



Orthographic Advantage Theory: National advantage and disadvantage due to orthographic differences

Bruce Allen Knight^{1*}, Susan A. Galletly¹, Pamela S Gargett²

1. Central Queensland University
2. Queensland Department of Education, Training & Employment

Abstract

Considerable research reports nations differ in orthographic complexity (regularity and consistency of spelling patterns used); that this impacts ease and speed of reading and writing development; and that, in contrast to the world's many regular-orthography nations, English word-reading and word-writing development is extremely slow, with difficulties more frequent and severe (Knight, Galletly & Gargett, 2017; Seymour, Aro, & Erskine, 2003; Share, 2008). Orthographic Advantage Theory proposes that, according to their level of orthographic complexity, nations experience disadvantage and potential advantage in multiple areas of education and national functioning. Building from current cross-linguistic theories and research on cross-linguistic differences, it proposes six dimensions of orthographic advantage and disadvantage, namely: ease of early literacy development; simplified school instruction and learning across primary and secondary school; ease of improving education; impacts of reduced workplace illiteracy; increased adult life advantage; and generational advantage through confidently literate parents being able to effectively support their children's literacy development. This article details Orthographic Advantage Theory, building from review of research findings that show the major differences in reading development and outcomes in regular-orthography and Anglophone nations. The theory is offered as a tool for educators and researchers towards optimising reading and literacy outcomes.

Keywords: Orthographic Advantage Theory, reading development, writing development

* Correspondence to:

Bruce Allen Knight, Centre for Regional Advancement in Learning, Equity, Access and Participation (LEAP), Central Queensland University, Level 1, 538 Flinders St, Townsville Qld 4810. Email: b.knight@cqu.edu.au

INTRODUCTION

Orthographic advantage is experienced by individuals, families, schools and nations reading transparent-orthographies in the many academic, social-emotional and economic ramifications of easy access to literacy. Orthographic disadvantage is experienced by English-reading individuals, families, schools and nations, in the many ramifications of difficult access to literacy, and high rates of reading failure.

(Galletly & Knight, 2004, p.8)

Word-reading and word-writing, the ability to read and write words as isolated words and in meaningful text, are gateway skills on the path to effective literacy. Reading and writing build from readers' language skills integrated with their word-reading and word-writing skills. Thus, whilst no readers have reading comprehension and written expression skills beyond their level of intelligence and language reasoning, those with poor word-reading and word-writing are impeded from reaching their potential.

Many nations use highly-regular orthographies (spelling systems), with close to one-to-one correspondence of graphemes and phonemes (Grapheme-Phoneme Correspondences, GPCs). In contrast, English orthography is so highly complex that researchers consider it an outlier on the continuum of orthographic complexity (Seymour, Aro, & Erskine, 2003; Share, 2008). Whereas Finnish uses only approximately 23 GPCs, one grapheme for each of its 23 phonemes (one-to-one GPCs), English uses more than 560 different spelling patterns (GPCs) for its approximately 40 common phonemes.

Regular orthographies have orthographic simplicity (transparency), one-to-one GPCs and a very small word-reading and spelling curriculum to master. This creates low cognitive load, due to minimal curriculum load and confusion for beginning readers, and expedites word-reading and spelling development. It follows that teaching, learning, and early intervention can be easier, non-intensive and highly effective, for virtually all children, including children with intellectual disability (Cossu, 1999; Olofsson & Niedersoe, 1999).

In contrast, English's high orthographic complexity means that children during early literacy development work through a large, complex word-reading curriculum which involves high cognitive load and high orthographic confusion from English's many potentially confusing GPCs (Knight, Galletly, & Gargett, 2017; Seymour & Duncan, 2001; Share, 2008; Ziegler & Goswami, 2005). As examples, in the four highly frequent words, was one two eight, only the four underlined letters, one per word, use their commonest, 'regular' GPC (the sound children are taught that letter says), with the remaining 10 GPCs offering potential learning confusion. Reading and spelling instruction and

learning are thus more complex in Anglophone nations, with word-reading and spelling development taking many years; many children and adults experiencing significant word-reading and word-writing difficulties; and interventions for weak readers often failing to achieve proficient reading (Compton, Miller, Elleman, & Steacy, 2014; Hindson, Byrne, Fielding-Barnsley, Newman, Hine & Shankweiler, 2005; Torgesen, 2000).

Research has established significant differences in reading development between Anglophone nations (nations of predominantly monolingual English speakers, where children learn to read using Standard English orthography), and regular-orthography nations where children learn to read highly regular spelling systems (Knight et al., 2017; Landerl, Ramus, Moll, Lyytinen, Leppänen, Lohvansuu & Schulte-Körne, 2013; Seymour et al., 2003; Share, 2008; Ziegler & Goswami, 2005).

Surprisingly, given the very strong impact of orthographic regularity and complexity, there is relatively little awareness of these important cross-linguistic differences among education leaders, researchers and educators (Joshi & McCardle, 2017; Galletly & Knight, 2013; Share, 2008). Share's (2008) seminal paper emphasises the need for greater awareness that English's extreme orthographic complexity makes Anglophone word-reading and literacy development highly atypical. This currently low awareness is evidenced in international reading studies such as PISA (Thomson, De Bortoli, & Underwood, 2016) and PIRLS (Thomson et al., 2012) not including orthographic complexity as a variable that can differentiate nations' reading and academic achievement.

In addition, whilst proliferating cross-linguistic research is currently focused on word-reading development, minimal research seems focussed on areas beyond word-reading. Logically, rapid as opposed to slow word-reading and word-writing development will impact ease of education and diverse aspects of literacy development. As examples, it is difficult to find cross-linguistic research exploring literacy beyond word-reading, including spelling, independent reading and writing, vocabulary and language skills, cognitive processing beyond phonological awareness and Rapid Automated Naming (RAN), and verbal efficiency. Whilst logically there will also be differences in support needs and pressures on children and teachers, it is difficult to find cross-linguistic research exploring ease of word-reading and word-writing instruction, teacher workload, and children's self-teaching and their needs for adult support.

With likelihood that orthographic disadvantage has detrimental impacts, thinking on cross-linguistic differences potentially offers useful directions towards optimising reading and literacy development (Knight & Galletly, 2017; Knight et al., 2017). There is therefore value in education policymakers, researchers and educators building greater awareness of the major cross-linguistic differences of literacy development and instructional needs between regular-orthography and Anglophone nations. This need is strong in Anglophone nations, given many Anglophone nations are struggling to improve literacy

outcomes (Knight & Galletly, 2017; Thomson et al., 2016; Thomson et al.; 2012). The authors have developed Orthographic Advantage Theory to support varied thinking on the impact of cross-linguistic differences on learning to read and write words (Galletly & Knight, 2004, 2011a, 2011b, 2013; Knight et al., 2017). Orthographic Advantage Theory builds from reading theories, including the Orthographic Depth Hypothesis (Frost, 2012) and Psycholinguistic Grain-Size Theory (Ziegler & Goswami, 2005), as well as research findings on children learning to read Standard English and regular orthographies.

This paper details Orthographic Advantage Theory and the significant cross-linguistic differences nations experience. It has two sections. The first section summarises research findings establishing orthographic advantage and disadvantage in regular-orthography and Anglophone nations. The second section describes Orthographic Advantage Theory.

Unless stated otherwise, the term 'regular-orthography nations' designates nations with the most regular orthographies, such as Estonia, Finland, Italy, and South Korea, whilst 'Anglophone nations' refers to nations such as the United Kingdom, United States, Australia and New Zealand, where many citizens are monolingual English speakers, and most children learn to read Standard English orthography.

ADVANTAGE AND DISADVANTAGE

Orthographic Advantage Theory is built from the considerable research establishing strong cross-linguistic differences in literacy development. Literacy development for Standard English readers is significantly delayed and more complex, with far more students experiencing literacy difficulties. This section discusses key findings establishing that research basis.

Word Reading

English word-reading and word-writing (spelling) development takes at least seven years, with studies developing test norms showing ongoing development from age six to at least age thirteen years, and some through to adulthood (Snowling et al., 2009; Torgesen, Wagner & Rashotte, 2012).

Word-reading and word-writing have two important components: accuracy (reading and writing words correctly) and fluency (increasing automaticity). Self-teaching is a pivotal aspect of literacy development (Share, 2008; Ziegler, Perry, & Zorzi, 2014) as children require less teaching support when they can work out unfamiliar words for themselves (Knight & Galletly, 2017). The pivotal role of self-teaching in early literacy development makes children's rate of skill development towards proficient word-reading and word-writing accuracy a key cross-linguistic factor, as it develops to a proficient level much more quickly in children learning to read regular orthographies. Whereas English

orthographic complexity markedly delays both self-teaching and proficient word-reading and word-writing accuracy in all children, and especially children experiencing difficulties, most regular-orthography readers are proficient self-teachers from mid-Year 1, when they are able to accurately read and write virtually all words. From a self-teaching perspective, whilst fluency is an advantage, proficient accuracy is crux.

