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Acquiring Reading Skills in Languages with Varying Orthographic Depth: A Case of Cinyanja-English Bilinguals in Zambia

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Abstract

This study sought to assess the influence of orthographic depth on literacy development by comparing the reading proficiency of Cinyanja-English bilingual primary students. Cinyanja, unlike orthographically opaque English, is a highly transparent orthography and is a first language and medium of instruction from first to fourth grade in Zambia. One hundred and nineteen grades 4-6 students were assessed on the Cinyanja measures of letter discrimination, phonological awareness, word reading, pseudo-word decoding and reading comprehension, while 121 participants received the English measures of the same constructs. Correlation analysis of the reading measures revealed high within-orthography associations as opposed to between-orthography associations. Generally, both single- and pseudo-word reading were significantly better in the transparent orthography than in English. However, Descriptive Discriminant Analysis (DDA) revealed that only three of the five reading measures were statistically significant, phonological awareness, word reading and pseudo-word decoding, with one linear discriminant function emerging from the analyses. Overall, our findings confirm the hypothesis that transparent orthographies facilitate reading acquisition and proficiency better than opaque orthographies.

Keywords: *English, Language, Cinyanja, Orthographic depth, Zambia.*

Introduction

Differences in orthographic opacity among writing systems have been associated with significant influences on students' rates of acquiring literacy skills (Joshi & Aaron, 2006; Share, 2008; 2021; Ziegler & Goswami, 2005). Correspondences between phonology and orthography vary significantly among writing systems as some exhibit highly *transparent grapheme-phoneme*

correspondences (GPC), such as Finnish, while for others, these associations are highly inconsistent, such as in English. Thus, the rate of acquiring and nature of reading skills is a function of orthographic transparency, with transparent orthographies easily facilitating the development of reading skills by speeding up the process (Seymour, 2005; Seymour et al., 2003), opaque orthographies pose significant challenges on novice readers (Share, 1995).

Unfortunately, there has been little research aimed at evaluating the influence of orthographic depth on reading proficiency among bilinguals, especially in resource-poor developing countries, to ascertain how it discriminates reading performance in light of these attenuating variables. Let alone among bilinguals learning to read in writing systems at the opposite ends of the orthographic depth spectrum, like English and Cinyanja writing systems (Chimuka, 1978; Kaani, 2014; 2021; Kaani & Joshi, 2013; Kaani et al., 2016; Stemler et al., 2009). The English language has long been the main language driving the science of reading globally despite having one of the most orthographically opaque writing systems. According to Share (2008; 2014; 2021), the English language—by comparison—has one of the most idiosyncratic *outlier* orthographies with narrow applicability, which cannot adequately direct and/or represent a universal science of reading. Thus, the scope of reading research should be widened to encompass more languages and writing systems in order for the science of reading to have a global application.

Although significant strides have been made to incorporate research from less orthographically opaque languages into the mainstream science of reading (Aro & Wimmer, 2003; Ellis et al., 2004; Frith et al., 1998; Seymour et al., 2003; van Daal & Wass, 2017), it “is still entrenched in *Anglocentric* and *Eurocentric/alphabeto-centric* theoretical frameworks” (Share, 2023, p. 34) at the expense of less studied languages, especially among orthographies of African languages. Most African orthographies are highly transparent and, therefore, renders themselves easier to read than English (Alcock & Ngorosho, 2003; Kaani, 2014, 2021; Kaani & Joshi, 2013; Kaani et al., 2016). Additionally, researching the acquisition of reading skills in English language in economically developing and poorly resourced environments, such as Zambia, is not only interesting for evaluating the effects of orthographic depth on learning to read as a contribution to the universal science of reading but also important because of the inherent sociocultural impediments affecting education systems in these countries. Apart from challenges imposed by the idiosyncrasies of the English orthography, other

compounding factors exerting negative influence on Zambian children's capacity to learn to read more effectively are poorly trained reading teachers (Kaani, 2018) and a general lack of appropriate teaching-learning materials (Kelly & Kanyika, 2000; Nkamba & Kanyika, 1998). The effects of orthographic variations on reading development between Cinyanja and English languages need to be empirically understood within the context of these cultural and structural limitations.

