeded to vocabulary building (target of six to twelve words per session), silly sentences (sentence construction by the child and demonstrations of preferred syntactic structures) and listening comprehension games (e.g. 'Who am I?' where children guessed at a word described by either the teacher or another member of the group). The sessions ended with a craft or cookery activity that allowed for spontaneous use of language. Feedback focused particularly on the use of 'doing' words (e.g. painting, crushing) and 'connector' words (e.g. and, is, the).

*Craft and calligraphy intervention.* This is the non-language based intervention received by the control groups (the RDC and the NRDC groups). The programme focused on art and craft activities, over the same contact time as the experimental groups. Children were allowed to interact in the language of their choice and no feedback was provided on language (e.g. on usage, pronunciation or vocabulary).

#### *Selection and training of volunteer teachers*

Three volunteer teachers with one year's prior training in the field of special educational needs participated in the study. Each teacher was trained in both the experimental interventions. Training was through two one-day workshops, with each day focused on one of the interventions. Teacher training was based on a video and a live demonstration class. Training focused on a) teacher instructions for particular activities, b) teacher feedback when a child made errors or showed success and c) linking of teaching ideas between activities and from earlier sessions.

An important consideration during the intervention phase was the possible contamination effect between interventions. Volunteer teachers monitored the sources for new words given as assignments in each intervention. Most often, children reported a parent or elder sibling as the source for new words. In one case where the source was consistently a child from the alternate intervention group, the pair continued with the intervention but was dropped from the analysis for this study.

Making the sessions structured contained, to some extent, any contamination effects that might have occurred because of the same volunteer teachers administering both the interventions. Furthermore, teachers were trained in one intervention at a time. A

**Table 3.** Effects of time and group on reading, comprehension and spelling.

	Time effect (T1, T2 T3) <i>df</i> (1, 87)	Group effect (PI, LE, RDC) <i>df</i> (2, 87)	Time X group interaction effect <i>df</i> (2, 87)
WORD basic reading	248.278***	4.449 ( $p = 0.014$ )	17.325***
WORD reading comprehension	288.770***	1.494 ns	1.569 ns
WORD spelling	175.436***	1.616 ns	7.411 ( $p = 0.001$ )

Note: Significance levels indicated by asterisks: \*\*\* $p < 0.001$ .

checklist of methods and guidelines highlighted what was specifically to be *avoided*. During the phonological intervention, no explicit instructions were to be given about grammatical structures of sentences and the meaning of words. In the language exposure intervention, no explicit instructions were to be given about the sub-lexical structure of words, the mono-, bi- or polysyllabic nature of words and strategies for word segmentation.

## Results

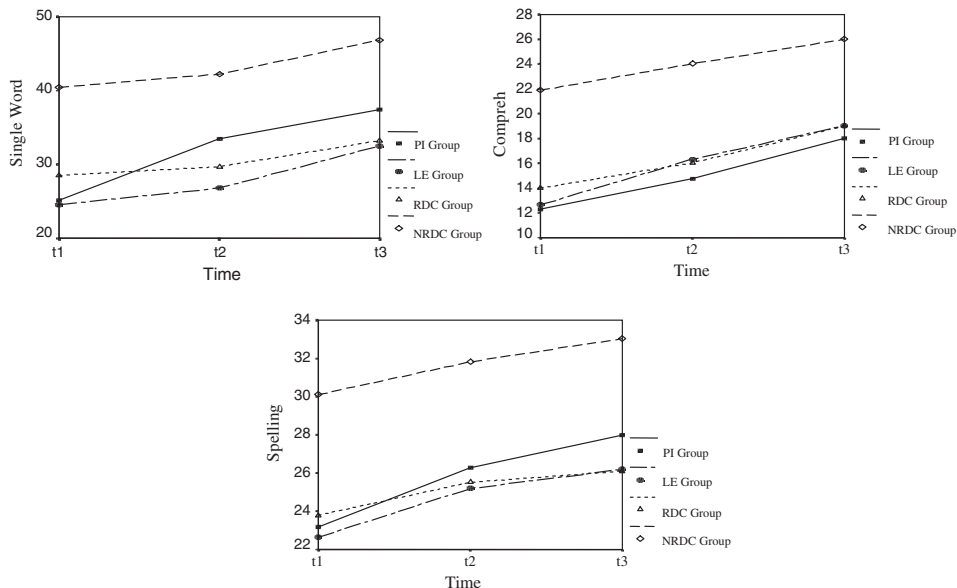
Changes over time in single-word reading, reading comprehension and spelling are considered first. A two-way fixed effects analysis of variance was performed with time of testing as the within-subjects factor (T1, T2 and T3), and group (PI, LE and RDC groups) as the between-subjects factor. A summary of the main and interaction effects for each of the reading and spelling measures is given in Table 3.