Evidence is growing that children's learning is significantly impacted through the balance of consistency and confusion in content being learned, with at-risk learners significantly disadvantaged by inconsistencies (Gabay, Thiessen, & Holt, 2015; Pollo, Treiman, & Kessler, 2007). Termed 'statistical learning', children's learning is found far more powerful when learning content is highly consistent (e.g., when learning to read a highly regular orthography with virtually one-to-one GPCs), and significantly weaker when confusion is present due to inconsistencies (e.g., when learning to read standard English orthography).

Using standard English orthography, it is difficult to avoid confusion in early Anglophone reading instruction, given English's three orthographic grainsizes (phonemes, spelling units, and whole-words, Ziegler & Goswami, 2005), the overlapping and confusing GPCs created by these grainsizes, and the large number of highly frequent words which have highly irregular spelling. As examples, in common words encountered frequently by early readers, children routinely experience at least three 'conflicting' GPCs for many sounds, e.g., *for* /a/ in *has*, *was*, *car*; /w/ in *was*, *who*, *write*, and /o/ in *one*, *does*, *to*. This orthographic confusion, and the amount of learning children must do to be able to effectively read English's many common words with irregular spelling, can greatly impede word-reading development. Seymour, Aro, & Erskine's (2003) study of Year 1 children in 14 European nations established the excessively slow rate of English word-reading development. When tested towards the end of Year 1, the readers of ten regular-orthography nations (Norway, Netherlands, Iceland, Sweden, Spain, Italy, Finland, Turkey, Austria and Greece) read with 90% to 98% accuracy. In contrast, English Year 1 readers had just 34% accuracy, with English Year 2 readers (after twice the learning time) having just 76% accuracy.

Huang and Hanley (1997) reported Taiwanese regular-orthography children taking only 10 weeks to achieve sufficient accuracy and self-teaching to accurately read and write using Zhuyin Fuhao (also termed Bopomofo), their fully regular initial orthography. Aro's (2004) Finnish study reported that Finnish beginning readers take a matter of weeks to master word-reading accuracy, and that children differ in the time-point when they start to master word-reading but, once started, progress at the same rapid rate. Like riding a bike, some children need the bike supported for longer, until subskills are coordinated, but once the child rides successfully and feels in control, skill builds rapidly with relatively minimal need for adult support (Galletly & Knight, 2013). This 'same-rate' word-reading development stands in contrast to Anglophone word-reading development where children differ greatly in rate of word-reading development, and most need considerable

ongoing adult support, and teachers are required to cater for a wide range of skill levels (Galletly, Knight, Dekkers, & Galletly, 2009; Snowling et al., 2009; Torgesen, Wagner & Rashotte, 2012).

Rapid regular-orthography early literacy development is also evident in Anglophone studies of children learning to read and write using the Initial Teaching Alphabet (I.T.A.) in the 1960s with many thousands of Grade 1 children being enthusiastic independent readers and writers (Downing, 1969; Knight et al., 2017; Mazurkiewicz, 1973).

Reading Difficulties

The ease of regular-orthography word-reading development is also evident in how effectively regular-orthography delayed readers master word-reading. Examples include German children with dyslexia having high word-reading accuracy from Grade 2 (Landerl & Wimmer, 2008), and regular-orthography nations testing only word-reading speed, not accuracy, because all children have proficient accuracy (Aro, 2017; Torppa, Eklund, van Bergen, & Lyytinen, 2015).

Landerl, Wimmer and Frith's (1997) study of German and English weak readers reveals the extent of English word-reading difficulties. The authors report German readers reading their study's most difficult words (three-syllable pseudowords, e.g., *quaduktrisch*, *miktanie*, *usion*, *plauferfant*) with greater accuracy than English students read the simplest words (1 syllable real words, e.g., *ball*, *round*, *blind*, *friend*). In addition, English readers made 16 times more vowel errors (342: 20 errors). There seem few recent studies comparing the extent of cross-linguistic differences in word-reading difficulties.

It is not the case that regular-orthography nations have no literacy weakness, but rather that weakness is much less severe. Anglophone weak readers struggle to develop both accurate and fluent reading and writing of words, and hence also struggle with self-teaching, reading comprehension, written expression, and independent reading and writing. While virtually all regular-orthography weak readers read accurately, a small proportion of children who have phonological-awareness weakness show spelling difficulties, and a small proportion who have weakness in Rapid Automatised Naming (RAN) struggle with fluency and reduced speed (Aro, 2017; Landerl & Wimmer, 2008; Liao, Deng, Hamilton, Lee, Wei & Georgiou 2015; Torppa et al., 2015). Some studies show that many regular-orthography slow readers still seem able to achieve age-appropriate comprehension (Thomson et al., 2016; Thomson et al., 2012; Torppa et al., 2015), likely because they can read all words accurately. This seems evidenced in high-achieving regular-orthography nations having far fewer weak readers than Anglophone nations in PIRLS and PISA international comparison studies (Thomson et al., 2012; Thomson et al., 2016).

In contrast to regular-orthography children, studies show it is common for many Anglophone children to have word-reading and word-writing difficulties across the school years, including upper primary school and secondary school (Galletly et al., 2009; Leach, Scarborough, & Rescorla, 2003; Roberts, Torgesen, Boardman, & Scammacca, 2008), with approximately one quarter of Australian and American children in Grades 7 and 8 having significantly weak word-reading and word-writing skills.

Intervention

Research reports cross-linguistic differences in the effectiveness of remedial and preventative intervention, with Anglophone nations struggling relative to regular-orthography nations. With children's skill levels likely reflecting effectiveness of the reading instruction and intervention, the major differences between German and English weak readers in Landerl et al.'s (1997) study suggest English instruction and intervention is far less effective. Similarly, differences in instructional effectiveness are indicated by the much higher proportions of children in Anglophone nations achieving at Low level in PISA and PIRLS studies (Galletly & Knight, 2011b; Knight & Galletly, 2017; Thomson et al., 2016; Thomson et al., 2012).

Major differences in effectiveness of word-reading intervention are also evident when long-term results of intervention programs are considered. Studies in regular-orthography nations show cohorts of children reaching high accuracy levels after approximately 18 months intervention (Cossu, 1999; Olofsson & Niedersoe, 1999). As an example, an Italian study of children with Down Syndrome and severe intellectual disability (mean IQ 44, IQ range 40 to 56) showed effective word-reading skills developed with relatively minimal extra support, with children correctly reading 93% of real words, and 88% of pseudowords, with skills retained effectively over time (Cossu, 1999). In contrast, studies of Anglophone weak readers with healthy intelligence show many making good gains which are maintained over time, but others making little to no progress, or over time losing gains made (Compton et al., 2014; O'Connor, 2000; Roberts et al., 2008; Torgesen, 2000).

While minimal research explores instructional differences, regular-orthography instruction and intervention seems brief, simple, and highly effective (e.g., Cossu, 1999; Olofsson & Niedersoe, 1999; Poskiparta, Neimi & Vauras, 1999; Schneider, Ennemoser, Roth & Kuspert, 1999). This contrasts strongly with Anglophone early intervention. For example, although there are effective gains for some Anglophone delayed readers (Shapiro & Solity, 2016; Stuart & Stainthorp, 2015), there is often a small but not insignificant proportion of children who are nonresponders, also termed 'treatment resisters', who do not improve significantly despite ongoing and intensive intervention (Torgesen, 2000). This is evident in many older children having weak word-reading (Leach, Scarborough, & Rescorla, 2003); and studies reporting the challenges of moving weak Anglophone readers to average level and keeping them there (Compton et al., 2014; Hindson et al.,

2005; O'Connor, 2000). Studies of the Anglophone 'summer slump' phenomena, whereby weak readers lose significant amounts of reading prowess across the summer vacation, also seem testament to the challenges faced in achieving highly effective Anglophone reading instruction (Knight et al., 2017).

Cognitive Load

It is likely that it is the high as opposed to low cognitive load of learning to read and write words that is the pivotal factor differentiating Anglophone and regular-orthography early literacy development.

Studies showing the need for working memory in learning to read and write permit insights into this area. Healthy working memory is consistently established as being strongly associated with English word-reading and literacy progress, with low short-term and working memory associated with reading difficulties (Gathercole & Pickering, 2000; Holmes, Gathercole, & Dunning, 2010). In contrast, studies report working memory is not strongly associated with regular-orthography reading development, with low working memory not preventing effective word-reading development (Cossu, 1999; Jimenez, Siegel, & Lopez, 2003).

As discussed elsewhere (Knight & Galletly, 2017; Knight et al., 2017), it is theorised that the young age (4-5 years) when Anglophone children start school and word-reading instruction, may well reduce their rate of word-reading development due to working memory being smaller at younger ages. Young-age disadvantage would likely compound difficulties caused by English orthographic complexity. In addition, it would likely cause younger regular-orthography readers to have slower reading development than older regular-orthography beginners. This is evident in comparing the younger Welsh regular-orthography Year 1 and 2 readers of Spencer & Hanley's (2003, 2004) English-Welsh study, with the older European regular-orthography Year 1 readers in Seymour, Aro & Erskine's (2003) fourteen nation comparison.