This study sought to evaluate the effects of orthographic depth on the reading process among Zambian Cinyanja-English bilingual students. The specific focus of the study is on understanding of how grades 4-6 children learning to read both Cinyanja and English languages compare at orthographic level. Consequently, due to substantial orthographic differences between the two languages and evidence from comparisons between the *outlier* English orthography and more transparent orthographies showing marked variations in reading achievement (Goswami, 2003), we envisioned similarly marked differences in children's mean reading performance between the two orthographies. Although the developers of Cinyanja orthography, like all of Zambia's writing systems, used the Anglocentric perspective because of its colonial legacy, its writing system is much more straight-forward orthographically by comparison with an almost 1-on-1 grapheme-phoneme ratio (Chimuka, 1977; Kaani & Joshi, 2013; Schroeder, 2010; Stemler et al., 2009). Therefore, proficiency in reading, especially in the early stages of instruction, is script-dependent—primarily defined by orthographic transparency. Therefore, our comparison is expected to mimic the findings by Seymour et al. (2003), albeit with some more moderated mean differences because reading in English and Zambian languages cross-pollinate and influence each other (Mukuka, 2021; Mwansa, 2017).

Reading in Orthographically Diverse Languages

The English orthography has grapheme-phoneme ratio of approximately 1:2. Thus, the 26 letters in the Latin alphabet map into approximately 44 unique and distinguishable phonemes comprising of 24 consonants and 20 vowels, which are represented by over 200 different graphemes (Beck & Beck, 2013). These unique characteristics render the English orthography significantly difficult to master by novice readers. On the other, in some transparent orthographies like Spanish, the 24 letters translate into 29 phonemes (Mora, 2001). Compared to Spanish word reading,

decoding words in the English orthography requires more effort and time because of its inconsistent and arbitrary grapheme-phoneme correspondences.

Many studies have established that struggles faced by beginning readers immersed in the English language to acquire literacy skills easily compared to learners in German (Mann & Wimmer, 2002), Dutch (de Jong & van der Leij, 1999), Hungarian (Csepe, 2006), Czech (Caravolas & Bruck, 1993), Italian (Cossu et al., 1988), Welsh (Spencer & Hanley, 2003), Turkish, (Oney & Durgunoglu, 1997), Finnish (Holopainen, al et., 2001), Greek (Nikolopoulos, et al., 2006), and Hebrew (Geva et al. 1993) is predominantly a function of the idiosyncrasies of its orthography (Share, 1995; 2008; 2014; 2021). The ability to reading fluently may be compounded when children are initially immersed in a less complex writing system such, as Zambian languages, where word reading relies primarily on direct phonetic manipulation.

Based on the premise that learning to read the opaque English orthography requires more than just synthetic phonics, Ziegler and Goswami (2005) proposed the psycholinguistic grain size theory (PGST), a theoretical framework developed to explain observed differences in word recognition between transparent and opaque orthographies. The PGST, a forerunner of *orthographic depth hypothesis* (Katz & Frost, 1992), states that depending on the orthographic consistency of the reading language, word recognition develops via a dual route system either through small or large grain units. The small grain size routes—also known as the *sub-lexical route* invokes letter-sound knowledge in decoding print, while the large grain route (*the lexical route*) depends on readers' prior exposure, which allows for word level processing. The difference between the word processing routes lies in the fact that the sub-lexical route focuses on individual phonemes through manipulation of grapheme-phoneme correspondences (e.g., */b/ /a/ /g/*), whereas the lexical route focuses on the whole or part of the target word. Thus, because of the varying degree of the English orthography, both routes are invoked to allow children to read regularly (e.g., *hat, sit*) and irregularly spelled words (*sight, laugh, know*) correctly and fluently.

Effects of Orthographic Depth on Rates and Correlates of Reading Acquisition

Variations in orthographic depth across languages affect both rates of acquiring reading and the nature of cognitive skills predicting its development in beginning readers. For example, more preliterate skills *must* be acquired for students to read the irregularly spelled English lexicon, which adds significantly to the time and effort

required (Hanley et al., 2004; Seymour et al., 2003; Spencer & Hanley, 2003). English children take as much as six years of instruction to catch up with their transparent orthography-taught counterparts. Hanley et al. (2004) longitudinally followed groups of Welsh and English beginning readers, and found that although initially the English readers lagged behind significantly on both real- and non-words measures, but the performance of the two groups were comparable three years later. Furthermore, a comparison of reading errors committed revealed more phonologically-based miscues leading to non-words in Welsh orthography, while real word-based errors were more common among English readers. This discrepancy in error types committed suggests deployment of different strategies in word reading between the two orthographies (Goswami, 2005; Wyse & Goswami, 2008).

