AIR®

AMERICAN INSTITUTES FOR RESEARCH®

Facilitating Reading Acquisition in Multilingual Environments in India (FRAME-India)

FINAL REPORT

Main Author: Pooja Nakamura, Ph.D.

Additional contributor: Thomas de Hoop, Ph.D.

ALL CHILDREN READING: A GRAND CHALLENGE FOR DEVELOPMENT

FRAME

Facilitating Reading Acquisition in Multilingual Environments - India

NOVEMBER 2014

Contents

Contributors iii
Acknowledgments iv
Acronyms v
Executive Summary vi
1.0 Introduction 1
1.1 Motivation 2
1.2 The Reading Situation in India 4
2.0 Theoretical Foundations 5
2.1 Monolingual, Alphabetic Reading 5
2.2 Monolingual, Alphasyllabic Reading 5
2.3 Multilingual Reading 6
3.0 Conceptual Model 8
4.0 FRAME Study 9
4.1 Research Questions 9
4.2 Methodology 10
4.2.1 Reading Subskill Test Battery 10
4.2.2 Data Collector and Hub Monitor Training 13
4.2.3 Participants and Data Collection Procedure 14
5.0 Results 15
Research Question #1: What Are Levels of Various Reading Subskills in Both Languages? 15
Research Question #2: What Are the Cognitive and Linguistic Predictors of Reading Outcomes Within Each Language? 22
Research Question #3: What Are the Cognitive and Linguistic Predictors of Reading Outcomes Across Both Languages? 25
Research Question #4: Does the Relationship Between Lit 1 and Lit 2 Reading Outcomes Change Significantly at Any Given Threshold of Lit 1? 25
6.0 Implications for Alphasyllabic-Alphabetic Biliteracy Program and Policy 30
6.1 Recommendations for Teaching and Assessment Approaches 30
6.2 Recommendations for Curricular Design 32
6.3 Recommendations for Language-in-Education Policy Decisions 33
7.0 Conclusions 35
Annex A. Test Item Construction Details 37
Annex B. Sample Items from the Tests and Photos of Data Collection Activities 38
Annex C. Training Agenda for Data Collectors and Hub Monitors 41
Annex D. Flowchart of Test Eligibility Criteria 43
Annex E. Means, Standard Deviations, and Summary Statistics for All Reading Subskills 44
References 45

Contributors

Facilitating Reading Acquisition in Multilingual Environments in India (FRAME-India) was a study conducted by the American Institutes for Research (AIR) as part of the All Children Reading Grand Challenge for Development initiative, which is jointly funded by the United States Agency for International Development (USAID), the Australian Agency for International Development, and World Vision International. FRAME was conducted in collaboration with the Dwaraknath Reddy Ramanarpanam Trust, a non-government organization that provided continuous, voluntary support and access to schools and communities for all research activities throughout the study.

This report benefited from the support of several individuals, including Ms. Lorina Richmond, Ms. Hema Krishnappa, Dr. Malatesha Joshi, Ms. Adria Molotsky, Ms. Bao Le, Ms. Mariela Groett, Ms. Claire Nowlin, Dr. Rebecca Stone, Dr. Terry Salinger, and Mr. Pedro Khoury.

Acknowledgments

We sincerely thank several organizations and individuals without whom this study would not have been possible. First, we thank the members of the Dwaraknath Reddy Ramanarpanam Trust, ably assisted by members of the Drishya Foundation and the Association for Voluntary Action and Services, who tirelessly and voluntarily supported all aspects of this study in India. Without their valuable community network support, we would not have been able to access many of the schools from which we collected the data for this study. We would also like to acknowledge the support of several members of the Department of Education, who supported this research from the very beginning, including the District Director of Public Instruction; the Block Education Officer and Cluster Resource Person in Chickballapur; the District Education Officer in Chittoor district; and the Mandal Education Officers of Chittoor, Pulicherla, Kalahasthi, and Yadaamari.

The FRAME team in India was the backbone of the entire project, and the following individuals and teams are sincerely thanked: Lorina Richmond (the in-country Research Supervisor); Hema Krishnappa (Project Associate and the main test designer); each data collector and hub monitor; translators; data entry assistants; artists; and support staff, especially Balaji Poojari and Ere Gowda.

We are finally, and most importantly, extremely grateful for each school and headmaster; and especially each child for allowing us to “play games” with them on several occasions to collect data for this project.

Acronyms

AIR	American Institutes for Research
ASER	Annual Status of Education Report
FRAME	Facilitating Reading Acquisition in Multilingual Environments
Lit 1	Literacy 1: Kannada or Telugu
Lit 2	Literacy 2: English
USAID	United States Agency for International Development

Executive Summary

Most of the world is multilingual—multilingual at the national level (policies), at the community and family level (practices), and at the individual level (cognitive)—and each of these has implications for teaching and learning. Yet, at present, most reading decisions are not based on empirical research of how children learn to read in multilingual contexts. Furthermore, several large-scale assessments of reading at early grade levels (e.g., EdData Global; ASER, 2013) have shed light on the extremely low reading scores that many countries in the developing world have across these multilingual contexts. The reasons for these low scores are multifaceted; however, one of the most central unanswered questions is **what languages should be taught in multilingual contexts, how they should be taught, and when they should be taught.** To begin addressing this need, the Facilitating Reading Acquisition in Multilingual Environments in India (FRAME-India) research study examined the process of acquiring literacy in multilingual environments. Findings from this study are converted into policy and practice guidelines for effectively and quickly improving reading outcomes.

Specifically, we investigated how biliteracy skills are acquired in Kannada or Telugu (Lit 1) and English (Lit 2)[1] in Karnataka and Andhra Pradesh, two states in South India. Kannada and Telugu are the official languages of the states of Karnataka and Andhra Pradesh, respectively. These two languages, and most of the languages used in India, as well across South Asia, Southeast Asia, and some parts of Africa, like Ethiopia—are called "alphasyllabic" languages. Literacy acquisition processes in alphasyllabic languages are less well understood and less researched than those in alphabetic languages. Thus, we asked what the predictors of reading success were *within* the alphasyllabic Lit 1 and *within* the alphabetic Lit 2, and also what the relationship was *between* the alphasyllabic Lit 1 and alphabetic Lit 2. Motivated by the literature that shows that Lit 1 reading is one of the strongest predictors of Lit 2 reading around the world (August & Shanahan, 2006; Cummins, 2001; Koda & Reddy, 2008) and specifically in India (Reddy & Koda, 2013), we were particularly interested in determining whether there was a threshold point of Lit 1 reading outcomes at which children were more likely to transfer their knowledge from Lit 1 to Lit 2 for successful reading outcomes in *both* languages.

This study included several major components:

- Adaptation, development, and validation of reading tests for 12 reading subskills in three languages (Kannada, Telugu, and English) for reading research purposes
- Recruitment and training of 27 data collectors and 4 hub monitors (regional supervisors) to collect reading data from local communities
- Three rounds of data collection from the same sample of approximately 550 students from 13 schools during one academic year
- Data analysis from a quantitative, psycholinguistic, learning science perspective to investigate predictors of reading success, and to determine a threshold point of Lit 1

[1]In this study, we use *Lit 1* to refer to the first language a child learns to read (i.e., primary literacy); this may or may not refer to the "mother tongue," "home language," or another language learned that may have been acquired orally before this language. *Lit 2* refers to the second language a child learns to read (i.e., secondary literacy), whether he or she has another "second" or later acquired oral language before Lit 2.

reading outcomes above which children are more likely to "transfer" their knowledge from Lit 1 to Lit 2 for successful reading outcomes in *both* languages

- Dissemination of results through policy dialog meetings with education stakeholders across India and other nations in South Asia, including government representatives, donor organizations, communities of literacy practice, education members of non-governmental organizations, creators of teaching and learning materials, and teachers
- Development and dissemination of (a) bilingual guidebooks on teaching reading that are constructed based on the findings from this research and comprehensive reviews of other literature and (b) training workshops for teachers on the use of the guidebooks

The research resulted in several key findings:

In terms of the **Lit 1 (Kannada or Telugu)** reading outcomes, we found the following:

- Both syllabic and phonemic awareness (e.g., "ka" is a syllable, and "k" and "a" are individual phonemes) were important for early decoding success.
- Oral language skills, such as oral vocabulary and comprehension of spoken sentences or stories, is also important for Lit 1 decoding success.
- The role of oral language skills in explaining reading skills increases over time through elementary school.
- The acquisition of decoding skills (ability to sound out words accurately and quickly) in alphasyllabic languages takes longer (around Grade 5) than in alphabetic languages (around Grade 2) (e.g., Liberman, Shankweiler, Fischer, & Carter, 1974).
- Oral reading fluency accuracy (reading a passage out loud with correct pronunciation and intonation) was not necessarily closely related to oral reading fluency comprehension (the ability to understand what was read in the passage).

In terms of **Lit 2 (English)** reading outcomes, we found the following:

- Phoneme awareness was a strong and significant predictor of English decoding scores.
- Oral vocabulary knowledge was a strong and significant predictor of English decoding scores, and its importance was relatively high through the grades.
- Oral reading fluency accuracy (reading a passage out loud with correct pronunciation and intonation) was closely related to oral reading fluency comprehension (the ability to understand what was read in the passage).
- Lit 1 decoding (i.e., Kannada or Telugu decoding scores) was one of the strongest independent predictors of Lit 2 English decoding, suggesting that for English decoding success, a child must have a certain degree of proficiency in their first literacy.
- Finally, to the best of our knowledge, this is the first study that provides an **empirical threshold point of approximately 60%,**[2] at which Lit 1 decoding ability substantively and significantly increases the likelihood of "transfer" of knowledge to Lit 2 decoding for effective biliteracy outcomes. Specifically, children who can easily and accurately "sound

[2] This exact threshold tipping point is relevant for a grade-appropriate decoding test in an alphasyllabic language. It may not necessarily be the same in different languages, different types of reading subskills, or even different levels of decoding difficulty, where the tipping point may be higher or lower.

out" approximately 60% of words in a grade-appropriate alphasyllabic word reading test are much more likely to succeed when formal English instruction begins than a child who scores lower than this threshold. For children who scored lower than 60% in a grade-appropriate alphasyllabic word reading test, small improvements are not, or hardly, associated with improvements in English. This threshold was NOT achieved for almost all students in Standard 1, 40% of the students in Standard 2, and approximately 30% of the students in Standard 3. It WAS achieved by about 80% of the sample at the end of Standard 4.

These research findings have both pedagogical and policy implications for teaching more effectively in alphasyllabic-alphabetic biliteracy contexts, and for deciding the timing and process of transition from Lit 1 to Lit 2. The two main recommendations we make based on these findings are:

- It is important to sequence reading subskills in Lit 1 alphasyllabic and Lit 2 alphabetic languages in ways that are reflective of the scripts, and in a way that incorporates "transfer" of Lit 1 skills for reading gains in both languages.
- For improving reading skills in Lit 1 *and* English, it may be beneficial not to introduce English decoding instruction until the child has achieved the necessary threshold value of Lit 1 decoding skills. Therefore, it may be best to either split classrooms into those who have enough Lit 1 decoding and introduce English to them; or alternatively, wait till a grade-level where most children in the class have achieved sufficient Lit 1 decoding for English to be introduced to the whole class.

A host of education stakeholders will benefit directly from this research:

- *Reading policy decision makers* will gain empirical knowledge on which to base decisions about which languages should be taught at what grades.
- *Developers of curricula, standards, and reading interventions* (e.g., developers at the national level or developers of small-scale programs or technology-enhanced reading materials) will be able to map scope-and-sequence charts based on an understanding of the underlying reading mechanisms of multilingual children.
- *Reading program impact evaluators and assessors* will have a better understanding of what skills to measure—and in what languages—to get a more accurate picture of reading (and reading program) success, and will also have a more multilingual-relevant evidence base upon which to construct hypotheses and theories of change for early grade reading programs.
- *Developers of teaching and learning materials for the classroom, and local language/multilingual books* will be able to decide what skills to highlight and when.

In summary, this is one of the first studies to focus on formative, pre-intervention research for developing a theory of change that is relevant for multilingual learners in the developing world. While continuing to conduct rigorous impact evaluations, technical assistance, and program design and implementation, we must also focus on understanding the mechanisms of learning that underpin successful reading acquisition in contexts characterized by multilingualism and limited resources. This is extremely important to construct successful programs that are likely to benefit millions of children, who are learning in these multilingual environments every day.

1.0 Introduction

This paper presents the final report of Facilitating Reading Acquisition in Multilingual Environments in India (FRAME-India)—a research project conducted by the American Institutes for Research (AIR). The research was conducted as part of the All Children Reading Grand Challenge for Development initiative funded by the United States Agency for International Development (USAID), Australian Agency for International Development, and World Vision; with voluntary support and partnership from the Dwaraknath Reddy Ramanarpanam Trust, a non-government organization in India.

The main objective of the project was to identify the key factors that predict literacy outcomes in multilingual environments in low-income communities in India. Undoubtedly, multiple facets need to be considered when understanding how to improve reading scores in these contexts. But to achieve literacy gains in multiple languages, one of the most central unanswered questions is what languages to teach, how to teach them, and when to teach them. In other words, there is a need for a multilingual-relevant theory of change for implementing, evaluating, and scaling reading programs in the developing world.

In FRAME, we addressed this critical, unmet need by examining: (1) what skills predicted reading outcomes in a primary literacy (Lit 1)—Kannada or Telugu, the regional languages of Karnataka and Andhra Pradesh, in India— and in a secondary literacy (Lit 2) English; and (2) how Lit 1 and Lit 2 skills were related. We were specifically interested in establishing an empirical threshold—that is, a point at which Lit 1 reading skills were most likely to transfer and facilitate reading in a new language, such as English.

The research project included several major components:

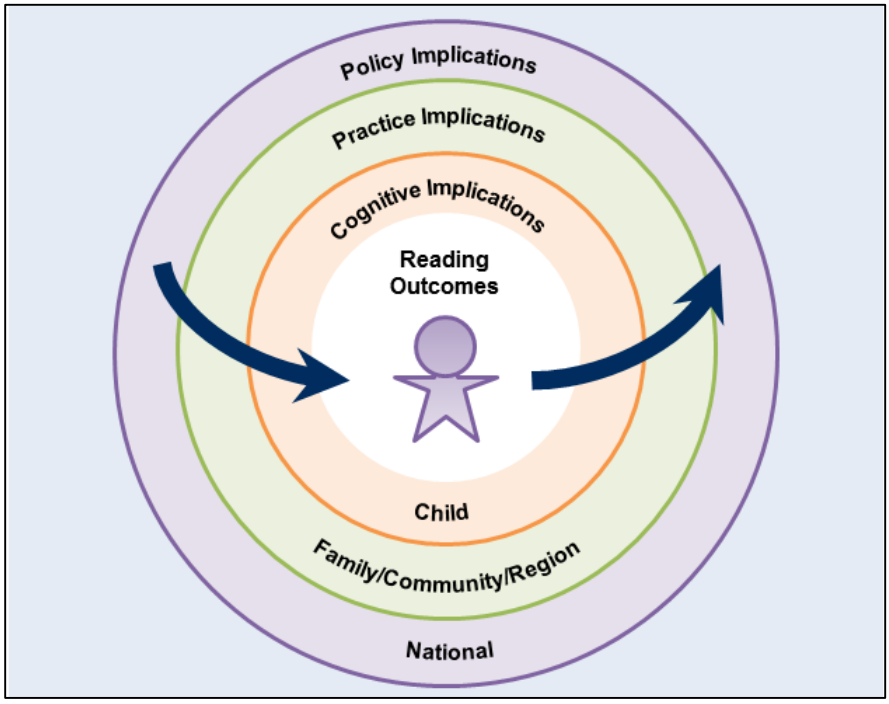
- Adaptation, development, and validation of reading tests for 12 reading subskills in three languages (Kannada, Telugu, and English) for reading research purposes
- Recruitment and training of 27 data collectors and 4 hub monitors (regional supervisors) from local communities
- Three rounds of data collection from the same sample of approximately 550 students from 13 schools during one academic year
- Data analysis from a quantitative, psycholinguistic, learning science perspective to determine predictors of reading success, and to determine a threshold point of Lit 1 reading outcomes above which children are more likely to "transfer" their knowledge from Lit 1 to Lit 2 for successful reading outcomes in *both* languages
- Dissemination of results through policy dialog meetings with education stakeholders across India and other nations in South Asia, including government representatives, donor organizations, communities of literacy practice, education members of non-governmental organizations, creators of teaching and learning materials, and teachers
- Development and dissemination of (a) bilingual guidebooks on teaching reading that are constructed from the findings from this research and comprehensive reviews of other literature and (b) training workshops for teachers on the use of the guidebooks

1.1 Motivation

There is a global learning crisis (Pritchett, 2013; UNESCO, 2014). Approximately 250 million children across the world are not acquiring basic reading and math skills, even though about half of them have spent at least 4 years in school (UNESCO, 2014). For several years now, large-scale early grade reading assessments (e.g., Annual Status of Education Report [ASER], 2013; EdData II, n.d.) have shed light on extremely low reading rates and worryingly high "zero" literacy scores from across the world, especially in South and Southeast Asia, Sub-Saharan Africa, and Latin America and the Caribbean. Data from these assessments have been pivotal in drawing our attention to the reading problem and ignited the desire of education stakeholders to remedy the problem (e.g., Gove & Cvelich, 2011). However, major gaps remain in our knowledge on *how* to design literacy programs that are likely to rapidly and significantly improve learning in multilingual settings, while utilizing minimal resources.

