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Effects of Orthographic Opacity on Reading Fluency among Zambian Nyanja-English Bilinguals

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Abstract: *The aim of the present study was to examine the effects of orthographic opacity on reading fluency. The focus was on evaluating the dynamics of reading fluency, particularly to determine how accuracy and speed skills are affected by orthographic transparency among bilinguals. A sample comprising of 108 fifth and sixth grade children were tested on two reading fluency passages in Nyanja and English writing system in Chipata and Chadiza Districts of the Eastern Province of Zambia. Errors committed and times taken to read were recorded in each language and child. Results reveal that the participants were more accurate in Nyanja in comparison to English, but they were faster in English that Nyanja. Reading fluency variables were highly correlated suggesting a non-significant relationship between the two orthographies. Although our results were in conformity with and the supported the traditional models of reading acquisition and development theories suggesting significant differences as a function of orthographic depth, the mean differences were not statistically significant indicating that variations in reading fluency achievement among Zambian children were as marked as variations reported in comparisons between English and other European orthographies. It could be argued that the non-significant performance resulted from Zambian children's bilingualism, which facilitates cross-linguistic transfer of reading skills between writing systems.*

Keywords: *Orthography, fluency, accuracy, reading speed, Nyanja, Zambia*

1. INTRODUCTION

The ability to read proficiently with comprehension is an important for success in life. The essence of reading is text comprehension, and this can only be achieved effectively if the process is fluently done—that is accurately and conducted at an appropriate rate (Rasinski, 2007). Reading fluency is one of the five critical components of the reading process (Javourey-Drevet et al., 2022; National Reading Panel, 2000). Several cross-linguistic studies reveal marked differences in reading fluency outcomes across orthographies (writing systems), which suggests that reading proficiency is attained more easily in orthographies with highly consistent grapheme-phoneme correspondences (GPC) compared to inconsistent languages (Aro & Wimmer, 2003; Daniels & Share, 2018; Landerl & Wimmer, 2008). However, there is very little empirical research focusing on the influence of orthographic depth on the role of reading fluency, and most of what is known in this area is based on the English writing system, which according to Share (2008) is an orthographic outlier to appropriately to effectively represent the diverse science of reading.

1.1. Importance of Fluency to the Reading Process

The role played by reading fluency in text comprehension has been gaining significant research recognition in the recent past (National Reading Panel, 2000; Javourey-Drevet et al., 2022). This was demonstrated by decomposing the reading process into its five critical components, which in addition to fluency, include phonemic awareness, phonics, vocabulary and reading comprehension (Piasta, Logan, Farley, Strang, & Justice, 2022). And because of this recognition, there has been increased research attention directed towards the understanding of the contribution of reading fluency on comprehension (Grabe, 2004; Young, Rasinski, & Mohr, 2016; Kim Y. S.-G., 2015). According to Meyer and Felton (1999), reading fluency defined as "the ability to read connected text rapidly, smoothly, effortlessly, and automatically with little conscious attention to the mechanics of reading, such as decoding" (p. 284) is cardinal for text comprehension (Rasinsk, 2006).

The main aim of reading is to derive meaning from print, and fluency acts as the bridge between decoding and comprehension. A study by Klauda and Guthrie (2008) reported "moderate to high positive correlations between measures of fluency and comprehension" (p. 310). Increased automaticity of decoding print enables the reader to dedicate more attention and cognitive resources to text comprehension, while failure to read fluently affects comprehension considerably. Failure to acquire basic skills necessary to attain automatic word recognition results in poor reading comprehension outcomes, whereas a successful transition from GPC-based decoding to automated word recognition improves reading fluency, which in turn promotes reading comprehension (Hasbrouck, 2006; Rassinsk, 2006). Available evidence seem to suggest that the reading process must be accurate, faster and effortless to yield desired text comprehension levels (Fuchs, Fuchs, Hosp, & Jenkins, 2009; Hasbrouck & Tindal, 2006).

Many early studies of literacy reveal that good performances on measures of phonemic awareness are the best predictors of reading comprehension (Adams, Foorman, Lundberg, & Beeler, 1998; Hasbrouck, Ihnot, & Rogers, 1999). Stanovich (1991) argues that fluency is a more reliable predictor of reading comprehension. A reader with poor fluency is expected to exhibit significant comprehension deficits. Many reading disability interventions and remediation programs emphasis the improvement of fluency because it is assumed that if child reads in a laboured and disjointed manner, she/he is likely to lose the intended meaning of what they reading (Hudson, & Lane, & Pullen, 2005).

1.2. Models of Reading Fluency Development

The two main theories, namely automaticity theory (LaBerge & Samuels, 1974) and verbal efficient theory (Perfetti, 1985) proposed to explain reading processes and developmental projectiles of fluency are "based on the notion that the attention resource capacity that readers can allocate at one time is limited" (Taguchi, Gorsuch, & Sasamato, 2006, p. 2). Automaticity theory states that the reading process should be achieved with minimum attention on lower-level skills (letter-sound manipulation, decoding and word recognition), so that the reader concentrates exclusively on text comprehension, otherwise deriving meaning from the print will be significantly hampered. The basic assumption of this theory is that for comprehension to be maximised, word recognition must be automatised (Gorsuch & Taguchi, 2010; Soleimani, Mohammaddokht, & Fathi, 2022).