Additionally, predictors of reading development also seem to be defined by orthographic depth (Furnes & Samuelsson, 2010; 2011). Although predictors of proficient reading comprehension are relatively universal regardless of orthographic depth—with letter knowledge, phonological awareness, rapid automatised naming, verbal memory and semantic and syntactic skills are frequently cited as best predictors in developing readers (Ziegler et al., 2010)—their dynamics differ significantly as a function of the orthography of the reading language. For instance, cross-orthography research shows that phonological awareness and rapid automatised naming account for substantial amount of variance in overall reading development (Holopainen et al., 2001; Muller & Brady, 2001). However, Furnes and Samuelsson (2011) noted that although the picture is still very unclear, in English, phonological awareness is not only the best but also the most prominent predictor of reading throughout its development, but it seems to have a time-limited effect in transparent Scandinavian. Rapid automatised naming (RAN), on the other hand, had long-term predictive potency in transparent languages. As a consequence, we expected significant differences in performance between Cinyanja and English measures. Additionally, apart from validating assumptions of existing models of reading development across diverse orthographies, this study was expected to provide empirical evidence and insights to support the need for the adoption of differentiated instructional strategies for bilinguals immersed in contrasting orthographies.

Education in Zambia, Language Policy, and Reading Proficiency

For methodological purposes, a brief background of the Zambian education system will suffice. Although there is a small private education sector for an average student at the primary level, the majority of the children attend schools run by the Ministry of Education. The country has a 3-tier education system consisting of seven years of primary level (Grades 1-7), five years of secondary level (Grades 8-12), and Tertiary level, which vary between six months to seven years. Unlike the norm in the West, a very small proportion of children have the chance of enrolling in preschool mainly because of limited access and constrained parents' capacity to finance their children's education (Kaani, 2014). Additionally, until very recently, the preschool system was almost non-existent. Thus, most children get into school without basic literacy knowledge readiness, making them struggle to learn. Overall, in Zambian schools, like most of sub-Saharan Africa, there is over-enrolment, which is coupled with inadequate teaching-learning resources. The recent introduction of free education policy, which has been done without corresponding investments in infrastructure and human resource deployment, has rekindled children's desire to return to school and exponentially augmented the teacher-pupil ratio (Odesomi, 2023).

Zambia's education policy stipulates that children are enrolled at the age of seven, but more often than not, school enrolment is delayed until much later than the recommended age. This leads to significant age variations within the same classrooms or grade level. According to the Ministry of Education Statistical Bulletin (Ministry of Education-Zambia, 2020, p. 9), "The number of Grade one entrants with official entry age (7 years) was 48.9% for boys while that of girls was 49.5% in 2020". The problem of under-age school enrolment is more rampant in the urban schools, while over-age enrolment is common in rural communities. The main reasons cited for late school enrolment vary from family forfeiture of income to prohibitively long distances to school (Alcock & Ngorosho, 2003). Interestingly, the majority of the students, especially in rural schools, do not know their actual dates of birth beyond the year of birth. In some cases, even parents do not know when their children were born due to the high literacy levels (Brudevold-Newman et al., 2018). Hence, even where consented efforts are made to determine every participant's date of birth, it is almost impossible to do so for all children.

After Zambia's political independence some 50 years ago, the country adopted English as the official language under the Zambia Primary Course (ZPC) after

consolidating them segmented community local language-based school systems depending on native languages spoken locally (Joshi et al., 2023). Therefore, under the ZPC program, school instructions were conducted exclusively in English, while the seven Zambian local languages (Bemba, Kaonde, Lozi, Lunda, Luvale, Cinyanja and Tonga) were taught as subjects (Linehan, 2005). Unfortunately, students were facing significant reading problems in English language than Zambian languages (Kaani & Joshi, 2013; Sharma, 1973; Williams, 1996), which affected achievement in the content areas. Serpell (1978) attributed the gross retardation in school subjects "to a failure in learning to read in English" language (p. 433).

Due to the poor reading achievement, the country adopted a new Zambian language-based reading instruction program—the Primary Reading Primary (PRP)—following extensive piloting across the country to determine the veracity of mother-tongue (Tambulukani et al., 1999). Under the PRP, first graders received school instructions in their mother tongue or most familiar language. Pilot studies showed that the programme was relatively more successful than the initial Zambia Primary Course, leading to its full implementation in 2002 (Sampa, 2005). However, the PRP did not meet the high expectations of stakeholders, who felt that one year of mother tongue instruction was not enough to jump-start English literacy development in second grade (Tambulukani & Bus, 2012). The programme was subsequently replaced by the Primary Literacy Program based on the Pan-African Early Grade Literacy Programme (EGLP). In the EGLP, the period of initial reading teaching in the mother tongue was extended to three years before English is introduced at fourth grade (Ministry of Education, 2013).

