

# Improved Cognitive Skills Accelerate English Language and Reading Development in Bilingual Students in India who used Fast ForWord® Products

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## ABSTRACT

**Purpose:** This study investigated the effects of the Fast ForWord products on the cognitive skills and English language and reading skills of bilingual English speaking students. **Study Design:** The design of this study was a case study using nationally normed assessments. **Participants:** Study participants were students attending a school for children with learning disabilities in Mumbai, India. **Materials & Implementation:** The Fast ForWord product was implemented at the Nalanda Institute as part of the educational curriculum. Before and after Fast ForWord participation, students had their cognitive skills, as well as their English language and reading skills, evaluated with a battery of tests: the Comprehensive Test of Phonological Processing (CTOPP), the Woodcock Reading Mastery Tests (WRMT), and the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW). **Results:** On average, students significantly improved their cognitive, language, and reading skills following Fast ForWord participation. Phonological Awareness improved from the 29<sup>th</sup> to the 41<sup>st</sup> percentile and reading ability improved by an average of 7 months during the 5 months between assessments. Student listening skills improved from the 4<sup>th</sup> percentile to the 17<sup>th</sup> percentile.

**Keywords:** India, urban, observational study, bilingual English speakers, Fast ForWord Middle & High School, Comprehensive Test of Phonological Processing (CTOPP), Woodcock Reading Mastery Tests (WRMT), Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW).

## INTRODUCTION

Numerous research studies in the United States have shown that cognitive and oral language skills are under-developed in struggling readers, limiting their academic progress (Lyon, 1996). University-based research studies reported the development of a computer software product that focused on learning and cognitive skills, and provided an optimal learning environment for building the memory, attention, processing and sequencing skills critical for reading success (Merzenich et al., 1996; Tallal et al., 1996). This prototype of the Fast ForWord Language software showed that an optimal learning environment and focus on cognitive and linguistic skills resulted in dramatic improvements in the auditory processing and language skills of school children who had specific language impairments (Merzenich et al, 1996; Tallal et al., 1996) or were experiencing academic reading failure (Miller et al., 1999).

The Nalanda Institute offers educational services for children with learning disabilities and was interested in evaluating the effectiveness of the Fast ForWord products as part of their range of services. Under the guidance of staff at the Nalanda Institute, students used the Fast ForWord software as part of their class

curriculum. In this study, a commercially available computer-based product (Fast ForWord Middle & High School) was used to evaluate the effectiveness of using an optimal learning environment focused on cognitive and linguistic skills for improving the cognitive skills and English language and reading skills of bilingual English speaking students.

## METHODS

### Participants

The Nalanda Institute in Mumbai, India, is an independent trust founded by Schoolnet India Limited as a non-profit education center for students with learning disabilities. Students attend small classes of nine or ten students and take part in courses designed for their individual needs. The goal of the Nalanda Institute is to integrate students into the general education population and provide them with the knowledge and self-esteem to succeed in life.

The twenty-five students included in this study all lived in Mumbai and could speak colloquial Hindi; however there was a diversity in the native languages spoken in the students' homes, with their mother tongues covering a range of Indian languages including Gujarati, Marathi, and Sindhi. The students

were bilingual English speakers and all had an Indian language as their mother tongue. The students had an average of 6.8 years of English language study.

Participants were 10 through 14 years of age (mean age of 12.5 years). All participants were attending the Nalanda Institute at the time of the study and used the Fast ForWord product during the 2005-2006 school year.

Before Fast ForWord product use, students were assessed with the Comprehensive Test of Phonological Processing (CTOPP), the Woodcock Reading Mastery Tests (WRMT), and the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW). After completing the Fast ForWord product, students were assessed a second time. Staff at the Nalanda Institute administered the assessments and reported scores for analysis.

