A STUDY OF THE ORTHOGRAPHIC INFLUENCE OF LEARNING ROMAJI BEFORE ENGLISH IN JAPANESE ELEMENTARY SCHOOLS

A Thesis submitted

by

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ABSTRACT

This thesis investigated the influence of learning *romaji* before English on the orthographic knowledge of Grade-5 Japanese elementary school students as measured prior to the Japanese education reform in 2020. While research has identified that orthographic depth can influence rate, strategy, and error types in *reading*, no research to date has investigated the orthographic influence from evidence in *written* responses of young children learning two orthographically contrastive alphabetic scripts.

One widely accepted assumption is that *romaji* facilitates English spelling. However, research surrounding orthographic influence indicates that shallow orthographies like *romaji* only partially facilitate orthographic knowledge transfer to deeper orthographies like English and this research considers the need to identify the place and direction of transfer. This thesis, therefore, contributes to the field of orthographic research by investigating the directional influence of learning *romaji* before English and by identifying what variables correlate with writing accuracy. As a result, three types of inhibitive orthographic influence were found, giving rise to the development of the Orthographic Gap Hypothesis (OGH).

To develop the OGH, a series of tests were administered to five groups of Japanese primary school students (N = 134) who had no formal English writing or reading skills. The primes/stimuli were designed according to developmental age word-frequency, word complexity, and orthographic complexity. Primes were ordered according to difficulty and grouped into categories. Each prime was presented for 300 milliseconds at three-second intervals. The series of tests included: a RAN test comprising native *kanji* and *kana*, colours, shapes and numbers, highly recognisable pictures, and aural primes of phonetically similar English alphabet names; a TACHiD test comprising 18 orthographically possible non-words; and two tests of implicit and explicit orthographic knowledge. Writing responses were collected on paper response forms and coded according to accuracy and error types for statistical and graphical analysis.

These tests provide new insights into the development of orthographic knowledge in preliterate learners of dual language alphabetic scripts of contrasting depth. Word frequency was related to word length as expected; however, word length had a non-

linear, random relationship with errors, which contradicts previous research in more advanced learners, particularly monolinguals. In addition, the RAN test indicated that word complexity was significantly inversely proportional to writing accuracy ($R2 = 0.98$), which provides insights into unexplained variability in previous ODH research. Furthermore, RAN test results indicated that word frequency is a weak predictor of accuracy, but orthographic complexity significantly influenced writing accuracy, which accounts for the variation in previous research. Finally, orthographic complexity is influenced substantially by geminate obstruents, diphthongs with a mid-place "y", and long vowels; a result that provides the answer to where orthographic influence is more significant during early literacy development.

The orthographic decision test (ODT) indicated that knowledge of English assisted the students' implicit understanding of word possibilities in each language, but poor English skills resulted in guessing. The orthographic recognition test (ORT) results, on the other hand, indicated that students with little to no English ability were better able to identify their native orthography based on the consistent V, CV, CVV patterns with a significance difference at $p < 0.1$, between the scores for *romaji* ($M = 0.5$, $SD = 0.0829$) and English ($M = 0.46$, $SD = 0.0772$), $t(34) = 1.33$, $p = .0960$. These results indicate that Japanese orthographic representations coincide with Japanese phonology as graphemic chunks, and therefore, can provide only negligible facilitation to English orthographic understanding at the letter level. These Japanese graphemic chunks bear little resemblance with English phonemic and graphemic patterns, which contradicts claims that *romaji* facilitates English.

These incidental results ushered the conception of the Orthographic Gap Hypothesis (OGH). The OGH recognises three types of inhibitory influences. A Type-0 gap is where there is no interference due to a one-to-one PG/GP correspondence between the two languages. A Type-1 gap is where there is no transference because the PG and GP correspondences are non-existent. Finally, a Type-2 gap is where the influence is confusing and requires mental processing that would usually take time and effort to correct (e.g., the vowels "A" and "U", and the phonemes for "L" and "R").

The development of the OGH in this thesis contributes to orthographic research because it identifies where and why some orthographic combinations are difficult to acquire and classifies the type of influence. Furthermore, the OGH is useful in identifying where students may struggle in reading and spelling new language scripts and also where learning a new language may interfere with existing orthographic knowledge even in other language settings. Finally, the OGH and methods developed in this thesis will be particularly useful in studying English earlier in Japanese schools.

CERTIFICATION OF THESIS

This thesis is entirely the work of Daniel G. Dusza except where otherwise acknowledged. The work is original and has not previously been submitted for any other award, except where acknowledged.

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DEDICATION

To the best of teachers, whose implicit knowledge of teaching exceeds the volumes referred to in this paper: my father Bill George Dusza and my spiritual father, mentor, and friend, who will attend my graduation from above.

Morris Cerullo

October 2, 1931 – July 10, 2020

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LIST OF ABBREVIATIONS

AmE	American English
ASEAN	Association of Southeast Asian Nations
BrE	British English
CMC	Computer-Mediated Communication
GP	Grapheme-Phoneme
GPC	Grapheme to Phoneme Conversion
ICT	Internet Communication Technology
IoT	Internet of Things
IPA	International Phonetic Alphabet
FL	Foreign Language
MEXT	Ministry of Education, Culture, Sports, Science, and Technology
NAM	Word Naming Test
ODT	Orthographic Decision Test
ORT	Orthographic Recognition Test
PG	Phoneme-Grapheme
PRC	People’s Republic of China
RAN	Rapid Automatised Naming (sometimes simply, rapid naming)
TACHiD	Tachistoscopic Identification Test

LANGUAGE REPRESENTATIONS

The following conventions are used for language representations in English following the example in Hunter (2014). In general, other languages that are not common to English will be italicised and followed by a two-letter country code.

Japanese words converted to *romaji* according to the modified Hepburn system (formally *Hebonshiki rōmaji*), as used in Kenkyusha's New Japanese English Dictionary, 4th edition, as cited in Gally (2009). An online tool for converting Japanese to *romaji* is also available (https://demo.cotonoha.io/cutlet). Long vowels are indicated by the use of macrons (e.g., Saigō, Ryūkyū), but these are omitted in the case of a few well-known place names (e.g., Tokyo, Osaka) and words commonly used in English language texts (e.g., daimyo, shogun). Where student writing samples are indicated, which use a non-conventional spelling, the written product will be aptly annotated and be written in italics within double quotation marks, for example, the student was presented with "bus" and accidentally wrote "*basu"*.

Chinese words are alphabetised according to the Pinyin system now in standard use, except where indicated, for example for place names or individuals, especially those connected with Taiwan or Manchuria. Japanese names are given in the Japanese order (i.e., family name preceding given name).

Alphabetic orders are according to the native language they represent. Japanese words are ordered according to the sequence of Japanese phonology (i.e., a, i, u, e, o, etc.) and English is ordered according to the 26 letters of the Roman alphabet from 'a' to 'z'. Any other exceptions are clarified in the text.

Nonwords are written in a single inverted comma, for example, '*sloppendash'*, and words in that are neither English nor Japanese will be italicised followed by the two-letter ISO-3166-1 ALPHA-2 code (albeit upper-, followed by lower-case) for the country of origin, examples of which would include: French '*merci'* (Fr), German '*danke dir'* (De), Greek '*arktos'* (Gr), Japanese '*konnichiwa'* (Jp), Spanish '*gracias'* (Sp), Korean '*gamsahabnida'* (Ko), and so on.