Cinyanja: The Language and Orthographic Structure

Cinyanja is one of the seven main Zambian local languages adopted for instruction in schools. It belongs to the Benue-Congo family of Bantu languages and is spoken by 9.5 million people spread around parts of Malawi, Mozambique and Zambia in Central Africa (Mchombo, 2006). Cinyanja orthography, like English, uses the Roman alphabet which consists of five vowels and 18 consonants, in addition to aspirated consonants *kh, ph, th, dz, ts,* and *ch.* Cinyanja orthography is highly consistent with very transparent and close one grapheme-phoneme correspondence ratio. It has exclusively open syllables which always end in vowels (Gray, Lubasi, & Bwalya, 2015; Hullquist, 1988). Each grapheme represents a single phoneme.

Common Cinyanja consonant-vowel notations are; V (as *a* in ***a**pa*), C (as *m* in *nda**m**peza*), CV (*mu* in ***mu**ntu*), CCV (***ndi***), and CCCV (as *ntha* in ***ntha**ŵi*) and CCCCV (as *ntch* in ***ntch**ito*).

Many studies evaluating literacy development in Cinyanja report very rapid growth of reading skills arguing that because once students learn the grapheme-phoneme correspondences rules, their vocabulary increases exponentially (Sampa, 2005; Tambulukani et al., 1999; Williams, 1996) as result using self-teaching mechanisms (Share, 1995). Beginning readers build their own vocabulary by leveraging phonological recoding, resulting in self-teaching processes. Kaani (2014; 2021), Kaani and Joshi (2013), and Stemler et al. (2009) report significant within- and between-subjects mean differences in reading, spelling, and writing skills between Cinyanja and English languages in Zambia. Self-teaching mechanisms are adversely affected by the reading language's orthographic depth because any transparent spelled words or legitimate letter strings can be easily deciphered exclusively through phonological recoding skills, while orthographically opaque words may require additional lexical skills to decipher (Shahar-Yames & Share, 2008). Thus, the observed differences in reading levels as a result of orthographic depth should be expected in this study.

Method

Research Participants

Participants were 240 enrolled in grades four, five, and six students drawn from five primary schools in Zambia's main city, Lusaka. Of the 240 participants, 121 (41 learners each from grades four and six, and 39 fifth graders) opted to be tested using the English version of the Zambia Achievement Test (ZAT), while the remaining 119 (40 participants from fourth and fifth graders and 39 sixth graders) received the equivalent reading assessments in Cinyanja language. The participants' age ranged from 8 to 18 years (M = 11.65 years; SD = 2.50). Almost half (49.65%) of the total sample were females. To accommodate varying SES demographics, the five schools were selected to include participants from a wide spectrum of SES backgrounds found in Zambian society. Hence, two of the five schools were in a high SES community, two in low SES, while the fifth one had students from both low and high SES communities. All participants were attending regular classrooms and no participant was reported to have any learning disabilities.

Reading Measures and Procedure

Two equivalent versions of Cinyanja and English batteries of the Zambia Achievement Test (ZAT) were administered to relatively well-matched groups of participants. The ZAT comprises measures of letter discrimination, phonemic awareness, word reading, pseudo-word decoding and reading comprehension skills (See Stemler et al., 2009 for a more comprehensive description of ZAT reading measures). The letter discrimination subtest elicited multiple-choice type of responses. On the phonological awareness tests, students were required to match or discriminate initial sounds of orally presented words or picture names, while for both word reading and pseudo-word decoding, participants were asked to read out loud real and pseudo-words. Students' responses were scored either 0 or 1 for incorrect and correct answers respectively. Reading comprehension measures elicited performance-based responses, in which students were expected to silently read the test-item word or statement and physically perform the action as stipulated. Reading comprehension responses were scored as; 0, 1, or 2 points depending on the accuracy of the participants' response. The number of correct answers constituted the participants' performance.