### **Implementation**

All professionals involved in this study were trained in current and established neuroscience findings on how phonemic awareness and the acoustic properties of speech impact rapid development of language and reading skills; the scientific background validating the efficacy of the products; methods for assessment of potential candidates for participation; the selection of appropriate measures for testing and evaluation; effective implementation techniques; approaches for using Progress Tracker reports to monitor student performance; and techniques for measuring the gains students have achieved after they have finished using Fast ForWord products.

### **Materials**

The Fast ForWord products are computer-based products that combine an optimal learning environment with a focus on cognitive and early reading skills. The product used by the Nalanda Institute, Fast ForWord Middle & High School, includes six exercises designed to build skills critical for reading and learning, such as auditory processing, memory, attention, and language comprehension as detailed in the following exercise descriptions.

*Sweeps:* Students hear a series of short, non-verbal tones. Each tone represents a different fragment of the frequency spectrum used in spoken language. Students are then asked to differentiate between these tones. This exercise improves working memory, sound processing speed, and sequencing skills.

*Streams:* Students listen to a stream of syllables. First a dummy syllable is repeated, then it changes to the target syllable. Students must click the mouse when

they hear that the syllable has changed. This exercise improves auditory processing, develops phoneme discrimination, and increases sustained and focused attention.

*IDs:* Students listen to a target syllable, and then listen to two comparison syllables. They must identify which comparison syllable matches the target. This exercise improves phoneme discrimination skills, develops working memory, and increases rate of auditory processing.

*Matches:* Students click on a tile from a grid and hear a sound or word. Each sound or word has a match somewhere within the grid. The goal is to match all the tiles and clear the grid. This exercise develops auditory word recognition and phoneme discrimination, improves working memory, and increases rate of auditory processing.

*Cards:* Students are presented with two pictures representing words that differ only by initial or final consonant (e.g., “tack” versus “tag”). After hearing the target word, they must click the matching picture. This exercise improves rate of auditory processing, phoneme discrimination, and word recognition.

*Stories:* Students listen to an episode from a story, then complete several tasks: answering comprehension questions, following instructions, and selecting the picture that best depicts a sentence. This exercise improves listening comprehension, rate of auditory processing, understanding of syntax and morphology, and sequencing skills.

### **Assessments**

Students’ cognitive skills were evaluated with the Comprehensive Test of Phonological Processing (CTOPP). English reading ability was assessed with the Woodcock Reading Mastery Tests (WRMT) and listening skills were assessed with the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW). The tests were administered before and after Fast ForWord participation.

**Comprehensive Test of Phonological Processing (CTOPP):** The CTOPP measures a student’s awareness of, and access to, the phonological structure of oral language as well as phonological memory, ability to rapidly execute a sequence of operations, and ability to blend and segment words and non-words.

The Institute for the Development of Educational Achievement in the United States recognizes the CTOPP as an appropriate assessment for measuring improvements in the phonemic awareness skills of children in early elementary school. Phonemic awareness is a cognitive skill that is an essential component of language and early reading skills.

**Woodcock Reading Mastery Tests (WRMT):** The WRMT is a comprehensive battery of tests measuring several important aspects of reading ability. It assesses three major underlying areas of reading including reading readiness, basic skills and comprehension.

The Institute for the Development of Educational Achievement in the United States recognizes the WRMT as an appropriate assessment for measuring improvements in the reading comprehension and vocabulary skills of children in early elementary school.

**Goldman Frisloe Woodcock Test of Auditory Discrimination (GFW):** The GFW is a screening measure of speech sound discrimination ability for students in quiet and noisy situations. Words are presented by means of a cassette tape in the absence of any noise and also in the presence of distracting background noise. The student hears a word and then points to a picture. Similar words such as lake, make, rake, and wake are presented as foils.

**Analysis**

Scores for the CTOPP and WRMT were reported in terms of standard scores and age equivalents. Some WRMT scores were also reported in terms of grade equivalents. Scores for the GFW were reported in terms of percentiles which were converted into normal curve equivalents (NCEs). Standard scores and NCEs are normed and therefore the most appropriate units for statistical analyses. The normative tables for the three assessments were based upon a cross-section of students in the United States.