Linguistic rules for representing phonemes, pronunciations, the names for letters, etc., follow the spellings conventions in the Oxford Learner's Dictionaries (n.d.). The symbolisation of letter and language use follow the International Phonetic Alphabet

(IPA) standard for British English unless otherwise indicated. The general name of a letter will be in slanted strokes (e.g., /a/, /b/, /c/). Words are represented as indicated earlier, however, the sounds of letters, that is the phonetic symbols in square brackets [] to distinguish them from ordinary letters. The following example is a summary of all of these conventions in context.

For example, 'rice' [raɪs] is '*gohan*' (Jp) [gohaN] when it is food, but 'field rice' [fild raɪs] is called '*kome*' (Jp) [kome] in Japanese; rice starts with the letter /r/ and /r/ sounds like [r]. "Food", on the other hand, starts with /f/, which sounds like [f], but '*gohan*' starts with /go/ because in Japanese /go/ is a single phoneme and a syllable which sounds like [gɒ], hereafter called, '*mora*'.

All English and Japanese to IPA conversions were made with the Internet service provider toPhonics® (https://tophonetics.com/) and a complete list of *romaji* to IPA conversions are included for reference in Appendix-A.

DEFINITION OF TERMS

This definition of terms is grouped into categories according to function. The index of terms, at the end of this document, contains an alphabetical list of these terms together with their functional placement in the thesis (see Taylor and Taylor, 2014, pp. 423-438, for a comprehensive glossary of language script terms).

Allograph - In linguistics each of two or more alternative forms of a single letter or grapheme including CAPITAL, lower case, *italic*, cursive, etc.

Allograph - In Phonetics, each of two (or more) letters (or combinations) representing a single phoneme (e.g., ‘p’ with ‘pp’ in poppy or ‘f’ in ‘face’ with the ‘ph’ of ‘phase’).

Grapheme - The smallest meaningful contrastive unit in a writing system. It can be a letter or several letters that represent a sound (phoneme) in a word. A basic example is the letter ‘c’ in the word “cat”, which represents the sounds /k/. A two-letter grapheme: l ea f. The sound /ee/ is represented by the letters 'e + a'. A three-letter grapheme is in the word “n + igh + t” and a four-letter grapheme is in “th + ough + t”. In *romaji,* graphemes are mapped directly from phonemes (e.g., 自然 (nature) is “shi+ze+n”. Japanese have no reason to learn ‘sh’ separate from ‘i’).

Phonological Awareness - Ability to recognise and manipulate the spoken parts of words. The following examples are listed from simplest to more complex.

Syllables - Made up of onsets, rimes, and phonemes.

Onset - The part of the syllable which precedes the vowel.

Rime - The part of a syllable consisting of its vowel and any remaining consonant sounds that come after it.

Phoneme - The smallest unit of sound in a language that makes two words distinct from each other.

Phonemic awareness - The ability to hear, identify and manipulate individual sounds in spoken words, and it is an indicator of reading ability.

Phonotactic constraints - The limits of possible combinations of phonemes within a syllable or word (e.g., /pl/ in play and plausible are plausible but /tl/ in ‘*tlinght*’ and ‘*tlay’* are undefined in the onset position.)

Graphotactic constraints - The “legal combinations of letters” (Deacon et al., 2008, p. 118) and “letter combinations” (Bourassa & Treiman, 2014, p. 572) that are permissible in words in any given language.

Orthographic Knowledge - The information in memory that represents spoken language in written form (Apel, 2011).

Exception-word - Any words in a language's corpus that are presented uniquely. The phonotactic- and graphotactic-constraints have not been floated. Therefore, they can usually be pronounced with.

Nonsense-word - Novel words that can be classified depending on their orthographic and phonetic similarity with real words in a given language.

Pseudoword - In this study, a word that complies with the phonotactic and graphotactic constraints of the language but “looks similar” to real words with meaning and can be pronounced according to a language's phonotactic constraints.

Nonword - In this study, is a word that complies with the phonotactic- and graphotactic constraints of the language but is without meaning and is not easily confused with similar real words.

Sight-word - Any memorised word that can be read as a whole and in most cases the mere shape of the word can elicit correct pronunciation and spelling.

Decoding Ability - When knowledge of letter-sound relationships is used correctly to pronounce written words.

Prosody - The rhythm, cadence, accent patterns, and pitch of a language (Sousa, 2010).

Mother Tongue - The language which a person has grown up speaking from early childhood, and is also influenced in multi-/pluri- lingual groups.

Plurilingual - A person who has competence in, and switches between, multiple languages depending on the situation and ease of communication.

Dialect - A particular form of language which is peculiar to a specific region or social group.

Creole - A mother tongue formed from contact with a European language (esp. English, French, Spanish, or Portuguese) with local languages.

Pidgin - A grammatically simplified means of communication that develops between two or more groups that do not have a common language.

Pinyin - A system of spelling used to transliterate ideographic Chinese character phonemes (i.e., sounds) into the Roman alphabet.

***Romaji* -** A Roman alphabet of 22 characters based on Japanese *kana* phonology (usually written in lowercase).

Confounding Influences - Confounding variables, which are related to the independent variable and affect the dependent variable.

Extraneous Variables - Similar to confounding variables in the experiment but not being studied.

Normal Distribution - Normal distribution is used to find significance levels in many hypothesis tests and confidence intervals

Poisson Distribution - Used to model the number of events occurring within a given time interval, like the onset and delays of responses.

Poisson Regression - Used to model discrete response variables. It tells you which explanatory variables have a statistically significant effect on the response variable, particularly for rare events.

Chi-Square Distribution - A test for independence between two variables in a contingency table to see if they are related.

Stochastic - Description of data having a random probability distribution, or pattern, that may be analysed statistically but may not be predicted precisely.

Interlanguage - Related to (Selinker, 1972) transfer of language, skills, learning and communication strategies, and generalisation of rules and principles.

Executive Functions - High-level cognitive skills that are used to monitor, control, and coordinate other cognitive abilities and behaviours. It affects organisation and planning processes and execution.

***Kanji* -** A logo-morphographic writing system derived from Chinese *kanji*, but with multiple meanings and phonemes derived from native language morphology.

***Kana* -** Made of single-syllable/mora *hiragana* which represents native phonology and *katakana* of similar phonology with greater flexibility to represent foreign language phonemes.

Mora - The single sound of Japanese phonemes, so blended syllables or long vowels are considered independently in the moraic system.

***Romaji* -** Latin-based alphabetic representations of Japanese *kana* consisting of 22 letters (i.e., 5 vowels and 17 consonants) which can be used in combinations to represent the 71 possible phonemes of *kana*.

***Gairaigo* -** Transliteration of foreign words, often abbreviated into *katakana*, and sometimes *romaji*.

***Ateji* -** Is *kanji* used to phonetically represent either native or foreign words, with little regard given to the original logographic meaning.

LANGUAGE CHOICE AND GENRE

The language used throughout this thesis is British English standard. Abbreviations use the ISO 639-1 standard language code. The difficulty in multidisciplinary studies is the variety of terminology between language genres. Any conflict or confusion is resolved by reformulating into less generic terminology, in the following order of precedence (exceptions are annotated in-text):

1. English Education
2. Linguistics
3. Psycholinguistics (incl. Cognitive Psychology)
4. Neurology

CHAPTER ONE
INTRODUCTION

1.1 Introduction

In the spring of 2020, English reading and writing were introduced into Japanese elementary schools. According to theories of orthography depth and language transfer, this change should have a measurable change in the processing of English and *romaji*. Literature regarding learning two languages has recently acknowledged the limitations in assuming facilitation and focused more on the negative influence of language interference. In preliterate learners, this shift of language knowledge is difficult to study, due to the various speeds that individuals acquire knowledge and competency, previous language ability, and the influence of the acquired language orthography. This study posits that *romaji* has a positive and negative influence on the implicit understanding of English orthography. This Chapter outlines the contents of this thesis and the background to this study in orthographic influence.