There was a significant main effect of time on all three measures. As seen in Figure 1, performance on all three measures increased in all groups from T1 to T2, and from T2 to T3. Details of the changes for each group are given in the following sections. Group effects on the basic reading measure and interaction effects on the basic reading and spelling measures were significant. The Eta-squared for the interaction effects for single word reading is 0.285, for reading comprehension is 0.035 and for spelling is 0.146. The Eta-squared statistic describes the proportion of total variability attributable to the intervention between time and group factor.

### *Single-word reading*

At T2 the performance of the four groups differed significantly on single-word reading (see Table 4). Post-hoc comparisons using Tukey's HSD showed that the mean raw score of the PI group was significantly better than both the LE and the RDC groups ( $p < 0.05$ ). The LE group and the RDC group did not differ significantly from each other. At T3 all groups showed further gains (see Table 4). Tukey's HSD at T3 showed trends very similar to T2, with the PI group still ahead of the LE and RDC groups. Nine months after intervention had stopped, the gains in single-word reading had been maintained. The PI group however continued to lag behind the NRDC group ( $t(57) = -8.189, p > 0.001$ ).

Qualitative analysis of the word-attack strategies used by each of the reading difficulties groups gives us some indication of the impact of the interventions. For the PI



Note: Levels of the no reading-difficulties control group (NRDC) are given to indicate the expected Grade-level performance for this sample.

**Figure 1.** Mean performance at T1, T2 and T3 in the experimental and control groups in Single Word Reading, Reading Comprehension and Spelling Skills

group, the predominant behaviour at T2 when confronted with an unfamiliar word was to 'persist when decoding' (90% of the children). For the LE group while 25% 'gave up easily' and 20% 'used no strategy', as many as 40% 'made no attempt', guessing at the word instead. Only 10% persisted in attempts to decode. In the RDC group all children either gave up, used no strategy or made no attempt, with novel words.

The phonological intervention had clearly changed the group's approach to word recognition. The change may have been in the mastery of decoding skills. At another level it is possible that these changes reflect the group's persistence in using these skills with novel words. Further analysis of success with single word reading at T2 was conducted. The mean success rate for regular words was at 65.72% (sd 9.28) while for irregular words was at 43.01% (sd 15.08). Clearly the intervention gave greater insights for words with systematic letter to sound correspondences.

### Reading comprehension

At T2 the main effect of group was not significant. No significant differences in performance were seen between the PI, LE and RDC groups. The interventions did not seem to have made any additional impact on the development of reading comprehension skills. Similar trends continued at T3. While all groups had changed between post-intervention and follow-up assessments at T3 (PI group,  $t(30) = -9.002$ ,  $p < 0.001$ ; LE group,  $t(30) = -7.726$ ,  $p < 0.001$ ; RDC group,  $t(27) = -8.216$ ,  $p < 0.001$ ) no one single intervention contributed to specifically boost reading comprehension skills.

**Table 4.** Means (and standard deviations) and *F* tests (and *p* values) in the experimental and control groups at T2 and T3.

Intake measures		Grade level NRDC (n = 28)	Reading-difficulties groups			<i>F</i> value (2, 87)
			PI (n = 31)	LE (n = 31)	RDC (n = 28)	
Single-word reading	T2	42.21 (3.83)	33.42 (5.25)	26.77 (7.86)	29.57 (3.16)	10.186***
	T3	46.82 (4.27)	37.45 (4.48)	32.48 (5.92)	33.12 (2.79)	10.473***
Reading comprehension	T2	24.04 (3.63)	14.77 (3.19)	16.32 (3.45)	16.14 (3.81)	1.816 (ns)
	T3	26.00 (3.44)	18.00 (2.84)	19.03 (3.94)	19.00 (3.88)	0.821 (ns)
Spelling	T2	31.82 (2.93)	26.25 (2.46)	25.19 (2.91)	25.39 (2.03)	1.566 (ns)
	T3	33.04 (3.20)	28.00 (2.32)	26.19 (2.55)	26.00 (2.02)	6.875**
Phonological skills	T2	134.55 (15.30)	118.35 (15.28)	106.87 (16.14)	103.71 (18.88)	6.353**
	T3	130.82 (11.73)	113.64 (11.62)	104.09 (10.40)	104.79 (9.78)	7.642**
Nonword reading	T2	23.75 (4.54)	20.81 (5.34)	13.39 (6.27)	16.71 (3.65)	15.529***
	T3	26.07 (2.59)	23.94 (3.99)	17.29 (5.06)	17.50 (4.86)	20.127***
TROG	T2	15.64 (1.83)	13.58 (2.19)	12.26 (2.09)	13.14 (2.05)	3.140 (ns)
	T3	16.92 (0.97)	14.09 (1.42)	14.65 (1.19)	14.25 (1.17)	1.525 (ns)