Multilingualism is widespread in educational contexts across the world. This has complex and multifaceted implications for improving reading outcomes (Figure 1), and is also one of the major reasons for education inequalities worldwide (Benson, 2005; Bruthiaux, 2002). At a national level, multilingualism forces policymakers to decide what language(s) should be taught, when they should be taught, and how they should be taught. At a regional level, multilingualism requires an understanding of different kinds of learning environments for effective teaching that is contextually relevant (e.g., linguistically heterogeneous urban communities versus linguistically homogenous rural communities). At a family level, each language might be associated with different practices and values; for instance, the home languages tend to be associated with identity and self-esteem, but postcolonial national languages tend to be associated with socioeconomic mobility and higher wages (Azam, Chin, & Prakash, 2010; Coleman, 2011). At a child level, multilingual learning has cognitive benefits, if acquired in a supportive, additive bilingual setting (Bialystok, 2001; Cummins, 2001), and the process of acquiring a language is significantly impacted by knowledge of any previous language (August & Shanahan, 2006; Koda & Reddy, 2008). Thus, the straightforward application of research from monolingual learning contexts—i.e., the evidence that is commonly used in reading program decision making across the developing world—is not always likely to be effective in such contexts.

Figure 1. Multifaceted implications of multilingualism on reading development



In addition to multiple languages in the educational system, the writing systems of South and Southeast Asia, and parts of Africa, such as Ethiopia use so-called "alphasyllabic" scripts, which are different from alphabetic scripts in important ways. For instance, alphasyllabic scripts require children to be sensitive to syllable and phoneme sounds (a syllable is "ka," and phonemes are "k" and "a"); necessitate the ability to deal with letters that may not appear in straight lines; and require children to learn a much larger set of symbols than required in alphabetic languages (Nag & Perfetti, 2014). Consequently, for instruction and assessments to be most effective, they must reflect these differences.

A final factor that characterizes learning environments in most low-income communities is rapid urbanization and the rise of urban slum communities. 2008 marked the first time in history that more people lived in cities than in villages, and that trend is expected to continue and grow (UNFPA, UNDESA, UN-HABITAT, and IOM, 2013). About one-third of city dwellers—or approximately 1 billion people—live in slums. This burst of urban poverty brings with it important consequences for learning, especially in terms of languages. Specifically, as families migrate from the villages to cities, they usually bring with them their own regional languages, and they settle in close proximity to other families from various "mother tongue" groups. As such, slums tend to be a melting pot of multiple "mother tongues," regional languages, and post-colonial languages (Reddy, 2011), and schools reflect this linguistic heterogeneity in each classroom. The question of which languages to teach children in these settings is an extremely important and challenging one, for which a limited amount of empirical evidence is available to guide policy makers.

1.2 The Reading Situation in India

Literacy rates are exceedingly low in many parts of India. Children's reading levels did not improve significantly between 2012 and 2013 (ASER, 2013). In fact, in many cases, the ability to read has decreased over time to the point where students cannot read even at levels substantially lower than their grade level. For example, the proportion of children in Standard 5 who could read a Standard 2-level text has decreased each year since 2009 to only 47% in 2013. The proportion drops even lower, to 41.1%, in government schools.[3] For example, in Standard 3 in Andhra Pradesh, about 31% of children cannot read a single word and 48% cannot read a Standard 1- level text. In Standard 3 in Karnataka, about 37% of children cannot read a single word and 62% cannot read a Standard 1-level text.

India is home to approximately 447 languages, 75 of which are institutional,[4] and 22 of which are officially used by different states (Paul, Simons, & Fennig, 2013). Reflecting this multilingualism, the nation's language-of-education policy is known as the Three Language Formula. This policy states that all school-going children must learn three languages—one as a medium of instruction, one as a second language (L2), and one as a third language (L3)—by the end of secondary school (Department of Elementary Education and Literacy & Department of Secondary and Higher Education, 2013).

The order in which the languages are taught depends on the school. Private schools are more likely than other types of schools to use English as the medium of instruction, followed by Hindi and a regional language. Government schools are more likely to use the state's official language (such as Kannada in Karnataka or Telugu in Andhra Pradesh) as the medium of instruction, followed by English and Hindi. Additionally, the prospect of socioeconomic mobility that comes with English language and literacy skills has led to a surge in parental and community demand for schools that use English as the medium of instruction (Azam, Chin, & Prakash, 2010; Coleman, 2011). However, evidence does not show that children attending these schools in low-resource settings acquire English any better or faster than those going to schools that use a regional language as the medium of instruction (Mohanty & Misra, 2000). Furthermore, no empirical guidelines are available to show when and how to introduce English to promote outcomes in *both* regional languages and English.

Given these prevailing environments of multilingualism, non-alphabetic writing systems, and limited resources, there is critical need for reading research to uncover the *process of learning acquisition* specific to these environments. Such formative, pre-intervention research is extremely important to increase the quality of rigorous impact evaluations, particularly the quality of the theory of change on which these evaluations are based (White, 2014). Furthermore, such a science-based learning framework is also highly likely to increase the *quality of learning outcomes* in children, by providing a theory of change that is relevant for educational contexts of the developing world, and for supporting the development of effective reading programs and policy decision making.

[3] Same as public schools.
[4] Used in media, education, legal systems, and various other official institutions.

2.0 Theoretical Foundations

2.1 Monolingual, Alphabetic Reading

The ultimate goal of reading is to understand printed information. This is a complex learning process that requires effortless, rapid, and accurate integration of visual (orthographic), sound (phonological), and meaning (semantic) information (e.g. Perfetti, 1985). Importantly, this process **progresses in stages**, from less complex integration when a child is learning-to-read to much more complex integration when a child is reading-to-learn. Chall (1996) presents a commonly used framework for the stages of English reading, in which the primary stages of reading are *emergent literacy* (birth to Grade 1), *decoding* (beginning Grade 1), and *automatic word recognition and fluency* (end of Grade 1– Grade 3).

The kinds of teaching approaches and resources necessary to support reading development differ depending on the stage of reading a child is at. There is ample evidence of the importance of the home literacy environment in supporting emergent literacy skills (e.g., Sénéchal & Le Fevre, 2002). Some of the most effective methods for teaching decoding and word recognition are explicit instruction of sound–symbol correspondences and sight words (those that are frequently used in English but do not have a one-to-one sound-symbol correspondence pattern, such as "you" or "said" or "have" or "one") (Snow, Burns, & Griffin, 1998). For fluency and comprehension, repeated exposure to word meanings in multiple contexts; and teaching children to use reading comprehension strategies are likely to have the most impact (Shanahan et al., 2010). Thus, each stage is characterized by different cognitive acquisition mechanisms and different teaching approaches that are most impactful.

Reading development is also a componential process that requires a well-orchestrated **set of cognitive and linguistic subskills.** According to one well-established model of reading comprehension, the Simple View of Reading, reading is a product of two important subskills: oral language comprehension and decoding ability (Gough & Tunmer, 1986; Joshi & Aaron, 2000). Building on these two main skills, the National Reading Panel (2000a; 2000b) points out five main component skills of reading: phonological awareness, decoding and word recognition, vocabulary knowledge, oral reading fluency, and comprehension. Each of these skills are complex constructs that develop differently. For instance, vocabulary might include receptive oral vocabulary recognition or expressive written vocabulary knowledge—skills that develop over different time periods and require different kinds and intensities of pedagogical support in the classroom (Beck, McKeown, & Kucan, 2013; McKeown & Beck, 2004). Thus, reading comprises a set of component skills, each of which requires various amounts of time, resources, and approaches to successfully teach.

2.2 Monolingual, Alphasyllabic Reading

Although some universal processes are involved in reading any language, many aspects of the stages and components of reading are language-dependent (e.g., Perfetti, 2003). Most Indian languages use a writing system called an *alphasyllabary*.[5] In fact, this writing system is used across South Asia (e.g., Hindi, Bangla, Sinhala, etc.), Southeast Asia (e.g., Thai, Javanese, etc.),

[5] Although this term is used in the most recent research literature on writing systems (e.g., Nag & Perfetti, 2014), other terms have been used, such as alphabetic syllable, syllabic alphabet, and abugida.

and in parts of Africa (e.g., Amharic in Ethiopia). The main symbol in Indian alphasyllabaries is known as an *akshara*, a syllabic symbol that can be marked with phonemes above, below, after, and before it, but always maintaining a syllabic block (such as ಕ = /ka/; ಕಿ = /ki/; and ಕ್ರಿ = /kri/). Thus, the syllable is more prominent and easy to teach, and the phoneme markers, although important, are much less salient and require more time on task to acquire (Nag, 2007).

Alphasyllabaries differ from alphabetic (e.g., English, Spanish, Kiswahili), syllabic (e.g., Japanese Kana), and morphosyllabic (e.g., Chinese or Japanese Kanji) writing systems (e.g., Nag & Perfetti, 2014) in important ways. For example, given the hybrid representation of syllables and phonemes in alphasyllabaries (Vaid & Gupta, 2002), *both* syllabic and phonemic awareness needs to be taught for successful early word reading (e.g., Reddy & Koda, 2013). This is in contrast to the "phonics" approach in English and other alphabetic languages, where it is important to teach the sound of individual phonemes (e.g. Adams, 1990). A second difference is that it takes longer to acquire all the symbol-sound mapping rules in alphasyllabic languages, and thus acquire a mastery level in decoding (until Grades 4 or 5) (Nag, 2007; Nakamura & Joshi, 2014) compared with learners of alphabetic languages (Grades 1 or 2) (Liberman, Shankweiler, Fischer, & Carter, 1974). A third difference is that alphasyllabic languages are visually more complex and do not represent their symbols in a straight, linear fashion, requiring extra time and practice to acquire (Kandhadai & Sproat, 2010; Nag & Snowling, 2011). Finally, alphasyllabic scripts are transparent—that is, they have a clear one-to-one correspondence between sounds and symbols. For example, ಕಿ is always sounded out as /ki/. But in English, "c" can be sounded out as /c/, /s/, /ch/, etc. Consequently, to nurture successful, independent alphasyllabic readers, pedagogical practice should teach sound–symbol rules and patterns (Rao, Vaid, Srinivasan, & Chen, 2011), instead of whole words or sight words.

Thus, even in monolingual learning environments, non-alphabetic languages require pedagogical and assessment methods that differ from what has been established with learners of alphabetic languages.

2.3 Multilingual Reading

This section briefly reviews the literature on "multilingual education" and "biliteracy acquisition". Language is the foundation of literacy acquisition, and thus there is an inextricable link between multilingual education and biliteracy acquisition research. However, the former tends to focus more heavily on education systems and educational attainment in all subjects; whereas research on the latter deals more closely with literacy development mechanisms in more than one language.

Looking first at multilingual education, ample evidence shows that the language of the school in many developing countries does not match a child's mother tongue or the language of the home (see Ball, 2010, for a review). There are several reasons for this, including:

- Sociopolitical forces that motivate decision makers to maintain or obtain access to power (or thwart access to power) through language policies (Tollefsen & Tsui, 2004)
- Demand from families and communities for education in the post-colonial language because of its proven link to socioeconomic mobility (Azam, Chin, & Prakash, 2010; Coleman, 2011)

- Perceived "global" identity that comes with achievement in a "global" language (e.g., de la Piedra, 2006)
- Difficulty in determining which mother tongue or L1[6] to teach in many linguistically heterogeneous contexts (Nag, Chiat, Torgerson, & Snowling, 2014)

Despite this demand for education in the post-colonial, global language, there are multiple studies from various low-income countries (e.g. Alidou et al., 2006; Heugh et al., 2007; Bamgbose, 2000) and high-income countries (e.g. Genesee et al., 2006; Thomas & Collier, 2002) that have demonstrated that education programs that transition from a mother tongue/local language[7] "too early" are likely to lead to poor educational outcomes in both languages, or children dropping out of the education system altogether. Some studies have probed these findings further in African contexts to show that at least 6-8 years of local language education is required in high-resource environments for successful bilingual education (Heugh, 2006); and that there are within-language threshold levels at which a child may be able to benefit from introduction of literacy instruction, such as ensuring a child understands 95% of the words in a text for them to be able to benefit from literacy instruction of that text (e.g. van Ginkel, 2014). Evidently, children must understand the language in which they are learning, but determining what that language is, is not a straightforward decision. Furthermore, and most importantly, until now no studies have formally determined a **cross-language threshold point** below which children fail to acquire Lit 2 reading skills. To the best of our knowledge, this study is the first to formally and empirically examine and establish such a threshold.

Turning to the processes of biliteracy acquisition, we know that one of the defining characteristics of L2 reading, which differentiates it from L1 and monolingual reading, is dual language involvement in the L2 (Cummins, 1979; Koda, 2007; 2008). In other words, there are several different manifestations of L1 influences on L2 that must be considered when designing bilingual reading programs (for reviews, see August & Shanahan, 2006; Koda & Reddy, 2008). For example, studies have shown that: (1) there are significant correlations between L1 and L2 reading subskills, especially metalinguistic awareness[8], such as phonological awareness[9]; (2) L1 subskills support L2 reading outcomes (e.g., a child who has strong L1 phonological awareness ability is likely to have strong L2 decoding ability in two alphabetic languages); (3) L1 reading subskills and L2 oral language skills jointly predict reading scores in the L2; and (4) transfer depends on the linguistic and script distance between the two languages. Thus, the impacts of L1 on L2 reading are predictable and significant. Understanding such cross-linguistic influences is critical to supporting biliteracy development.

Very few studies have focused on alphasyllabic-alphabetic biliteracy acquisition, but the emerging consensus—in line with other biliteracy studies—is that there are both language-neutral and language-specific acquisition processes (e.g. Reddy & Koda, 2013; Kim, 2009). Specifically, there are particular reading subskills that are shared across languages, and therefore,

[6] First language.
[7] Depending on the context, this could be a language of an entire state or a small minority community.
[8] Metalinguistic awareness is an awareness of how language components (such as sounds, meaning parts, or sentence parts) work, i.e. it is an awareness that there are rules that govern languages, but those rules may be different in different languages.
[9] An awareness of, and the ability to manipulate, the *sound structure* of one's language. The sound units may be syllables, phonemes, onsets, rimes, codas, etc.

do not need to be taught twice, such as phonemic awareness. Once developed in one language, these skills will support reading in a new language. There are also language-specific skills that do need particular attention in each language separately, such as oral vocabulary knowledge. Furthermore, the nature of cross-linguistic transfer changes as children progress through the early grades of reading development, with more language-specific skills required after grade 4 (Nakamura et al., 2014). These psycholinguistic studies, therefore, explain some of the mechanisms for why it is important to continue teaching certain subskills of the L1 (versus others) for improving biliteracy impact.

In summary, the main theoretical notion framing this study is that much of the cognitively demanding tasks that underlie reading in multilingual children are ***sharable, transferrable, and facilitative across languages.*** According to the Transfer Facilitation Model (Koda, 2007; 2008), the mechanism of biliteracy transfer is the following: skills that are required in *both* languages are shared in the multilingual mind, and through this process, L1 literacy outcomes directly transfer to L2 literacy outcomes. This has two implications. First, learning to read two or more languages is a facilitative—*not interruptive*—process if it is based on an understanding of how to build on available skills. Second, these teachable skills predict reading success in multilingual learners, even when they have limited or no print resources and support in their homes and communities (Reddy, 2011), and these skills must be harnessed for higher impact reading planning in multilingual environments.