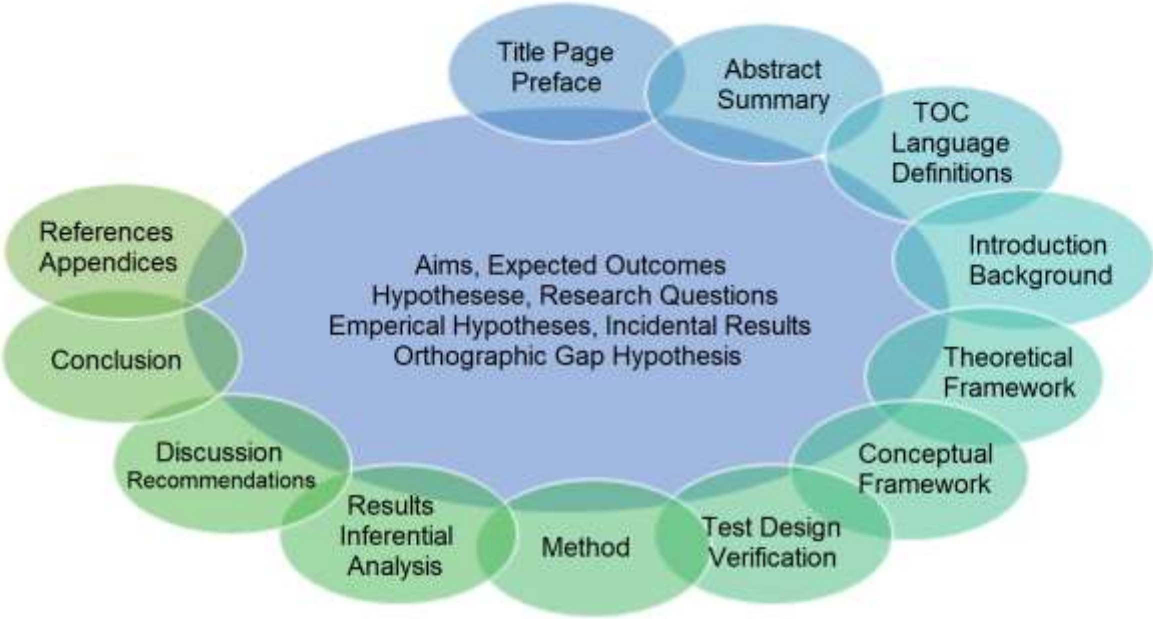
1.2 Thesis Outline

This thesis comprises seven chapters (see Figure 1.1). Chapter One introduces the background to this study and then, defines and clarifies the sometimes confusing and contradictory terminology that is often experienced in studies that span such a diverse field of research like this (i.e., linguistics, pedagogy, psychology, neurology, and psycholinguistics).

The literature review in Chapter Two provides the theoretical foundations and conceptual (i.e., methodological) frameworks for investigating this study of orthographic influence. To study the negative influence of *romaji* on English, one cannot ignore the areas of the brain responsible for language, the cognitive processes that are responsible for language processing, and the effect of language on these cognitive processes. Chapter Two, therefore, contains a section concerned with the biological processes of how and where the brain stores and processes information. Theories of these neurological processes are presented to understand the transition of memory and processing from initial exposure to language through to the storage and retrieval of semantic and lexical information. The following section then provides cognitive models and associated research concerned with how the brain processes new and existing knowledge, its dependence on learning, and the influence between languages in individuals. Chapter Two culminates in the formulation of concrete research questions based upon this study of the literature.

Figure 1.1

Thesis Outline-Detailing 12 Main Sections Starting with the Title Page



Note. This research aims to measure the orthographic influence of learning *romaji* before EFL in Japanese students. The incidental outcomes are developed after the initial results are analysed. Background knowledge, presented in Chapter One, and theoretical foundations discussed in Chapter One are essential to understanding the development of the Orthographic Gap Hypothesis presented in the closing Chapters.

Due to the unique setting of this study, substantial research and development were required to design a series of tests and primes for answering the questions presented in Chapter Two. The process for selecting and creating priming material, and designing and administering the tests that were particular to this unique study, is presented in Chapter Three. Previous research was predominantly concerned with literate individuals (i.e., able to construct word meanings and sound in continuous texts), so priming materials were drawn from corpora and word frequency data that are not appropriate for pre-literate students (i.e., students with limited lexis and who struggle to map sounds to letters or make meaning from words and struggle to spell).

More so, the “native” alphabetic script studied in this thesis (i.e., *romaji*) is merely a representation of native phonology. Therefore, Chapter Three is an essential addition to this thesis, and also essential for future replications. The method of administering this series of tests and data collection is detailed in Chapter Four.

Chapter Five presents quantitative results from the series of five tests developed earlier in Chapter Three, followed by inferential analysis. The inferential analysis presents the hypothesis that orthographic influence is most detrimental where there are inconsistencies between the two language orthographies, and that this influence can be unidirectional. These inferential results give rise to the Orthographic Gap Hypothesis (OGH) discussed in the following Chapter.

The final three Chapters culminate with evidence that supports the need for continued research into the influence of learning English earlier in the curriculum. Chapter Six discussed the finer-grained effects of words and their spellings on accuracy. These finer-grained effects are presented so that inferences can be formulated to guide further research, material design and assessment, and possible diagnosis and treatment of developmental problems that are most likely to occur between two languages. Chapter Seven provides a summary of the simple and empirical hypotheses, followed by a definition of the OGH developed from the incidental findings in this thesis. The thesis conclusions are presented in Chapter Eight.

The remainder of this Chapter provides background information regarding the writing systems covered in this thesis, followed by a description of the progression of English into the elementary school system, which is the cause for concern in this thesis.

1.3 Introducing the Japanese Writing System

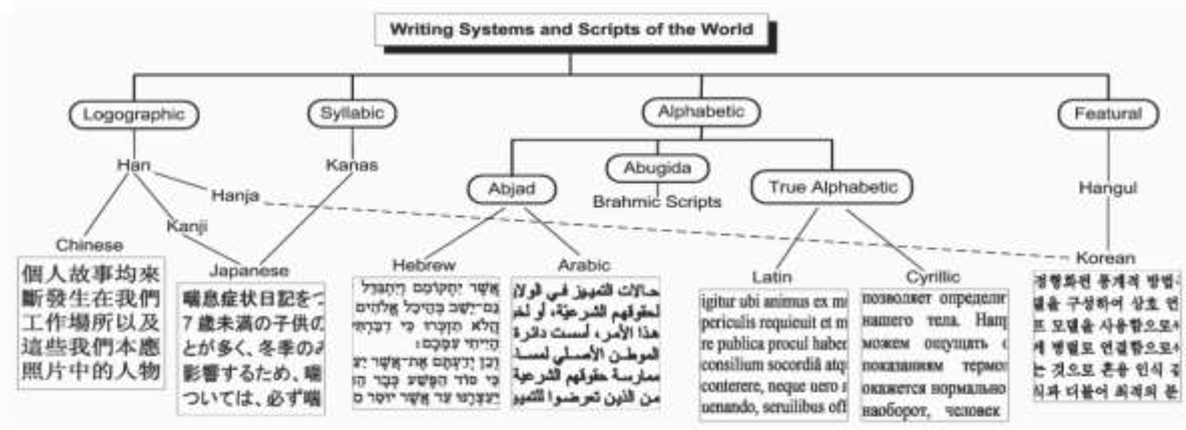
This section introduces the Japanese writing system and provides evidence of how the various scripts work together to create an efficient system for representing the language phonology in script form. The section also suggests why learning to read and subsequently write in Japanese is such a time-consuming and mentally strenuous task, “even for native speakers” (Unger, 1993, p. 48).