Using revised Learned Helplessness theory (Maier & Seligman, 2017), built from studies showing Learned Helplessness is a default option moved into relatively automatically when early failure and helplessness are experienced, the impact of resilience inoculation from early success also seems an important factor impacting cross-linguistic differences in early word-reading development. Anglophone beginning readers engaging with a complex word-reading curriculum with many confusing GPCs and high cognitive load, at an age when working memory is quite low, would seem more at risk of Learned Helplessness, and its accompanying negative effects (Knight et al., 2017)

Phonemic Awareness, Vocabulary and Lexical Efficiency

Fluent effective word-reading and word-writing skills support children's subsequent language and literacy skill development. This occurs through heightened phonological and orthographic skills, reading and writing proficiency, independent reading, and ongoing vocabulary and language expansion, with this in turn increasing verbal, lexical, language, and literacy efficiency (Ziegler et al., 2010).

Rapid mastery of word-reading generates phonemic-awareness advantage from early primary school, with sophisticated phonemic and orthographic awareness present from when children master word-reading accuracy and self-teaching in Year 1 (Aro, 2004; Hanley, Masterson, Spencer, & Evans, 2004). Rapid early literacy development is also likely to create vocabulary and language advantage through empowering independent reading and writing. Additionally, regular-orthography texts can use unrestricted vocabulary and sentence structure, enriching language development, whereas Anglophone beginning-reader texts restrict vocabulary and sentence structure to scaffold word-reading. Regular-orthography children thus have sophisticated phonological, reading, and writing skills; and language enrichment from Year 1 (Ziegler et al., 2010). This seems likely to build strong learning advantage, with Anglophone students, particularly weak readers, experiencing corresponding disadvantage.

Whilst there is minimal cross-linguistic research on these areas, it seems likely that other aspects of cognitive processing, notably executive functioning, are also improved by or within rapid development to proficient word-reading and word-writing. In the same way that multilingual children have heightened executive functioning linked to their skill using and moving between two linguistic codes (Greenberg, Bellana, & Bialystok, 2013; Kuo & Anderson, 2010; Morales, Calvo, & Bialystok, 2013), being proficient in verbal and literacy codes (speaking and listening, reading and writing) and moving between them may impact development not just of phonological and orthographic awareness, but also of executive functioning.

Pre-school Intervention

The gentleness of regular-orthography word-reading instruction is highlighted by the role of pre-existing weakness at school entry in phonological, language and pre-literacy skills (Caravolas, Lervåg, Defior, Seidlová Málková, & Hulme, 2013; Christopher, Hulslander, Byrne, Samuelsson, Keenan, Pennington & Olson, 2015; Hulme, Nash, Gooch, Lervåg, & Snowling, 2015; Snowling & Melby-Lervåg, 2016; Torppa et al., 2013), and Literate Cultural Capital, the bank of language and literacy experience which children build at home and bring to school (Prochnow, Tunmer, & Chapman, 2013). Whereas phonological and language weakness and low parent literacy predict major difficulties mastering accurate word-reading and word-writing in Anglophone nations, they do not impede the development of word-reading and word-writing accuracy in regular-

orthography students. In like manner, whilst RAN and family history do predict lasting weakness in all nations (evident in regular-orthography nations as fluency difficulties), in regular-orthography nations this is usually only slower reading, whereas in Anglophone it is often severe word-reading, writing and literacy weakness, and increased likelihood of low progress made from intervention (Compton et al., 2014; O'Connor, 2000).

Thus, whilst predictors are universal, in practical terms, it seems they create urgency only for Anglophone nations, with effective early intervention prior to word-reading instruction important for at-risk learners. This appears a major aspect of Anglophone orthographic disadvantage, made even more challenging through children being so much younger when they start reading instruction.

Triple Risk Disadvantage

A triple risk disadvantage appears likely for many Anglophone pre-school children with language and Literate Cultural Capital weakness (Hulme et al., 2015; Prochnow et al., 2013; Stuart & Stainthorp, 2015) with children experiencing disadvantage overlaid on other disadvantages. Firstly, generational disadvantage is experienced when parents with low literacy skills themselves are unable to support their children's literacy progress by building their Literate Cultural Capital (Compton, 2014). Secondly, these weak skills make it likely the children will have poor phonological awareness, and word-reading and word-writing difficulties. Thirdly, their weak word-reading and word-writing skills are likely to then prevent access to confident independent reading and writing, and the vocabulary, language and verbal efficiency growth available to effective readers.

Initial Orthographies and Cognitive Load

Crux factors creating the relative ease with which regular-orthography children learn to read and write appear to be keeping curriculum cognitive load sufficiently low to enable children's cognitive processing and working memory to not be overwhelmed, with high consistency of GPCs creating strong statistical learning and low cognitive load. These seem key factors currently differentiating early literacy development in regular-orthography and Anglophone nations.

Several Asian nations (Japan, China and Taiwan) require children to master Kanji (termed Hanzi in China and Taiwan), complex, largely logographic orthographies that seem at least as difficult, if not more difficult to master than English, given there are far more GPCs to be learned. However, PIRLS and PISA comparisons show these nations as much higher achievers than Anglophone nations, and to have fewer weak readers (Galletly & Knight, 2011b; Thomson et al., 2016; Thomson et al., 2012).

These nations begin word-reading and word-writing instruction using transitional fully-regular orthographies (Japanese Hiragana, Chinese Pinyin, and Taiwanese Zhuyin

Fuhao), used firstly as children's initial orthography, then as a parallel orthography enabling self-teaching of Kanji. This seems effective in achieving strong statistical learning, keeping cognitive load (and curriculum content load) manageable, and maximising children's word-reading, word-writing, self-teaching, and phonemic, orthographic and cognitive processing efficiency. Their orthographic advantage may well build from the children's strong statistical learning, lack of confusion, and confident success, along with the phonemic, orthographic, vocabulary, language, reading, writing and lexical efficiency advantages experienced from early primary school (Galletly & Knight, 2011b; Huang & Hanley, 1997).

Insights on this area are also available from reflecting on Initial Teaching Alphabet (ITA) research (Knight et al., 2017). While explored purely as a temporary initial orthography, in many ways, ITA use was similar to current Asian use of fully-regular orthographies. Like the Asian initial orthographies, the fully-regular English ITA orthography was used to remove confusion (and thus provide strong statistical learning), and to build strong early literacy skills that would enable later successful learning and mastery of a highly complex orthography, in this case, standard English orthography. ITA research finished abruptly at the time when Whole Language philosophy became dominant in Anglophone nations, with many planned research projects not completed. However the available research findings consistently report that the fully-regular ITA orthography kept cognitive load and early learning manageable, and expedited confident early literacy development (Downing, 1969; 1972; Knight et al., 2017; Mazurkiewicz, 1973).

Improving Outcomes

Since 2000, PISA and PIRLS international reading studies have provided nations with data allowing them to compare nations' elementary and secondary school educational achievement. Consideration of PISA data suggests the likelihood that regular-orthography nations can improve education and outcomes more easily than Anglophone nations (Galletly & Knight, 2011b; Thomson et al., 2016; Thomson et al., 2012). Many Anglophone nations show polarised achievement with many students doing very well (sufficiently well to keep mean achievement high), but also having much higher proportions of low achievers than high-achieving non-Anglophone nations. Successive PISA and PIRLS rounds show Anglophone nations generally not improving despite more teaching hours (Galletly & Knight, 2011b; Knight & Galletly, 2017; OECD, 2015; Thomson et al., 2016; Thomson et al., 2012).

It is in optimising the early years of Anglophone instruction that the current cross-linguistic reading achievement gap will most likely be narrowed (Compton et al., 2014, Stuart & Stainthorp, 2015). Recent PIRLS data is encouraging towards this end. The United States has had a strong national focus on optimising word-reading and reading instruction since 2000 (United States Government, 2004), as has the United Kingdom (Rose, 2006; UK DfES, 2006). In contrast, far more weak readers were evident for Australia and New

Zealand, which have not had this strong word-reading focus (DEST, 2005; Tunmer, Chapman, Greaney, Prochnow, & Arrow, 2013).

Educational Emphases

Children's early and later literacy are highly dependent on the quality of the instruction provided. The importance of early literacy instruction seems evidenced in nations which have regular orthographies still having widespread poor literacy levels (Galletly & Knight, 2013; Thomson et al., 2016; Thomson et al., 2012). For example, Portuguese children's reading was much lower than other regular-orthography readers in the Seymour et al., (2003) study of Year 1 reading.