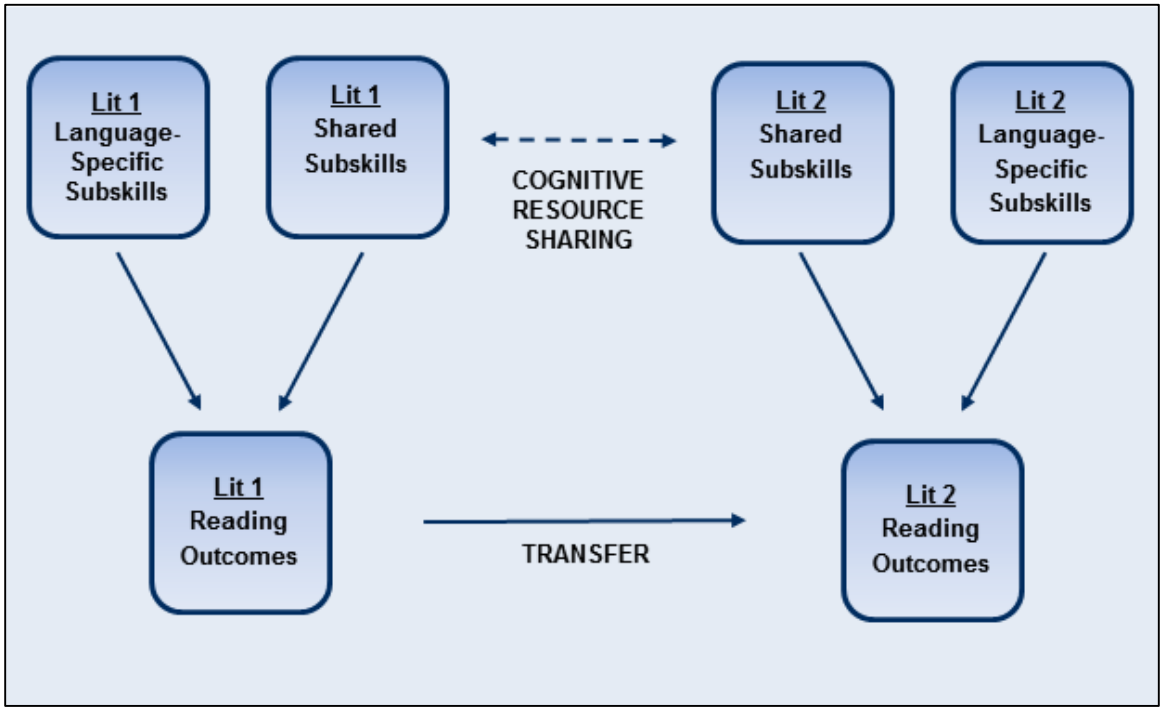
3.0 Conceptual Model

The synthesis of the literature makes it apparent that:

1. reading acquisition in any language progresses in stages, and requires a set of well-integrated subskills;
2. a child cannot learn to read a language that he or she does not understand;
3. there are both universal and language-dependent skills for reading different types of scripts, and some of the orthographic differences in alphasyllabic literacy acquisition have important consequences for teaching and assessment; and
4. reading skills from L1 transfer to and facilitate L2 reading.

Despite these strides in our understanding of biliteracy development, we still do not have evidence on precisely what combination and sequence of skills are most important for teaching and learning an alphasyllabic language. In other words, if only limited teaching resources and time are available, which tasks and skills should the teacher emphasize in the classroom at various grade levels. In addition, although we know that the acquisition of L2 is significantly related to, and facilitated by, L1, we still do not know at what point the L1 is "good enough" to provide a sufficient base for successful transition from L1 to L2 for **biliteracy achievement**. This study addresses both of these policy and practice gaps, using the following conceptual model as a theoretical base (Figure 2).

Figure 2. Conceptual model of transfer in biliteracy acquisition



4.0 FRAME Study

Grounded in the conceptual framework, the main objective of FRAME was to identify the cognitive and linguistic factors that significantly predict **biliteracy success** among children in Standards 1–5 in various low-income schools in Karnataka and Andhra Pradesh in South India. In particular, the intent was to use the findings to construct empirically based curricula, standards, and pedagogical and assessment approaches for designing reading programs and policies. As such, FRAME is a pre-intervention formative research study aimed at increasing the scientific evidence upon which we can design reading programs in multilingual educational contexts, particularly those with both alphasyllabic and alphabetic scripts.

4.1 Research Questions

Based on the gaps in the literature discussed previously, we pose the following research questions:

1. What are levels of various reading subskills in Lit 1 (Kannada or Telugu) and Lit 2 (English)?
2. What are the cognitive and linguistic predictors of reading outcomes within each language?
3. What are the cognitive and linguistic predictors of reading outcomes across languages?
4. Does the relationship between Lit 1 and Lit 2 reading outcomes change significantly at any given threshold of Lit 1 reading outcomes?

4.2 Methodology

4.2.1 Reading Subskill Test Battery

The main purpose of the FRAME reading tests was to determine the cognitive and linguistic skills that predict multilingual reading outcomes. As such, the tests were designed for reading research purposes. The skills that were included in the test battery were selected based on two criteria:

1. A review of the literature on the predictors of reading success in monolingual alphabetic literacy development (e.g., Snow et al., 1998), alphasyllabic literacy development (e.g., Nag & Perfetti, 2014), and biliteracy development (e.g., Koda, 2008)
2. Theoretical postulations of the skills necessary for reading in limited-resource, multilingual environments that may not be usually included in many international assessments. We included these skills because of particular points of divergence from established research that need to be considered. For example, emergent literacy skills that are nurtured at home prior to formal literacy instruction in school cannot be assumed in these contexts, and thus, should be measured; and sharable, cross-linguistic, metalinguistic awareness skills may be stronger predictors of reading in these contexts than monolingual, print-rich environments, and thus, should be measured.

It is important to note that these tests were not designed for direct decision making on reading programs. In other words, they were not intended for any continuous, diagnostic, evaluative, or summative assessment purposes. Instead, the intent was to use the tests to conduct research, in which the findings could be used to make empirically based recommendations on designing future reading programs and policies.

Table 1 summarizes the FRAME test battery, including which reading skills were assessed, the languages in which they were administered, the definitions of each skill, and the testing method used. Annex A contains more detailed information about the construction of the tests. Annex B presents some sample items from the tests and a few photos of data collection activities.

Table 1. FRAME reading subskill test battery

Literacy Subskill	Operational Definition	Test Name and Task Description	Language of Test Administration
		Emergent Literacy Skills	
Concept of Print	The ability to understand how print "functions"	*Concept of Print test:* Children were shown a book with some print anomalies (such as upside down texts or jumbled sentences) and asked to identify errors.	Kannada and Telugu
		Oral Language Skills[10]	
Syllable-Level Phonological Awareness	Awareness of, and the ability to, orally manipulate the syllabic sounds of a language	*Blending test:* Children were asked to blend syllable sounds, such as "pen-cil." *Deletion test:* Children were asked to delete a syllable from a word, such as "key" from "monkey."	Kannada, Telugu, and English
Phoneme-Level Phonological Awareness	Awareness of, and the ability to, orally manipulate the phonemic sounds of a language	*Blending test:* Children were asked to blend phoneme sounds, such as "c-a-p." *Deletion test:* Children were asked to delete a phoneme from a word, such as "d" from "dog" or "l" from "plan."	Kannada, Telugu, and English
Receptive Oral Vocabulary Knowledge	The ability to understand the meaning of a spoken word	*Oral Vocabulary Knowledge test:* Children heard a word and saw four pictures and were asked to select the picture that matched the meaning of the word they heard.	Kannada, Telugu, and English
Language Comprehension	The ability to understand several sentences of spoken language, including the ability to understand words, sentences, and grammatical structures and have sufficient background knowledge and inference-making ability to integrate the oral information	*Listening Comprehension test:* Children listened to a short passage or story and answered explicit comprehension and inferential questions about the text.	Kannada, Telugu, and English

[10] All of these skills are oral language processing skills and do not require any knowledge of print rules or writing.

Literacy Subskill	Operational Definition	Test Name and Task Description	Language of Test Administration
		Script Processing Skills[11]	
Letter Naming	Knowledge of the names of all capital and lowercase letters	*Letter Naming test:* Children saw letters typed on large flashcards and said the name of the letter out loud.	English
Decoding	The ability to connect phonemes and syllables (sounds) to their matching letters to "sound out" known and unknown words	*Decoding test:* Children saw words (real and pseudo) typed on large flashcards and said the word loudly and clearly.	Kannada, Telugu, and English
Oral Reading Fluency	The ability to read connected sentences of text out loud with speed; accuracy; and correct stress, intonation, and emphasis	*Oral Reading Fluency Accuracy test:* Children were given a short passage to read out loud, accurately, and quickly. This was a timed test. *Oral Reading Fluency Comprehension test:* Based on the above passage, children were asked comprehension questions.	Kannada, Telugu, and English
Reading Comprehension	The ability to read and comprehend written passages and stories of text	*Reading Comprehension test:* Children were given a short story or passage and asked to read silently and answer explicit comprehension questions and implicit inference-making questions.	Kannada, Telugu, and English
Fluent Word Recognition	The ability to read words fluently in a passage—an advanced form of reading comprehension ability that requires word recognition and strong oral vocabulary knowledge and syntactic processing ability	*Slasher test:* Children were given a passage without any space between words and were asked to draw a line (slash) between each set of letters that they believed was a word. For example: ▪ Test: longagotherewasacrowinajungle ▪ Answer: Long/ago/there/was/a/crow/in/a/jungle	Kannada, Telugu, and English
		Writing Skills	
Spelling	The ability to correctly write isolated words	*Spelling Test:* Children were dictated a list of words and were asked to write down the words.	Kannada, Telugu, and English

[11] All of these skills require script processing ability, including orthographic knowledge and knowledge of sound–symbol mapping rules, and in most cases are supported by oral language skills.

4.2.2 Data Collector and Hub Monitor Training

All data collection activities were conducted by trained data collectors. Data collectors were overseen by hub monitors or regional supervisors, who in turn were overseen by the in-country research supervisor. The data collectors were recruited from poor communities in urban and rural settings for two main reasons:

- To build research capacity and data-based decision making capacity from the "grassroots" level
- To ensure high levels of sensitivity and comfort—and thus higher quality learning data—from young children of extreme poverty backgrounds.

Each candidate to be a data collector participated in a one-on-one interview with the principal investigator or the research supervisor, had to have at least a high school degree, and was required to take the reading comprehension tests to ensure that their own reading and language skills were adequate to collect the required data.

In June 2013, data collectors and hub monitors participated in training workshops—one in each state—to receive intensive hands-on training, practice, and testing on the rules, methods, and protocols for collecting the highest quality reading data from the children (Figure 3). The workshops also familiarized participants with the goals of the All Children Reading Grand Challenge and FRAME and the importance of research for decision making. Twenty-five participants took part in the team training in Karnataka, including 14 data collectors, 1 hub monitor, the research supervisor, the principal investigator, and 8 members from our partner non governmental organization, the Dwarakanth Reddy Ramanarpanam Trust, who voluntarily attended and supported the facilitation of the workshop. Sixteen participants took part in the team training in Andhra Pradesh, including 12 data collectors, 2 hub monitors, the research supervisor, and the principal investigator. Annex C presents a sample of the training agenda.

During Rounds 2 and 3 of data collection, hub monitors conducted refresher training sessions that were overseen virtually by the principal investigator.

Figure 3. Photos from the data collector and refresher trainings

4.2.3 Participants and Data Collection Procedure

Data was collected from a total of approximately 556 children in 13 schools in the states of Karnataka and Andhra Pradesh in South India. Students were from Standards 1 to 5. The schools were from various low-income educational settings: urban, peri-urban, rural, government, and private. Since all data collection activities were implemented through the voluntary support of the Dwaraknath Reddy Ramanarpanam Trust, the schools we selected were those that our partner had strong community connections with. This allowed us to have flexible and open access to the schools, community members, and children, and allowed us to collect several hours of high-quality reading data from each child over the span of the year. Table 2 presents further information about the schools and participants in the study.

Table 2. Schools and participants in the study

	Karnataka	Andhra Pradesh
Number of Schools	9	4
Number of Participants	322 (168 boys, 154 girls)	234 (116 boys, 118 girls)
Standards	1–5	1–5
Urbanicity	4 urban and 5 peri-urban	2 urban, 1 peri-urban, and 1 rural
Type of School	6 government and 3 private	3 government and 1 private
Mother Tongue Groups	Kannada = 78; Telugu = 132; Tamil = 45; Urdu = 10; Marathi = 6; Hindi = 3	Telugu = 172; Tamil = 2; Urdu = 4

Three rounds of data collection were conducted on the reading subskills. Before the start of the first round, pilot testing occurred with a small group of participants (N=30) to obtain qualitative information about the usability of the tests and ease of understanding by the children. Round 1 (July 2013) of data collection included 9 tests (Concept of Print, blending, deletion, letter naming, decoding, slasher, oral vocabulary knowledge, listening comprehension, and reading comprehension; Round 2 (December 2013) included 3 new tests (*akshara* knowledge, spelling, and oral reading fluency); and Round 3 (April 2014) included 6 tests (deletion, letter naming, decoding, oral vocabulary knowledge, listening comprehension, and reading comprehension), which was a subset of the subskills from Round 1. In Round 3, the tests contained most of the same items, but to control for test familiarity effects, new items were included to judge whether the results were applicable to learning the subskill constructs of interest, rather than memorization of the test items. Each round of data collected included the same participants. The attrition rate was 3.71%.

Testing began with the Concept of Print test, the easiest test for all students regardless of grade. This test measured emergent literacy skills and built into the harder tests, ending with the Slasher test. If learners could not pass an eligibility score of 30% in the easier tests, they were not tested on subsequent tests, because, they would not be able to read a passage of text with comprehension if they could not identify a single letter or sound. The reason the easier tests were given to even the older students is because of growing evidence (e.g., ASER, 2013) of wide variations in reading scores among many learners in India. Thus, a grade-appropriate level of reading proficiency could not be assumed. This was also done with the intention of keeping testing cost-efficient but comprehensive. By setting a conservative cut-off of 30% for a child to

pass and be eligible for the next level of reading subskills, we did not conduct multiple tests where the chances of the child scoring zero were extremely high. The progression of subskills was based on the theoretical framework and the literature of the stages of reading, as discussed previously. Annex D presents a flowchart of eligibility criteria for all FRAME tests.

Data were collected from each child in Lit 1 (Kannada in the state of Karnataka or Telugu in the state of Andhra Pradesh) and Lit 2 (English). To avoid testing fatigue effects on either language, the language in which the data were collected from each child was counterbalanced such that about half the children had their data collected in Lit 1 first and the other half had their data collected in Lit 2 first, and vice versa. All data were collected on the school grounds during school hours in a quiet, separate classroom or outside space. All testing was voluntary, and anonymity was guaranteed.

The hub monitors oversaw and supported all data collection activities and logistics, including conducting planned and spot checks, scheduling testing, securing data transfer procedures, leading refresher training sessions, and troubleshooting any technical aspects of data collection. Two data collectors were assigned to each school and were always present together to increase accountability and support for unforeseen circumstances. In addition, the data collectors maintained a log book in which they wrote daily reports and were required to attend weekly review meetings to continuously monitor all data collection activities.