Most of the world's writing systems (see Figure 1.2) are descendants of earlier prototypes (Crystal, 1987). Like almost all writing systems, the Japanese writing system also captures and records spoken words and thoughts (Fischer, 2001, p.8) through some underlying efficient process of "matching" the language phonology and morphology to the written form (Katz & Frost, 1992). Additionally, the Japanese writing system comprises multiple writing systems, each with their own unique and corresponding orthography.

The complex Japanese writing system is similar to most successful languages, because it has changed and adapted to facilitate greater functionality and efficiency in matching the language's morphology and phonology with its written form. This matching typically determines whether the chosen orthography is a syllabary script, a syllabary-cum-logographic script, or an alphabet (Frost & Katz, 1992). This choice consequently affects the depth or transparency of the orthography.

Figure 1.2

Classification of Prominent Modern-Day Writing Systems and Scripts



Note. From " Script recognition--a review," by D. Ghosh, T. Dube and A. P. Shivaprasad, 2010, *IEEE Transactions on Pattern Analysis and Machine Intelligence, 32*(12), p. 2144. (https://doi.org/10.1109/TPAMI.2010.30). Copyright 2010 by IEEE.

Writing systems with the highest level of organisation, use phonographic and morphographic systems for encoding language. A language that employs a phonographic writing system encompasses alphabets, abjads, abugidas, and syllabaries/moraic scripts (Chen et al., 2015). Morphographic systems, on the other hand, use script types that employ meaning. The Japanese *kanji* system is unique because it employs both. Within each specific script type, the graphemes are the physical written instantiations of a language or languages (Cook & Bassetti, 2005). When two languages share the same script, their language-specific orthographies determine the conventions for spelling, phoneme-grapheme (PG) correspondences, as well as other mechanics (e.g., punctuation and capitalisation), which is the central focus of this thesis.

1.3.1 The Japanese Logo-Morphographic Writing System

Japanese *kanji* have undergone centuries of modification to fit the needs of written Japanese, which includes the development of new characters unique to Japan. As a result, some *kanji* characters are not derived from Chinese at all (Robertson, 2020). As a result of this processing, simplification and morphology, the majority of Japanese *kanji* have multiple meanings and multiple pronunciations, making it possibly the most opaque-orthography in the world (Ellis et al., 2004, p. 439).

Japanese *kanji*, therefore, is not monosyllabic but made of various "syllable-like" units called '*mora*' that make up Japanese phonology (Robertson, 2020). For example, "tree" (木, '*ki*') has one *mora*, but "body" (体, '*karada*') comprises three morae. Some rarer *kanji* have as many as 12 *morae*. A less intuitive example is the word *say* (言[う], '*i(u)*'). This word is made of two *morae*, but uses a single mora *kanji* (言 '*i*') together with the single mora *kana* (う, [*u*]).

1.3.2 Syllabic Writing Systems

The Japanese phonemes are represented by *kana*, an almost purely syllabic writing system. By incorporating phonology into the graphemic characters, the reliance on a vast set of pictorial symbols, and pictures representing real things, are significantly reduced (Adams, 1990). *Kana*, therefore, rely heavily on morphology and orthographic processing (i.e., a mental process) to derive the meaning of the words; readers and writers must perform some mental process to connect with lexis, word meaning, and context. Japanese *kana* comprises both *hiragana* and *katakana*. Due to the consistency of *kana* with phonology, *hiragana* is usually mastered by the end of the first term of Grade-1 (Ellis et al., 2004; Kess & Miyamoto, 2000), and *katakana* is usually learned soon after, before the end of Grade-2 (MEXT, 2019).

All *kana* similarly originated from *kanji* (see Table 1.1 and Appendix-B for a complete list).

Table 1.1

The Kanji Origins of Hiragana and Katakana

Original *kanji*	*Hiragana*	Original *kanji*	Katakana
安	あ (a)	加	カ (ka)
乃	の (no	千	チ (chi)
不	ふ (fu)	不	フ (fu)
天	て (te)	天	テ (te)

Note. Adapted from "The psychology of reading," by I. Taylor and M. M. Taylor, (2014). Academic Press.

The standardised *kana* system is made up of 46 basic signs (cf. Henderson, 1982, p. 19; and Hoxhallari, 2006, p. 4, claim "47 basic signs"). With these 46 basic signs and additional diacritics (see Table 1.2), the entire Japanese language of around 10, 000 *kanji* can be attended to, thereby, significantly reducing the number of symbols that a learner needs to recognise.

Table 1.2

The "Fifty" Sounds of Japanese (五十音) Represented by Hiragana and Romaji

Phonemes	-	k	s	t	n	h	m	y	r	Other
a	あ	か	さ	た	な	は	ま	や	ら	わ
i	い	き	し*	ち*	に	ひ	み		り	
u	う	く	す	つ*	ぬ	ふ*	む	ゆ	る	を
e	え	け	せ	て	ね	へ	め		れ	
O	お	こ	そ	と	の	ほ	も	よ	ろ	ん
Diacritic (``)		g	z	d		b				
Diacritic (゜)						p				

Note. From "The Japanese writing system: Challenges, strategies and self-regulation for learning kanji" by H. Rose, 2017, Multilingual Matters. (https://doi.org/10.21832/9781783098163)

Kana represents the Japanese language phonology which comprises five '*boin*' (i.e., vowel sounds, /a/, /i/, /u/, /e/, /o/) and 14 *'shiin'* (i.e., consonant sounds, /k/, /g/, /s/, /z/, /t/, /d/, /n/, /h/, /p/, /b/, /m/, /y/, /r/, /w/), plus a single consonant /n/ and symbol for a glottal stop. Listing the complete set of phonemes would necessitate more than

100 entries. During the process of making the “standardised *kana*” the redundant sounds and their associated *kana* were removed over many decades. *Kana* that became redundant were /ye/, /yi/, and the /we/, /wi/ and /wu/. These phonemes were not used and, therefore, became obsolete in both *hiragana* and *katakana*. *Katakana* is used to represent foreign loan words (*gairaigo*). These *gairaigo* are introduced to students as they systematically encounter foreign words during their progress through school. As children develop, and their use of foreign and academic language increases, *kanji* becomes necessary to remove the ambiguity of phonemes and homonyms (i.e., words that have the same sound but different meanings).

Kana functions also as a means of transliterating all Japanese words, sometimes written as furigana above unfamiliar and ambiguous *kanji* or as *katakana* above names and addresses, due to its tremendously consistent GP mapping. *Hiragana* also has three functional purposes; phonology, grammar, and a few less frequent, but equally important, inflectional purposes (see Appendix X). For example, “は” can be used as a topic marker, however, it is pronounced as /wa/ instead of /ha/ (most frequent pronunciation) (Kasahara et al., 2011). Pairs of “を” /wo/ (accusative case marker) and /o/, “へ” /he/ (locative-goal case marker) and /e/ also have a similar role.

By mixing the two syllabic systems with the logographic system of *kanji*, reading fluency can be significantly increased for experienced readers. Reading times have been found to be faster for the *kana*/*kanji*-mixed sentences as normally integrated syllabary-logograph texts than for the stand-alone type (Kitao, 1960; Sakamoto & Makita, 1973). Mixed texts are also processed faster than the *hiragana*-only texts (Kitao, 1960). Interestingly, mixed texts also facilitated more accurate responses than *hiragana*-only texts (Kess & Miyamoto, 2000). The choice of script and the amount of mixing is not always consistent; it varies according to the writer’s intention (Chikamatsu et al., 2000).