According to Taguchi et al. (2006), verbal efficient theory "refers to the degree to which readers' subcomponents of reading is exercised with speed and accuracy" (p. 3). This implies that if the lower-level skills such as word recognition are executed efficiently enough, more cognitive resources will be reserved for deriving meaning from print through comprehension. Therefore, poor comprehension should be viewed as a result of the readers' slow and laboured decoding prowess because the laboriousness of the slowed decoding process depletes cognitive resources that readers need for text comprehension. Although both theories emphasis the important role played by reading fluency, there are some minor differences in explaining its influence. The automaticity theory posits that once a child attains automaticity in decoding and word recognition, lexical access development automatically follows. On the other hand, the verbal efficient theory states that even after a child has developed automatic word retrieval, post-lexical sub-skills continue being enhanced by identifying elements of text such as, proposition integration, anaphors resolution, and activating relevant schema from memory.

1.3. Reading Fluency and Orthographic Opacity

Many research findings show marked differences in levels of fluency as a function of orthographic depth (Landerl & Wimmer, 2008; Aro & Wimmer, 2003; Hanley, Masterson, Spencer, & Evans, 2004; Spencer & Hanley, 2003; Pillunat & Adone, 2009). These variations in levels of reading fluency, particularly between English and other European languages, are mainly attributed to differences in strategies employed to decipher words in response to demands posed by variations in GPC necessitated by orthographic differences. For instance, readers' basic knowledge of GPC rules may be sufficient for a child to read any legitimate letter string in orthographically transparent languages, such as Finnish and Spanish, through self-teaching mechanism (Share, 1995). However, for those immersed in writing systems where these GPC are irregular and, hence more challenging the GPC rules may only be partially helpful, and require to be complemented by lexical strategies (Goswami, 2003; 2008; Ziegler & Goswami, 2005; Share, 2008).

Employing the principles of the psycholinguistic grain size theory, Kerek and Niemi (2009) argued that "reading acquisition in irregular orthographies demands more time and greater effort to develop several recoding strategies and a high degree of flexibility in reliance on grain units of varying sizes" (p. 2). On the other hand, the more transparent orthographies facilitate the reading process and enable beginning readers to acquire high reading proficiency with relative ease (Goswami, 2008; Goswami & Ziegler, 2005; Share, 1995; 2008). A cross-language study by Landerl and Wimmer (2008) found that German readers were reading close to ceiling by the end of their first grade, and their development was stable over an eight-year period they were followed, whereas English counterparts faced significant problems, in addition to taking a considerable effort and time to catch up. Several studies have replicated this trend across many languages (Aro & Wimmer, 2003; Hanley, Masterson, Spencer, & Evans, 2004; Spencer && Hanley, 2003; Pillunat & Adone, 2009).

However, some cross-orthography studies report negative correlations between reading accuracy and speed. Children reading in transparent orthographies tend to show high reading accuracy levels, but their reading speed is laboured (Borleffs, Maassen, Lyytinen, & Zwarts, 2019; Holopainen, Ahonen, & Lyytinen, 2001). In opaque orthographies, this phenomenon is reversed. The rate of reading is higher, while their accuracy is impaired. This is the most defining difference in reading between transparent and opaque orthographies. For instance, Landerl and Wimmer's (2008) study, which compared the development of reading skills between English and six relatively transparent European orthographies among typically developing children, revealed that although the accuracy of English readers was severely impaired, their reading speed was relatively better. On the other, while children's reading accuracy in the six transparent was considerably better than English, but their reading slow and laboured.

The orthographic transparency also has significant implications on conceptualizations of reading disability (Share, 2008; Goswami, 2003). Goswami posits that variations in prevalence of reading disabilities may be explained in part by the nature of the orthography into which the "disabled reader" is immersed. Landerl, Wimmer, and Frith (1997) compared German- and English-speaking dyslexics on focusing on reading accuracy and speed. This study revealed that German dyslexics had a significant advantage on both accuracy and reading speed over English dyslexics, and attributed this advantage to the two languages orthographic differences. English orthography, being a more opaque and complex to decode posed more challenges than the more transparent German writing system. Additionally, although some studies show that reading in transparent orthographies promotes reading accuracy, there are a few which reveal that reading speed is relatively slow compared to opaque writing systems. A study by Pillunat and Adone (2009) evaluating the effects of orthographic opacity on reading development among children who "were learning English as L2 for almost two years at the time of testing and had already received two years of reading and writing instruction in their L1 German before they started to learn English," (p. 2) found that German real and pseudo words were recognised faster and read more accurately than English words. This suggested that participants relied on word sight skills to English decipher target words.

However, for Zambian children, these processes were reversed; as children instead exhibited high levels of accuracy, albeit laboured and slower reading speed (Kaani, 2014; Kaani, 2021; Kaani & Joshi, 2013) as reported by Holopainen and colleagues (2001). Other findings from literacy studies in Zambia may, in addition to the noting the effects of orthographic depth on the reading process, also point to the inherent systemic teaching-learning inadequacies in the country's education system (Sharma, 1973; Williams, 1993; 1996; Kelly & Kanyika, 2000; Stemler et al., 2009). However, none of the research reviewed above compared the influence of reading fluency to determine the nature of variations across orthographies using a repeated-measures design. Additionally, there is need to understand how these observed reading fluency variations will compare among bilingual children learning English as a second language in the developing world where the teaching-learning process is compromised by under-funding. A rare opportunity that this study provides. Similarly, these results are based on cross-national studies also offer very little insights into the performance of bilinguals immersed in orthographically diverse languages, such as Nyanja and English orthographies. It is, therefore, imperative that reading outcomes, especially fluency that seem to develop differently across orthographies, are evaluated, as the case may be, to provide additional empirical insights and evidence to that effect.