5.0 Results

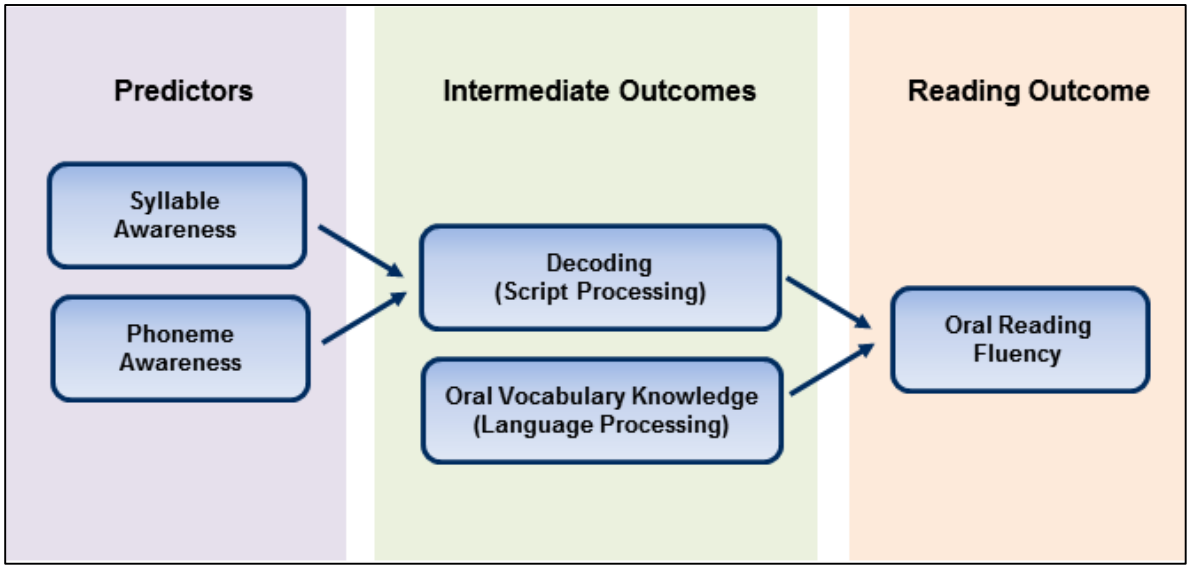
Initial data cleaning and descriptive analyses were conducted to select the key variables of interest for answering each research question. Through this process, only syllable awareness, phoneme awareness, oral vocabulary knowledge, decoding, oral reading fluency accuracy, and oral reading fluency comprehension were selected because of their high reliability scores and their role in explaining reading acquisition processes in multilingual learners. Rounds 1 and 3 tested the same sub-skills over one school year, and thus we compared these scores for all questions that were focused on longitudinal differences or patterns of learning over time. For all cross-sectional analyses, where we were interested in a snapshot of reading development, we utilized the data from Rounds 2 and 3 due to their higher reliability scores than Round 1. In addition, the *akshara knowledge* test scores were combined with decoding scores in Lit 1 (Kannada and Telugu) because they measured the ability to map graphemes to phonemes, which draws on the same psychological process. As measured in this study, *akshara knowledge* did not measure any additional orthographic manipulation ability. A final point to note is that we have merged the data from the two states for research purposes, and Lit 1 represents Telugu scores for Andhra Pradesh participants and Kannada scores for Karnataka participants.

Research Question #1: What Are Levels of Various Reading Subskills in Both Languages?

The objective of the first research question was to determine where children stood on the various subcomponent aspects of reading. As laid out in the literature review, reading is a componential process in which various cognitive and linguistic skills are required to support the development of literacy. At the bare minimum, reading is a combination of language processing skills (i.e., comprehending spoken language) and script processing skills (i.e., the ability to map symbols and sounds and "sound out" text). This question describes learners' ability levels in

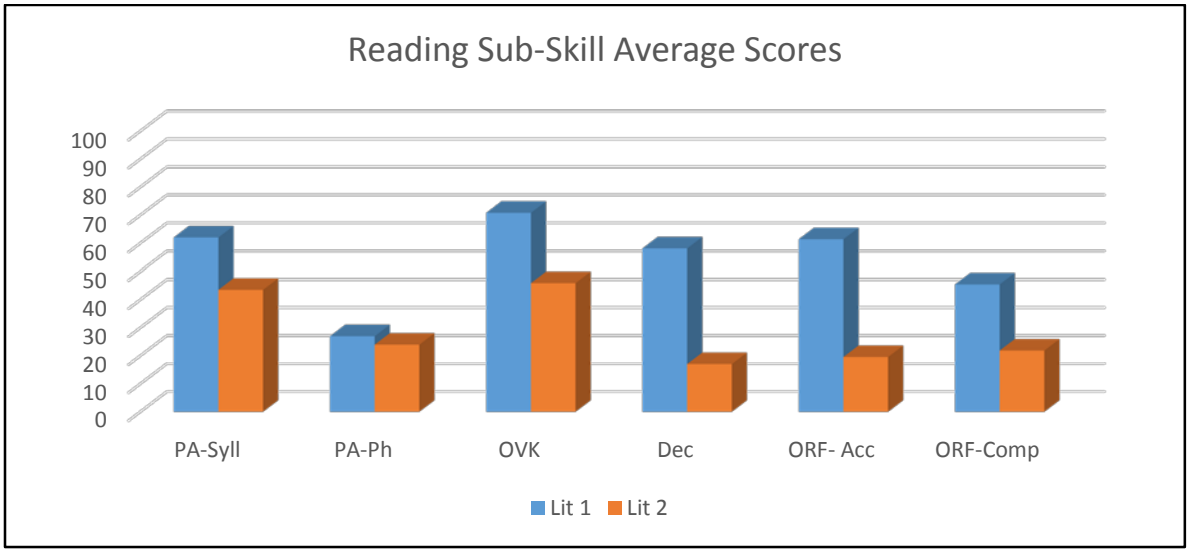
these two skills, and various other subskills, when relevant. We also disaggregate the scores for selected relevant subgroups and compare the scores to established benchmarks for reading tests commonly used in India, such as the ASER test. Figure 4 offers a graphical representation of the theoretical links between reading subskills.

Figure 4. Theoretical links between reading subskills and processes



As a first step, we present the mean scores of the key reading subskills in Lit 1 and Lit 2 for the entire sample (Figure 5). The table in Annex E provides detailed summary statistics on all reading subskills, including standard deviations and Cronbach's alpha reliability scores.

Figure 5. Mean scores of key reading subskills in Lit 1 and Lit 2



Note. PA-Syll = syllable awareness; PA-Ph = phoneme Awareness, and OVK = oral vocabulary knowledge; Dec = decoding; ORF-Acc = accuracy of oral reading comprehension; ORF-Comp = comprehension of questions after oral reading fluency.

Not surprisingly, these data show that students performed better in Lit 1 than in English on all reading subskills, except phonemic awareness (syllable awareness: $t(423) = 14.91$, $p < .001$; oral vocabulary knowledge: $t(422) = 23.42$, $p < .001$; decoding: $t(431) = 26.10$, $p < .001$; oral reading fluency accuracy: $t(372) = 24.23$, $p < .001$; oral reading fluency comprehension: $t(336) = 12.72$, $p < .001$). Looking at the two phonological awareness subskills—the building block of decoding development (e.g., Adams, 1990)—we see that children struggle much more with phonemic awareness than syllabic awareness in *both* languages, despite the fact that both skills are required for literacy acquisition in Kannada and Telugu (Nag, 2007) and are important for transfer from the Indian language to English (Reddy & Koda, 2013). These data also reveal extremely low decoding ability (about 17.6% on average) in English.

Another important finding here is the contrast between reading accuracy scores (the number of words that were decoded correctly) and reading comprehension scores (the number of comprehension questions that were correctly answered after reading a passage) in the Indian language and in English. In Kannada and Telugu, accuracy scores were considerably higher than comprehension scores, but the scores were almost the same in English. We did not conduct a *t*-test to test whether these differences were significant in this case, because there were several children who did not attempt the comprehension questions because they could not understand the text. If we do include these children, the results get skewed toward a much higher comprehension score than may be true.

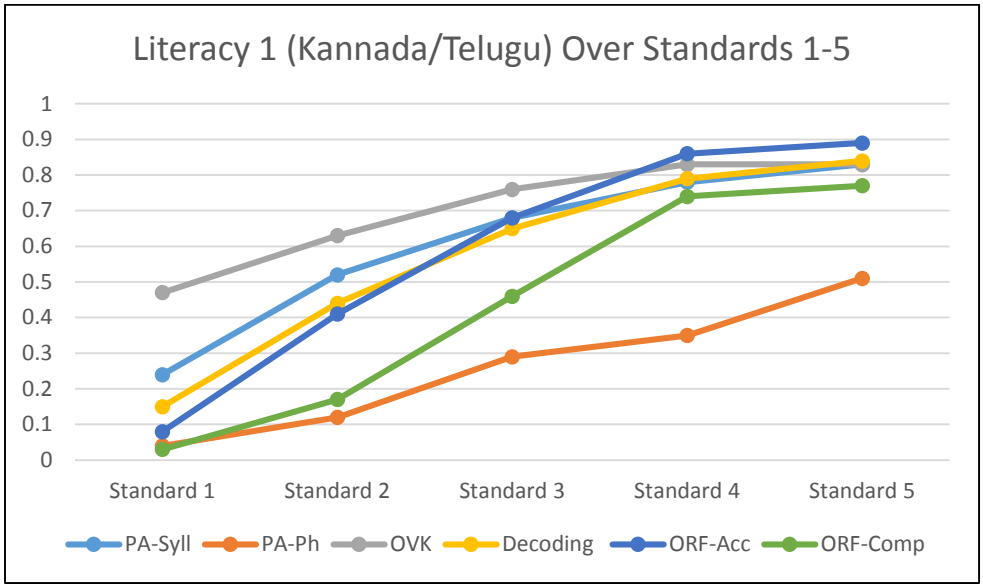
This finding suggests that a child can sound out and pronounce correctly words written in an alphasyllabic, transparent language without necessarily comprehending what the words mean. In other words, the one-to-one application of sounds to symbols in the Lit 1 could support the ability of children to fluently read text out loud, but this does not mean that they understand what they are reading. Because comprehension is the ultimate goal of reading, this is an important aspect that needs to be measured in any assessment. In English, on the other hand, accuracy scores and comprehension scores are more closely related—that is, if children can fluently read text out loud, they are more than likely to comprehend what they are reading.

In interpreting the *levels* of achievement in these subskills, it is important to note that the scores reported are from children who made the cut-off to be eligible, which was about 91% of the entire sample for decoding, 76% for Lit 1 oral reading fluency, and 62% in Lit 2 oral reading fluency.

Figures 6 and 7 plot the scores in reading subskills for Lit 1 and Lit 2 by grade to show the cross-sectional differences across the primary school years. In both languages, syllable awareness consistently grows across the years, but phoneme awareness remains low over the years. This finding likely results from the fact that the syllable is salient in Indian writing systems, despite the necessity of phoneme knowledge for reading development (Nag, 2007). It is also possible that not enough pedagogical attention is given to phoneme awareness. Oral vocabulary skills are generally high, but their growth rate appears to plateau and not increase robustly as Standards increase. This could be due to the limited amount of teaching time allocated to oral language skills—something that may be taken for granted or seen as a separate skill from reading acquisition. Scores in decoding and oral reading fluency grew from Standard 1 to Standard 5, which is encouraging. These data also appear to show that reading accuracy scores and reading comprehension scores parallel each other across the Standards in Lit 1, and therefore might be

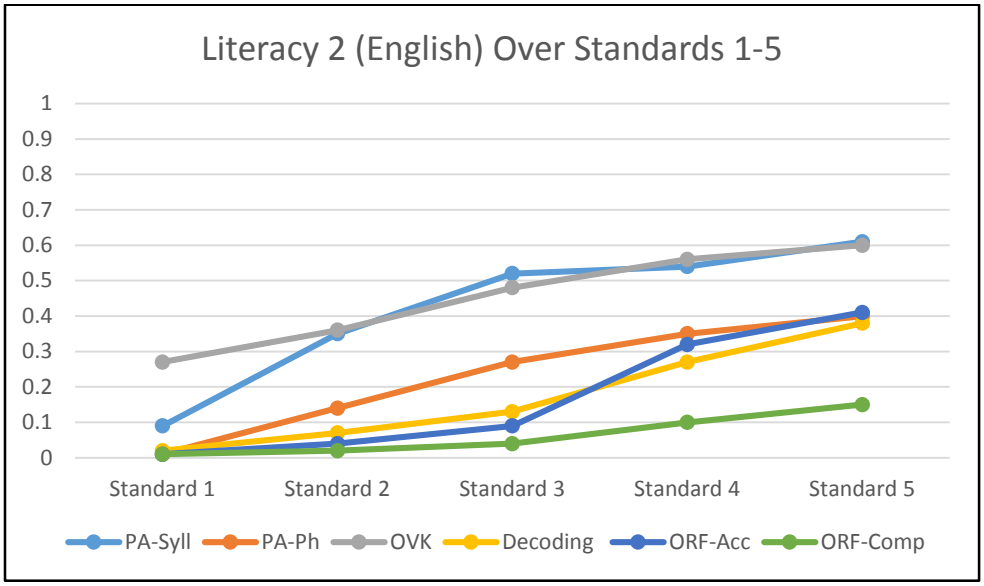
separate constructs in the alphasyllabic languages; but they appear to be overlapping constructs until Standard 3 in English, at which point they begin to diverge. Thus, oral language skills may be less supportive of reading accuracy in the Lit 1 than the Lit 2 in the very early stages of biliteracy development in this sample.

Figure 6. Lit 1 scores, Standards 1–5



Note. PA-Syll = syllable awareness; PA-Ph = phoneme awareness, and OVK = oral vocabulary knowledge; Dec = decoding; ORF-Acc = accuracy of oral reading comprehension; ORF-Comp = comprehension of questions after oral reading fluency.

Figure 7. Lit 2 scores, Standards 1–5

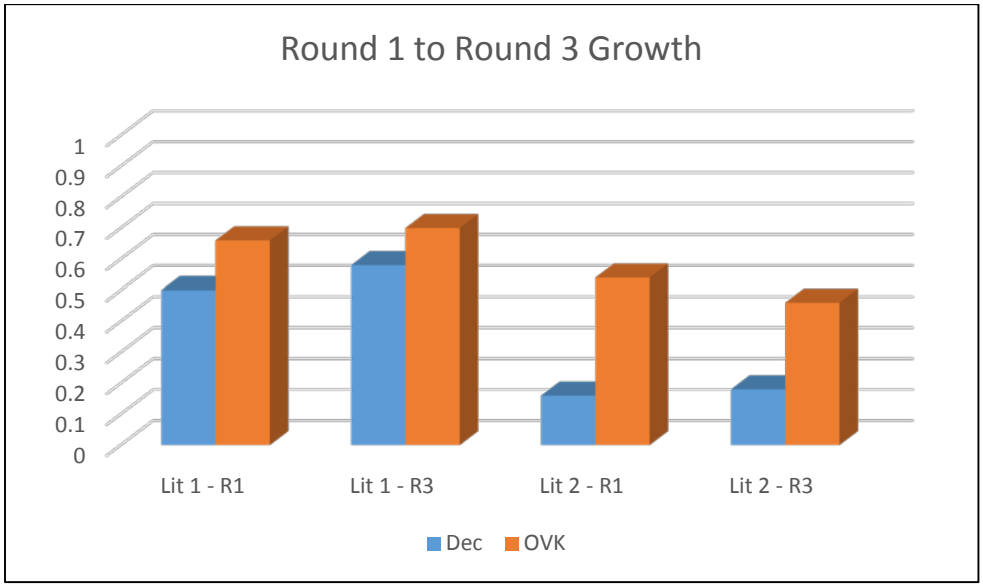


Note. PA-Syll = syllable awareness; PA-Ph = phoneme awareness, and OVK = oral vocabulary knowledge; Dec = decoding; ORF-Acc = accuracy of oral reading comprehension; ORF-Comp = comprehension of questions after oral reading fluency.

We now turn our attention to decoding and oral vocabulary knowledge,[12] two important reading skills, and disaggregate these scores by various important subgroups and time points.

Figure 8 compares the decoding and oral vocabulary knowledge scores from Round 1 and 3 of data collection, which were collected one school year apart. For Lit 1, paired sample *t*-tests revealed significant growth over the year in decoding scores ($t(374) = -.8.72$, $p < .001$) and oral vocabulary knowledge scores ($t(424) = -.5{,}35$, $p < .001$). However, for Lit 2, significant growth was seen in only decoding scores ($t(349) = -5.12$, $p < .001$). Oral vocabulary knowledge scores in English actually declined significantly over the year ($t(392) = 6.37$, $p < .001$). To ensure this was not due to test differences, we also conducted the same analysis for just the items that were the same in Rounds 1 and 2 of data collection, and found a similar result. These results highlight the lack of importance given to oral language skills in the current teaching system, especially in the Lit 2, despite the proven predictive role of oral language skills in supporting literacy growth.