Kana, therefore, serves multiple functions: as topic and grammar markers and to teach and remove ambiguity from written communication, which consequently inflates their frequency in corpora lists. The sounds of *kana* are also directly related to the alphabetic writing system, *romaji*.

1.4 Alphabetic Writing Systems in Japan - *Romaji* and English

Most alphabetic writing systems are not learned implicitly and require instruction for various reasons. The assignment of alphabetic scripts to their sounds is arbitrary, and in many languages, the correspondences between these letters and sounds are not always consistent. Many of the Indo-European languages and Western European languages have been progressively developed from the Latin alphabet. While Spanish, German, and *romaji* are tremendously consistent in their mapping of sounds to the script, other languages are not so transparent. The assignment of letters and sounds in French and English is extremely ambiguous (Frost, 2012; Seymour et al., 2003). This orthographic complexity makes reading and spelling virtually impossible without first building phonetic, and later lexical, knowledge, a process that takes significant time and effort to develop through teaching. Therefore, French and English are defined as having a deep (i.e., opaque) orthography.

English, however, is not entirely opaque. A good example of consistent correspondences in English comes from the letter B as it is almost always pronounced by using the sound /b/ (cf. exceptions include climb and comb). The letter ‘i’, on the other hand, can be read in different ways depending upon the position in the word and its neighbours (e. g., bird /ba:d/, give /giv/, and life /laif/). The consistency of this PG mapping in any given language is indicative of the orthographic depth of that language’s alphabet. Second, visually similar graphemes such as 'b' and 'd', or ‘p' and 'q' are easily confused (graphemic confusion).

Romaji, like many modern alphabet systems (e.g., Korean and English), employ combinations of consonants (C) and vowels (V) to represent the sounds (i.e., phonemes) of their language, and then reconstruct a semblance of the syllabic system to facilitate speech. While many languages use the Roman style alphabet (i.e., a, b, c… x, y, z) as their native script, others have transliterated their native language, with varying degrees of success (e.g., Hansha, Pinyin, and *romaji*). This thesis is interested in both the native and transliteration use of alphabets in Japan.

1.4.1 Alphabetic Representations of Native Scripts

Some languages (e.g., Chinese, Vietnamese, Burmese, Korean, and Japanese) use these Romanised versions of the languages for various and unique functions, which vary somewhat from country to country. Many of these languages include diacritical marks, or accents, above the letters, usually to assist in pronunciation, tone, intonation, etc. Some examples include acute (é), grave (è), circumflex (â, î or ô), tilde (ñ), umlaut and diaeresis (ü or ï), and cedilla (ç). In Japanese, the diacritic marks above the 'o' signify either a dual mora 'ou' (e.g., こうず (神津), /ko u zu/, |Kōzu|. or the sustained /o/ sound of 'oo' (e.g., Tokyo (東京) may be written as Tōkyō, or phonetically /to//u//kyo//u/). These variations in alphabetic representations of Japanese phonology become problematic when individuals are unsure of the *romaji* writing system in use, or when writing Japanese words using *romaji*.

1.4.2 Orthographic Understanding of Romaji

Japanese *romaji* comprises 22 letters of the Roman/Latin alphabet. The 22 *romaji* are somewhat similar to the 26-letters of the English alphabet minus l, q, v, and x (Kess & Miyamoto, 2000, p. 111). All five vowels are used; however, they adopt the Latin pronunciation. A vowel can be used in isolation (e.g., *romaji* 'u', [ɯ], 宇 meaning universe), however, consonants (C) are always followed by a vowel (V) to represent the other *kana* phonemes (see Appendix A). This consistency of orthography makes reading *romaji*, and consequently articulating the Japanese phonemes, an easy task for readers of Latin-based scripts.

Early Latin alphabets comprised twenty-one letters, written similarly to West Greek letters (Jensen, 1969, as cited in De Francis, 1989). The modern Latin alphabet comprises fundamentally 22-letters (see Table 1.3).

Table 1.3

The Orthographic "Gaps" Between English and Latin Alphabets

English Alphabet		Japanese Romanised Alphabet		
Uppercase	Lowercase	*Romaji*	Latin name	Latin (IPA)
A	a	*A, a ([ʌ])	Ā	[aː]
B	b	B, b	Bē	[beː]
C	c	C, c	Kē	[keː]
D	d	D, d	Dē	[deː]
E	e	E, e	Ē	[eː]
F	f	F, f	Ef	[ɛf]
G	g	G, g	Gē	[geː]
H	h	H, h	Hā	[haː]
I	i	I, i	Ī	[iː]
J	j	J, j		
K	k	K, k	Kā	[kaː]
L	l	***	el	[ɛl]
M	m	M, m	em	[ɛm]
N	n	N, n	en	[ɛn]
O	o	O, o	ō	[oː]
P	p	P, p	pē	[peː]
Q	q	Q, q	qū	[kuː]
R	r	R, r	er	[ɛr]
S	s	S, s	es	[ɛs]
T	t	T, t	tē	[teː]
U	u	*U, u ([aː])		*
V	v	***		
W	w	**W, w (wa, wo)		
X	x	***	ex	[ɛks]
Y	y	Y, y (yu, yu, yo)	*	*
Z	z	Z, z	zēta	['zeːta]

Note.

* signifies a phonemic difference (Japanese sound in brackets).

** signifies a partial gap (present graphemes indicated).

*** signifies a complete absence from one orthography.

As fluency improves, each doublet or triplet (CV, CCV) is eventually recognised and processed as a single phonemic block. This means spelling and writing is much easier in *romaji* than English because if any individual can remember the sound of the Japanese word, they can spell it. There is a single letter exception to this simplistic representation of *romaji*, the consonant, ‘n’.

The moraic nasal [n] (in *hiragana* ん) is the only vowel-less mora and has several realisations (Marta, 2011). When the consonant ‘n’ is found at the end of some words like pan (bread) and mikan (mandarin orange), the grapheme can take two phonemes, /n/ and /m/. The phoneme /m/ is used when blended with subsequent words, which start with ‘b’ (e.g., three pencils (En); 3 本鉛筆 ‘san hon’ is articulated as /sam bon/). While the final ‘n’ is a linguistic anomaly, it is orthographically well defined and phonemically natural, even in other language systems. Other variations include (Marta, 2011, p.3): [n] > [m] / [m, b, p]; [s, t] > [ɕ, ʨ] / [i]; [t] > [ts] / [ɯ]; [h] > [ɸ]* / [ɯ]; and [z] > [ʥ] / [i].

Reading and transcribing *romaji* should be straightforward because of the consistency between the sounds of *kana* and the corresponding alphabetic representation. However, due to blending and the functional uses of *kana* mentioned previously, transcribing *kana* to *romaji* is fraught with a few unique contradictions. Additionally, there are over a dozen different *romaji* systems (Taylor & Taylor, 2014), and popularity in the use of these various forms of *romaji* can be the cause of tremendous confusion when learning to spell.

1.4.3 What Type of Romaji?

Three of the more familiar forms of the five-or-so present-day *romaji* that are still widely used in Japanese society are *Hebonshiki* (i.e., Hepburn *romaji*), *Kunreishiki*, and *Nihonshiki* (Kasahara et al., 2011). These three alphabetic versions of representing Japanese phonology (see Table 1.4) using alphabetic scripts, are nearly never intermixed but can be used with native Japanese *kanji* and *kana* and with English.