Results

Descriptive Statistics

A series of statistical analyses were performed to determine the mean differences between the two sets of participants. Means and standard deviations based on raw scores are displayed in Table 1. With the exception of phonological awareness, the mean differences are higher in Cinyanja than English language, but not all differences are statistically significant. The correlations coefficients ranged from -0.15 to 0.87 (see Table 1). Only Cinyanja letter discrimination had statistically significant correlations with English word reading ($r = 0.22$, $p < 0.05$) and pseudo-word decoding ($r = 0.23$, $p < 0.05$). The rest of the cross-orthography correlations were not statistically significant. The following within-orthography bivariate correlations are statistically significant; phonological awareness and word reading, and pseudo-word decoding and reading comprehension in both languages. And so are the bivariate correlations between word reading and pseudo-word decoding, word reading and reading comprehension, and pseudo-word decoding and reading comprehension. Word reading and pseudo-word decoding recorded the strongest bivariate

associations, with $r = 0.87$ ($p < .01$) and $r = 0.85$ ($p < 0.01$) in Cinyanja and English respectively, the difference between the two correlations are not statistically significant, $z = 0.59$, $p > 0.05$. In other words, both two variables contributed significantly to the reading process. Generally, these findings may be suggesting that reading development is language specific.

Table 1: Pearson Product Moment Correlations among Measured Variables, Means and Standard Deviations

Variable	1	2	3	4	5	6	7	8	9	10	*M*	*SD*
NLTD	1.00										9.79	0.80
NPAW	0.03	1.00									13.17	3.93
NWRD	0.03	**0.42****	1.00								45.65	28.09
NPWD	-0.01	**0.53****	**0.87****	1.00							21.17	11.33
NRDC	-0.15	**0.41****	**0.65****	**0.65****	1.00						21.74	13.82
ELTD	-0.05	-0.10	0.10	0.12	0.10	1.00					9.58	1.04
EPAW	0.07	-0.09	-0.03	0.06	-0.01	0.10	1.00				16.20	3.53
EWRD	**0.23***	-0.11	-0.01	-0.02	-0.14	0.13	**0.40****	1.00			33.67	21.15
EPWD	**0.22***	-0.07	0.05	0.04	-0.06	0.03	**0.34****	**0.85****	1.00		16.77	11.59
ERDC	0.07	-0.12	0.02	0.05	-0.06	0.13	**0.38****	**0.75****	**0.65****	1.00	21.33	12.81

Note: NLTD = Cinyanja Letter Discrimination; NPAW = Cinyanja Phonological Awareness; NPWD = Cinyanja Pseudoword Decoding; NWRD = Cinyanja Word Reading; NRDC = Cinyanja Reading Comprehension; ELTD = English Letter Discrimination; EPAW = English Phonological Awareness; EPWD = English Pseudoword Decoding; EWRD = English Word Reading; ERDC = English Reading Comprehension. * $p < 0.05$. ** $p < 0.01$

Multivariate Analyses of Variance

Table 2 shows below results of the 2 (orthography) X 3 (grade level) MANOVA which were computed to evaluate the dynamics of reading proficiency measures. It was hypothesized that orthographic depth (transparent versus opaque) and grade level (grade 4 versus 5 versus 6) would have statistically significant main and interaction effects on students' reading proficiency. Results from this MANOVA demonstrated a statistically significant multivariate effect for both orthography, $F(5, 230) = 19.09$, $p < 0.01$; Pillai-Bartlett's $V = 0.29$; partial $\eta^2 = 0.29$, and grade level, $F(10, 462) = 3.51$, $p < 0.01$; Pillai-Bartlett's $V = .14$; partial $\eta^2 = 0.07$. The interaction

effects were not statistically significant, $F(10, 462) = 0.06$, $p = 0.19$; Pillai-Bartlett's V = 0.06; partial $\eta^2 = 0.03$. These findings support the hypothesis that orthographic transparency facilitates reading proficiency.

Table 2: Pillai-Bartlett's Test for MANOVA Effects

Effect	Value	*F*	Hyp. *df*	Error *df*	*p*	Partial η^2
Orthography	0.29	19.09	5	230	0.001	0.29
Grade Level	0.14	3.51	10	462	0.001	0.07
Ortho. * Grade	0.06	1.38	10	462	0.190	0.03