Figure 8. Decoding and oral vocabulary knowledge scores from Rounds 1 and 3



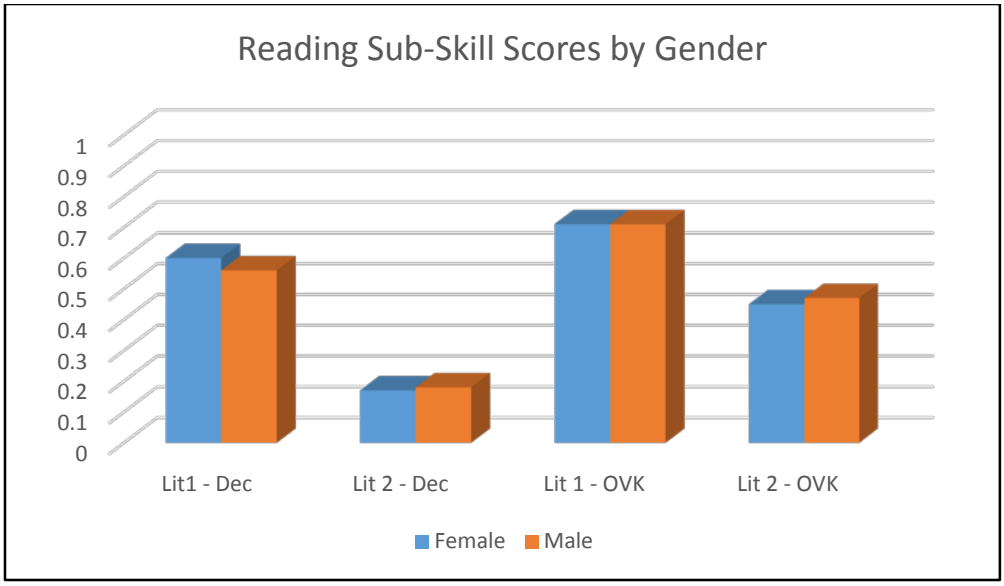
Note. Dec = decoding; OVK = oral vocabulary knowledge; R1 = Round 1 of data collection; R2 = Round 2 of data collection.

Because of the growing importance of understanding and improving gender equality in learning outcomes, Figure 9 reports scores for reading subskills by gender. According to independent sample *t*-tests, there were no significant differences in any of the subskills across girls and boys, suggesting an encouraging pattern for reading achievements in this sample of primary school children in India. However, it is important to point out that when looking at the data for specific subgroups, some gender effects were still observed. For example, we found that girls in rural areas scored significantly higher than boys in rural areas on Lit 1 decoding scores ($t(293) = 2.12$, $p < .05$) but not on English scores. We also found that girls in urban areas did better than girls in

[12] We chose these two subskills as the most important for these analyses because (a) they represent the two subconstructs that are the most significant predictors of reading comprehension in the early grades (e.g., Gough & Tunmer, 1986), (b) their high reliability scores in our study, and (c) the large number of students who met the eligibility criteria and actually completed the test.

rural areas on Lit 2, but not Lit 1. Therefore, although we see more girls doing well in schools when compared with boys, it is important to factor in urban–rural distinctions and language distinctions when interpreting gender equality trends in learning outcomes.

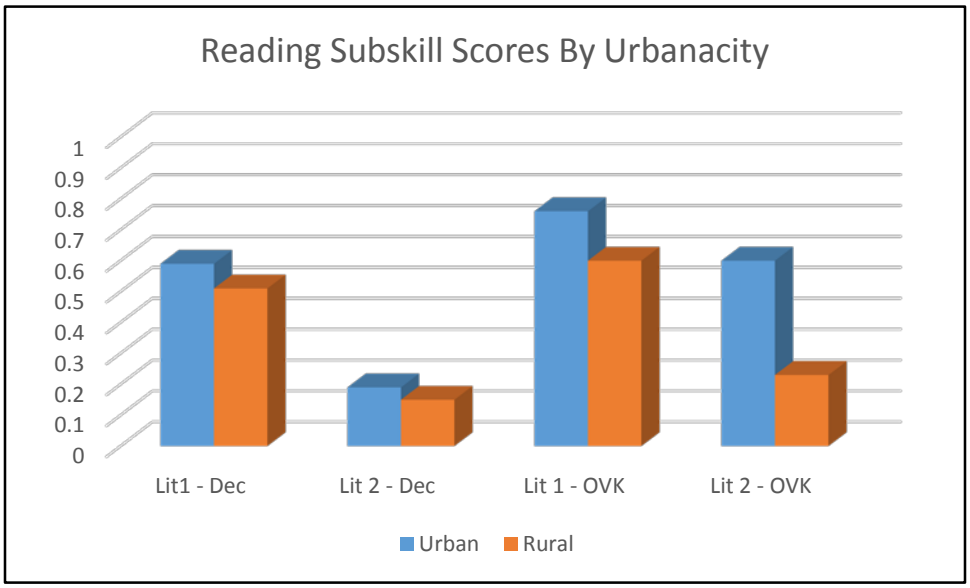
Figure 9. Scores for reading subskills, by gender



Note. Dec = decoding; OVK = oral vocabulary knowledge.

Figure 10 presents scores for reading subskills by urban and rural areas. Low-income urban slum communities are growing at a rapid rate (UNFPA et al., 2013). These communities affect learning in various ways. Despite being characterized as high poverty, more resources are finding their way into these neighborhoods, especially low-cost digital technologies, English language resources, and more global products. Slums are also characterized by much more linguistic heterogeneity than villages, which also affects learning outcomes in significant ways. In this study, children in urban areas outperformed children in rural areas on all skills, but the difference was significant only for oral vocabulary knowledge for Lit 1 ($t(270) = 4.94$, $p < .001$) and Lit 2 ($t(261) = 12.26$, $p < .001$). This finding may point to the fact that exposure to spoken language (through TVs, cell phones, radios, and a generally more populated environment) could lead to higher scores in language skills; however, it is also possible that the rural schools in this sample were higher performing than most. Either way, the urban–rural distinction in learning achievements may be more nuanced than previously thought, and thus warrants further research with larger samples on factors that might contribute to these differences.

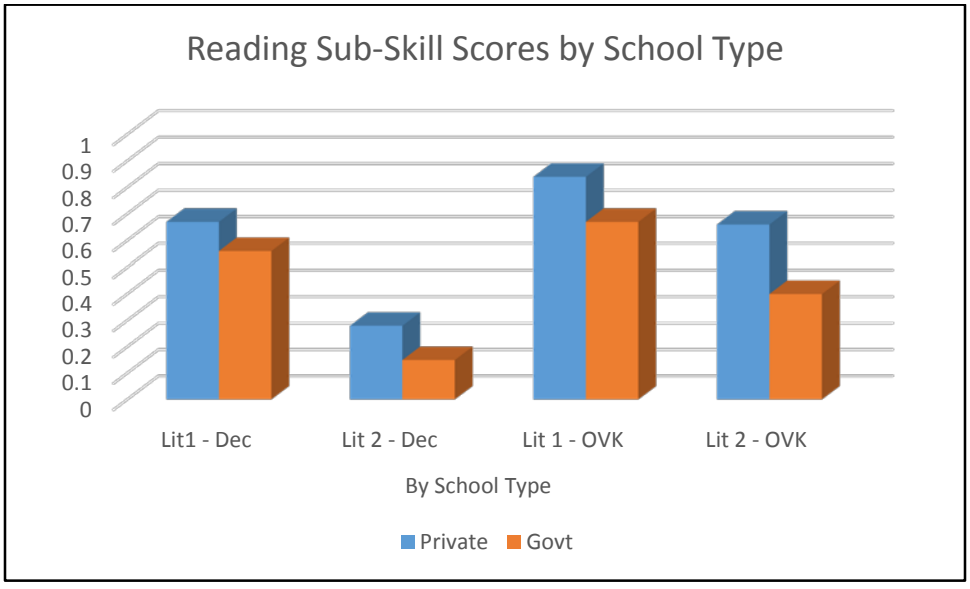
Figure 10. Scores for reading subskills, by urban and rural areas



Note. Dec = decoding; OVK = oral vocabulary knowledge.

Figure 11 provides a final breakdown of the data by school type. Private schools outperformed public schools on all measures: Lit 1 decoding ($t(438) = 2.57$, $p < .05$), Lit 1 oral vocabulary knowledge ($t(434) = 6{,}12$, $p < .001$), Lit 2 decoding ($t(438) = 3.84$, $p < .001$), and Lit 2 oral vocabulary knowledge ($t(428) = 8.73$, $p < .001$). Again, there is limited evidence of what exactly accounts for these private school advantages on particular reading outcomes; however, resource use availability or efficiency, teacher training, teacher absence, teacher motivation, and student motivation are all possible reasons (e.g. Nazmul, Hammer, Kremer, Muralidharan, & Rogers, 2006).

Figure 11. Scores for reading subskills, by school type



Note. Dec = decoding; OVK = oral vocabulary knowledge.

In one final analysis to understand the current state of reading subskills in this sample of primary school children in India, we compared the "zero scores" in our tests to the tests conducted by the ASER (2013). Our data showed the following percentage of children in the entire sample scored zero on the following subskill tests: 33% in Lit 1 decoding, 1.4% in Lit 1 oral vocabulary knowledge, 43% in Lit 2 decoding, and 6.3% in Lit 2 oral vocabulary knowledge. Several more students scored just above zero, so reporting just zero scores may not be useful unless the numbers are exceedingly high. According to ASER (2013), 22% of children in Karnataka and 18.5% in Andhra Pradesh could not read a single word.

Before interpreting the comparison of our results to national and regional assessment data from India, we underscore that our tests were created to examine the sources of variance that might predict reading success, and therefore were not designed for assessing levels of reading in a particular representative sample. That said, our results show comparable results in terms of word reading outcomes with the ASER scores. The additional analysis of oral language skills in our study provides an important contrast in the abilities children have in oral language skills (which are much higher) than script processing skills in these low-income communities of South India. Given that oral language skills is one of the most important building blocks of all reading ability, this nuanced understanding of the separate constructs—oral language abilities versus decoding abilities—provides a window into the multidimensional cognitive and linguistic resources available to students for biliteracy achievement in multilingual environments.

Research Question #2: What Are the Cognitive and Linguistic Predictors of Reading Outcomes Within Each Language?

The intent of this research question was to investigate which cognitive and linguistic factors predict decoding outcomes in the Lit 1 (Kannada or Telugu) and Lit 2 separately. Table 3 reports all bivariate correlations within and across languages. The reason we chose decoding skills as the outcome of interest was that there was limited variance and very low scores on reading comprehension in this sample.

First, we examined the predictors of success in Lit 1 decoding ability. Given the significant correlations between syllable awareness, phoneme awareness, and oral vocabulary knowledge and decoding skills (Table 3), we conducted a multiple regression analysis to test if each of these Lit 1 variables predicted Lit 1 decoding outcomes. The results of the regression demonstrated that these three predictors together accounted for approximately 65% of the variance in Lit 1 decoding ($R^2 = .65$, $F(3,413) = 252.85$, $p < .001$). Syllable awareness ability ($\beta = .54$, $p < .001$), phonemic awareness ability ($\beta = .14$, $p < .01$), and oral vocabulary knowledge ($\beta = .38$, $p < .001$) each independently contributed to alphasyllabic decoding ability in Kannada or Telugu. These results imply the importance of teaching each of these skills for the development of fluent decoding ability in the alphasyllabic languages of South and Southeast Asia, reflecting the nature of the script.

Second, we examined the predictors of Lit 2 (English) decoding ability. Again, we see significant correlations between syllable awareness, phoneme awareness, oral vocabulary knowledge, and the outcome decoding skills in English. Multiple regression results for these variables indicated that syllable awareness was not a significant predictor of English decoding ability, which is also in line with the nature of the alphabetic script. Only phoneme awareness ($\beta = .41$, $p < .001$) and oral vocabulary knowledge ($\beta = .28$, $p < .001$) were significant predictors

of English Lit 2 decoding ability, and these two abilities together accounted for about 44% of the variance in English decoding (R^2 =.44, $F(3, 413) = 107.53$ $p < .001$). These findings suggest that for English as a secondary literacy, it is important to teach English phonemic awareness and oral vocabulary skills for English decoding ability. This is also a manifestation of the alphabetic script, which necessitates phonemic skills for mapping each sound to each letter, and is in line with the research on monolingual alphabetic readers.

Table 3. Bivariate intercorrelations of reading subskills in Lit 1 and Lit 2

Reading Subskill	1	2	3	4	5	6	7	8	9	10	11	12
1. Lit 1 PA-Syll	—											
2. Lit 1 PA-Ph	.65***	—										
3. Lit 1 OVK	.58***	.52***	—									
4. Lit 1 Dec	.75***	.60***	.63***	—								
5. Lit 1 ORF-Acc	.71***	.57***	.62***	.87***	—							
6. Lit 1 ORF-Comp	.53***	.46**	.48**	.69***	.75****	—						
7. Lit 2 PA-Syll	.70***	.59***	.51***	.65***	.61***	.51***	—					
8. Lit 2 PA-Ph	.51***	.49***	.37**	.50***	.46**	.42**	.75***	—				
9. Lit 2 OVK	.52***	.52***	.64***	.56***	.53***	.50***	.59***	.53***	—			
10. Lit 2 Dec	.42**	.53***	.34**	.51***	.46**	.49***	.50***	.59***	.52***	—		
11. Lit 2 ORF-Acc	.42**	.50***	.36**	.55***	.50***	.55***	.49**	.57***	.54***	.82***	—	
12. Lit 2 ORF-Comp	.25**	.30**	.26**	.40***	.35***	.41***	.33**	.47**	.45**	.68***	78***	—

Note. PA-Syll = syllable awareness; PA-Ph = phoneme awareness, and OVK = oral vocabulary knowledge; Dec = decoding; ORF-Acc = accuracy of oral reading comprehension; ORF-Comp = comprehension of questions after oral reading fluency.
*p < .05. **p < .01. ***p < .001.

Research Question #3: What Are the Cognitive and Linguistic Predictors of Reading Outcomes Across Both Languages?

For this question, we examined the cross-language influences from the primary alphasyllabic literacy to the secondary literacy English. As in question #2, we focus on decoding outcomes in this questions as well due to the very low reading comprehension outcomes scores in English. Given that syllable awareness was not a significant predictor of within-language English decoding, it was not included in the model for this analysis. In this multiple regression, we included the significant English predictors—phonemic awareness and oral vocabulary knowledge—*and* added Kannada or Telugu Lit 1 decoding ability to examine their roles in Lit 2 English decoding. In this model, English phoneme awareness ($\beta = .37$, $p < .001$), English oral vocabulary skills ($\beta = .21$, $p < .001$), and Kannada or Telugu decoding skill ($\beta = .15$, $p < .001$) were significant predictors of English decoding; together accounting for approximately 46% of the variance in English Lit 1 decoding ($R^2 = .46$, $F(3, 406) = 116.12$, $p < .001$).

This result is also in line with the Transfer Facilitation Model, in which we see evidence that Lit 1 reading ability transfers and predicts the likelihood of success on English reading. Furthermore, this result speaks to the importance of sustaining Lit 1 instruction for the likelihood of increasing Lit 2 reading ability. What is still unknown is for how long to sustain Lit 1 for biliteracy outcomes—a question we turn to next.

Research Question #4: Does the Relationship Between Lit 1 and Lit 2 Reading Outcomes Change Significantly at Any Given Threshold of Lit 1?

As discussed previously, our conceptual framework suggests that there might be a threshold value of decoding and reading outcomes in Lit 1 below which students might not have sufficient ability to transfer this skill and facilitate decoding and reading in English. In other words, students who have limited Lit 1 decoding skills might not improve their English decoding skills by much even if their Lit 1 decoding skills improve substantially. However, students with a reasonable knowledge of Lit 1 decoding might improve their English decoding skills substantially even if their Lit 1 decoding skills improve only marginally.