Table 1.4

Differences Between Hepburn, Kunreishiki, and Nihonshiki Romaji

Hepburn	*Kunreishiki*	*Nihonshiki*
Shi	si	si
Sha	sya	sya
Shu	syu	syu
Sho	syo	syo
Ji	zi	zi
Ja	zya	zya
Ju	zyu	zyu
Jo	zyo	zyo
Chi	ti	ti
Cha	tya	tya
Chu	tyu	tyu
Cho	tyo	tyo
Ji	zi	di
Ja	zya	dya
Ju	zyu	dyu
Jo	zyo	dyo
Tsu	tu	tu
Zu	zu	du
Fu	hu	hu
O	0	WO

Note. From “The Japanese Mental Lexicon: Psycholinguistic Studies of Kana and Kanji processing,” by J.F. Kess and T. Miyamoto, 2000, John Benjamins Publishing, p. 116. (https://doi.org/10.1075/z.95).

One source of orthographic confusion originates from the irregular use of these *romaji* conventions. The intermixing with other *romaji* styles leads to misunderstandings, poor practice, and weak lexical representations. The most influential factor for young learners is possibly due to modern technology. The modern QWERTY keyboard is used for *kanji* entry using *romaji*. The computer uses context to predict a short list of possible *kanji*, thereby reorganizing the task of *kanji* retrieval (Yamada, 1983) into an efficient system that rivals handwriting fluency. The ‘problem’ is, however, that the keyboard accepts not only Hepburn *romaji*, but shortcuts (e.g., “si” instead of “shi”, and “ti” instead of “chi”), which is expected to be the source of confusion in young learners' impression of the graphemic representations of the *kanji*/*kana* phonemes they are typing (Yamada, 1983).

Due to the proliferation of *Hebonshiki* in Japanese society (i.e., in signage, advertising, road signs, stores, railway station destination transliterations, company names, and in schools), the regularity of *Hebonshiki* also makes it ideal for teaching alphabets, but not necessarily English.

1.5 Orthographic Structure of *Romaji* and English in This Thesis

Hebonshiki is used in this thesis because it generally follows English phonology, albeit with Romance (i.e., Latin) phonology for vowels. It is an intuitive method of showing the pronunciation of a word in Japanese, through Roman alphabets. The Hepburn system is used in this paper to represent the Japanese language. This means the macron (-) will not be used above the vowels to represent a sustain. Long vowels are transcribed as ou, aa, ii, ei, or ee, uu (rather than ô, â, î, ê, û), except in proper names, linguistic terms, and in the bibliography (see Labrune, 2012 for a detailed explanation). Therefore, Tokyo (東京) may be written as *Toukyou* (literal transcription) or Tokyo (English equivalent transcription), but not as Tōkyō.

The rationale behind using *Hebonshiki* is based predominantly on the availability of this style of *romaji* in Japanese society; signage and advertising have both adopted this system because it is more readily understood by the wider global community (Romance and English languages). Additionally, *romaji* is an effective input method for computing, and finally, the use of the macron and '*u*' after the '*o*' is used in higher education, and in academic language in government and technical writing, which is beyond the level of education in this study.

1.6 English Education in Japan

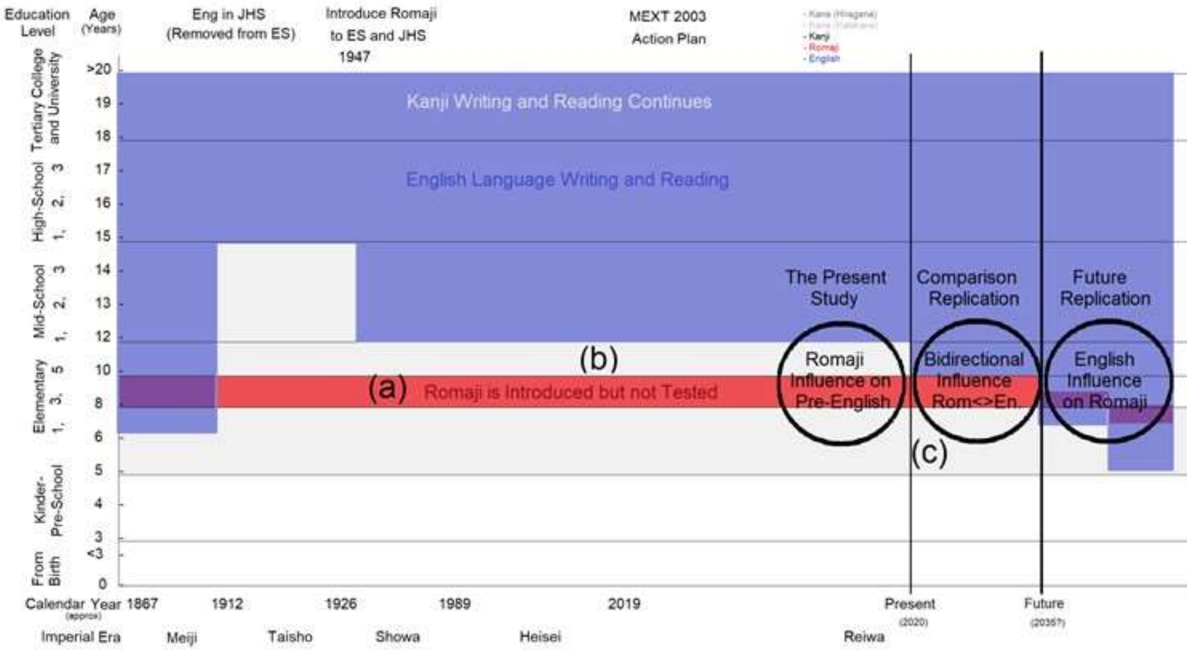
The importance of literacy in modern society cannot be overemphasised (Wilson, 2016). Literacy skills are essential to learning development and have long been associated with success in both the educational mission (Elias et al., 1997), and later in professional success. Literacy from an early age plays a critical role in improving children's academic performance in early education (Adams, 1990). Literacy is also directly correlated with academic performance in higher education (Bellity et al., 2017) and lifelong learning (Hanemann, 2015, as cited in UIL, 2017; Zins et al., 2007).

Life in Japan is closely related to literacy. In fact, Japanese education, culture, sports, the progress of science and technology, and economic success are synonymous with literacy in Japan. Being literate is not only a strategic part of social, emotional, and mental-health development (Rosewater & Meyers, 2016), but literacy in a second language is also associated with social, cognitive, and biological changes to behavioural, cognitive, and neural processes (Cossu & Marshall, 1990; Goswami, & Bryant, 1990; Hoxhallari, 2006; Tanaka, 2019). For native Japanese, language literacy has been the predominant means by which Japanese have documented, conveyed, and maintained their culture and place within their society and in the global community.

One contributor that has often shaped foreign language education reform over the last century in Japan (see Figure 1.3) has been to gain and retain economic and strategic dominance in the global community (see examples in Ng, 2016). Until the beginning of the 20th century, Japan was focused on unifying Asia and the Pacific, and therefore foreign languages were mainly a conduit for communicating these plans. Before then, educated individuals were mustered for Chinese and Russian interventions (Hunter, 2014; Shimizu, 2010), and later German and English language skills were pursued for intellectual and industrial knowledge (Bowers, 1979), and trade (Shimizu, 2010). One obvious result of this interaction is the high number of German terms in medicine and industry. These foci on language were driven by business and international relations, and often interpreters were used, not the general workforce. In an effort to be independent, English was later introduced at the primary school level, presumably reading and writing too (see Figure 1.3b).

Figure 1.3

The Shifting Influence of Romaji on English in Japanese Education



Note. From "Japanese English Education and Learning: A History of Adapting Foreign Cultures," by M. Shimizu, 2010, *Educational Perspectives, 43*, p. 5-11. (https://files.eric.ed.gov/fulltext/EJ912110.pdf).