Standard scores and NCEs were analyzed using repeated measures multivariate analysis of variance (MANOVA) and paired t-tests. All analyses used a p-value of less than 0.05 as the criterion for identifying statistical significance.

**RESULTS**

**Participation Level**

Research conducted by Scientific Learning shows a relationship between product use and the benefits of the product. Product use is composed of content completed, days of use, and adherence to the chosen protocol (participation and attendance levels). Students at the Nalanda Institute used the Fast ForWord Middle & High School product for 48 minutes a day, five days per week. Detailed product use is shown in Table 1.

Figure 1 shows the average daily progress through the Fast ForWord Middle & High School product exercises for students who had scores available for analysis. The final day shown is determined by the maximum number of days that at least two-thirds of the students participated. For students who used the product fewer than the number of days shown, percent complete is maintained at the level achieved on their final day of product use.

	Number of Students	Days Participated	Number of Calendar Days	Percent Complete	Participation Level	Attendance Level
Fast ForWord Middle & High School	25	40	82	63.4%	99.6%	67.1%

Table 1. Usage data showing the number of students who used the Fast ForWord Middle & High School product, along with group averages for the number of days participated, the number of calendar days between start and finish, the percentage of product completed, the participation level, and the attendance level.

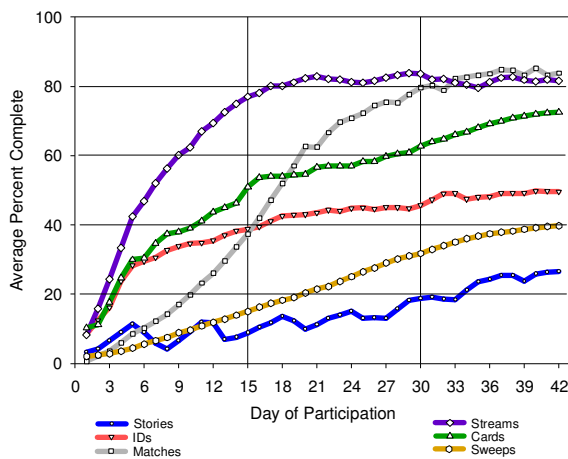


Figure 1. Average daily progress through the Fast ForWord Middle & High School product exercises. Results from 25 students are shown.

**Assessment Results**

**Comprehensive Test of Phonological Processing (CTOPP):**

Standard scores for the CTOPP can be reported for individual subtests or in composite scores. Three composite scores, the Phonological Awareness Quotient, Phonological Memory Quotient, and Rapid Naming Quotient, were used in the initial analyses. There were significant time and test effects as well as a time by test interaction (Table 2). Post hoc analyses showed that there were significant improvements in both the Phonological Awareness and Rapid Naming Quotients (Table 2)

The average student score for Phonological Awareness improved one-third of a standard deviation (Figure 2). Students made significant gains in the Rapid Naming Quotient after using Fast ForWord products, improving eleven points and moving from the low average range of rapid naming skills to well into the average range of ability (Figure 3).

CTOPP	n	Before		After		t-statistic	MANOVA F		
		Mean	SE	Mean	SE		Test	Time	Test x Time
Phonological Awareness	25	91.8	2.03	96.7	1.58	2.57*			
Phonological Memory	25	106.8	3.11	104.6	2.57	1.35			
Rapid Naming	25	86.2	3.16	97.2	3.86	4.87*			
							14.59*	9.96*	23.00*

Table 2. After Fast ForWord use, students significantly improved their language skills as measured by the Phonological Awareness and Rapid Naming Quotients. \*p<0.05.