Note: Ortho = Orthography, hyp. = hypothesis

Descriptive Discriminant Analysis

Following statistically significant main effects of both orthographic depth and grade level on reading variables, a descriptive discriminant analysis (DDA) was conducted as a follow-up to MANOVA findings to examine specific differences in reading proficiency between the two languages and grade levels. Relating to orthographic depth, the mean differences in reading proficiency differed significantly on three of the five measures: phonological awareness, Wilks' $\Lambda = 0.86$, $F(1, 238) = 39.47$, $p < 0.001$; word reading, Wilks' $\Lambda = 0.95$, $F(1, 238) = 13.95$, $p < 0.001$; and pseudo-word decoding, Wilks' $\Lambda = 0.96$, $F(1, 238) = 8.84$, $p < 0.01$. Unlike word reading and pseudo-word decoding subtests, where performances are better in Cinyanja, phonological awareness proficiency was better on the English assessment. One statistically significant linear discriminant function emerged; Wilks' $\Lambda = 0.71$, $\chi^2 (5, 240) = 79.99$, $p < 0.001$; eigenvalue = 0.40; canonical correlation = 0.54. The model explained 29.16% of the variation in the grouping variable as defined by squaring the canonical correlation ($0.54^2 = 29.16\%$). In order to further understand group differences, standardized discriminant function and structure coefficients were identified and examined (see Table 3).

Table 3: Tests of Equality of Group Means and DDA Standardized Function and Structure Coefficients of Reading Measures for Orthographic Opacity

DV	*Wilks' Λ*	*F*	*p*	*Function*	*Structure*
Letter Discrimination	0.99	3.11	0.080	-0.19	-0.18
Phonological Awareness	0.86	39.47	0.001	**0.96**	**0.64**
Word Reading	0.95	13.95	0.001	**-0.68**	**-0.38**
Pseudoword Decoding	0.96	8.84	0.001	**-0.32**	**-0.30**
Reading Comprehension	1.00	0.06	0.810	0.27	-0.02

Note: df1= 1, df2 = 238.
Coefficients > |.30| are **bolded**. The function score centroids/means are -0.64 for Cinyanja and 0.63 for English.

The standardized discriminant function coefficients also displayed in Table 3 show that the effect of orthographic depth was maximally differentiated by canonical variates (function coefficients > |0.30|) of three reading measures; phonological awareness (0.96), word reading (-0.68), and pseudo-word decoding (-0.32). Letter discrimination and reading comprehension skills made non-significant contributions. The two group centroids (Cinyanja = -0.64 and English = 0.63) show considerable group "separation". In addition, a close inspection of Figure 1 below which illustrates the distribution of discriminant scores also show a relatively minimal overlap between Cinyanja and English function scores, implying that the function was able to discriminate between the two groups reasonably well. All in all, the discriminant analysis successfully predicted differences in reading proficiency between Cinyanja and English for 75.8% of the cases; with a 73.9% correct prediction of the readers in the transparent orthography (Cinyanja) and 77.7% accurate prediction in the opaque orthography (English).

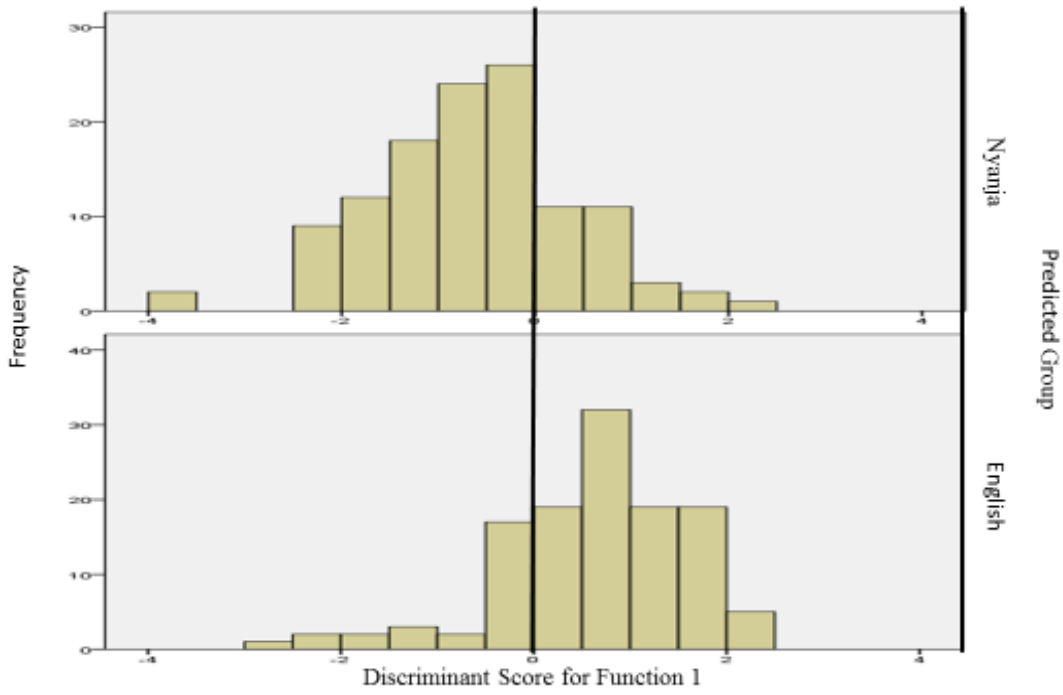

Figure 1: Histograms showing the Distribution of Discriminant Scores in Cinyanja and English.