The importance of later literacy instruction currently seems evident in Sweden's achievement on international reading tests. Sweden has rapid development of early word-reading and word-writing (Seymour et al., 2003), but unlike many other regular-orthography nations, Sweden's advantage seems to diminish over time. For example, Sweden achieves reasonably high results in Year 4 PIRLS reading (Thomson et al., 2012), but much lower achievement for students at age 15 years in PISA reading (Thomson et al., 2016).

ORTHOGRAPHIC ADVANTAGE THEORY

It can be seen from the research discussed above that there is sufficient and considerable research establishing there are major differences in literacy development between Anglophone and regular-orthography nations. Anglophone nations are experiencing negative outcomes due to English orthography's outlier complexity. Orthographic Advantage Theory builds from this research and current theories on cross-linguistic differences.

The Tenets

Orthographic Advantage Theory holds that nations' choices of orthographies can strongly impact children's ease of learning to read and write words, and create proliferating effects on education and achievement. Regular-orthography nations have orthographic advantage, while Anglophone nations have orthographic disadvantage, as do other nations using single complex orthographies, e.g., Thailand.

Orthographic advantage in regular-orthography nations begins with rapid easy word-reading and word-writing development, and has positive impact in at least six areas (see Figure 1):

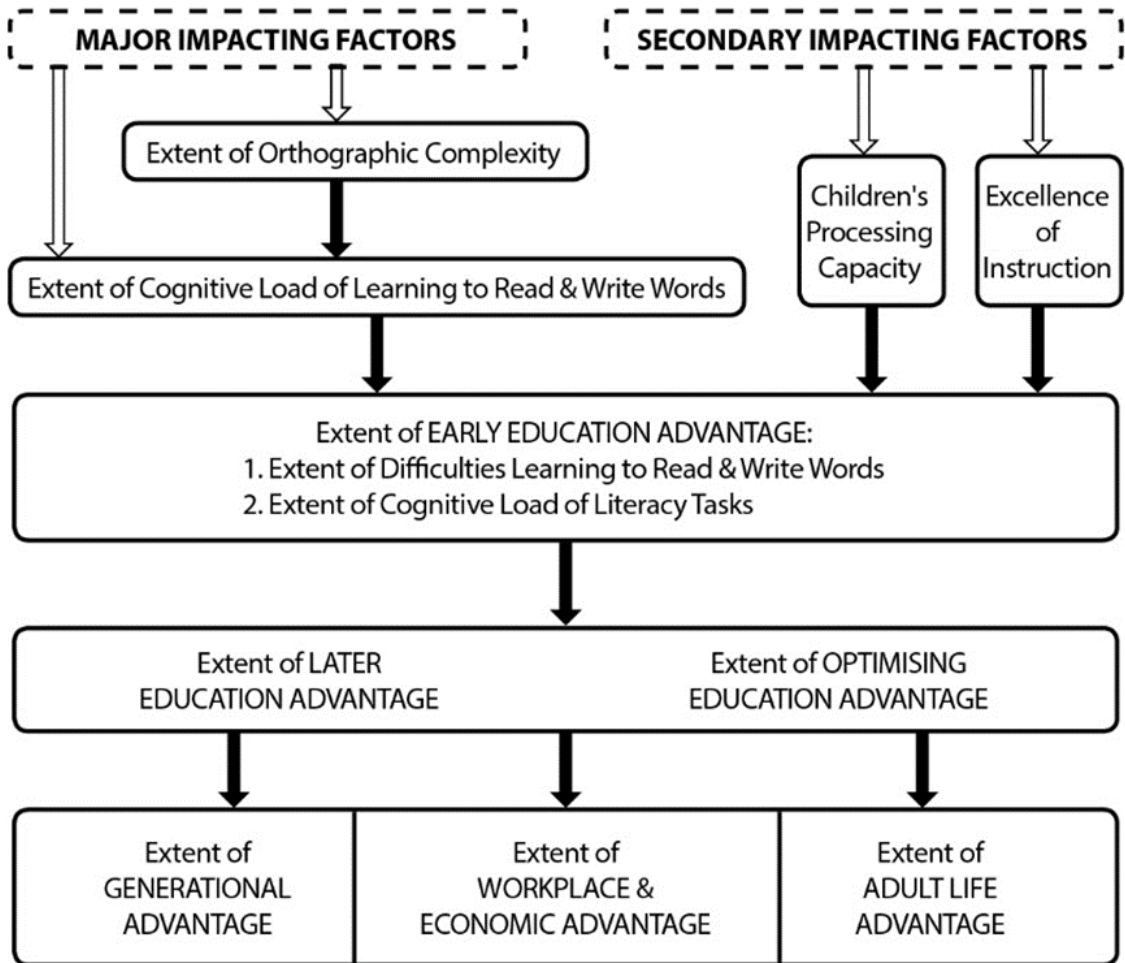


Figure 1. Orthographic Advantage Theory (from Knight et al., 2017)

1. Early education advantage, because of the low cognitive load that regular orthographies create for learning to read and write, with children quite quickly becoming proficiently accurate at word-reading, word-writing, and self-teaching.
2. Later education advantage, due to students having strong confident literacy skills, and likelihood of fewer struggling readers, with associated behaviour and social-emotional difficulties.
3. Optimising education advantage, as it seems easier to improve education and outcomes when schools do not face the challenges of overcoming relatively widespread literacy learning difficulties.

4. Generational advantage, as literate parents are able to effectively support their children's language and literacy development prior to and during their school years.
5. Adult life advantage, as adults with proficient literacy skills have heightened opportunities to access education, career, income and social-emotional benefits associated with effective literacy.
6. Workplace and economic advantage, through nations having higher workplace literacy levels.

Each of these six facets of advantage is likely present along a continuum ranging from strong disadvantage to strong advantage. Towards thinking more deeply on the dimensions of each of the six facets of orthographic advantage and disadvantage, the Appendix to this article contains tables detailing differences between Anglophone and regular-orthography nations with regards to these areas.

It is theorised that Anglophone nations experience orthographic disadvantage in the above areas. This is due to, firstly, the high cognitive load that Anglophone children experience in learning to read a complex orthography. This results in slower literacy development for virtually all children, with ongoing literacy weakness experienced by many. Slower literacy development creates complexities for teaching, learning and school resourcing needs. In addition, it is hypothesised that Anglophone early education disadvantage is compounded by children starting reading instruction at much younger ages than many other nations, and thus having reduced working memory.

It is also posited that differential disadvantage occurs for students with increased risk factors. These include family history of reading and learning difficulties; weakness in language skills, phonological awareness, Rapid Automated Naming (RAN), Literate Cultural Capital, behaviour or attention; or having parents with low school achievement and poor literacy skills (Galletly & Knight, 2011a).

Language and Literacy Optimisation

It is proposed that language and literacy optimisation occurs through the interacting skills of language and literacy, including cognitive processing (and particularly executive functioning); word-reading, word-writing and phonological awareness; reading comprehension, written expression, and independent reading and writing; speaking, listening, and language reasoning; and vocabulary and the syntactic and semantic forms used in verbal and written modes. Elsewhere, we have proposed an expanded-form Literacy Component Model (see Figure 2), highlighting the many factors impacting language and literacy development.

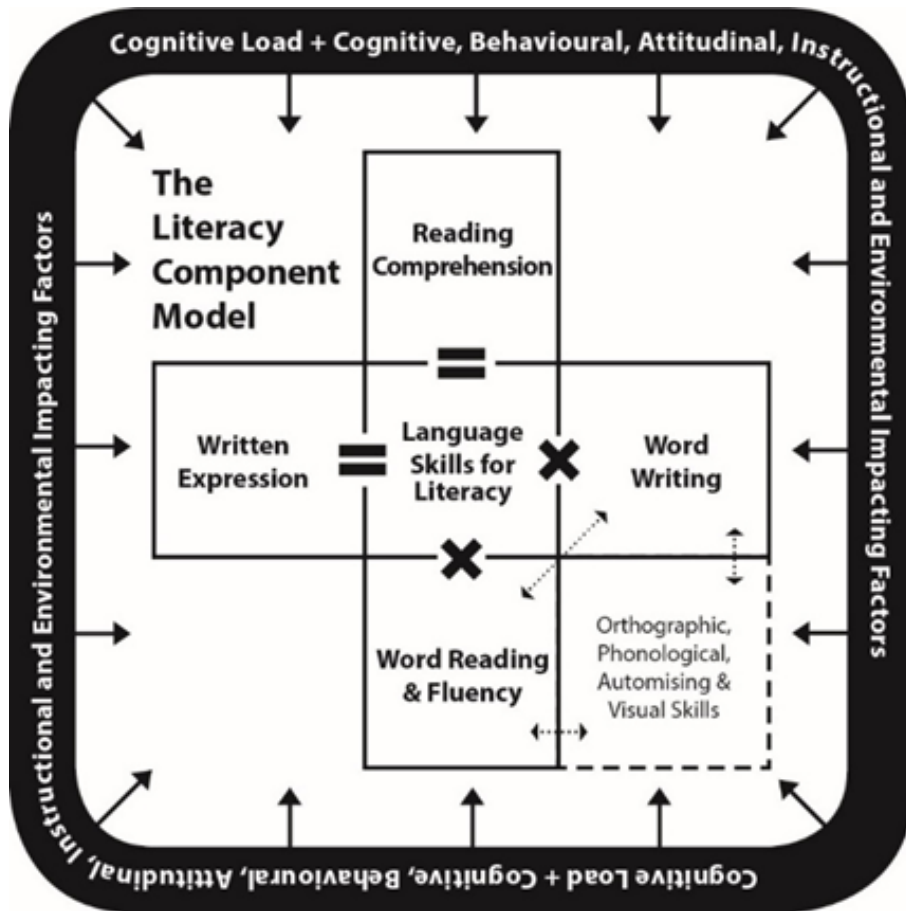


Figure 2. Literacy Component Model (Knight et al., submitted).