There is evidence based on bilingual studies, which report that reading skills are transferrable across writing systems (Bialystok, 2007; Tong & McBride-Chang, 2010). To that effect, it is expected that transfer of basic literacy skills will enable children initially taught how to read in transparent Zambian orthographies to apply skills acquired in one to the other language, thereby moderating or reducing the severity of the achievement gap between the two writing systems. This transfer is more beneficial for children initially taught in a transparent and apply skills acquired in an opaque language (Geva, 2014; Jamal & Monga, 2010). Cunningham and Graham (2000) matched fifth and sixth graders monolinguals and bilinguals and found that Spanish bilinguals exhibited English language learning advantage over monolinguals. It will also be interesting to determine whether the cross-language transfer will also influence the performance between Nyanja and English bilinguals.

1.4. Education and the Language Policy in Zambia

In 2018, Zambia had an estimated population of 16.5 million and over 45% of these are children under the age of 14 years (Universalia Management Group, 2020). Statistics also show that in the same year, the net educational enrolment rate stood at 83.6% (UNICEF, 2020/21). Although school enrolment dropped drastically during the COVID19pandemic crisis in 2020, there has a considerable resurgence in number of children seeking school re-enrolment since the new Zambian government re-introduced free education following the removal of school fees—a major barrier to educational progression in the developing world—for all eligible children following the 2021 national elections (Zenda, 2022). As a result of the new policy, schools are over-flowing with over-enrolled classrooms, while the teacher-to-pupil ratios have risen significantly. Many argue that this policy is unsustainable under the current economic conditions in Zambia and will ominously affect the quality of teaching in the long run.

The national educational policy stipulates that children should been rolled at the age of 7 years. Unfortunately, adherence to this policy is affected by a number of socio-economic factors (Kelly, 1999). And therefore, like in most of the developing world, a sizeable proportion of school-age children still enrol relatively late creating substantial age variations in each classroom. Reasons for this large age variability range from "family finance—there are various payments associated with schooling as well as loss of income from a potentially economically active member of the family—and distance from school, where there is not a school in every village," (Alcock & Ngorosho, 2003, p. 640). This trend is a more common phenomenon in rural than urban areas, where schools are inaccessible to younger children due to long distances between schools in rural parts of Zambia.

1.5. Reading Proficient Studies in Zambia

Over the years, several studies examining reading proficiency in Zambia have revealed low reading standards (Ginsburg, Balwanz, Banda, Park, Tambulukani, & Yao, 2014; Kelly & Kanyika, 2000; Sharma, 1973; Stemler et al., 2009; Williams, 1993; 1996). Sharma assessed grades 1-3 children on a 40-item single word test and found that only 4.5 percent of the third graders were reading at their grade level. This finding goes to show that the phenomenon of poor reading outcomes is not a new in Zambia. Additionally, low reading achievements were also reported in studies by Kelly and Kanyika (2000) and Matafwali (2005). In addition, Williams (1996) reported significant achievement gaps between gender (boys/girls) and location (urban/rural).

Similar results are posted when cross-national studies are conducted between Zambian learners and children from other countries. For instance, in a comparison of Zambian and Malawian children on reading achievement in the Nyanja and English languages, Williams (1993) found that Malawian children immersed in Nyanja (also known as Chewa in Malawi) out-performed their Zambian counterparts on both measures of reading in Nyanja and English language, although the mean difference between the two groups were not statistically significant. Similarly, multinational cross-national studies also placed Zambian children at the bottom or near the bottom of the achievement ranking on most school subjects. The 1998 Southern African Consortium Monitoring Education Quality report revealed that Zambian children were ranked on in a study of reading achievement at grade six level consisting of 14 African countries (Ginsburg et al., 2014). A similar pattern was reported by the 1996 Monitoring Learning Achievement study (Chinapah, 2003). Reasons cited for such achievement gaps and poor standards of literacy attainment in Zambia include; high pupil-teacher ratio (49:1), poor resourced learning environments due rapidly declining funding to the sector,

HIV/AIDS pandemic preying on teachers, and lack of effective supervision (Kelly & Kanyika, 2000; Sampa, 2005; Mulubale, 2019; 2020). Additionally, Kaani (2018) also noted that in general teachers tasked with the role of teaching literacy skills are poorly equipped to provide effective literacy instructions they do not possess appropriate pedagogical-content knowledge—the peter effect.