Note: Significance levels: \*\*\* *p* < 0.001; \*\* *p* < 0.01; \* *p* < 0.05.

*Spelling*

At T2 the main effect of group was not significant. No significant differences in performance were seen between the PI, LE and RDC groups. However, nine months later at T3, main effect of group was significant (see Table 4). Post-hoc comparisons show the PI group to be significantly better than both the other reading difficulties groups and the LE and the RDC groups as not significantly different from each other. The PI group however continued to lag behind the grade level ( $t(57) = -6.96, p > 0.001$ ).

*Number skills*

All four groups started at T1 with no differences in number skills and continued to show no difference at T3. A one-way Anova revealed that none of the intervention groups differed from the control groups at T3 ( $F(2, 87) = 1.369, ns$ ). The gains reported earlier for the PI group, were therefore specific to reading and spelling measures, rather than a general academic improvement.

### *Phonological skills*

We anticipated that an intervention that explicitly focused on sub-lexical structures of words, would affect outcomes on a phonological battery. There was a significant main effect of group at T2 (see Table 4), with post-hoc comparisons showing that the PI group performed significantly better than the LE group and the RDC group, and the skill levels of the LE and RDC groups were not significantly different from each other. Between T2 and T3 except for the PI group ( $t(30) = 2.43, p < 0.05$ ), all the other groups showed no gains in phonological skills (LE group,  $t(30) = 1.757$ , ns, RDC group,  $t(27) = -0.487$ , ns). Once again at T3 post-hoc tests showed that the PI group remained significantly ahead of the LE group and the RDC group. The performance level however continued to be significantly behind the no reading-difficulty group ( $t(57) = -4.059, p < 0.001$ ).

### *Nonword reading*

The three groups differed significantly at T2 (see Table 4). Post-hoc comparisons showed the PI group to be significantly better than the LE and RDC groups, and the LE and RDC groups not significantly different from each other. The same trends were maintained at T3, with post-hoc tests showing that while the LE group continued to remain at the same level as the RDC group, the PI group continued to be significantly ahead. However, a gap remained in decoding skills between the PI group and the NRDC group ( $t(57) = -2.408, p < 0.01$ ).

### *Changes in language proficiency in the reading language*

We were particularly interested to look at how the interventions had strengthened proficiency in the non-dominant language. Tukey's HSD at T2, based on the performance of the three groups on the TROG, shows no significant difference between groups. Maintaining the trends seen in T1 and T2, at T3 also there were no significant differences at the 0.05 level between the proficiency levels of the LE group and either the PI group or the RDC group. The language exposure intervention which had focused on controlled vocabularies, language apprenticeship and demonstration of syntactic structures, had not had any specific language proficiency effects.

### *Who has gained the most from the phonological intervention?*

The earlier section clearly shows positive training effects of the phonological intervention on single word reading, spelling, decoding and phonological skills. There may, however, be variability of responsiveness to the intervention (Torgesen & Davis, 1996). Who are the children who respond best to the specific phonological intervention under study? Is it only children with mild deficits? Or are those who have severe phonological deficits and are the poorest readers also responding to the intervention?

A difference score was computed between the WORD basic reading score at pre-intervention and at post-intervention. This difference score (T2-T1) was taken as an indicator of the degree of change seen in single-word reading skills at the end of the phonological intervention. A series of Pearson's correlations was conducted to see the associations between the single-word difference score and all the measures assessed at T1. A significant correlation was found between the difference score on single-word reading and age of the child. The associations that are seen between the quantum of change with intervention and baseline skills at T1 could thus be an association of age

**Table 5.** Mean (sd) of difference scores of the lowest and highest quartile sub-groups in the phonological intervention group (n = 31).