Cross-linguistic differences in word-reading and word-writing development are built from the level of ease of school teaching and learning. These can be considered more specifically using a model of Transition from Early to Sophisticated Literacy (TESL, Galletly & Knight, 2011b), which supports reflection on the teaching, learning, and learning environment differences of Anglophone and regular-orthography classrooms (see Figure 3).

In the TESL model, literacy is a broad construct with two components, namely Core Literacy (reading and writing words as single words and in connected text (i.e. learning to read and write by mastering the alphabetic principle) and Continuing Literacy (meaning-based literacy skills, including reading, reflecting on text content at varying levels, and transferring meaning using multiliteracies). The TESL model supports consideration of major educational differences between Anglophone and regular-orthography nations. As discussed elsewhere (Galletly & Knight, 2011b), nations and education systems can be classified as three types: Rapid-tesl, Facilitated-tesl and

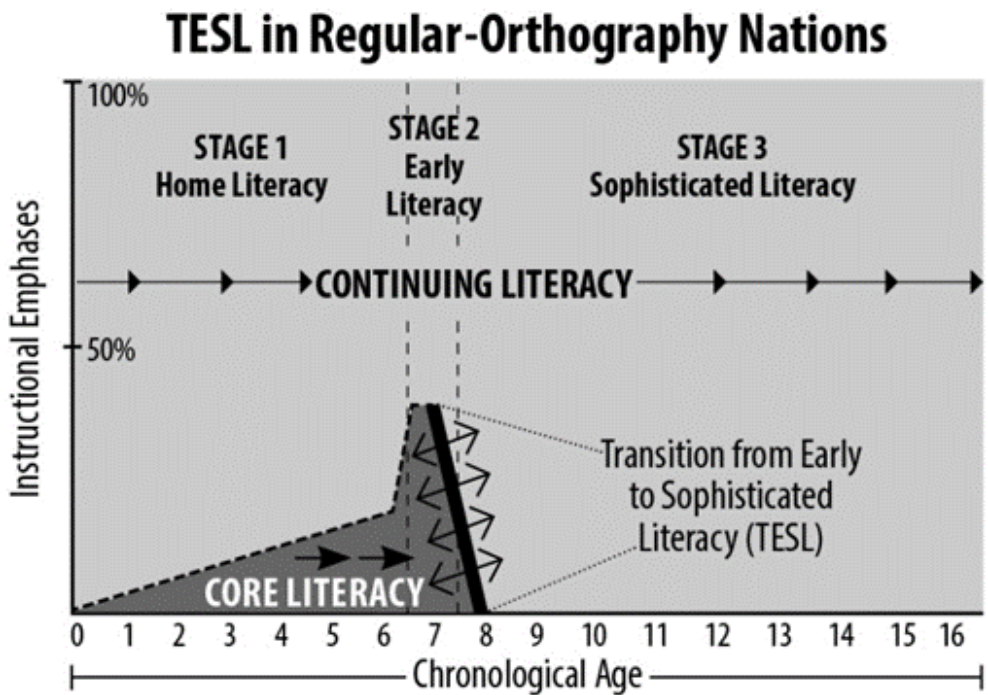
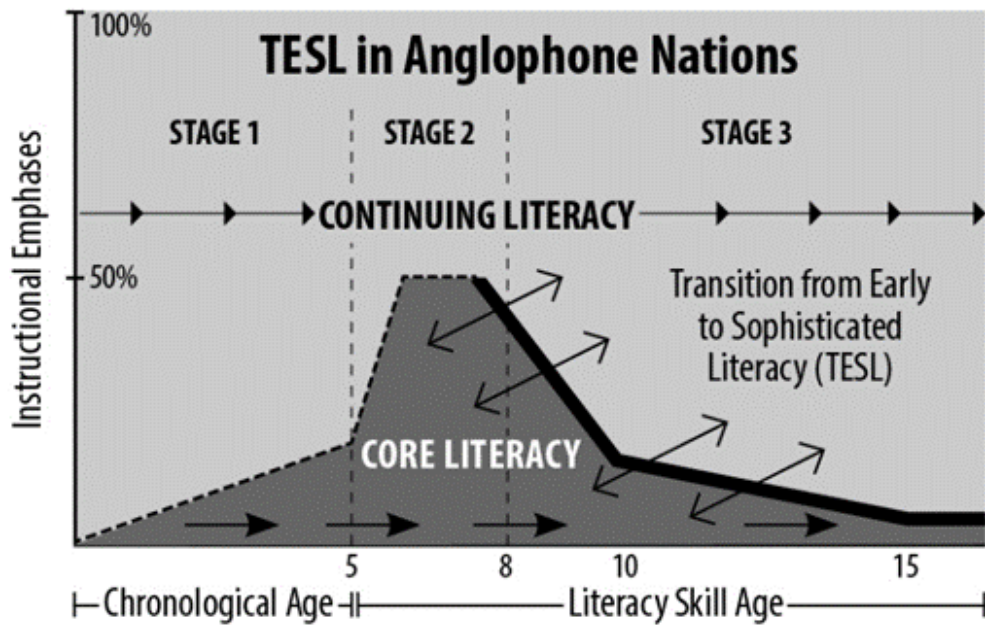


Figure 3. The Transition from Early to Sophisticated Literacy (TESL) model, showing Anglophone nations using Standard English (top) and nations using regular-orthographies (bottom).

Complex-TESL. Rapid-TESL nations (e.g., Finland, Estonia, South Korea) use highest-regularity orthographies and have the most orthographic advantage available to them. Facilitated-TESL nations (e.g., Japan, China, Taiwan) use parallel regular and complex orthographies, with the regular orthography taught first to facilitate self-teaching and literacy development, with resultant high orthographic advantage. Anglophone nations and Thailand are Complex-TESL nations. South Korea is a useful case study of a nation moving from Complex- to Rapid-TESL status, when it replaced its traditional highly-complex orthography with highly-regular Hangeul in 1946, with rapid expansion of literacy, education and the economy from that time. (While South Korea also has a logography, Hancha, it is increasingly less used, e.g., not used in newspapers and education, such that, in education, Hangeul can be considered a sole orthography. South Korea can therefore be considered a Rapid-TESL, rather than Facilitated-TESL nation.)

Regular orthographies enable the optimising of education through rapid TESL, with virtually all children quickly becoming proficiently accurate at word-reading, word-writing and self-teaching, who are thus able to benefit from focused Sophisticated-Literacy and academic learning, with word-reading and word-writing creating minimal cognitive load. Thus, whereas regular orthographies and effective instruction bring early education advantage (see Figures 1 and 3), subsequent advantages of orthographic transparency build from language and literacy progress across the school years (Galletly & Knight, 2011b; Knight & Galletly, 2017; Thomson, De Bortoli, & Underwood, 2016; Thomson et al., 2012). There is value in research exploring the dimensions and implications of Orthographic Advantage Theory towards the optimising of literacy and its development in Anglophone nations.

WIDESPREAD FORMS OF ADVANTAGE

In education and child development, few factors operate in isolation, and therefore orthographic complexity is unlikely to work in isolation in creating orthographic advantage and disadvantage. Within Orthographic Advantage Theory, it is considered likely that other factors impacting early literacy development will mimic, moderate, and interact with the effects of orthographic complexity. Factors discussed above, including the effectiveness of early literacy instruction, age when commencing school, and socio-emotional functioning encompassing extent of early success and resilience for complex learning (Maier & Seligman, 2016), will doubtless interact with the effects of orthographic complexity. Factors such as spoken-language characteristics, orthographic features beyond GPCs, multilingualism, and family work ethic supporting school and beyond-school learning would also seem likely to have significant impacts.

The research on multilingualism, for example, reports that young children who are multilingual (either proficiently from early childhood or through commencing learning a second language from the start of school) have heightened phonological sensitivity,

executive function skills, and metalinguistic awareness, which produce similar effects to those of mastering reading of a highly regular orthography (Greenberg et al., 2013; Kuo & Anderson, 2010; Morales et al., 2013). With multilingual children having high phonemic awareness, executive functioning and skill using, reflecting on and moving between different codes, multilingualism seems likely to be a factor which mimics and interacts with orthographic impacts. This is supported by the PIRLS and PISA results from Hong Kong which does not use a regular orthography prior to children learning to read and write Kanji, with multilingual competence appearing to act similarly to the orthographic advantage of other nations, in offsetting orthographic disadvantage linked to complex Kanji orthography.