When Zambia realized that there was a literacy achievement problem in the country, the government decided to take deliberate steps to remedy the situation. Thus, in 2000, the Zambia Primary Course (ZPC), which was the mainstay policy of education since the country got political independence in 1964, and blamed for the poor reading outcomes was replaced by the Primary Reading Program (PRP). Unlike the ZPC, in which the English language was primary medium of school instruction, the PRP introduced Zambian languages in initial reading instruction in a bid to leverage learners' language familiarity. Hence, the country's seven most widely spoken and intelligible languages, which include Bemba, Kaonde, Lozi, Lunda, Luvale, Nyanja, and Tonga languages, were adopted as media of instruction in grade one before introducing the English language at second grade (Sampa, 2005). Although, Bemba, Nyanja, and Tonga are the most predominant and widespread languages, and used as *de facto* provincial languages in northern (Copperbelt, Luapula, and Northern provinces), Eastern, and Southern regions respectively. They have a total of 6.31 million (Bemba [3.80m]; Nyanja [2.18m]; Tonga [1.33m]) native speakers. The remaining four languages are minority languages confined to specific regions (Eberhard, Simons, & Fennig, 2020).

It was assumed that beginning readers would acquire skills acquired in their mother-tongue or most familiar before transferring them to learning to read in English language (Ministry of Education, 2013). This is advantageous because compared to the challenges posed by the idiosyncratic English orthography (Share, 2008), Zambian languages are more transparent, and a number of literacy studies in Zambia seem to show that learning to read in local languages is quite easy (Kaani, 2014; Kaani, 2021; Kaani & Joshi, 2013; Kaani, Mulenga, & Mulubale, 2016; Sampa, 2005; Sampa, Ojanen, Westerholm, Ketonen, & Lyytinen, 2018; Stemler et al., 2009; Tambulukani, Sampa, Musuku, & Linehan, 1999). Apart from orthographic transparency, local languages also offer the advantage of the fact that children already have a well-developed oral vocabulary from everyday use.

Initially, the PRP showed a lot of promise as the children involved were able to breakthrough to reading within the first year of formal instruction (Tambulukani et al., 1999). However, learners still experienced some problems with reading in the English language. English posed two problems because apart from being unfamiliar to learners, it also posed orthography-induced challenges (Folotiya-Jere, 2014). Additionally, the one year of mother-tongue instruction was deemed inadequate for effective skills transfer. As a result, the Primary Literacy Programme (PLP) with a longer period of initial mother-tongue based literacy instruction was adopted. The period of local language-based instruction was increased from one to three years to give beginning readers more time to get familiarised with the reading process (Chibamba, Mkandawire, & Tambulukani, 2018).

1.6. The Present Study

The aim of this study was to evaluate the influence of orthographic depth on reading fluency, as defined by reading accuracy and speed, among Nyanja-English bilingual children in primary schools in Chipata and Chadiza Districts in the Eastern Province of Zambia. In addition, the study also explored whether grade level and gender exert some influence on reading fluency between the two orthographies. The critical research questions the study was aimed at answering were; (a) what is the influence of orthographic transparency on reading fluency in Nyanja and English languages? (b) Are there significant variations in developmental trajectories of reading fluency across the two orthographies as children progress through their grades?

Based on the literature reviewed above (Kaani, 2014; Kaani, 2021; Kaani & Joshi, 2013; Kaani et al., 2016; Sampa, 2005; Sampa et al., 2018; Stemler et al., 2009; Tambulukani et al., 1999), we expect statistically significant mean differences in fluency proficiency between Nyanja and English orthographies as a function of orthographic depth. We, however, envisage that the mean differences to be slightly moderated by cross-linguistic transfer. Additionally, a significantly higher mean reading rate was expected in the English orthography because of the application lexical strategies in sub-lexical skills in Nyanja orthography because school environments and children are more likely to have more books for reading practice in the English than Zambian languages (Chansa-Kabali, Serpell, & Lyytinen, 2014).

1.7. Nyanja Orthography

Nyanja or CiNyanja, language is the mother-tongue for 10 percent of Zambia's population; and it is also a *lingua franca* for 20 percent of urban dwellers (Joshi, McBride, Kaani, Elbeheri, in press). Due to high density of *linguistic diversity*, the country has selected seven of the most widely spoken languages for use in schools (Aro & Ahonen, 2011; Costley, Kula, & Marten, 2022). Nyanja is a Bantu language spoken by people inhabiting the area covering parts of Malawi, Mozambique, Zambia, and Zimbabwe (Mchombo, 2009). Like most African languages whose orthographies were recently developed, Nyanja has a transparent writing system (Alcock & Ngorosho, 2003; Schroeder, 2010). Schroeder (2010) notes that "Bantu languages are quite transparent in their morphological and morpho-phonological structure, though there is great variation in the ways they handle them" (p. 27).Its orthography has five vowels, 24 singles consonants and 9 digraphs, which are consistently pronounced the same way everywhere they occur (Mwansa, 2018).

In terms of the syllable structure, Nyanja orthography shares a lot of similarities with Chewa, a language widely spoken in Malawi (Kaani, 2014; Kaani, 2021; Kaani et al., 2016; Kaani & Joshi, 2013; Mchombo, 2004; Williams, 1993). The syllables of Nyanja orthography, like many of the Bantu languages, are typically of the open syllable type CV. As Kashindo and Kunkeyeni (2006) noted the "common features of Bantu languages is skeletal syllabic structure of consonant vowel consonant vowel (CVCV), e.g., *siya* (*leave*). All syllables thus ends in vowels. The acceptable syllable structure is therefore CV, V, and C consisting of a syllabic nasal, e.g., *m* in *mbale* (*relative*)" (p. 30).