PI Group	Mean difference scores* (sd)	
	Lowest quartile at T1 on WORD basic reading	Highest quartile at T1 on WORD basic reading
WORD basic reading	15.25 (2.60)	3.64 (2.16)
WORD reading comprehension	2.50 (1.77)	2.45 (1.86)
WORD spelling	4.87 (2.42)	1.45 (1.37)
Cross-language phonological skills	38.00 (14.94)	19.09 (10.10)
Nonword reading	12.87 (2.79)	2.27 (6.75)
TROG	3.00 (2.14)	2.27 (1.27)

Note: \*Scores at T2 – Scores at T1, on each of the measures

rather than between the variables under study. In order to clarify the extent of association between the variables after the intervening effect of age of child has been controlled for, a series of partial correlations were conducted. Associations with single-word reading skills ( $r = -0.690$ ,  $p < 0.001$ ), phonological skills ( $r = -0.563$ ,  $p < 0.001$ ) and spelling skills ( $r = -0.448$ ,  $p < 0.05$ ) weakened to a small extent but remained significant. Associations with nonword reading ( $r = -0.602$ ,  $p < 0.001$ ) became even stronger.

The negative associations between age of the child and difference scores on single-word reading indicate that the youngest children in the sample had responded with the largest gains. In order to further analyse the rate of change among those who started with the lowest levels of skills a comparison was done between the lowest and the highest quartile sub-groups on the WORD basic reading baseline scores (T1) (Table 5). The two groups were compared on the mean difference scores (T2–T1) on each measure.

The mean difference scores for the group in the lowest quartile at T1 were consistently higher than for the highest quartile sub-group. The poorest readers appeared to have gained the most from the intervention. A significant number of children in the lowest quartile in the pre-intervention basic reading score were found to be in the highest quartile in basic reading difference score (seven out of eight participants). Explicit phonological instructions appeared to have been the most effective for those who came into the intervention with the lowest levels of single-word reading, spelling, phonological and decoding skills.

## Discussion

Earlier intervention studies have documented the links between improved phonological skills and word-decoding skills among poor readers in a dominant language (e.g. Byrne & Fielding-Barnsley, 1993; Hatcher, Hulme & Ellis, 1994). This study extends these findings to show the effectiveness of phonological interventions on reading attainments in non-dominant languages. The dilemma when planning an intervention for children who fail to read in a language in which they have limited fluency is whether one should focus on building oral-language proficiency or work on underlying skills that have a causal link with reading development. Commenting from her outcome researches, Geva (2000) points out that while oral proficiency is a better predictor of difficulties with reading for

the later stages, differences in phonological skills are the more sensitive indicators of variances in the early stages. From the present study we see that in the early stages of reading, a phonological intervention shows better outcomes in reading attainments than an oral proficiency or semantics intervention, providing support for part of Geva's prediction.

The impact of the phonological intervention reported in the current study clearly centred around a circumscribed cluster of skills. First were the changes in attainments seen in single-word reading which were maintained even at follow-up. Then followed the generalisation of intervention effects to a closely associated skill of spelling. The intervention improved spelling skills substantially, though the gains were neither rapid enough nor large enough to keep pace with grade-level attainments. The intervention also clearly gave impetus to phonological skills development, with gains continuing to be seen well after the close of intervention. But it is another index of change – nonword reading – that most clearly captures the impact of the intervention. Changes in nonword reading can be taken to be a pure measure of how children apply phonological rules (Gough & Tunmer, 1986) and how well-specified their underlying phonological representations are (Snowling, 2000). The phonological intervention helped with immediate gains in use of phonological rules and set in motion skills that over the next nine months markedly reduced the gap with the group that had no reading difficulties, though statistically the performance remained below grade levels.

The phonological intervention in this study did not have any explicit orthography-phonology or letter-sound linkage activities. In this sample basic letter-sound linkages were in place, but the students continued to struggle. It may be argued that in groups where basic letter sound linkages are in place, children can continue to struggle because of fuzzy phonological representation. This may be because the phonological domain is structured with the salient phonological units of the dominant language and access to sub-lexical structures critical for reading in the non-dominant language are less available. In the absence of explicit instructions about letter-sound linkages, it is at the level of phonological representations that the phonological intervention in this study set changes in motion. We suggest that the activities in the intervention helped to catalyse the fine-tuning of the phonological domain, making phonological representations optimally available for decoding, phonological manipulations and literacy development.