At the end of the second world war, English education was moved later in the curriculum to junior high school (JHS). *Romaji* was introduced soon after in more than 85% of the elementary schools in 1947 (Eells, 1952) in the third grade or higher (Encyclopedia Nipponica, 1994) (see Figure 1.3a). The choice of Hepburn *romaji* would have been useful because it reflects the foreign understanding of alphabet phonemes and could almost completely transparently represent Japanese phonemes. However, the chosen standard for *romaji* instruction was far from simple and took another fifty years to finally settle on a revised international standard (International Organisation for Standardisation [ISO] 3602, 1989). The problems associated with standard use are discussed later.

Since the Meiji Era, English script knowledge has faded in-and-out of importance. From the end of the Meiji era until recently, teaching English reading and writing have been left until middle school, where the influence of preconceived notions of alphabetic orthography from *romaji* or advertising, had to be either corrected or taught afresh. Until the end of the first decade of this millennium, English in Elementary schools was used as a source of foreign understanding and language experience; it was not intended to be formally learned until students entered JHS.

After Japan lost dominance in the global economic community, the importance of English language education was reassessed. In 2011, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) recognised the importance of foreign language activities to Japan's future and introduced foreign language studies in Elementary schools (see Figure 1.3b). In response to further rapid globalisation, MEXT held a series of five meetings in 2014, which resulted in the development and implementation of the English Education Reform Plan (MEXT, 2014a). One of the guidelines resulting from this reform was the introduction of a more communicative approach to teaching and learning English in Elementary Schools and JHS. In response to ongoing globalisation and the crucial role of English in Japan's global presence, MEXT again reformed the course of study (MEXT, 2014b), shifting English, once again, to prominence in education (see Figure 1.3c).

The predominant outcome of the 2014 MEXT reform was the decision to move English reading and writing earlier in the curriculum, from junior high school to the fifth grade in elementary school. While the introduction of *romaji* will remain in the third, or fourth, grades, English conversation will move from Grade-5 to Grade-3, and reading and writing will move from the first grade of Middle School (i.e., Year-7) to Grade-5 in elementary school (see Figure 1.3). This change is, by design, expected to impact the foreign language learning ability of native Japanese.

However, the study of negative transfer, and how this transfer can be measured as it changes through the development of language learning, has yet been largely neglected. The following literature review provides evidence of neurological, cognitive, and psycholinguistic theoretical rationale for concern.

1.7 Problem Identification

The focus of this study is, therefore, to investigate the influence between *romaji* and English. The predicted result is that facilitation (i.e., the transfer of alphabet knowledge) from orthographically shallow *romaji* to orthographically deep English will be marginal. Alternately, students with English reading and writing skills should perform better in both orthographies, which would indicate English facilitates *romaji* orthographic understanding. The incidental results should reveal that regardless of language preference, the dissociations between the two orthographies will be the prominent cause of errors, especially in learning English after *romaji*. This assumption has yet to be established in Japanese educational research. These causes of errors between the two scripts are expected to occur in the following areas:

1. vowel conflict in frequent V and φV (i.e., ‘a’ and ‘u’),
2. consonant conflict (e.g., ‘r’ and ’l’; ‘si’, ‘yi’, ‘ye’ not in the *romaji* phonetic library; etc.), and
3. directional problems with whole letters (e.g., s-z, p-q, b-d, and j with し/shi/ ‘s’ and ‘z’).

Areas in writing that present the greatest problems are:

1. where fossilisation of the wrong impression is greatest by frequency,
2. where inhibition is greatest by frequency or impact (r, v, n),
3. where the gap is greatest according to frequency (e.g., sh, l, x, z, yi, ye, wi, wu, we, etc),
4. where non-moraic phonemes and syllables are in effect,
5. where there is there any evidence of effects of the orthographic structure defined by single-letter positional frequency (Mason, 1975), and
6. where facilitation occurs between English to *romaji* in either direction (also need to consider facilitation of *kana* frequency to *romaji* <i.e., the phonetic influence>).

CHAPTER TWO
LITERATURE REVIEW

2.1 Chapter Introduction

This Chapter presents theoretical and conceptual foundations essential to this investigation into the influence of learning *romaji* before English in preliterate individuals. It reviews the neurological and cognitive theories that have shaped the psycholinguistic body of knowledge regarding orthographic knowledge and processing (see Sections 2.2 and 2.3). From these brain-based accounts of orthographic knowledge and processing, theories underlying usage-based accounts of early language and lexical development are presented with theories indicating what influences have been found in previous research. The purpose of this approach is to recognise the various influences on orthographic development so that an approach can be developed later in this thesis (see Chapter Three).

Various factors are known to influence spelling. This Chapter provides theoretical evidence to formulate a prediction of where (i.e., the possible phonemes and graphemes that cause problems) and when (i.e., according to learning order and language maturity) these factors should either facilitate or interfere with language transfer and the subsequent development of orthographic knowledge. These predictions, hypotheses, and research questions are summarised in Section 2.6.

Measuring orthographic understanding in contrasting orthographies is particularly difficult because the stimuli are naturally different. Additionally, the focus group in the present study have yet to be taught English reading or spelling, and the “native” orthography has not been judiciously administered. Any one of these problems would give reasons for the dearth of research regarding orthographic influence. Prominent researchers (Chen et al., 2020; Ellis et al., 2004; Joshi & Aaron, 2005; Joshi et al., 2008) have indicated that the influences between orthographies may support and inhibit orthographic knowledge development, and others have studied the inhibiting effects (Dewaele, 2001; Dixon et al., 2010). Recent articles have suggested that the gap between two language orthographies is the probable cause for learning problems (Chen et al., 2020; Dong et al., 2021; Zarić et al., 2020). However, these authors did not provide specific script-dependent data specifying the possible cause of problems associated with developing new orthographic knowledge in early

EFL, ESL, and multilingual language development. Therefore, this Chapter discusses the theories and approaches to investigate specific areas that influence dual-language orthographic processing, particularly in Japanese children learning *romaji* and then English.

The conceptual framework for this thesis identifies candidate approaches, recognises their shortcomings, and provides a theoretical rationale for creating a reliable test. Chapter Three will apply these theories to developing and verifying a system for measuring the orthographic influence of *romaji* on English in Japanese elementary school students.

2.1.1 Literature Review Questions

Three areas of scientific research were studied to investigate if orthographic influence could in fact be measured in preliterate children using mere written response data. The literature review was guided by the following preliminary questions.

1. Cognition - Is there any evidence to support the hypothesis that the Japanese language mind processes language unique to the models presented in other studies, and are these unique processes influential to alphabetic scripts?
2. Orthography - Is there any evidence to support the widely accepted belief that the orthographic knowledge of *romaji* is positively transferred to English spelling, and if it is, is it possible to measure such an influence and identify areas of support or hindrance based on phoneme and grapheme combinations?
3. Orthographic Influence - Is there a relationship between the orthographic complexity, the gaps between orthographies, and the support or hindrance of transference between the orthographies in these areas, and is there any published evidence to support the measurement of directionality in this influence?

2.2 Neurological Framework

No single referenced work in neuroscience, or psycholinguistics, includes every idea or fact about the workings of the brain and how it processes language. To completely analyse what we do when we read would require understanding the most intricate workings of the human mind and comprehending the tangled story of the most remarkable specific performance that civilization has learned in all its history (Huey, 1908, p.6). Frans Gall (1791) was the first to publish the relationship between cognitive functions and particular regions of the brain (see Eling & Finger, 2019). Marc Dax (1836, as cited in Friederici, 2017) soon after identified the involvement of the left hemisphere (LH) in language processing, by identifying the link between language impairments and lesions in the LH.