The straight-forward and transparent GPC facilitates the acquisition and development of reading skills relatively easy because once novice readers master the alphabetic principle, knowledge of the GPC rules, they are able to decode a greater proportion of Nyanja words acquired using the self-teaching mechanisms (Share, 1995). In fact, basic letter-sound skills seem transferrable across many alphabetic orthographies, such as Bantu languages, as exemplified by the ability of children who migrate from one linguistically diverse region of the Zambia to another to decipher words even if they do not understand the text.

2. METHOD

2.1. Participants

The sample consisted of 108 grades 5-7 children drawn from 28 primary schools in Chipata and Chadiza Districts of the Eastern Province of Zambia. There were 34 (20 boys; 14 girls) 5th graders, 34 (16 boys; 18 girls) 6th graders, and 40 (23 boys; 17 girls) 7th graders, with ages ranging from 10 to 21 years old (M = 14.33; SD = 2.13). The sampling frame of 28 schools was deliberately enlarged to incorporate wide ranging of characteristics exhibited by Zambian children, which ensured a more representative sample. All participants were typically developing as no child in the sample was reported to have any physically or special education needs.

2.2. Measures

2.2.1. Reading Fluency Measures

The participants were presented with two grade 3 level reading fluency passages in Nyanja and English languages. The reading passages were approximately the same length; with 132 and 129 words long in Nyanja and English languages respectively. The passages were extracts from approved Grade 3 Zambian Ministry of Education reading comprehension textbooks. The passages were administered by trained assessors.

2.2.2. Backwards and Forwards Digit Span

This is a subtest of the Wechsler Intelligence Scales for Children (5th Ed.) (Wechsler, 2003). It was administered to elicit verbal intelligence. The subtest measured participants' auditory short-term memory, sequencing, attention, and concentration skills. The forwards digit span requires participants to repeat gradually increasing sequence of number digits in the order presented by the examiners. For the backwards digit span, participants repeat the number sequence in reverse order presented by the examiner to determine the working memory.

2.3. Procedure and Analysis Technique

Qualified class teachers were trained to administer both assessments. Only teachers fluent in both spoken and written Nyanja and English languages were selected and trained to conduct the administration of the tests following strict predetermined assessment protocols. Each child was individually tested in a quiet room within the premises of their school. The assessments took approximately 20 minutes to complete each instrument. The reading test was discontinued if the child was not able read any word from the passage after a period of two minutes (120 seconds). Each participant's final scores constituted both the reading rate (time taken to read in seconds) and number of errors committed during the reading of the comprehension. The reading rate (words per second) was computed by dividing the total number of words in the passage by time taken by each child. In the both the forwards and backwards digit span, the raw score was the total number of correct trials. However, the assessment was discontinued when a participant failed to correctly recite both the backward and forward trials in a given trial pair.

3. RESULTS

3.1. WISC-IV Digit Span

The mean scores for the forwards and backward digit span trials were 14.12 (SD = 5.05) and 5.20 (SD = 2.83) respectively. Overall, the difference between these means was statistically significant (p> 0.05). Additionally, although participants from rural-based schools out-performed their urban-based counter-parts, the mean difference was also not statistically significant on both the forwards (p = 0.95) and backwards digit span trials (p = 0.81). It is counter-intuitive to note that rural-based participants would out-performed their urban-based counterparts on an activity that is seemingly urban oriented. However, when the results were desegregated by gender, the mean difference on the backwards trials was statistically significant (F(1, 106) = 5.58, p < 0.05), with the male participants performing significantly better than females on the backward trials, but not on the forwards trials (p = .22).

3.2. Reading Accuracy and Reading Speed Mean Performance

Table 1 below shows the means of reading errors committed and reading speed as determined by words-per-second in Nyanja and English measures by grade level. Generally, the results show gradual increases in mean performance as a function of grade level in reading accuracy and rate in both orthographies, except for English reading speed (words/second) where 7th graders were out-performed by 6th graders. As expected, participants were more accurate in Nyanja (M = 11.74; SD = 18.96) compared to English (M = 14.97: SD = 23.09), although the total mean error difference was not statistically significant (p = 0.10). Similarly, children exhibited a considerably higher English reading speed (M = 1.31; SD = 1.52) compared to Nyanja (M = 0.78; SD = 0.39), and the observed mean difference in words read per-second between orthographies was statistically significant (t(54) = -2.25, p< 0.05).

Table1. *Mean Performance in Reading and Digit Span*

				Errors committed			Words/second	
Nyanja		**Grade**		***M***	***SD***		***M***	***SD***
		5		6.29	14.07		0.66	0.24
		6		10.15	15.61		0.70	0.35
		7		17.72	23.39		0.88	0.44
		Overall		**11.74**	**18.96**		**0.78**	**0.39**
English		**Grade**		***M***	***SD***		***M***	***SD***
		5		12.44	19.12		0.83	0.45
		6		14.41	26.19		1.86	2.81
		7		17.60	23.68		1.23	0.59
		Overall		**14.97**	**23.09**		**1.31**	**1.52**

The minimum and maximum Nyanja reading durations were 57 and 673 seconds, whereas in English they recorded 11 and 715 seconds respectively. Reading quality—both reading rate and accuracy—seem to get increasingly better with a corresponding grade progression in both Nyanja and English languages on all subtests, with children in grade 7 out-performing the lower grades. In conclusion, despite the poor quality of reading fluency, accuracy and speed seem improve as a function of grade level.