Word factors beyond GPC ratios will also be interacting factors (Aro, 2017; Borleffs, Maassen, Lyytinen & Zwarts, 2017). As an example, Aro (2017) discusses the major morphological complexity of many Finnish words (e.g., *mustaviinimarjamehupullo: a bottle of black current juice*). with many words having over 2000 different forms (including up to fifteen core forms). This complex merging of many semantic categories at word level suggests that whilst Finnish children with language weakness would be able to read words accurately, they may experience higher cognitive load for reading comprehension and written expression, due to difficulties processing language aspects of words.

Using a broad form of Orthographic Advantage Theory, we emphasise that whilst these additional impacting factors moderate the effects of orthography, there is nonetheless sufficient research establishing major cross-linguistic difficulties due to differences in orthographic complexity.

Cross-linguistic Theories

Orthographic Advantage Theory is built from the research reporting strong literacy development differences between Anglophone and regular-orthography nations, and influential theories on reading and literacy development cross-linguistic differences. Relevant theories it aligns with include cross-linguistic theories namely connectionist, Simple View (Gough & Tunmer, 1986) and Literacy Component Models.

Cross-linguistic theories about word-reading and literacy development have strongly influenced research on differences between learning to read Standard English and regular orthographies. Two key theories, which Orthographic Advantage Theory aligns with, are the Orthographic Depth Hypothesis (Frost, 2012) and the Psycholinguistic Grainsize Theory (Ziegler & Goswami, 2005).

The Psycholinguistic Grainsize Theory (Ziegler & Goswami, 2005) emphasises nations' orthographies differing by the psycholinguistic grainsizes which are used. These in turn impact reading development through differing word-reading strategies being used for each grainsize. Regular orthographies use a single grainsize, usually phonemes with

close to one-to-one GPCs, and virtually all words thus being regular words. In contrast, English uses three grainsizes, namely phoneme grainsize (in fully regular words and syllables); orthographic unit grainsize (in words using common English spelling patterns); and whole word grainsize (for highly irregular words). Using Psycholinguistic Grainsize Theory, reading development is impacted through differing word-reading strategies being needed for each grainsize, and early readers meeting many confusing GPCs.

The Orthographic Depth Hypothesis proposes cross-linguistic differences in word-reading relate to readers' use of lexical processing (whole-word reading) and sub-lexical processing (phonological recoding, 'sounding out' words) during reading. It is a highly influential theory which has been widely explored (Carrillo, Alegria, & Marin, 2013; Frost, 2012; Schmalz, Beyersmann, Cavalli, & Marinus, 2016). Complex, incomplete and inconsistent orthographies such as Standard English make decoding more difficult and slower to develop; and increase the likelihood of whole-word reading because phonological recoding is often ineffective; whilst highly-regular orthographies make decoding easier and increase likelihood of early reading using sub-lexical processing (phonological recoding).

In proposing language and literacy optimisation as part of orthographic advantage (Knight et al., submitted), Orthographic Advantage Theory aligns with multiple theories showing strong interrelationships of reading, writing, cognitive processing and language skills and development. Considerable research and models establish these strong interrelationships, including Seidenberg and colleagues' connectionist models (Harm & Seidenberg, 2004); Perfetti and colleagues' Verbal Efficiency, Lexical Quality and Reading Systems Framework models (Perfetti, 2007; Perfetti & Stafura, 2014); multilingualism advantage and structural sensitivity theory (Kuo & Anderson, 2010; Morales, Calvo, & Bialystok, 2013); theories of differential disadvantage of Anglophone weak readers with language and cognitive processing weakness language (Galletly & Knight, 2011a); and the expanded-form Literacy Component Model (see Figure 2; Knight & Galletly, Submitted). Elsewhere, we discuss this latter model that highlights many important factors impacting literacy development and interactions between them (Knight et al., Submitted). These interactions seem likely to be involved in the more efficient development of cognitive processing, language and literacy skills of regular-orthography readers and multilingual children.

CONCLUSION

Whereas a half-century ago nations could operate relatively independently of each other, the world now operates globally on an international stage. Cross-linguistic and other research presents a plethora of knowledge and dimensions for thinking on cross-linguistic differences, and how best to optimise reading development in different nations, for all children, and particularly at-risk learners. This knowledge is useful for all stakeholders involved in improving reading instruction, including teachers and schools,

education leaders, policymakers and reading researchers. Orthographic Advantage Theory is a useful tool for reflecting on these areas.

As shown in Figures 1 and 3, orthographic advantage starts with the ease and rapidity of word-reading, word-writing, and self-teaching development in regular-orthography nations, for all children, including children with disabilities. Their relatively rapid word-reading and word-writing has potential to generate advantages at individual citizen and national levels. This advantage is likely to include greater ease of school instruction in primary and secondary school, and improving of education and its outcomes. It is also likely to include less workplace illiteracy, adult life advantage, and generational advantage as literate parents are able to support their children's literacy development. Orthographic advantage and disadvantage are experienced by beginning readers, teachers, schools, education systems, and nations as a whole.

At the current time, Anglophone nations and other nations using a sole complex orthography, experience strong disadvantage in these areas, and improving literacy development and outcomes is a high priority. Orthographic advantage is experienced by regular-orthography nations, both those use a sole, highly-regular orthography (rapid-TEFL nations), and those using an initial fully-regular orthography prior to use of their complex orthography (Facilitated-TEFL nations).

Potential for optimising effectiveness of Anglophone word-reading and literacy instruction is clearly the answer towards mitigating current effects of English orthographic complexity and orthographic disadvantage (Knight et al., 2017; Landerl, 2000), and it seems likely that it is achieving success in the earliest years of Anglophone schooling that is crux if success in later school years is to be achieved. However, the benchmark set by high-achieving regular-orthography and multilingual nations is high, and current research shows continuing difficulties optimising Anglophone word-reading instruction and development, with many children having continuing word-reading reading weakness (Compton et al., 2014; Hindson et al., 2005; Knight et al., 2017; O'Connor, 2000; Torgesen, 2000).

Using Orthographic Advantage Theory and cross-linguistic and other research findings, Anglophone at-risk learners seem significantly disadvantaged in important areas which may be key to improving Anglophone instruction. These areas likely include the high cognitive load of current English word-reading and word-writing development; the high confusability of English GPCs that English orthographic complexity creates; likely weaker statistical learning because of GPC confusion; and the likely reduced readiness, resilience and working memory Anglophone children have for this learning, due to being much younger (4 to 5 years old) when learning to read and write.

Certainly there seems value in nations carefully considering the type and number of GPCs which are to be introduced for beginning readers, the order and timing of their

introduction, and the need for children to experience ongoing strong success, including being highly successful when reading early books and texts.

Towards each nation optimising reading and literacy development for its children and nation there is huge value in thinking at an international level, and reflecting on cross-linguistic differences and aspects of orthographic advantage and disadvantage.

Orthographic Advantage Theory is offered as a tool for researchers and educators, for multiple purposes. Orthographic Advantage Theory encourages reflection on the extent to which orthographic complexity impacts reading and literacy development, instruction, outcomes and difficulties. It also has potential to facilitate thinking in paradigmatically new ways towards optimising nations' reading and literacy development for all children, and especially at-risk and struggling readers. Further, it has potential to inspire needed useful research on currently underexplored aspects of potential cross-linguistic differences.

REFERENCES

- Aro, M. (2004). *Learning to read: The effect of orthography*. Jyväskylä, Finland: University of Jyväskylä.
- Aro, M. (2017). Learning to read Finnish. In L. T. W. Verhoeven & C. A. Perfetti (Eds.), *Learning to read across languages and writing systems* (pp. 416-436). Cambridge: UK: Cambridge University Press.
- Borleffs, E., Maassen, B., Lyytinen, H., & Zwarts, F. (2017). Measuring orthographic transparency and morphological-syllabic complexity in alphabetic orthographies: A narrative review. *Reading & Writing, 30* (8), 1617-1638.
- Caravolas, M., Lervåg, A., Defior, S., Seidlová Málková, G., & Hulme, C. (2013). Different patterns, but equivalent predictors, of growth in reading in consistent and inconsistent orthographies. *Psychological Science, 24*(8), 1398-1407.
- Carrillo, M. S., Alegria, J., & Marin, J. (2013). On the acquisition of some basic word spelling mechanisms in a deep (French) and a shallow (Spanish) system. *Reading and Writing: An Interdisciplinary Journal, 26*(6), 799-819.
- Christopher, M. E., Hulslander, J., Byrne, B., Samuelsson, S., Keenan, J. M., Pennington, B., . . . Olson, R. K. (2015). Genetic and environmental etiologies of the longitudinal relations between prereading skills and reading. *Child Development, 86*(2), 342-361.
- Compton, D. L., Miller, A. C., Elleman, A. M., & Steacy, L. M. (2014). Have we forsaken reading theory in the name of "Quick Fix" interventions for children with reading disability? *Scientific Studies of Reading, 18*(1), 55-73.
- Cossu, G. (1999). The acquisition of Italian orthography. In M. Harris, & G. Hatano, (Eds.), *Learning to reading and write: A cross-linguistic perspective* (pp. 10-34). Cambridge: Cambridge University Press.
- Department of Education, Science & Training (DEST; 2005). *Teaching reading: Report and recommendations: National inquiry into the teaching of literacy*. Retrieved from <http://>

research.acer.edu.au/tll_misc/5/.