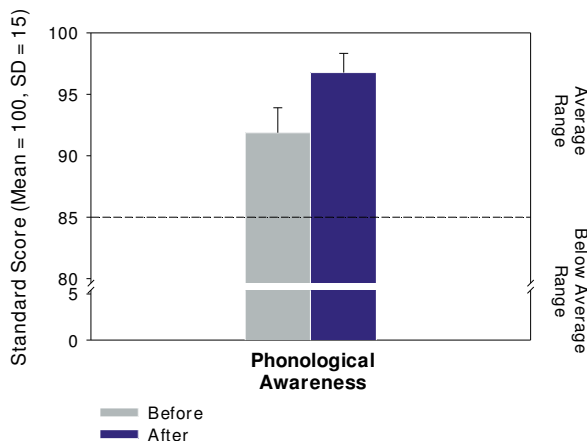


Figure 2. On average, after Fast ForWord participation, students had significant gains in phonological processing. Results from 25 students are shown.

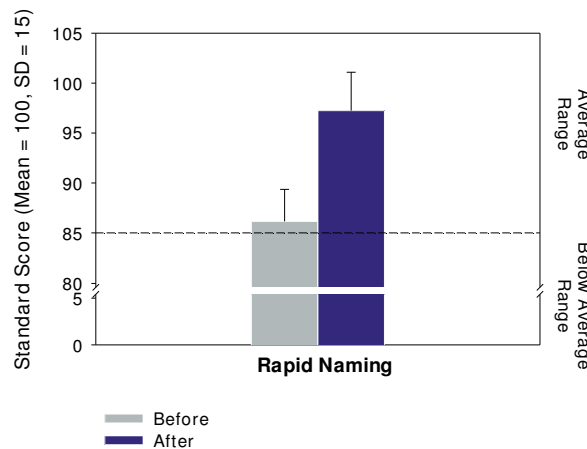


Figure 3. After Fast ForWord use, students, on average, gained 11 points in Rapid Naming. Results from 25 students are shown.

**Woodcock Reading Mastery Tests (WRMT):**

Students in this study were assessed with four subtests of the WRMT: Word Identification, Word Attack, Word Comprehension, and Passage Comprehension. Twenty-five students had standard scores from the four subtests available for analysis. A MANOVA of the four subtests revealed a main effect of time demonstrating significant improvements between the pre-test and post-test with an average change of one-fifth of a standard deviation. There was also a significant effect of test, but no test by time interaction

(Table 3). The main effect of test was a result of students demonstrating much higher achievement on the Word Identification and Word Attack subtests, performing in the average range, while they had weaker skills on Word Comprehension and Passage Comprehension, performing well below the average range. Averaging the age equivalents for the four subtests shows that across the four subtests, average gain in reading ability during the 5.4 months between the two assessments was 7.3 months (Table 4).

WRMT	n	Before		After		MANOVA F		
		Mean	SE	Mean	SE	Test	Time	Test x Time
Word Identification	25	88.3	2.93	91.6	3.10			
Word Attack	25	93.3	2.12	94.0	2.93			
Word Comprehension	25	64.4	2.93	71.7	1.86			
Passage Comprehension	25	73.7	3.01	73.2	2.84			
						34.37*	5.94*	1.47

Table 3. Students overall made significant gains in reading ability after using the Fast ForWord product. \*p<0.05.

WRMT	n	Before		After	
		Mean	SE	Mean	SE
Word Identification	25	10.4	0.41	11.4	0.53
Word Attack	25	10.9	0.80	11.7	0.92
Word Comprehension	25	7.7	0.12	8.3	0.15
Passage Comprehension	25	8.4	0.25	8.5	0.30

Table 4. Age-equivalent scores are shown for the 25 students who were assessed on the WRMT and used the Fast ForWord products. The second test was administered 5.4 months after the first.

**Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW):** Scores on the GFW were reported in terms of percentiles which were converted into normal curve equivalents (NCEs). NCEs are normed and therefore the most appropriate units for statistical analyses. Twenty-five students had NCE scores available for analysis. A MANOVA of the Quiet and Noise subtests revealed a significant subtest by time difference (Table 5). T-tests showed a

significant improvement in the Quiet subtest following Fast ForWord use. Before Fast ForWord participation, students were performing in the below average range of auditory ability. Students, on average, significantly improved their auditory skills as measured by the Quiet subtest and moved into the average range of ability after using the Fast ForWord product (Figure 4).