We tested this hypothesis by using a three-stage statistical procedure to determine the nonlinearities in the relationship between Lit 1 decoding outcomes and Lit 2 English decoding outcomes for the students in our sample. First, we examined the association between Lit 1 and Lit 2 decoding using a univariate locally weighted regression model. These models allow for nonlinearities in the association between Lit 1 and Lit 2, by fitting linear regression models to observations in the neighborhood of a point that is associated with a certain local language decoding skill. In other words, different levels of Lit 1 decoding skills are associated with different levels of correlation between Lit 1 and Lit 2 decoding outcomes. As such, we estimated the locally weighted regression model for those students who were eligible for the decoding test. This model analyzed the potential for nonlinearities in the association between Lit 1 and Lit 2 decoding outcomes by allowing for different correlations between the two across the distribution of Lit 1 decoding skills.

Second, we analyzed the relationship between Lit 1 decoding outcomes and English decoding outcomes by analyzing the two-dimensional scatterplots between the two variables (Figures 12

and 13). These two-dimensional scatterplots indicate whether a threshold value of decoding exists, and if so, how high that threshold value might be. Basically, the threshold value can be approximated by determining the value of Lit 1 decoding above which the correlation of the relationship between Lit 1decoding outcomes and English decoding outcomes increases substantively. This can be examined by a visual analysis of the two-dimensional scatterplots.

Third, we formally tested for the existence of a threshold value of Lit 1 decoding by analyzing the difference in correlations between Lit 1 and English decoding outcomes below and above the threshold value that was identified. We used multivariate Ordinary Least Squares regression analysis to determine the linear relationship between Lit 1 decoding and English decoding skills both below and above the threshold value that was identified. Then we examined whether these relationships were statistically significantly different from each other by conducting a Chow test. The Chow test can be used to determine whether there is a structural break in the relationship between two variables. In this case, the structural break may happen above the threshold value of local language decoding.

We first present the joint locally weighted regression models from the full sample in Rounds 1 and 3. We looked at Rounds 1 and 3 for this question in order to examine differences between the beginning and end of the school year. For the locally weighted regression models, we used a bandwidth of 0.3. This ensured that only 30% of the observations that are closest to the specific value of local language outcomes would be used to determine the correlation between Lit 1 outcomes and English outcomes. The smaller the bandwidth, the closer the estimate of the correlation will confirm the data. However, the use of bandwidths < 0.25 is not recommended because the regression function will capture random noise instead of the real relationship between Lit 1 and English decoding outcomes (Jacoby, 2000).

Figure 12. Scatterplot of Lit 1 and Lit 2 decoding scores, Round 1

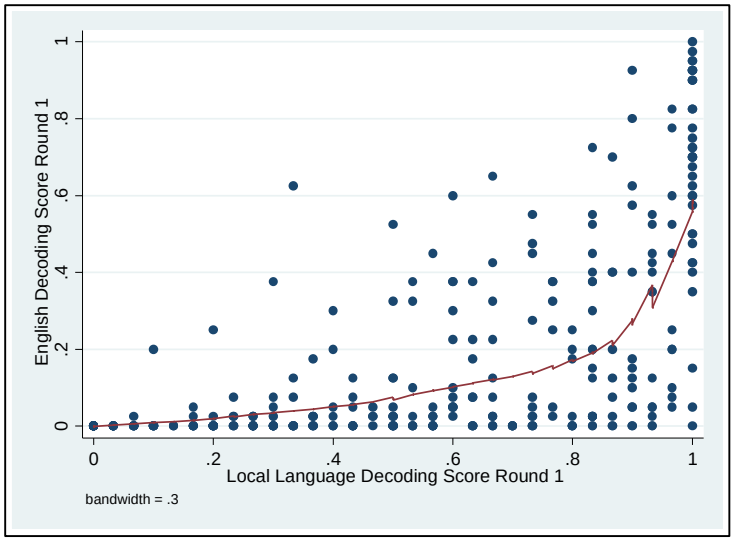
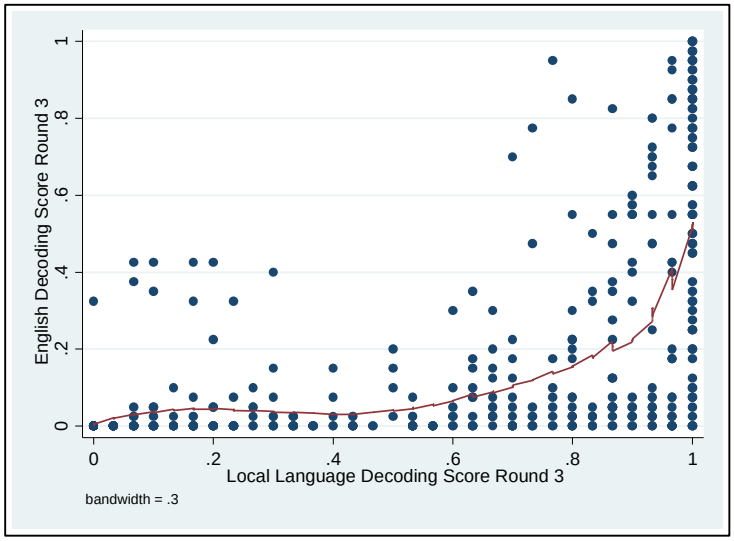


Figure 13. Scatterplot of Lit 1 and Lit 2 decoding scores, full sample, Round 3



A visual inspection of both scatterplots (Figures 12 and 13) indicates that the relationship between Lit 1 decoding outcomes and English decoding outcomes is much less steep below the potential threshold value of 0.6 for Kannada or Telugu reading skills than above the potential threshold value of 0.6. Importantly, this finding is consistent with the idea that children will not be able to improve their English decoding skills until they achieve a score 0.6 on Lit 1 decoding skills. In order to assess the formal relationship between Lit 1 decoding and English decoding skills below and above this potential threshold value of 0.6, we used a multivariate regression model, in which we included dummy variables for the state, school, grade, gender, urbanicity, and age of the students. The results are reported in Table 4.

Table 4. Threshold regression with control variables

	(1) Round 1 Score, English, Below Threshold	(2) Round 1 Score, English, Above Threshold	(3) Round 3 Score, English, Below Threshold	(4) Round 3 Score, English, Above Threshold
Lit 1 Decoding Score, Round 1	0.138**	0.733***		
	(0.0450)	(0.147)		
Lit 1 Decoding Score, Round 3			-0.00688	0.847***
			(0.0382)	(0.135)
Constant	0.298**	0.00555	-0.0356	-0.205
	(0.0934)	(0.311)	(0.0709)	(0.230)
Control Variables	Yes	Yes	Yes	Yes
Observations	174	162	181	240
R^2	0.357	0.595	0.376	0.575
Adjusted R^2	0.278	0.540	0.302	0.539

Note. Standard errors are presented in parentheses. Observations are below threshold if the local language score is < 0.6. Controlled for age, gender, school, grade, urbanicity, and state.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 4 clearly shows that the quantitative relationship between Lit 1 decoding skills and English decoding skills is larger above the threshold value of 0.6 than below the threshold value of 0.6. In Round 1, the association was more than 5 times as high above the threshold value (β = 0.733) as below it (β = 0.138). For Round 3, the results are even more striking. In fact, we found no positive relationship between Lit 1 decoding skills and English decoding skills below the threshold value (β = -0.205), while the relationship is large and statistically significant above the threshold value (β = 0.847).

As a last step in establishing this threshold value between an alphasyllabic Lit 1 and an alphabetic Lit 2, we determined whether the relationship between Lit 1 decoding skills and English decoding skills is statistically different below and above the threshold using the Chow test. Table 5 shows that in fact there was a clear structural break above the threshold value of 0.6. In both rounds, the Chow test demonstrated a significant difference at the 1% level in the correlations above and below the threshold value. Thus, importantly, this result is consistent with our hypothesis *that a threshold value of local language decoding skills exists below which children might not be able to improve their English decoding skills.*

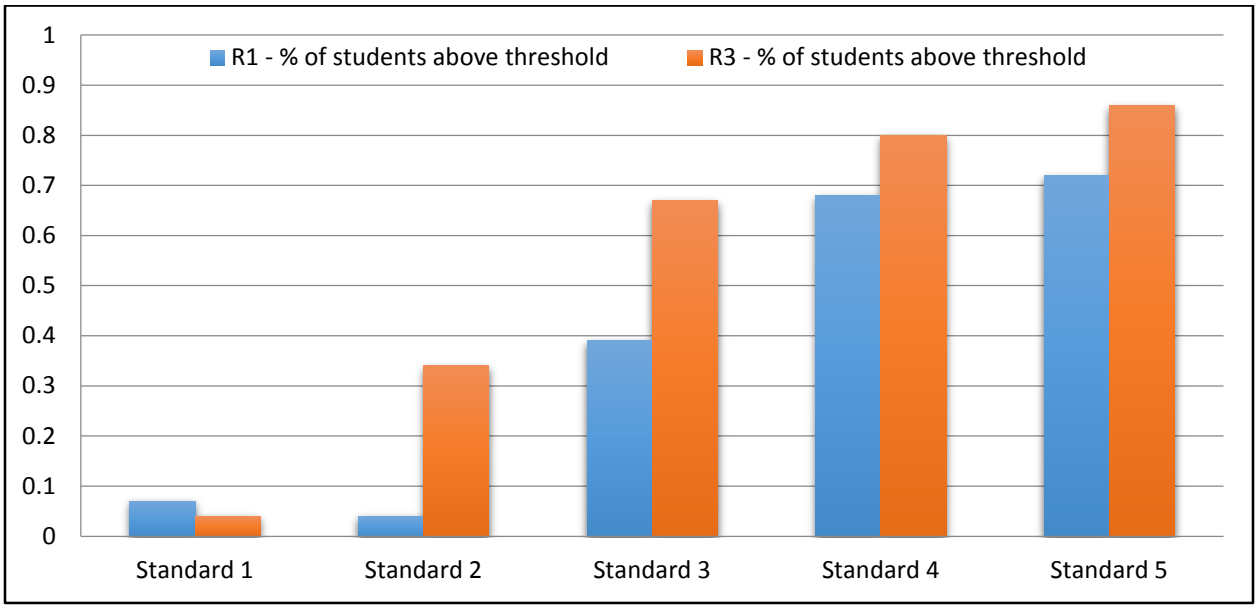
Table 5. Chow Test for structural break in relationship of Lit 1 and Lit 2 decoding

	(1) Round 1	(2) Round 3
Lit 1 Decoding Score, Round 1	0.197**	
	(0.0674)	
Above Threshold, Round 1	-0.903***	
	(0.110)	
Interaction Above Threshold Score, Lit 1, Round 1	1.241***	
	(0.141)	
Lit 1 Decoding Score, Round 3		0.0141
		(0.0821)
Above Threshold, Round 3		-0.847***
		(0.109)
Interaction Above Threshold Score, Lit 1, Round 3		1.251***
		(0.145)
Constant	-0.0108	0.0310
	(0.0232)	(0.0240)
Observations	338	431
R^2	0.494	0.382
Adjusted R^2	0.489	0.378
Chow Test	38.50***	37.34***

Note. Standard errors are presented in parentheses. Observations are below threshold if the Lit 1 score is < 0.6.
*p < .05. **p < .01. ***p < .001.

To further examine approximately how many children in each Standard had achieved this Lit 1 transfer threshold level of 0.6, we conducted a descriptive analysis of the breakdown of students above and below the threshold at the beginning and end of each school year. As Figure 14 indicates, in Round 3 of data collection (at the end of the school year), almost all of the students in Standard 1, about three-fifths of the students in Standard 2, more than one-third of the students in Standard 3, and about one-fifth of the students in Standard 4 did not (yet) have the required Lit 1 Kannada or Telugu decoding skills to make improvements in English decoding skills. These students included those who did not qualify for the decoding test because they also had decoding skills below the threshold value.

Figure 14. Distribution of students above and below the threshold at Rounds 1 and 3, by standard



6.0 Implications for Alphasyllabic-Alphabetic Biliteracy Program and Policy

The results of this 2-year research study have several implications for the design of literacy programs for alphasyllabic-alphabetic biliteracy learners. Below we list some key guidelines and recommendations that stem from the results.

6.1 Recommendations for Teaching and Assessment Approaches

The following are recommendations for teaching and assessing an **alphasyllabic Lit 1.** In this case, the languages were Telugu and Kannada, but these are applicable to any alphasyllabic languages that are used across South Asia, Southeast Asia, and some countries in Africa.

- Because of the *dual syllabic and phonemic* nature of the orthography (called *akshara* in Kannada and *aksharamu* in Telugu), children should be explicitly taught *both* syllable and phoneme awareness for fluent decoding ability. This is critical for acquiring the sound–symbol mapping rules in these languages, and in turn, is an important predictor of later reading success. Dual syllable and phoneme awareness can be taught and assessed in several ways, for example:
  - Explicitly segment each *akshara* syllable block into their representative phonemes and then ask students to play games or conduct activities that involve combining and or taking apart the phonemes in each syllable block.
  - Start teaching *akshara* as whole syllables, and then sequentially add the phoneme markers into more complex syllables (move from C+shwa to C+V to C+V+V[13] etc.).

[13] C = consonants; V= vowels, and schwa = an inherent sound that is part of all base *akshara.* It's a suppressed sound, such as the "e" sound in "taken" in American English pronunciation.

  - Teach rhymes, songs, games, and other activities where children have to match syllable and phoneme sounds to their appropriate symbols (which can be done on big pieces of cardboard, with sticks, mud, or stones, or through low-cost technology games).
  - Have large consonant and vowel matrix charts in the classrooms visually present as much of the time as possible.
  - Allow children to play with *akshara* where they can automatize the spatial position in which each phonemic marker goes. For example, any games and activities where children learn that adding an /i/ sound to any consonant always goes on top of the consonant.

- It is important to acknowledge the difference between oral language processing and script processing in any language—especially in transparent languages where there is a one-to-one correspondence between sounds and their symbols. Although the role of oral language skills increases in the later classes (after Standard 3), teachers should support these skills as early as possible, creating a safety net for children who may not have the language skills to cope with more difficult comprehension activities in the later classes in elementary school. For example, oral language skills can be nurtured through radio, television, cell phone games, oral folktales, theatre, song, and rhymes in the classroom or in community settings. Teachers, parents, and other community members can—and should—be a part of this activity.
- International reading assessments that work with alphasyllabic and transparent languages should include comprehension subtests in their assessments, if not already doing so.

The following are recommendations for teaching an **alphabetic Lit 2** to alphasyllabic-alphabetic biliteracy learners (i.e., most children in multilingual environments learning English as a second—or later—language).

- Reflecting the alphabetic nature of the orthography, and as has been known for decades from research with English learners (Adams, 1991), phonemic awareness or the ability to hear, manipulate, and match individual sounds to their symbols, is critical for fluent decoding in English. Multiple tools and techniques are available for such a "phonics" approach to teaching English decoding (e.g. Jolly Phonics, Reading Rockets etc.)
- Oral language skills cannot be taken for granted in these second (or later) language learners. Thus, oral language skills must also be stressed in the classroom from the very early stages of exposure to languages. If there are not enough English resources in the immediate community, external low-cost technology solutions may be an option.
- In line with our theoretical framework of reading transfer and many studies on biliteracy acquisition, this study's results also stress that Lit 1 decoding is one the most important skills for developing Lit 2 decoding. Thus, sustained instruction in Lit 1 is one of the most important ways to improve reading in a local language *and English*.
- Finally, our results indicate an empirical tipping point of approximately 60% Lit 1 decoding ability for a significantly higher likelihood of "transfer" of knowledge to Lit 2 decoding, and thus effective *biliteracy outcomes.* In other words, children who can easily and accurately "sound out" approximately 60% of words in a grade-appropriate alphasyllabic word reading test are much more likely to succeed when formal English

instruction begins than a child who scores lower than this threshold. For children who score lower than 60% in a grade-appropriate alphasyllabic word reading test, small improvements are not associated with improvements in English. This threshold was achieved by approximately 80% of this sample at the end of Standard 4. Thus, it is important to use continuous assessment tools for decoding ability in Lit 1 in order to determine when it may be appropriate to begin teaching literacy in a new alphabetic language.