3.3. Locational and Gender Mean Differences on Reading Fluency

Results in Table 2 below show mean raw scores of children's reading fluency by location (urban-rural) and gender (male-female). Nyanja language reading errors were committed by urban participants (*M* = 18.10; *SD* = 19.57 than in the English language (*M* = 10.21; *SD* = 18.61). For English, urban children read the comprehension text more accurately (*M* = 13.19; *SD* = 16.26) than their rural counterparts (*M* = 15.40; *SD* = 24.52). Both mean differences are statistically significant (*p*> 0.05). On the other hand, urban children exhibited higher reading speed both Nyanja (*M* = 0.80; *SD* = 0.32) and English (*M* = 1.56; *SD* = 0.98), while the reading rate of their rural counterparts were relatively slower [Nyanja (*M* = 0.77; *SD* = 0.41) and English (*M* = 1.25; *SD* = 1.63)]. Similarly, both mean differences were also non-significant (p > 0.05). The mean differences in reading rate was expected because by comparison children in rural Zambia, like most of the developing world, have very limited access to print for practice (Kafusha, Mwelwa, Mkandawire, & Daka, 2021) which adversely affects their reading fluency.

Table2. *Reading Fluency Mean scores for Location and Gender*

	Nyanja			**English**		
Location	**Urban**		**Rural**	**Urban**		**Rural**
Errors: *M* *(SD)*	18.10 (19.51)		10.21 (18.61)	13.19 (16.26)		15.40 (24.52)
Words/sec: *M* *(SD)*	0.80 (0.32)		0.77 (0.41)	1.56 (0.98)		1.25 (1.63)
Gender	**Male**		**Female**	**Male**		**Female**
Errors:*M* *(SD)*	12.35 (21.52)		10.98 (15.96)	17.17 (23.36)		12.22 (22.36)
Words/sec: *M* *(SD)*	0.81 (0.40)		0.73 (0.38)	1.13 (0.57)		1.63 (2.38)

Female participants [Nyanja (*M* = 10.98; *SD* = 15.96) and English (*M* = 12.22; *SD* = 22.24)] read more accurately, albeit committing less errors, than their male counter-parts [Nyanja (*M* = 12.35; *SD* = 21.52) and English (*M* = 17.17; *SD* = 23.36)], the mean error differences across genders were, however, not statistically significant (*p*> 0.05). By contrast, while male participants (*M* = 0.81; *SD* = 0.04) exhibited higher reading rates on the Nyanja passage than females (*M* = 0.73; *SD* = 0.38), they (*M* = 1.13; *SD* = 0.57) were out-performed by female (*M* = 1.63; *SD* = 2.38) on the English subtest, a phenomenon commonly reported in most English-language studies with western monolinguals (NAEP, 2000) and also reported in the Nyanja versus English bilinguals study in Malawi and Zambia (Williams, 1993). Similarly, the mean differences were not significant (*p*> 0.05).

3.4. Developmental Change in Reading Fluency

Additionally, to determine developmental trajectories in reading fluency skills over time, mean differences in performance across grade levels were analysed using the ANOVA test. According to Table 2 above, there were steady and appreciable mean increases in reading fluency from the lowest to the highest grade level on all subtests in both languages. One-way ANOVA conducted to determine whether the differences observed between grade levels were statistically significant. The ANOVA analyses were restricted only to differences between 5thand 7th graders, because the observed mean differences between consecutive grades were negligible, i.e., 6th graders were not compared to either 5th or 7th graders (see table 1 above).

In Nyanja, the difference in reading accuracy between 5th(*M* = 6.29; *SD* = 14.07) and 7th(*M* = 17.72; *SD* = 23.39) graders was statistically significant (*p*< 0.05). For English reading accuracy, but the mean reading error difference between 5th grade (*M* = 12.44; *SD* = 19.12) and 7th (*M* = 17.60; *SD* = 23.68) were not statistically significant (*p* = 0.61). Although 7th graders were to read the comprehension passage presented faster compared to 5th graders, the mean differences were not statistically significant in neither Nyanja (*p* = 0.16) nor English (*p* = 0.62) respectively. These results suggests, as expected, that learners were progressively improving their general reading fluency abilities (rate and accuracy) over time, although the gains made do not seem to be large enough.

3.5. Correlation between Nyanja and English Reading Fluency Variables

Since almost all mean differences between the various reading fluency variables were not statistically significant, the Spearman rho's correlational analyses were conducted to determine the strength of the relationships among the variables, which would help us appreciate bivariate associations. Table 3 below shows a few statistically significant bivariate correlation coefficients among variables within and between the two orthographies. The results show statistically significant correlation coefficients between Nyanja $_{errors}$ and English $_{errors}$, $r(108) = 0.55$, $p < 0.05$; Nyanja $_{errors}$ and Nyanja $_{words/sec}$, $r(67) = 0.04$, $p < 0.05$; and Nyanja $_{words/sec}$ and English $_{words/sec,}$ $r(62) = 0.34$, $p < 0.05$. However, the correlation coefficients between the following were not statistically significant ($p > 0.05$); Nyanja $_{errors}$ and English $_{words/sec}$, English $_{errors}$ and Nyanja $_{words/sec}$, and English $_{errors}$. The bivariate correlational coefficient between the forwards and backwards digit spans was statistically significant, $r(109) = 0.43$, $p < 0.05$, but not with any other measures of reading fluency and speed.