- Downing, J. (1969). Initial teaching alphabet: Results after six years. *The Elementary School Journal*, 242-249.
- Downing, J. (1972). The orthography factor in literacy acquisition in different languages. *Literacy Discussion*, 3(3-4), 409-427.
- Frost, R. (2012). Towards a universal model of reading. *Behavioral and Brain Sciences*, 35(5), 263-279.
- Gabay, Y., Thiessen, E. D., & Holt, L. L. (2015). Impaired statistical learning in developmental dyslexia. *Journal of Speech, Language, and Hearing Research*, 58(3), 934-945.
- Galletly, S. A., & Knight, B. A. (2004). The high cost of orthographic disadvantage. *Australian Journal of Learning Disabilities*, 9(4), 4-11.
- Galletly, S. A., Knight, B. A., Dekkers, J., & Galletly, T. A. (2009). Indicators of late emerging reading-accuracy difficulties in Australian schools. *The Australian Journal of Teacher Education*, 34(5), 54-64.
- Galletly, S. A., & Knight, B. A. (2011a). A theory of differential disadvantage of Anglophone weak readers with language and cognitive processing weakness. *Australasian Journal of Special Education*, 35(1), 72-96.
- Galletly, S. A., & Knight, B. A. (2011b). Transition from Early to Sophisticated Literacy as a factor in cross-national achievement differences. *Australian Educational Researcher*, 38, 329-354.
- Galletly, S. A., & Knight, B. A. (2013). Because trucks aren't bicycles: Orthographic complexity as a disregarded variable in reading research. *Australian Educational Researcher*, 40(2), 173-194.
- Gathercole, S. E., & Pickering, S. J. (2000). Working memory deficits in children with low achievements in the national curriculum at 7 years of age. *The British Journal of Educational Psychology*, 70(2), 177-194.
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading and reading disability. *Remedial and Special Education*, 7(1), 6-10.
- Greenberg, A., Bellana, B., & Bialystok, E. (2013). Perspective-taking ability in bilingual children: extending advantages in executive control to spatial reasoning. *Cognitive Development*, 28(1), 41-50.
- Hanley, J. R., Masterson, J., Spencer, L. H., & Evans, D. (2004). How long do the advantages of learning to read a transparent orthography last? An investigation of the reading skills and incidence of dyslexia in Welsh children at 10-years of age. *The Quarterly Journal of Experimental Psychology*, 57(8), 1393-1410.
- Harm, M. W., & Seidenberg, M. S. (2004). Computing the meanings of words in reading: Cooperative division of labor between visual and phonological processes. *Psychological Review*.
- Hindson, B., Byrne, B., Fielding-Barnsley, R., Newman, C., Hine, D. W., & Shankweiler, D. (2005). Assessment and early instruction of preschool children at risk for Reading Disability. *Journal of Educational Psychology*. Vol., 97(4), 687-704.
- Holmes, J., Gathercole, S. E., & Dunning, D. L. (2010) Poor working memory. Impact and interventions. *Advances in Child Development & Behavior*, 39, 1-43).
- Huang, H., & Hanley, J. R. (1997). A longitudinal study of phonological awareness, visual skills, and Chinese reading acquisition among first-graders in Taiwan. *International Journal of Behavioural Development*, 20(2), 249-268.
- Hulme, C., Nash, H. M., Gooch, D., Lervåg, A., & Snowling, M. J. (2015). The foundations of literacy development in children at familial risk of dyslexia. *Psychological Science*, 26(12), 1877-1886.

- Jimenez, J. E., Siegel, L. S., & Lopez, M. R. (2003). The relationship between IQ and reading disabilities in English-speaking Canadian and Spanish children. *Journal of Learning Disabilities, 36*(1), 15-23.
- Joshi, R. M. & McCardle, P. (2017). Models of Reading in Different Orthographies: An Introduction. *Journal of Learning Disabilities, Jul 1*, doi: 10.1177/0022219417718196. [Epub ahead of print]
- Knight, B. A., & Galletly, S. A. (2017). Effective literacy instruction for all students: A time for change. *International Journal of Innovation, Creativity & Change, 3*(1), 65-89
- Knight, B. A., Galletly, S. A., & Gargett, P. S. (2017). Managing cognitive load as the key to literacy development: Research directions suggested by crosslinguistic research and research on Initial Teaching Alphabet. In R. Nata (Ed.), *Progress in Education*, pp. 61-150). New York: Nova Science Publishers.
- Knight, B. A., & Galletly, S. A. (Submitted). The Literacy Component Model: A pragmatic universal model for researchers and educators.
- Kuo, L., & Anderson, R. C. (2010). Beyond cross-language transfer: Reconceptualizing the impact of early bilingualism on phonological awareness. *Scientific Studies of Reading, 14*(4), 365-385.
- Landerl, K. (2000). Influences of orthographic consistency and reading instruction on the development of nonword reading skills. *European Journal of Psychology of Education, 15*, 239-257.
- Landerl, K., Ramus, F., Moll, K., Lyytinen, H., Leppänen, P. H. T., Lohvansuu, K., . . . Schulte-Körne, G. (2013). Predictors of developmental dyslexia in European orthographies with varying complexity. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 54*(6), 686-694.
- Landerl, K., & Wimmer, H. (2008). Development of word reading fluency and spelling in a consistent orthography: An 8-year follow-up. *Journal of Educational Psychology, 1*, 150-161.
- Landerl, K., Wimmer, H. C. A., & Frith, U. (1997). The impact of orthographic consistency on dyslexia: A German-English comparison. *Cognition, 63*, 315-334.
- Leach, J. M., Scarborough, H. S., & Rescorla, L. (2003). Late-emerging reading disabilities. *Journal of Educational Psychology, 95*(2), 211-224.
- Liao, C.-H., Deng, C., Hamilton, J., Lee, C. S.-C., Wei, W., & Georgiou, G. K. (2015). The role of rapid naming in reading development and dyslexia in Chinese. *Journal of Experimental Child Psychology, 130*, 106-122.
- Maier, S. F., & Seligman, M. E. P. (2016). Learned helplessness at fifty: Insights from neuroscience. *Psychological Review, 123*(4), 349-367.
- Mazurkiewicz, A. J. (1973). I.T.A. Revisited. Paper presented at the Annual Meeting of the College Reading Assn. (17th, Silver Springs, Md., November 1-3, 1973).
- Morales, J., Calvo, A., & Bialystok, E. (2013). Working memory development in monolingual and bilingual children. *Journal of Experimental Child Psychology, 114*(2), 187-202.
- O'Connor, R. E. (2000). Increasing the Intensity of Intervention in Kindergarten and First Grade. *Learning Disabilities Research & Practice, 15*(1), 43-54.
- OECD. (2015). *Education at a Glance 2015: OECD Indicators*. Retrieved from <http://dx.doi.org/10.1787/eag-2015-en>.
- Olofsson, A., & Niedersoe, J. (1999). Early language development and kindergarten phonological awareness as predictors of reading problems: From 3 to 11 years of age. *Journal of Learning Disabilities, 32*(5), 464-472.
- Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading,*