6.2 Recommendations for Curricular Design

Based on the findings from FRAME, which provide a breakdown of the reading subskills that predict biliteracy outcomes of students in Standards 1–5, as well as a synthesis of other existing research (e.g., August & Shanahan, 2006; Snow et al., 1998), Table 5 recommends a curricular framework for the skills to be taught in each language at the various grades for effective biliteracy outcomes. As can be seen, some skills are shared and therefore, can be taught once and will transfer to the new language. But some skills are more language-specific and need to be taught in both languages. Furthermore, some skills, such as vocabulary, remain a focus and keep increasing in difficulty throughout the grade levels. Other skills, such as concept of print and syllabic phonological awareness, are taught only in the first few years. Once students have mastered those foundational skills, they can move on to new skills. This preliminary plan needs further experimentation and implementation to determine its effectiveness, but it can be used as a general rule of thumb to supplement government curricula that are currently being used.

Table 5. Suggested curricular framework for developing alphasyllabic-alphabetic biliteracy

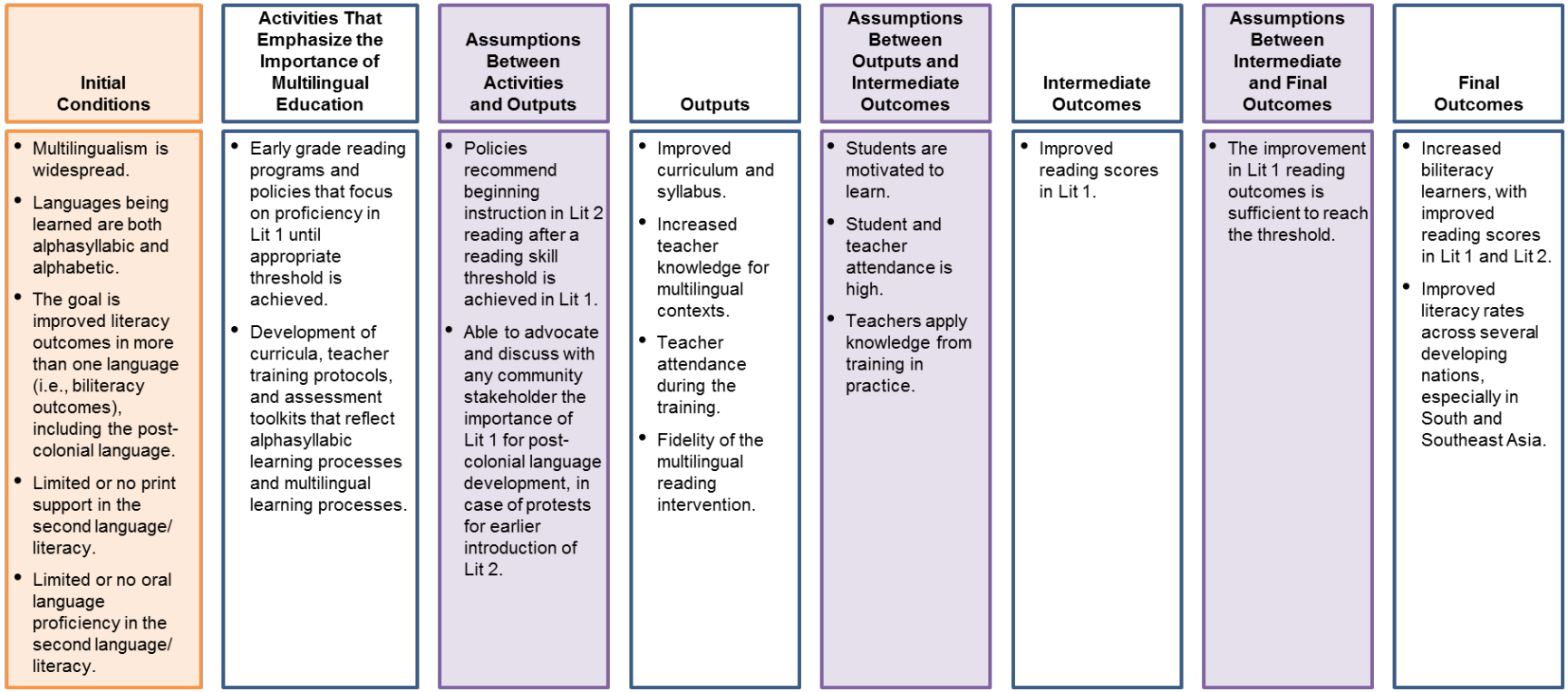
	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5
Concept of Print					
Phonological Awareness-Syllabic					
Phonological Awareness-Phonemic					
Symbol Knowledge					
Decoding					
Vocabulary (Spoken and Written)					
Spelling and Writing					
Morphological Awareness					
Listening Comprehension					
Reading Texts With Fluency and Comprehension					

Key: Kannada or Telugu = (blue); English = (pink).

6.3 Recommendations for Language-in-Education Policy Decisions

One of the main policy goals of this research was to present a testable multilingual-relevant theory of change. Figure 6 presents this preliminary theory of change, based on the findings from this study.

Figure 6. Preliminary multilingual-relevant theory of change



The proposed theory of change suggests that a comprehensive education policy should take multilingualism into consideration in the development of teacher, curricula, and assessment toolkits, but also in the development of other education programs, such as teacher attendance monitoring programs or programs to change the attitudes and behaviors of parents. For example, the theory of change indicates that monitoring teacher attendance could only increase reading scores in English if the improvement in Lit 1 reading outcomes, due to increased teacher attendance, is sufficient to reach the threshold. Furthermore, programs that aim to improve education outcomes by motivating parents to send their children to school might not be effective if parents are not supportive of the introduction of English only in a later stage.

We also make a case for **cross-language skill-level thresholds** for better tailoring programs for multilingual children. Based on our results, it is clear that for students with local language decoding skills that are below the threshold, it is close to impossible to improve English decoding skills. Therefore, we recommend not introducing English decoding in Standard 1 because students would most likely not be able to make progress in this area. Furthermore, we recommend teaching English decoding only to those students in Standards 2–5 who score above the threshold in local language decoding. This may require splitting classes, or providing teachers with toolkits to handle varying levels of Lit 1 proficiency in the same class. This is consistent with recent findings from a study in Haryana, India, where splitting classes resulted in an improvement in scores in written tests of Hindi (Duflo, Berry, Mukerji, & Shotland, 2014). However, the effect size in that study was small (0.135 standard deviations). Our analysis suggests that the impact of splitting classes on reading outcomes might increase if threshold analysis is considered when making decisions about the level at which to split classes. It may be optimal to split classes into students who score above and below the threshold value of local language decoding outcomes. This hypothesis needs to be tested using rigorous impact evaluations.

7.0 Conclusions

This research highlights some of the critical differences between monolingual and multilingual environments of learning and why research is required to support the development of rapid and scalable reading solutions in developing countries. In doing so, this study is one the first to establish *cross*-linguistic thresholds of transfer from alphasyllabic languages to an alphabetic language. An understanding of these empirical thresholds is vital for constructing effective multilingual reading programs and policies, and research such as this is needed in several multilingual contexts worldwide for more effective decision making. This research clearly demonstrates that even in the most resource-strapped environments, cognitive and linguistic skills predict reading outcomes in multilingual children, and these teachable and assessable skills should be considered seriously when developing reading policies and curricula in multilingual contexts.

As we grapple with the **learning crisis** that is gripping several communities across the developing world, it is important to bring **learning science** into the forefront of our agenda to improve **learning outcomes** and developing education curriculum and policy frameworks. To improve learning skills in young children in low-income communities worldwide, our question must expand from “does it work?” to “why does it work or not work” and “how do we make it work better” (see also White, 2014). This, by no means, negates the necessity of understanding if

a program works once it has been implemented. Nor, does this mean that we do not have any empirical understanding of the mechanisms underlying reading acquisition. However, critical gaps remain in our understanding of *why* a learning program works. This makes it challenging to plan and design effective programs with a limited number of resources. FRAME has begun to address one such challenge in terms of better understanding how children transition from a primary local language to English for successful biliteracy reading in the multilingual learning environments in India.

Annex A. Test Item Construction Details

Round of Testing	Test Name	# of Items			Test Construction Notes
		Kannada	Telugu	English	
Round 1	Concept of Print	9	9	—	Test questions adapted from Clay (1979). Book adapted from *Manchi Pustakam* (the publisher) with permission.
	Blending	15	15	Syllable 15, Phoneme 15	Adapted from Reddy and Koda (2013).
	Deletion	30	30	30	Adapted from Reddy and Koda (2013).
	Oral Vocabulary Knowledge	39	38	25	Items based on FRAME-generated word bank.
	Listening Comprehension	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Researcher-generated.
	Letter Naming	—	—	26	Researcher-generated.
	Decoding	Real words, 15; pseudo words, 15	Real words, 15; pseudo words, 15	Real words, 20; pseudo words, 20	English items were adapted from the Woodcock (1987) Word Identification Test and FRAME-generated word bank.*
	Reading Comprehension	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Researcher-generated.
	Slasher	—	—	—	Researcher-generated on common Indian fables.
Round 2	Oral Reading Fluency	22 words; 2 comprehension questions	18 words; 2 comprehension questions	20 words; 2 comprehension questions	Adapted from Pratham's ASER tests.
	Akshara Knowledge	20	20	—	Researcher-generated.
	Spelling	30	30	30	Researcher-generated based on the FRAME-generated word bank.
Round 3	Deletion	28	27	30	Adapted and based on findings from Round 1.
	Oral Vocabulary Knowledge	40	49	25	Adapted and based on findings from Round 1.
	Listening Comprehension	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Adapted and based on findings from Round 1.
	Letter Knowledge	—	—	26	Adapted and based on findings from Round 1.
	Decoding	Real words, 15; pseudo words, 15	Real words, 15; pseudo words, 15	Real words, 20; pseudo words, 20	Adapted and based on findings from Round 1.
	Reading Comprehension	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Level One, 8; Level Two, 8	Adapted and based on findings from Round 1.

* A set of government-mandated textbooks were analyzed and frequency counts were conducted in order to develop this word bank.

Annex B. Sample Items from the Tests and Photos of Data Collection Activities

Figure B-1. Page from the Concept of Print book used for testing, and testing in progress

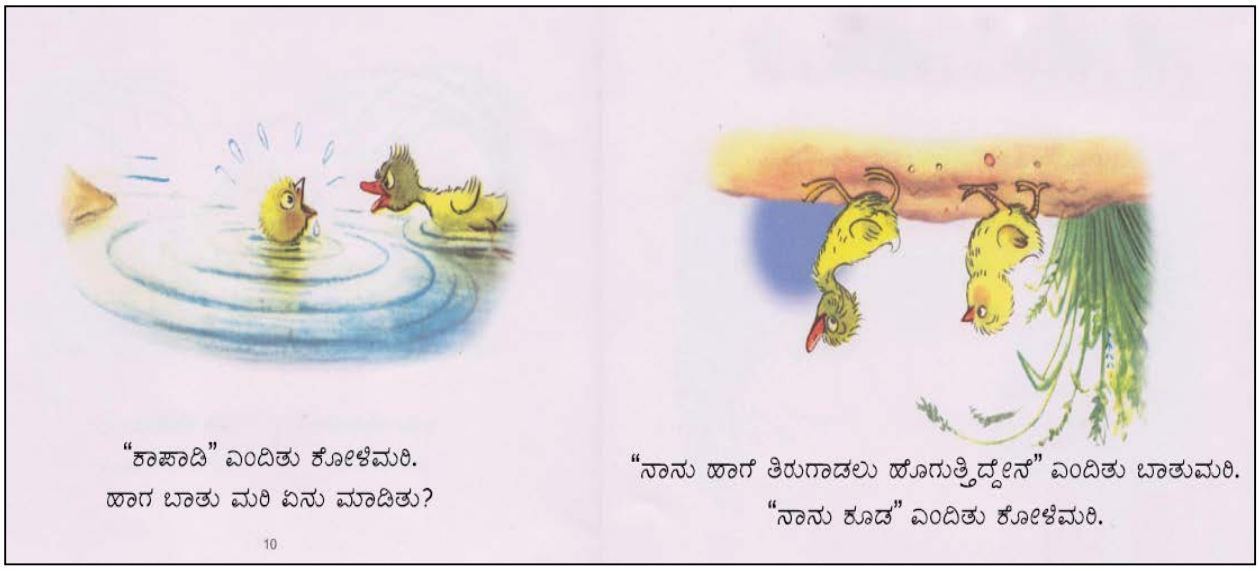


Figure B-2. Slides shown to children during the oral vocabulary knowledge test

Figure B-3. Concept of Print test, in progress

Figure B-4. Deletion test, in progress

Figure B-5. Letter Naming test, in progress

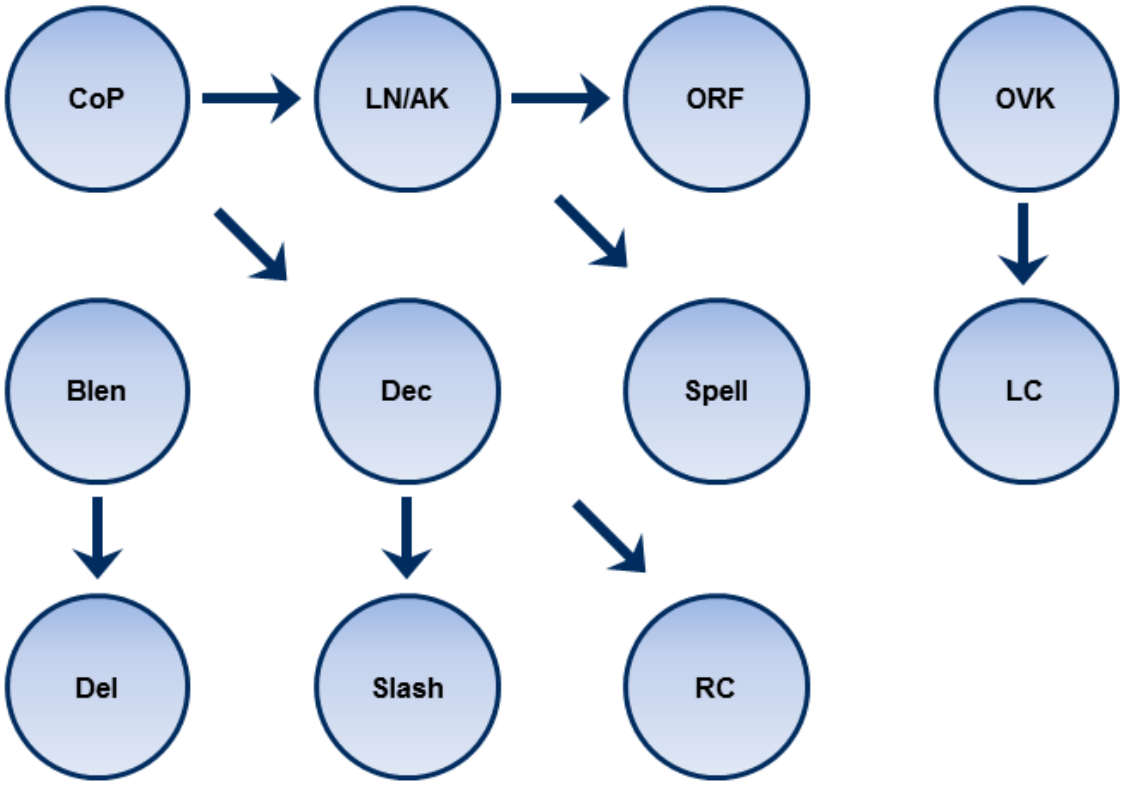
Annex C. Training Agenda for Data Collectors and Hub Monitors

Hub Monitor and Data Collector Training, Indian Social Institute, Bangalore ***Program Agenda***	
Day 1 Agenda—10th June 2013	
Time	**Activity**
9:30–10:00 a.m.	▪ Introduction by Mrs. Anita Reddy ▪ Introduction by Dr. Pooja Reddy Nakamura ▪ Introduction of all hub monitors, data collectors, and other attendees
10:00–10:30 a.m.	▪ Pooja—PowerPoint presentation about the project – Reading in India – FRAME Data Collection
10:30–10:45 a.m.	Morning Tea
10:45–11 a.m.	Team Building Exercise
11:00 a.m.–12:30 p.m.	▪ Distribution of manuals and training kits ▪ Training goals and training objectives and outcomes ▪ Expected project timeline ▪ Overall roles and responsibilities of data collectors and hub monitors ▪ Codes of conduct ▪ Overall data collection process (in brief)
12:30–1:15 p.m.	Lunch
1:15–4:00 p.m.	▪ Begin tests: – Overview – Concept of Print test – Phonological Awareness (Blending and Decoding) test
4:00–4:15 p.m.	Evening Tea
4:15–6:00 p.m.	▪ Letter Knowledge tests ▪ Practice all tests from this day ▪ Recap and review
DAY 2 Agenda—11th June 2013	
9:00–9:30 a.m.	▪ Recap events from Day 1 ▪ Feedback and review tests from Day 1 ▪ Q and A
9:30–10:30 a.m.	▪ Decoding test ▪ Oral Vocabulary Knowledge test
10:30–10:45 a.m.	Morning Tea Break
10:45 a.m.–12:30 p.m.	▪ Slasher Word Recognition test ▪ Practice
12:30–1:15 p.m.	Lunch Break
1:15–4:00 p.m.	▪ Reading Comprehension test ▪ Listening Comprehension test ▪ Practice

4:00–4:15 p.m.	Evening Tea
4:15–6:00 p.m.	▪ Continue any pending sessions ▪ Recap and review
Day 3 Agenda—12th June 2013	
9:00–10:30 a.m.	▪ Recap of Days 1 and 2 ▪ Training review ▪ Practice sessions
10:30–10:45 a.m.	Morning Tea
10:45 a.m.–12:00 p.m.	▪ Discuss remuneration process ▪ Conclude data collector training
12:00–12:45 p.m.	▪ Begin Hub Monitor training ▪ Hub Monitor responsibilities ▪ Diaries, data responsibilities (anonymity, confidentiality etc.) ▪ Logistics of training
12:45–1:15 p.m.	Lunch (optional)
Notes:	

Annex D. Flowchart of Test Eligibility Criteria

If students scored above 30% on a test with an arrow coming from it, they were eligible for the next test.