Overall, these analyses show that orthographic depth regulates group mean differences in reading proficiency, and that three variables—phonological awareness, word reading, and pseudo-word decoding—contribute the most in defining differences in reading between Cinyanja and English orthographies. This finding suggests that reading abilities in English, even as late as sixth grade, are determined by phonological awareness, a low-order skill, whereas in Cinyanja, reading proficiency depends on higher-order decoding-related skills, namely word reading and pseudo-word decoding. In a nutshell, the language of instruction, vis-à-vis its orthographic transparency, can be instrumental in defining reading proficiency.

Discussion

This study sought to examine the effects of orthographic depth on reading proficiency by comparing performance of students from 4th to 6th grade in Cinyanja (transparent) and English (opaque) languages in Zambia. The main research question focused on comparing variations in reading proficiency as defined by letter discrimination, phonological awareness, pseudo-word decoding, word reading and reading comprehension across these two orthographies. In general terms, findings

show statistically significant differences in reading proficiency between transparent and opaque orthographies, with Cinyanja participants out-performing their counterparts tested in the English language. This corroborates findings from Finnish studies by Seymour et al. (2003), Landerl and Wimmer (2008), and Aro and Wimmer (2003), who found that students taught to read in the transparent Finnish orthography faced considerably less challenges than those taught in the English language. Similar orthographic differences have been reported in English and German (Mann & Wimmer, 2002), Dutch (de Jong & van der Leij, 1999), Hungarian (Csepe, 2006), Czech (Caravolas & Bruck, 1993), Italian (Cossu et al., 1988), Welsh (Spencer & Hanley, 2003), Turkish, (Oney & Durgunoglu, 1997), Finnish (Holopainen et al., 2001), Greek (Nikolopoulos et al., 2006), and Hebrew (Geva et al., 1993).

However, it should be noted that the findings from studies cited above are based on bilingual children learning to read English as a second language. The participants in the present study may be considered as *successive bilinguals*—the English language being primarily used for classroom discourse, while Zambian languages are oral communication outside the walls of the classroom. As a result, one would be forgiven for attributing the observed mismatch between learners' reading and oral proficiency between English and Cinyanja languages to this phenomenon. In fact, the achievement gap in reading skills is expected to almost be insurmountably wide and take long periods of systematic and well-planned classroom instructions before it is bridged.

However, in the current study, the magnitude of the mean differences between Cinyanja and English bilinguals among Zambian children are not as highly magnified as compared to, for instance, Finnish-English comparisons (Holopainen et al., 2001; Muller & Brady, 2001; Seymour et al., 2003). This is probably because Zambian students are taught primarily in two languages their first language, in this case, Cinyanja, and the national language, English. Studies by Durgunoglu and Oney **(**2000) and Pillunat and Adone (2009) argued that one of the main reasons for the small achievement gap among bilingual students between L1 and L2 is the cross-linguistic transfer of skills. Basic reading skills, such as print awareness, phonemic awareness, and other meta-awareness skills acquired in Cinyanja-based instructions, are applied to enhance reading in the English language and vice-versa (Talebi, 2013).

Furthermore, the mean performance differences observed between the two languages in this study reflect the assumptions stipulated by the psycholinguistic grain

size theory (Ziegler & Goswami, 2005), which surmise that reading proficiency in opaque orthographies is defined more by large than small grain sizes. The idiosyncratic nature of the English orthographies seems to pose significant challenges in reading than the transparency of Cinyanja writing systems (Goswami, 2005). Thus, these results also appear to suggest that, in English, getting to appropriate automatized single word reading level to facilitate good comprehension requires the invocation of both sub-lexical and lexical routes. Since ascension to automatized level depend on pre-exposure and mastery of the target word. The process of learning to read starts with sub-lexical letter-sound manipulation in initial stages of instruction before children can process sight word recognition—lexical route—through word exposure (Price-Mohr & Price, 2018), whereas in Cinyanja model, pseudoword manipulations based on the sublexical facilitates comprehension prediction in the English model (Jere-Folotiya et al., 2014; Sampa et al., 2018). Generally speaking, these findings seem to validate the orthographic depth hypothesis (Katz & Frost, 1992) and psycholinguistic grain size theory.