GFW	n	Before		After		t-statistic	MANOVA F		
		Mean	SE	Mean	SE		Test	Time	Test x Time
Quiet	25	14.9	3.27	30.3	6.71	2.20*			
Noise	25	15.1	3.50	15.4	3.44	0.07			
							4.13	3.30	4.33*

Table 5. On average, student listening ability improved significantly on the Quiet subtest after Fast ForWord participation. \*p<0.05.

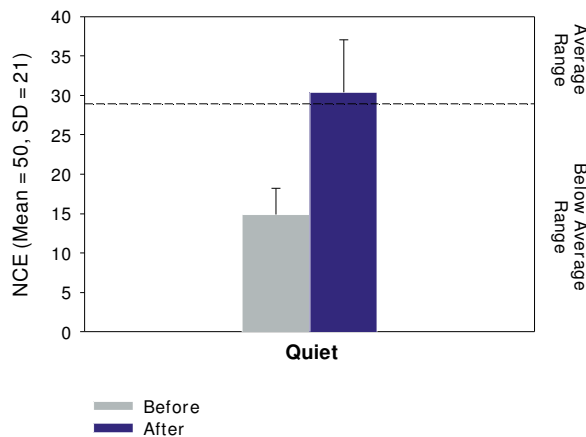


Figure 4. Students overall moved into the average range of listening ability following Fast ForWord use. Results from 25 students are shown.

## DISCUSSION

Following Fast ForWord participation, students attending the Nalanda Institute during the 2005-2006 year achieved significant gains in cognitive skills as well as in English language and reading skills.

Overall, students significantly improved their cognitive skills as measured by the Phonological Awareness and Rapid Naming Quotients with gains of one-third and more than two-thirds of a standard deviation respectively. In terms of percentiles, Phonological Awareness improved from the 29<sup>th</sup> percentile to the 41<sup>st</sup> percentile; Rapid Naming improved from the 17<sup>th</sup> percentile to the 42<sup>nd</sup> percentile.

Gains in English reading skills, on average, were up to one year's growth. At the time of pre-testing, age equivalents for all four of the WRMT subtests were below the average chronological age of the students. In approximately five and a half months between test administrations, students improved an average of 7.3 months in reading skills. Taking into account student reading skills were as much as four years below their age level at pre-test, a growth of seven months in five months time is a notable gain.

For the GFW, improvements on the Quiet subtest were excellent with average student improvement of more than two-thirds of a standard deviation, corresponding to an improvement from the 4<sup>th</sup> percentile to the 17<sup>th</sup>. The average improvement on the Noise subtest was not statistically significant but it should be noted that there was a floor effect with approximately one quarter (24%) of the students. That is, at pre-test, these students were below the 1<sup>st</sup> percentile in measures of auditory ability. Although most made some improvement, they were still below the 1<sup>st</sup> percentile at post-test. It is important to note that these students were all living in India and had an Indian language as their native tongue. The normative tables used in the analysis were based upon a cross-section of children in the United States. Therefore, the actual magnitude of the improvements might be slightly different than what is shown here.

## CONCLUSION

Cognitive and linguistic skills are critical for all students, impacting their ability to benefit from instruction, follow directions, and participate in class discussions. Strong cognitive and linguistic skills also provide a critical foundation for building later reading

and writing skills. After Fast ForWord use, students with learning disabilities who were attending the Nalanda Institute in India made significant gains in their cognitive skills as well as their language and reading skills. This suggests that using the Fast ForWord products strengthened the students' foundational cognitive and linguistic skills, allowing them to benefit more from the classroom curriculum. This study supports earlier studies done in the United States and extends the results to a group of students in India who were bilingual English speakers.

#### Notes:

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Please note that the results shown may be conservative estimates of the actual improvements since the results are based upon