Similar gains in attainments were not seen with the intervention that focused on the semantic domain. The sequence of activities in the language exposure intervention had been kept the same across all sessions with random presentation of word lists occurring *within* each activity. Errors because of 'order of presentation' in the language exposure intervention therefore cannot be ruled out. Based on this study it is premature to dismiss the language exposure intervention. Use of the intervention once decoding skills are in place may show positive training effects especially in the area of reading comprehension.

While the phonological intervention focused on sub-lexical tasks using structured word and nonword lists, for children with low language proficiency, the intervention inevitably also offered opportunities for learning about vocabulary and grammatical structures. During assignments participants were encouraged to look for new words (e.g. with five 'claps' (syllables)) and could source the words from anybody in school, home and neighbourhood. The number of words that were returned to the teacher was much larger than had been anticipated. The fact that assignments were enjoyed and became a competition between participants was to the advantage of the language learning process. Another popular activity was making 'silly sentences' linking words generated with a

target sound blend like ‘ph’ or ‘sl’. Reciprocal teaching of new words occurred between students as they brainstormed together during the sessions. This study extends to a younger age group, the finding that reciprocal teaching is a powerful method for language learning among older children (Klinger & Vaughn, 1996; Snow, Burns, & Griffin, 1998). Though data is not available from this study, it would be of interest to identify the components of teacher–student language communications in this phonological intervention that promote language learning. Some areas that may be explored are the short and frequent turn taking and the range of alternative sentence structures that are used to explain phonological tasks that are not immediately transparent to a child.

The impact of phonological interventions in containing reading failure for mixed-language groups raises another pedagogic issue. Should the components of a phonological intervention for such a target group be similar to what has worked with monolingual samples? There is a need to examine whether phoneme-focused training is an irreplaceable route to mastery of reading in English. Do the phonological-decoding strategies promoted by the dominant language in all cases keep non-dominant learners at a disadvantage? The transfer effects may not automatically imply difficulties with reading. To illustrate, multi-scriptal children in Singapore, while using visual analytic strategies from their logographic first languages, do not always show reading difficulty in alphabetic English (see Rickard Liow, (1999)). There is a need to specify what aspects of the phonological-decoding resources of earlier languages hinder reading development. Such an understanding will help to fine-tune the components of a phonological intervention for multilingual children.

### *Service delivery issues*

Responsiveness of individuals to an intervention programme can be lost in discussions about average training effects. This study has shown positive outcomes for children with a wide range of reading levels. The positive effect of the intervention for readers with the lowest reading scores and greatest phonological difficulties is an important finding. This is particularly so in a context where researchers have been asking questions about whether the phonological interventions reported in the literature are able to help the most severe cases who need support most urgently (Hatcher et al, 1994; Lundberg et al, 1988; Torgesen & Davis, 1996; Torgesen, Morgan and Davis, 1992). The effectiveness of the intervention for a wide range of reading difficulties increases the relevance of the programme in schools where intervention in groups with mixed abilities is a preferred service delivery model.

The educational implications of the phonology intervention presented in this study are many. Preventive and remedial programmes need to balance type of intervention with the resources needed to conduct these programmes. This study shows that a ten-session programme conducted over three to five weeks can help contain reading failure amongst children with English as the first literacy language. Second, the intervention roughly targeted the bottom 20% of children in schools where English was the non-dominant language for the majority of the students. The positive training outcomes with an intervention that *supplements* regular class-based reading instructions, offers an alternative to the more expensive pull-out programmes with structured phonics and reading instruction. Finally the intervention targets Standard 3, which may be considered one of our last chances at making interventions at the group level. Left any later, the gap

with grade-level attainments will only widen, and to contain reading failure the service delivery model might need to be of longer duration, using individual sessions.

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### Notes

1. India's three-language education policy allows schools to offer English as the first, second or third language.

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### Appendix 1: Kannada and English phonology

The phonological properties of English and Kannada are very different. One of the areas of obvious difference is the proportion of mono-, bi- and multisyllabic words in the two languages. The proportion of monosyllabic words in English is far greater than bi- and multisyllabic words. For example, the proportion of monosyllabic words when compared to bisyllabic words is 3.5:1 (Caravolas, 1993). Kannada however consists mainly of bi-, tri- and multisyllabic words. Monosyllabic words are rare in Kannada. A 50-word text from a Kannada and English Grade 3 book shows the following distribution of words: monosyllabic – 66% in English, 4% in Kannada, bisyllabic – 32% in English, 62% in Kannada, trisyllabic – none in English, 14% in Kannada, and polysyllabic – 2% in English and 30% in Kannada.