Table3. *Correlations between various reading fluency variables in the two Orthographies*

Assessments	1	2	3	4	5	6
1. Errors-Nyanja	-	**0.55****	**-0.30***	-0.04	0.08	0.11
2. Errors-English		-	-0.24	0.25	0.16	0.10
3. Words/sec-Nyanja			-	**0.34***	-0.17	0.12
4. Words/sec-English				-	-0.11	0.18
5. Digit span-forwards					-	**0.41****
6. Digit span-backwards						-

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

In summary, the results seem to show an orthographic transparency-induced achievement gap between Nyanja and English languages in Zambia, which has been reported in a few other local studies in spelling (Kaani & Joshi, 2013), writing (Kaani, 2021) and reading comprehension (Kaani, 2014). The findings suggest that transparent orthographies facilitate accuracy, but depress reading speed, while the opposite is true for the opaque orthographies.

4. Discussion And Conclusions

The aim of this study was to examine the influence of orthographic transparency on reading fluency—as defined by reading rates in *words per second* and reading accuracy conceptualized in terms of *decoding errors committed during the reading process*—between transparent and opaque orthographies. This was achieved by comparing bilingual students learning to read in Nyanja and English languages in the Eastern Province of Zambia. The focus was on reading accuracy (errors committed) and reading speed (words/second). Based on the literature reviewed (Share, 1995; 2008; Ziegler & Goswami, 2005), substantial mean differences in learners' mean reading fluency skills were expected between the two contrasting writing systems because their orthographic differences placed varying cognitive demands on readers (Goswami, 2003; Kaani et al., 2016).

4.1. Reading Accuracy and Speed

The results show that generally students' reading accuracy was significantly better in Nyanja orthography than in English, whereas the rate of their reading speed was better in the English language. Learners drawn from urban-based schools out-performed their counter-parts from rural schools on almost all reading fluency subtests. Furthermore, female participants out-performed the male participants on reading accuracy in both languages. Additionally, despite being out-performed by boys on the Nyanja reading speed subtest, girls excelled in English language. These findings corroborate findings of several cross-linguistic studies comparing English language reading proficiency to other European orthographies (Aro & Wimmer, 2003; Landerl & Wimmer, 2008; Goswami, Gombert, & de Berera, 1998).

Although our results do not provide an exactly mirror image reflection of the findings of the cited studies above in terms of the achievement gap between orthographies (Aro & Wimmer, 2003; Landerl & Wimmer, 2008; Goswami et al., 1998), these findings still provided very important insights into the discourse regarding the influence of orthographic depth on reading fluency, in particular, and reading ability, in general (Share, 2008). Some of the fluency reading achievement gaps between Nyanja and

English orthographies were not significant, even though these results show that respondents have considerable advantages in the more orthographically consistent Nyanja over the highly inconsistent English orthographies. The low reading proficiency feature in the English orthography is corroborated by other comparative studies conducted between European transparent orthographies—like Finnish (Aro & Wimmer, 2003), Spanish (Goswami et al., 1998), Italian (Landerl & Wimmer, 2008)—and the more opaque English orthography.

Similarly, a number of Zambian studies show that learners still struggle with reading proficiency even five-to-seven years after the beginning of formal literacy instructions. Studies by Sharma (1973), Chikalanga, (1990), Williams (1993), Kelly and Kanyika (2000), and Matafwali (2005) reveal that children generally struggle with reading in both English and Zambian languages and fail to read at appropriate reading proficiency long after the beginning instructions as shown by this study. These poor reading outcomes have, in part, been attributed to the low quality of literacy instructions provided in schools and the mismatch between children's mother tongue (or familiar language) and the language of instruction (Tambulukani et al., 1999; Kaani, 2021), problems which stakeholders believe the introduction of more effective reading programmes, like the PRP (Sampa, 2005) and PLP (Chibamba et., 2018) would help to overcome.

Additionally, other cross-language comparative studies around identities (Mulubale, 2019a), among bilinguals, such as Altmisdort (2016), Kim (2019), and Wang, Park, and Lee (2006) also show similar, but slightly moderated mean differences in reading between transparent and opaque orthographies and corroborate our findings. These reading achievement gaps suggest that the non-significant differences are a consequence of cross-linguistic skill transfer. That is the fact that skills acquired in one language are transferred and used to support reading development in the second language, as learners do not have to relearn the same skills again. According to Kim and Altmisdort, cross-languagefacilitates better and faster acquisition of fluency in the second language as also shown in studies between English and Kiswahili (Alcock & Ngorosho, 2003) and Turkish languages (Durgunoğlu, 2002).