Note. CoP = concept of print; LN = letter naming; AK = akshara knowledge; ORF = oral reading fluency; Blen = blending; Dec = decoding; Spell = spelling; Del = deletion; Slash = slasher; RC = reading comprehension; OVK = oral vocabulary knowledge; and LC = listening comprehension.

Annex E. Means, Standard Deviations, and Summary Statistics for All Reading Subskills

	Kannada or Telugu						English				
	Max	**Min**	**Mean %**	**SD %**	**Cronbach's α**		**Max**	**Min**	**Mean %**	**SD %**	**Cronbach's α**
Round 1											
CoP (*N* = 473)	100	0	58.84	24.74	.79	CoP	—	—	—	—	—
LN	—	—	—	—	—	LN (*N* = 442)	100	0	62.00	32.81	.96
Dec (*N* = 414)	100	0	50.39	33.69	.97	Dec (*N* = 372)	100	0	15.61	25.32	.98
OVK (*N* = 461)	100	0	65.96	20.38	.90	OVK (*N*= 430)	100	0	53.92	19.75	.82
Spelling (*N* = 427)	96.67	0	24.33	23.40	.94	Spelling (*N* = 350)	66.67	0	7.5	12.23	.91
ORF-Acc (*N* = 428)	100	0	61.41	39.66	.97	ORF-Acc (*N* = 438)	100	0	19.58	31.59	.97
ORF-Comp (*N* = 426)	100	0	45.48	43.88	.79	ORF-Comp (*N* = 344)	100	0	21.88	37.74	.82
Round 3											
PA-Syll (*N* = 433)	100	0	62.05	35.97	.96	PA-Syll (*N* = 434)	100	0	43.56	34.37	.97
PA-Ph (*N* = 428)	100	0	27.00	32.54	.98	PA-Ph (*N* = 434)	100	0	23.98	32.78	.95
LN	—	—	—	—	—	LN (*N* = 442)	100	0	68.02	34.83	.97
Dec (*N* = 440)	100	0	58.14	36.41	.98	Dec (*N* = 440)	100	0	17.60	27.71	.98
OVK (*N* = 436)	100	0	70.85	24.42	.95	OVK (*N* = 430)	100	0	45.93	26.54	.91

Note. CoP = concept of print; PA-Syll = syllable awareness; PA-Ph = phoneme awareness, and OVK = oral vocabulary knowledge; LN = letter naming; Dec = decoding; ORF-Acc = accuracy of oral reading comprehension; ORF-Comp = comprehension of questions after oral reading fluency.

References

Adams, M. A. (1990). *Beginning to read.* Cambridge: MIT Press.

ASER. (2013). *Annual status of education report 2013—rural.* Retrieved from http://www.prathamusa.org/sites/default/files/aser_2013.pdf

Alidou, H., Boly, A., Brock-utne, B., Diallo, Y. S., Heugh, K., & Wolf, H. E. (Eds.). (2006). Optimizing learning and education in Africa—the language factor: A stock-taking research on mother tongue and bilingual education in Sub-Saharan Africa. Paris, France: Association for the Development of Education in Africa.

August, D., & Shanahan, T. (Eds.). (2006). *Developing literacy in second-language learners: Report of the National Literacy Panel on language-minority children and youth.* Washington, DC: Center for Applied Linguistics.

Azam, M., Chin, A., & Prakash, N. (2010). *The returns of English language skills in India* (IZA Discussion Paper 4802). Retrieved from http://ftp.iza.org/dp4802.pdf

Ball, J. (2010). *Enhancing learning of children from diverse language backgrounds: Mother tongue-based bilingual or multilingual education in the early years.* Retrieved from http://unesdoc.unesco.org/images/0021/002122/212270e.pdf

Bamgbose, Ayo. (2000). *Language and exclusion: The consequences of language policies in Africa.* London: Lit Verlag.

Beck, I., McKeown, M., & Kucan, L. (2013). *Bringing words to life, second edition: Robust vocabulary instruction*. New York, NY: Guilford Press.

Benson, C. (2005). *Girls, educational equity and mother tongue-based teaching*. Bangkok, Thailand: UNESCO Asia and Pacific Regional Bureau for Education.

Bialystok, E. (2001). *Bilingualism in development: Language, literacy, and cognition.* Cambridge, UK: Cambridge University Press.

Bruthiaux, P. (2002). Hold your courses: Language education, language choice, and economic development. *TESOL Quarterly, 36,* 275–296.

Chall, J. S. (1996). *Stages of reading development* (2nd ed.). Fort Worth, TX: Harcourt-Brace.

Clay, M. M. (1972). *Sand: The Concepts About Print Test.* Auckland, New Zealand: Heinemann Educational Books.

Coleman, H. (Ed.). (2011). *Dreams and realities: Developing countries and the English language*. London, UK: The British Council.

Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Review of Educational Research*, *49*(2), 222–251. doi:10.3102/00346543049002222

Cummins, J. (2001). *Language, power, and pedagogy: Bilingual children in the crossfire.* Clevedon, UK: Multilingual Matters.

de la Piedra, M. T. (2006). Literacies and Quechua oral language: Connecting sociocultural worlds and linguistic resources for biliteracy development. *Journal of Early Childhood Literacy, 6*(3):383–406.

Department of Elementary Education and Literacy, Department of Secondary and Higher Education. (2005). *Annual report.* New Delhi, India: Government of India.

Duflo, E., Berry, J., Mukerji, S., & Shotland, M. (2014). *A wide angle view of learning: Evaluation of the CCE and LEP Programmes in Haryana.* Retrieved from http://www.3ieimpact.org/media/filer_public/2014/07/25/evaluation_of_the_cce_and_lepprogrammes_in_haryanow41005.pdf

EdData II. (n.d.). Early grade reading. Retrieved from https://www.eddataglobal.org/reading/index.cfm

Genesee, F., Geva, E., Dressler, C., & Kamil, M. L. (2006). Synthesis: Cross-linguistic relationships. In D. August & T. Shanahan (eds.), *Developing literacy in second-language learners: Report of the National Literacy Panel on Language-minority Children and Youth* (pp. 153–183). New York, NY: Routledge.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading ability. *Remedial and Special Education, 7*(1), 6–10.

Gove, A., & Cvelich, P. (2011). *Early reading: Igniting education for all.* Research Triangle Park, NC: Research Triangle Institute.

Heugh, K. (2006). Theory and practice—language education models in Africa: Research, design, decision-making, and outcomes. In H. Alidou, A. Boly, B. Brock-utne, Y.S. Diallo, K. Heugh, and H. E. Wolf (Eds.), *Optimizing learning and education in Africa—the language factor: A stock-taking research on mother tongue and bilingual education in Sub-Saharan Africa* (pp. 56–84). Paris, France: Association for the Development of Education in Africa.

Heugh, K., Benson, C., Berhanu, B., & Yohannes, M. A. G. (2007). *Final report study on medium of instruction in primary schools in Ethiopia*. Retrieved from: http://www.everythingharar.com/publication/4379_Heugh_Studyonmediumofinstruction.pdf

Jacoby, W. G. (2000). Loess: a nonparametric, graphical tool for depicting relationships between variables. *Electoral Studies 19,* 577–613.

Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology, 21*(2), 85–97.

Kandhadai, P., & Sproat, R. (2010). Impact of spatial ordering of graphemes in alphasyllabic scripts on phonemic awareness in Indic languages. *Writing Systems Research, 2*(2), 105–116.

Kim, Y.-S. (2009). Cross-linguistic influence on phonological awareness for Korean-English bilingual children. *Reading and Writing, 22*(7), 843–861. doi:10.1007/s11145-008-9132-z

Koda, K. (2007). Cross-linguistic constraints on second-language reading development. In K. Koda (Ed.), *Reading and language learning* (pp. 1–44). Malden, MA: Blackwell Publishing.

Koda, K. (2008). Impacts of prior literacy experience on second language learning to read. In K. Koda & A. M. Zehler (Eds.), *Learning to read across languages: Cross-linguistic relationships in first- and second language literacy development* (pp. 68–96). New York, NY: Routledge.

Koda, K., & Reddy, P. (2008). Research timeline: Cross-linguistic transfer in second language reading. *Language Teaching, 41*(4), 497–508.

Liberman, I. Y., Shankweiler, D., Fischer, F. W., & Carter, B. (1974). Explicit syllable and neme segmentation in the young child. *Journal of Experimental Child Psychology, 18,* 201–212.

Mohanty, A. K., & Misra, G. (2000). *Psychology of poverty and disadvantage.* New Delhi, India: Concept Publishing Company.

McKeown, M. G., & Beck, I. L. (2004). Direct and rich vocabulary instruction. In J. F. Baumann and E. J. Kame'enui (Eds.), *Vocabulary Instruction* (pp. 13–27). New York, NY: Guilford Press.

Nag, S., & Perfetti, C. A. (2014). Reading and writing: Insights from alphasyllabaries of South and Southeast Asia. *Writing Systems Research, 6*(1), 1–9.

Nag, S. (2007). Early reading in Kannada: The pace of acquisition of orthographic knowledge and phonemic awareness. *Journal of Research in Reading, 30*(1), 7–22.

Nag, S., & Snowling, M. J. (2011). Cognitive profiles of poor readers of Kannada. *Reading and Writing, 24*(6), 657–676.

Nag, S., Chiat, S., Torgerson, C., & Snowling, M. J. (2014). *Literacy, foundation learning, and assessment in developing countries. Final report.* London, UK: Department for International Development.

Nakamura, P. R., Koda, K., & Joshi, M. (2014). Biliteracy acquisition in Kannada and English: A developmental study, *Writing Systems Research, 6*(1), 132–147. doi:10.1080/17586801.2013.855620

Nakamura, P. R., & Joshi, R. M., (2014, July 17). *Examining the simple view of reading in alphasyllabic Kannada.* Presentation at the 21st Annual Meeting of the Society for the Scientific Study of Reading, Santa Fe, NM.

National Reading Panel. (2000a). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Washington DC: National Institute of Child Health and Human Development.

National Reading Panel. (2000b). *Teaching Children to read reports of the subgroups*. Washington, DC: National Institute of Child Health and Human Development.

Nazmul, C., Hammer, J., Kremer, M., Muralidharan, K., & Rogers, F. H. (2006). Missing in action: Teacher and health worker absence in developing countries. *Journal of Economic Perspectives, 20,* 91-116.

Paul, L. M., Simons, G. F., & Fennig, C. D. (Eds.). (2013). *Ethnologue: Languages of the world* (7th ed.). Dallas, TX: SIL International.

Perfetti, C. A. (1985*). Reading ability.* New York: Oxford University Press.

Perfetti, C. A. (2003). The universal grammar of reading. *Scientific Studies of Reading, 7*(1), 3–24. doi:10.1207/S1532799XSSR0701_02

Pritchett, L. (2013). *The rebirth of education: Schooling ain't learning.* Washington, DC: Center for Global Development.

Rao, C., Vaid, J., Srinivasan, N., Chen, H.-C. (2011). Orthographic characteristics speed Hindi word naming but slow Urdu naming: Evidence form Hindi-Urdu biliterates. *Reading and Writing, 24*(6), 679–695.

Reddy, P. (2011). *Biliteracy development in middle-school students from the slums of India* (Unpublished doctoral dissertation). Carnegie Mellon University, Pittsburgh, PA.

Reddy, P. & Koda, K. (2013). Orthographic constraints on phonological awareness in biliteracy development. *Writing Systems Research, 5*(1), 110–130. doi:10.1080/17586801.2012.748639

Sénéchal, M., & Le Fevre, J. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development, 73,* 445–460.

Shanahan, T., Callison, K., Carriere, C., Duke, N. K., Pearson, P. D., Schatschneider, C., & Torgesen, J. (2010). *Improving reading comprehension in kindergarten through 3rd grade: A practice guide* (NCEE 2010-4038). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/PracticeGuide.aspx?sid=14

Snow, C. E., Burns, M. S., & Griffin, P. (1998). *Preventing reading difficulties in young children.* Washington, DC: National Academy Press.

Thomas, W. P., & Collier, V. P. (2002). *A national study of school effectiveness for language minority students' long-term academic achievement.* Washington, DC: Center for Research on Education, Diversity & Excellence.

UNESCO. (2014). *Teaching and learning: achieving quality for all* (Education for All Global Monitoring Report 2013/4). Paris, France. Retrieved from http://unesdoc.unesco.org/images/0022/002256/225660e.pdf

United Nations Population Fund (UNFPA), United Nations Department of Economic and Social Affairs (UNDESA), United Nations Human Settlements Programme (UN-HABITAT), International Organization for Migration (IOM). (2013). *Population dynamics in the post-2015 development agenda: Report of the Global Thematic Consultation on Population Dynamics.* Retrieved from http://unfpa.org/webdav/site/global/shared/documents/publications/2014/Population%20Dynamics%20in%20Post-2015%20FINAL.pdf

Tollefson, J. W., & Tsui, A. B. M. (Eds.). (2004). *Medium of instruction policies: Which agenda? Whose agenda?* Mahwah, NJ: Erlbaum.

Vaid, J., & Gupta, A. (2002). Exploring word recognition in a semi-alphabetic script: The case of Devanagari. *Brain and Language, 81*(1–3), 679–690.

van Ginkel, A. J. (2014). *Additive language learning for multilingual settings.* Washington, DC: U.S. Agency for International Development.

White, H. (2014). Current Challenges in Impact Evaluation. *European Journal of Development Research, 26,* 18–30.

Woodcock, R. W. (1987). *Woodcock reading mastery test-revised.* Circle Pines, MN: American Guidance Services.

ABOUT AMERICAN INSTITUTES FOR RESEARCH

Established in 1946, with headquarters in Washington, D.C., American Institutes for Research (AIR) is an independent, nonpartisan, not-for-profit organization that conducts behavioral and social science research and delivers technical assistance both domestically and internationally. As one of the largest behavioral and social science research organizations in the world, AIR is committed to empowering communities and institutions with innovative solutions to the most critical challenges in education, health, workforce, and international development.

LOCATIONS

Domestic

Washington, D.C.

Atlanta, GA

Baltimore, MD

Chapel Hill, NC

Chicago, IL

Columbus, OH

Frederick, MD

Honolulu, HI

Indianapolis, IN

Naperville, IL

New York, NY

Portland, OR

Rockville, MD

Sacramento, CA

San Mateo, CA

Waltham, MA

International

Egypt

Ethiopia

Honduras

India

Liberia

Zambia

Zimbabwe

1000 Thomas Jefferson Street NW
Washington, DC 20007-3835
202.403.5000 | TTY 877.334.3499

http://www.air.org

Making Research Relevant