Similarly, although, on average, reading achievement of the Cinyanja, group was significantly better when the measures are independently analyzed, some interesting cross-orthography variations emerge. For instance, with the exception of letter discrimination, every Cinyanja variable correlates highly with all other Cinyanja measures. English variables show similar patterns in associations. This finding is not entirely unexpected as similar dynamics also reported comparable variations between Czech- and English-speaking learners (Caravolas et al., 2005). This phenomenon may be attributed to transferability of basic skills across orthographies between L1 and L2. Thus, since mastering literacy skills among learners starts in familiar mother tongues, children leverage their oral language competencies to acquire reading skills—a process also facilitated by the orthographic transparency of Zambian languages (Kaani, 2014; Kaani & Joshi, 2013; Stemler et al., 2009). And when it is time to learn to read the more opaque orthographically English language, novices transfer skills acquired in L1 to L2 (Durgunoğlu & Öney, 1999; Pillunat & Adone, 2009).

However, only three—phonological awareness, word reading, and pseudo-word decoding—of the five reading variables under consideration determined the observed variations in reading proficiency between Cinyanja and English orthographies. Interestingly, this was not only unexpected in bilingual samples but also corroborated by some earlier studies (Caravolas et al., 2013; Furnes & Samuelsson,

2010; Holopainen et al., 2001). According to Furnes and Samuelsson (2011), phonological awareness skills, particularly the phonemic awareness component, strongly predict both word reading and reading comprehension in both orthographies. Specifically, they argue that in transparent orthographies, phonemic awareness has a more robust influence in the early stages of reading development, but its effects diminish as learners begin to depend more on phonological recoding. On the contrary, phonemic awareness skills continue to exert its influence throughout the period of reading acquisition in opaque orthographies.

With regard to both word reading and pseudo-word decoding, our findings are consistent with other available cross-orthography studies (Aro & Wimmer, 2003; Landerl & Wimmer, 2008; Seymour et al., 2003), which reported that as students become familiar with and more competent in manipulation letter-sound associations, they invoke self-teaching mechanisms to decode words (Share, 1995; 2008). This phenomenon could explain why students who were tested in the English language had heightened phonological processing awareness than their Cinyanja counterparts as late as sixth grade, which seem to mimic Hanley et al.'s (2004) findings. Hanley and colleagues revealed that the Welsh children were already fluent readers by the end of first year of instruction, while some of their students tested in English still struggled significantly six years later.

In conclusion, despite the limitations of failing to control for age variability and quality of literacy instructions across participating schools, these findings provide important insights to science of reading, specifically with regard to the influence of orthographic transparency on reading acquisition among bilinguals (Aro & Wimmer, 2003; Furnes & Samuelsson, 2010, 2011; Holopainen et al. 2001; Seymour et al., 2003). Essentially, this study strengthens arguments against framing models of reading from an extremely outlier Anglocentric perspective to explain "a universal science of reading" (Share, 2008, p. 584). The findings call into question the universality of current best practices used in reading instructions, especially in multilingual education systems (Kaani et al., 2016). Current models framed primarily from the Anglocentric perspective state that reading develops through lexical and sublexical means, an argument which may be true in orthographically opaque writing systems, especially English (Share, 2008), but only partially true for transparent orthographies (Goswami, 2003; 2005). Exclusive reliance on the idiosyncratic English orthography has "confined reading science to an insular Anglocentric research agenda

addressing theoretical and applied issues with only limited relevance for a universalistic science of reading" (Schwartz et al., 2014, p. 35). There is an urgent need to broaden the scope of reading research beyond a single language by increasing cross-orthography studies such as this one in order to gain a full understanding and insights of the reading process.

Additionally, due to observed variations in children's reading proficiency between Cinyanja and the English orthographies, it is important to consider adopting differentiated orthography-specific teaching-learning strategies. The instruction methods should be responsive and congruent to both the *phonological complexities* and *symbol-to-sound* correspondences of languages of instruction for learners in multilingual settings where socio-cultural contexts vary significantly (Goswami, 2003; Goswami & Wise, 2008; Kaani et al., 2016; Ziegler et al., 1997). Instruction based on *one-size-fits-all* may not be sufficient for beginning readers, particularly bilinguals to achieve expected levels of reading proficiency.

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