The gender achievement gaps in fluency reading, especially on reading speed, mimics Williams' (1993) findings among Malawian and Zambian children where female students posted marginal literacy achievement superiority over their male counter-parts. However, this finding is counter-intuitive for the Zambian situation, and probably most of the developing world because of inherent gender biases against female children, which interfere with girls' schoolwork. Thus, Kathuria and Serpell (1998) noted that gender roles in Zambian cultures, which apart from educationally disadvantage girls it also seem to dispute the observed discrepancies, these cultural norms tend, not only affect school enrolment, but also educational progression. Similarly, the rural-urban achievement gap is a ubiquitous phenomenon in Zambia, where urban-based children tend to persistently out-performed children in rural schools, although the differences in performance is usually marginal and not statistically significant (Williams, 1993; 1996).

Another interesting finding, yet counter-intuitive finding from this study is that urban children out-paced rural-based children in Nyanja language, yet they were out-performed on English language reading subtests. This may, however, be a function of significantly higher print exposure to reading material and electronic media in urban regions compared to people, in general, found in rural areas (Kafusha et al., 2020). Another explanation to this phenomenon could relate to the attitude towards the sociolinguistic benefits of knowledge of the English language because as children progress from lower to higher grades, the need for good skills in written and spoken English language takes precedence over local languages. As the English language, being the national official language is a means to finding more lucrative and sought-after white-colour jobs. Consequently, both teachers and learners begin to place more emphasis on reading in English language material than in Nyanja books, thereby gaining more proficiency compared to the Nyanja language. However, more research is required in this area to determine why rural children seem have better reading fluency in the English language instead of the more familiar and everyday Zambian languages.

4.2. Reading Fluency Developmental Trends

Our findings reveal some evidence of steady and relatively large reading fluency improvements between 5^{th} and 7^{th} graders in both Nyanja and English orthographies, although the mean differences were not statistically significant ($p > 0.05$). The non-significant mean differences could be a result of

the short teaching-learning period between the comparison periods. This finding show similarity to Alcock and Ngorosho's (2003) findings, who reported non-significant mean differences between 2nd to 3rd grade Swahili speaking children, and suggested that the short period between grade levels, could be the cause. The quality of the teaching-learning process inherent in our education system, especially in relation to reading instruction, may be another factor. Although the Zambian Ministry of Education has introduced more robust reading instructions programmes, which are conducted in less opaque local Zambian languages, little effort has been made at improving teachers' pedagogical skills to effectively manage the program (Jere-Folotiya, 2014; Kaani, 2018).

4.3. Correlations between Reading Fluency Variables

Spearman's correlation analyses to evaluate interactions among variables revealed that reading fluency proficiency in the two orthographies was only closely associated between measures of reading accuracy. The high correlations between reading fluency variables, specifically between measures of reading accuracy, may be related to skill transferability between L1 and L2 among bilinguals (Bialystok, 2007; Tong & McBride-Chang, 2010). Unlike findings from mono-linguistic studies which are usually statistically significant between orthographies (see Aro & Wimmer, 2004; Goswami et al, 1998; Landerl & Wimmer, 2008), students' ability to transfer and apply skills acquired in their L1 to L2 seem to moderate the size of the achievement gaps. Based on findings of this study, therefore, it is possible that metacognitive and phonological awareness skills acquired in Nyanja, during the initial stages of reading instructions, will be applied in English reading fluency (Kim, 2014). The non-significant associations among the rest of the variables may be due to substantial differences in cognitive demands posed by the two languages (Goswami, 2003). The above explanation is plausible considering that these participants have had five to seven years of reading instructions.

5. CONCLUSIONS

In conclusion, orthographic depth seem to exert similar influence on reading fluency asit does on spelling (Kaani & Joshi, 2013), writing (Kaani, 2021) and reading [phonemic awareness, decoding, word recognition, comprehension] (Kaani, 2014). Generally, there are marked variations in reading performance among Zambian students as a function of orthographic transparency. Furthermore, our findings simulate results from several studies conducted across monolingual education systems in European orthographies (Aro & Wimmer, 2003; Daniels & Share, 2018; Goswami et al., 1998; Landerl & Wimmer, 2008; Pillunat & Adone, 2009), which revealed considerable advantages for children learning to read in transparent orthographies over those immersed in opaque ones, especially the English orthography. Most studies claim that it takes a minimum of three years for English-immersed children to read at the same level as their Finnish and Spanish counter-parts (Hanley et al., 2004). This, in part, suggests that orthographic depth places varying demands, not only on reading fluency, but on the reading process, in general (Goswami, 2008; Ziegler & Goswami, 2005). Therefore, as Share (2008) noted our findings challenge the narrow Anglocentric view on which the science of reading is almost exclusively based.

Furthermore, this study seem to support traditional theories proposed to explain reading development and proficient across diverse orthographies, such as the dual route model (Coltheart & Leahy, 1996, Kaani et al., 2016), and psycholinguistic grain size (Ziegler & Goswami, 2005), which posit that the reading process demands different strategies in transparent and opaque languages. The study was a worthy undertaking as it departs from the traditional Eurocentric perspective of studying the development of reading across different orthographies (Share, 2008) by offering a non-western perspective to the science of reading and the insights herein are important to the understanding of the process of reading. However, more research is required to examine and provide a cross-orthography perspective of the nature of prosody, considering low proficient revealed by this study in Nyanja and English. Research on the influence of orthographic opacity on reading prosody will help explain how children with low proficient manage the reading process. Furthermore, an examination of reading fluency based on single word reading, real and non-words, can add an interesting dimension to any future studies on this subject.

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