The intrasyllabic structure of the languages is also different in the two languages. Syllables in Kannada may have a V, CV, CCV or CCCV structure, with the later present mainly in loan words. Kannada has a simple CVCVCV word structure. This also makes the syllable boundaries in Kannada clear and obvious ('uu-ta', 'ma-ne', 'i-ru-li'). English meanwhile is ambisyllabic and the frequency of CVCVCV word structures is considerably lower. An analysis was made of the percentage of different word structures in the two languages. The same 50-word text analysed above was used for the analysis of word structure. Words with simple CV clusters – 16% in English, 42% in Kannada, words with a mix of simple CV and CCV clusters – 24% in English, 42% in Kannada, words with VC and VCC endings – 24% and 28% in English, none in Kannada.

Closely linked to the syllabic characteristics of the languages is the open and closed endedness of words. In Kannada most words are open syllabled. Closed-syllable words found in guest or loan words borrowed from other languages, usually have a vowel added and converted into an open syllabled word (e.g. 'ticket' becomes 'ticketu', 'bus' becomes 'busu', 'pencil' becomes 'pencilu'). In English, in contrast, most words are closed ended (Treiman, Mullenix, Bijeljac-Babic & Richmond-Welty, 1995).

### Appendix 2: The test battery

#### *Kannada language comprehension*

This is a 45-item test developed to identify children with a minimum level of comprehension of spoken Kannada. Responses required from the child were either 'yes', 'no' or a one word answer. Scoring was based on the number of correct responses to the

statements and questions. A cut-off score of 29 (success rate of 65% and above) was used for recruitment into the study.

### *Non-verbal reasoning*

The Raven's Coloured Progressive Matrices (CPM) were used as the measure of non-verbal ability (Raven, 1965). The task requires the recognition of a visual stimulus from a group of four options that will appropriately fill a blank within a larger pattern.

### *Letter-sound correspondence*

Mastery of letter-sound correspondence was tested on a list of five single letters and five sound blends, presented randomly using flashcards.

### *WORD tests*

The UK edition of the Wechsler Objective Reading Dimensions (WORD) (Rust, Golombok & Trickey, 1993) was used for assessing reading, spelling and comprehension in this study. All analysis was based on the raw scores except at the time of intake, when age-equivalent scores were considered for group allocation.

*Single word reading.* We used the WORD basic reading test to assess single-word reading. This is a graded test assessing decoding and word recognition of both regular and irregular words. Behavioural observations coded were a) persistent when decoding, b) gave up easily when decoding, c) used no strategy (guessed) and d) made no attempt.

*Reading comprehension.* Reading comprehension was assessed using the WORD reading comprehension test. In this test children answer open-ended questions based on single sentences and short paragraphs. The test is graded in complexity of sentence structure and questions are inferential in nature.

*Spelling skills.* Spelling skills were assessed based on the graded WORD spelling test. The test comprised both regular and irregular words.

### *Nonword reading*

The 70-item nonword reading list developed in Hatcher, Hulme and Ellis (1994) was adapted for use in this study. A shortened list of 30 mono-, bi- and polysyllabic items was used. In the absence of clear grading of decoding difficulty across the items, the discontinuation criteria was relaxed from five to ten consecutive failures.

### *Proficiency in the reading language*

The TROG (Test for the Reception of Grammar, Bishop, 1989) was used to measure proficiency in English. The test consists of 20 blocks of graded sentences testing specific grammatical contrasts. TROG was chosen after an initial pilot study found Indian children understood all items. TROG was also chosen because it ensured that proficiency levels were not undervalued in cases of poor expressive language fluency.

*Phonological skills battery*

A cross-language phonological skills battery of 12 tasks was developed for this study. For each task, as great a parity across languages as possible was attempted, given the differences in the phonological characteristics of English and Kannada (see Appendix 1). In each language, four tasks used nonwords and two tasks used words. Teacher ratings were used to ensure that all word lists were familiar to children in Grade 3. Nonword lists were matched across languages for the number of phonemes and syllables. The tasks in English and Kannada assessed segmentation and blending of syllables and phonemes, and phoneme deletion and substitution in the initial and terminal position. English words and nonwords were adapted from lists used in Hatcher, Hulme & Ellis (1994) and Muter, Hulme, Snowling, & Taylor (1997). The author in consultation with specialist teachers developed Kannada words and nonwords. Testing for each task was discontinued after five consecutive failures.

*Number skills*

A set of ten sums based on the arithmetic curriculum of Grade 3 was used. All four arithmetic operations were assessed.