- 11(4), 357-383.
- Perfetti, C., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading, 18*(1), 22-37.
- Pollo, T. C., Treiman, R., & Kessler, B. (2007). Three perspectives on spelling development. In E. Grigorenko & A. Naples (Eds.), *Single-word reading: Behavioural and biological perspectives*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Poskiparta, E., Neimi, P., & Vauras, M. (1999). Who benefits from training in linguistic awareness in the first grade, and what components show training effects? *Journal of Learning Disabilities, 32*(5), 437 - 447.
- Prochnow, J. E., Tunmer, W. E., & Chapman, J. W. (2013). A longitudinal investigation of the influence of literacy-related skills, reading self-perceptions, and inattentive behaviours on the development of literacy learning difficulties. *International Journal of Disability, Development and Education, 60*(3), 185-207.
- Roberts, G., Torgesen, J. K., Boardman, A., & Scammacca, N. (2008). Evidence-based strategies for reading instruction of older students with learning disabilities. *Learning Disabilities Research & Practice, 23*(2), 63-69.
- Rose, J. (2006). *Independent review of the teaching of early reading: Final report*. Retrieved from <http://dera.ioe.ac.uk/5551/2/report.pdf>.
- Schneider, W., Ennemoser, M., Roth, E., & Kuspert, P. (1999). Kindergarten prevention of dyslexia: Does training in phonological awareness work for everybody? *Journal of Learning Disabilities, 32*(5), 429-442.
- Schmalz, X., Beyersmann, E., Cavalli, E., & Marinus, E. (2016). Unpredictability and complexity of print-to-speech correspondences increase reliance on lexical processes: More evidence for the orthographic depth hypothesis. *Journal of Cognitive Psychology, 28*(6), 658-672.
- Seymour, P. H. K., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*, 143-174.
- Seymour, P. H. K., & Duncan, L. G. (2001). Learning to read in English. *Psychologia, 8*(3), 281-299.
- Shapiro, L. R., & Solity, J. (2016). Differing effects of two synthetic phonics programmes on early reading development. *British Journal of Educational Psychology, 86*(2), 182-203.
- Share, D. L. (2008). On the Anglocentricities of current reading research and practice: The perils of overreliance on an 'outlier' orthography. *Psychological Bulletin, 134*(4), 584-615.
- Snowling, M. J., & Melby-Lervåg, M. (2016). Oral language deficits in familial dyslexia: A meta-analysis and review. *Psychological Bulletin, 142*(5), 498-545.
- Snowling, M., Stothard, S. E., Clarke, P., Bowyer-Crane, C. A., Harrington, A., Truelove, E., & etal., (2009). *York Assessment of Reading for Comprehension: GL Assessment*.
- Spencer, L. H., & Hanley, J. R. (2003). Effects of orthographic transparency on reading and phoneme awareness in children learning to read in Wales. *British Journal of Psychology, 94* (1), 1-29.
- Spencer, L. H., & Hanley, J. R. (2004). Learning a transparent orthography at 5 years-old: Reading development of children during their first year of formal reading instruction in Wales. *Journal of Research in Reading, 27*(1), 1-14.
- Stuart, M., & Stainthorp, R. (2015). *Reading development and teaching*. London: SAGE Publications.
- Thomson, S., De Bortoli, L., & Underwood, C. (2016). *PISA 2015: A first look at Australia's results*. Retrieved from Australian Council for Educational Research (ACER): research.acer.edu.au
- Thomson, S., Hillman, K., Wernert, N., Schmid, M., Buckley, S., & Munene, A. (2012). *Highlights from TIMSS & PIRLS 2011 from Australia's perspective*. Retrieved from <https://www.acer.edu.au/>

files/TIMSS-PIRLS_Australian-Highlights.pdf

- Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (2012). *Test of Word Reading Efficiency 2 (TOWRE-2)*. Austin, Texas: Pro-Ed, Inc.
- Torgesen, J. K. (2000). Individual differences in response to early interventions in reading: The lingering problem of treatment resisters. *Learning Disabilities Research & Practice, 15*(1), p55 - 65.
- Torppa, M., Eklund, K., van Bergen, E., & Lyytinen, H. (2015). Late-emerging and resolving dyslexia: A follow-up study from age 3 to 14. *Journal of Abnormal Child Psychology, 43*(7), 1389-1401.
- Torppa, M., Parrila, R., Niemi, P., Lerkkanen, M. K., Poikkeus, A. M., & Nurmi, J. E. (2013). The double deficit hypothesis in the transparent Finnish orthography: A longitudinal study from Kindergarten to Grade 2. *Reading and Writing, 26*(8), 1353-1380.
- Tunmer, W. E., Chapman, J. W., Greaney, K. T., Prochnow, J. E., & Arrow, A. W. (2013). Why the New Zealand National Literacy Strategy has failed and what can be done about it: Evidence from the Progress in International Reading Literacy Study (PIRLS) 2011 and Reading Recovery monitoring reports. *Australian Journal of Learning Difficulties, 18*(2), 139-180.
- UK DfES. (2006). *The Primary Framework for literacy and mathematics: Core position papers underpinning the renewal of guidance for teaching literacy and mathematics*. UK Government: London.
- United States Government. (2004). The facts about Reading First. Retrieved from <http://www.ed.gov/nclb/methods/reading/readingfirst.pdf>.
- Ziegler, J. C., Perry, C., & Zorzi, M. (2014). Modelling reading development through phonological decoding and self-teaching: Implications for dyslexia. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences, 369*(1634), 20120397.
- Ziegler, J. C., Bertrand, D., Tóth, D., Csépe, V., Reis, A., Faisca, L., . . . Blomert, L. (2010). Orthographic depth and its impact on universal predictors of reading: A cross-language investigation. *Psychological Science, 21*(4), 551-559.
- Ziegler, J. C., & Goswami, U. C. (2005). Reading acquisition, developmental dyslexia and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin, 131* (1), 3-29.

APPENDIX: EXPANDED VIEW OF ORTHOGRAPHIC ADVANTAGE THEORY'S SIX FACETS OF ADVANTAGE AND DISADVANTAGE

Orthographic Advantage Theory proposes six aspects of advantage and disadvantage: Early Education Advantage, Later Education Advantage, Optimising Education Advantage, Generational Advantage, Workplace and Economic Advantage, and Adult Life Advantage.

Towards thinking more deeply on the dimensions of each of the six facets of orthographic advantage and disadvantage, this Appendix to the article has five tables detailing the differences between Anglophone and regular-orthography nations with regards to

1. Bases, rationale and categories for orthographic advantage and disadvantage.
2. The role of orthography in word reading and writing development and advantage.
3. Early education advantage and disadvantage from the impacts of low and high cognitive load.
4. Later education advantage and disadvantage.
5. Generational, workplace and adult life advantage and disadvantage.

BASES, RATIONALE & CATEGORIES FOR ORTHOGRAPHIC ADVANTAGE AND DISADVANTAGE	
REGULAR-ORTHOGRAPHY NATIONS experience orthographic advantage	ANGLOPHONE NATIONS experience orthographic disadvantage
<p>Basis for orthographic advantage: Word reading & literacy development is easy & rapid because regular orthographies create very low cognitive load, making it easy for beginning readers learning to read & write words.</p>	<p>Basis for orthographic disadvantage: Word reading & literacy development is arduous & slow for all readers, and especially hard for at risk readers because English spelling creates high cognitive load, making it hard to learn to read & write.</p>
<p>Reasons for choosing orthographic regularity: Most nations use regular orthographies because they inexpensively expedite reading & literacy development, and provide the benefits of nationwide high literacy levels. Nations seem to vary in the extent to which they utilise their orthographic advantage.</p>	<p>Reasons for orthographic complexity: English orthography is vastly more complex than most orthographies. There seems to have been little thought of English spelling being a poor choice, making reading & literacy development complex and expensive (with the result being many children and adults having low literacy and the disadvantages associated with low literacy skills.</p>

BASES, RATIONALE & CATEGORIES FOR ORTHOGRAPHIC ADVANTAGE AND DISADVANTAGE	
REGULAR-ORTHOGRAPHY NATIONS experience orthographic advantage	ANGLOPHONE NATIONS experience orthographic disadvantage
Categories of advantage: Orthographic advantage is experienced by beginning readers, teachers, schools, education systems, & the nation as a whole:	Categories of disadvantage: Orthographic disadvantage is experienced by beginning & struggling readers, teachers, schools, education systems, & the nation as a whole:
Early education advantage: virtually all children are accurate readers and writers from very early in primary school, able to read and write all words.	Early education disadvantage: difficulties of providing effective resourcing and instruction for children progressing at different rates, and the major difficulties in achieving effective early intervention and remediation.
Later education advantage: proficient reading & writing enables easier, more efficient primary and high school education. It is likely much easier to teach & learn in those classes due to no children having reading difficulties, and the likelihood of fewer behaviour and social-emotional difficulties.	Later education disadvantage: highly diverse instructional needs due to many children having weak literacy; high needs for resourcing to support struggling readers; likely increased social emotional & behaviour difficulties due to frustration; reduced time available for sophisticated literacy instruction, and additional time needed for Core Literacy instruction.
Optimising education advantage: the ease of optimising literacy and academic teaching, learning and outcomes when virtually all children are effectively literate.	Optimising education disadvantage: difficulties optimising literacy & academic teaching, learning and outcomes due to classes having diverse word-reading and writing levels, with many children struggling with literacy and associated social-emotional issues.
Generational advantage: virtually all adults are literate and able to effectively support children prior to and during their school years.	Generational disadvantage: struggling readers become parents with difficulty building their children's pre-literacy and language skills, with children thus more likely to struggle with reading and literacy.
Workplace and economic advantage: high workplace literacy levels offer potential national economic advantage.	Workplace and economic disadvantage: many adult workers having low literacy levels and workplace illiteracy issues creates significant disadvantage and expense.
Adult life advantage: the education, career, income and social-emotional benefits adults have through high literacy.	Adult life disadvantage: adults with weak literacy may experience low career and income options, and lower social-emotional wellbeing.