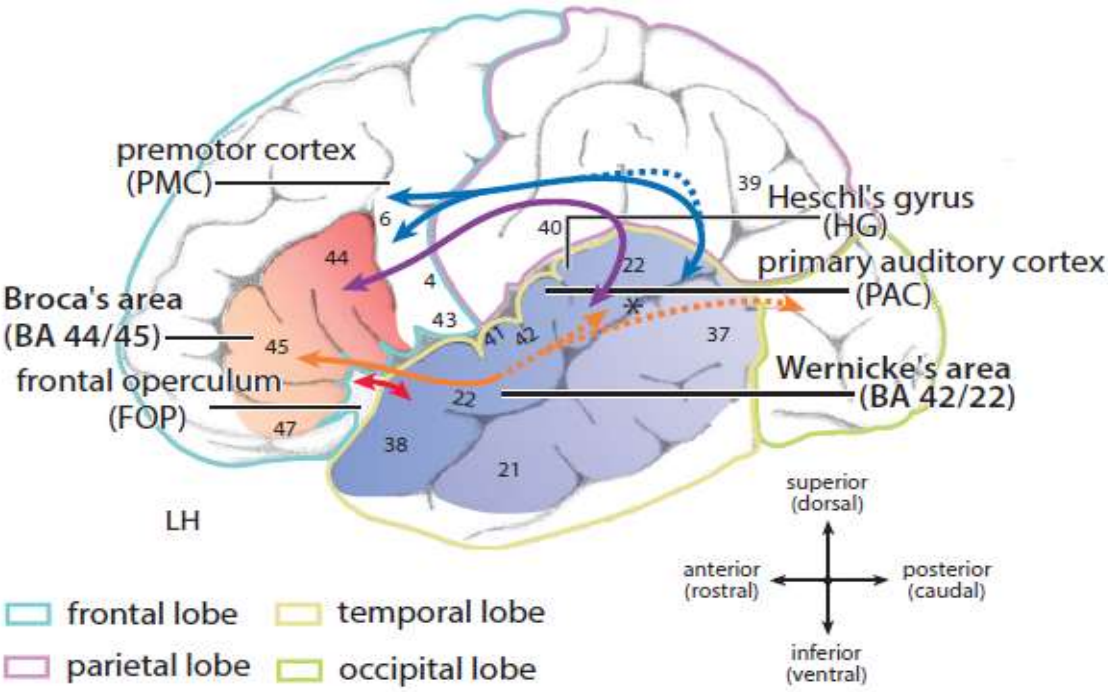
This section provides the biological foundations of where and how language is processed, stored, and retrieved within the human brain. These accounts are useful in understanding how cognitive processes change over time, and also accounts for variations in earlier research that merely studied the orthographic influence in languages. This section also provides neurological and cognitive accounts of why response delays change and how they explain the development of procedural knowledge, lexical knowledge, and other semantic interference from previous script knowledge, and how this can be measured from written responses.

2.2.1 Developmental Understanding

Many of the early studies that linked language to cognitive functions relied upon autopsies on documented cases of specific language disorders. The first such empirical proof of this link between language and particular parts of the brain was a patient who suffered from a severe deficit in language production (see Figure 2.1). The researcher, Paul Broca (1861a), defined and described the language behaviour of this patient meticulously and then, in a subsequent autopsy, Broca could link this language behaviour to the affected brain area, now known as the Broca's area. Later, in several different studies of comprehension deficit, Wernicke (1874, 1974) linked these symptoms to the left temporal cortex, now readily identified as the Wernicke's area.

Figure 2.1

Neurological Anatomy Concerning Early Neuro-Psycholinguistic Studies



Note. Neurological Anatomy of Language Showing the Anatomical and Cytoarchitectonic Details of the Left Hemisphere (LH) and Their Relation to Early Neuro-psycholinguistic Studies. Adapted from "Language in our brain: The origins of a uniquely human capacity" (p. 6), by A. D. Friederici, 2017, MIT Press. Copyright 2017 by The MIT Press.

The Broca's area and Wernicke's area in the left hemisphere brain regions have been attributed to language processing for more than a century. Over time, partialisation studies have revealed the finer-grained architecture of brain functionality, for example, cortical structure (Brodmann, 1909, as cited in Friederici, 2011); further subdivisions of the Broca area (Amunts et al., 1999); BA22 was differentiated from the primary and secondary auditory cortex [BA 41, 42]; and the inferior, middle temporal gyrus (Brodmann, 1909, as cited in Friederici, 2011). Since the cognitive psychological development of neurolinguistics, which emerged at the end of the 1960s, more cognitively sound approaches to measuring impaired reading performance resulting from brain damage have been developed (Luzzatti, 2008, p. 212).

In the past, bio-neurological studies could only deduce the neurological functional areas from brain-damaged patients that had lost, or retained, certain brain functions after some kind of trauma. One well-studied example is the case of Henry Molaison (Scoville & Milner, 1957). After a total bilateral hippocampus removal, Scoville could deduce that the hippocampus is not responsible for lexical and semantic retrieval from long term memory (NOVA, 2009). Almost a decade later, Milner et al. (1968) found that Henry's language comprehension was undisturbed. He could repeat and transform sentences with complex syntax, and he could get the point of jokes, including those turning on semantic ambiguity (Corkin, 2002). This led Corkin to deduce that the processing of syntax could also be achieved outside the hippocampus. The case of Henry presented an opportunity to learn a significant amount about the cognitive and neural organisation of memory (Corkin, 2002). Also, the function of the hippocampus in episodic and semantic knowledge, declarative knowledge, and the acquisition of new semantic knowledge (Gabrieli et al., 1988) in particular could be studied in greater depth.

Additionally, the twenty-first century has not only seen the development of novel methods of further parcellating and modelling for different regions of the brain, but also for identifying language processing areas of the brain in response to a variety of stimuli. Technologies at the forefront of these brain-based language studies include electroencephalography (EEG), magnetoencephalography (MEG), and magnet resonance imaging (MRI). The benefit of MRI is, it can be used *in vivo* (i.e., on living organisms) to image cognitive functions in the brain (fMRI) as well as grey matter anatomy and white matter fibre tracts using diffusion-weighted MRI (e.g., Behrens et al., 2003; Binder et al., 2009b; Price, 2010; Vigneau et al., 2006). Dynamic Causal Modeling (DCM) is a Byesian comparison modelling technique that uses time-series data from fMRI or EEG/MEG to investigate the influence between brain areas.

Technology has also provided scientists with additional means of measuring the interconnections and time course of brain activation in healthy, living individuals. While Dronkers et al. (2004) identified several regions of the left hemisphere to be critical for language comprehension in greater detail, fMRi studies (e.g., Turken & Dronkers, 2011) have been able to investigate the importance of these regions in the development of comprehension. Other examples have investigated the receptor-architectonic density of neurotransmitters in a given region using vitro receptor autoradiography (Amunts et al., 2010) and cytoarchitectonics brain mapping (Zilles

& Amunts, 2009); connectivity-based parcellation that differentiates cortical areas based on their white-matter fibre connections to other areas in the brain using diffusion-weighted MRI (Anwander et al., 2007) together with fMRI (Johansen-Berg et al., 2004); and in other connectivity-based parcellation analysis, Broca's area has been further subdivided into BA 44 and BA 45 (see Figure 2.1), which have both been identified as separate from the more ventrally located frontal operculum (Anwander et al., 2007).

These technologies have been effective in providing more detailed evidence and insights into the functions of brain regions within both left and right hemispheres (cf. a concentration of hemisphere activity was recognised Broca, 1861b; Lindell, 2006) that support both general and specific language functions (Friederici, 2011). For example, the position of the primary auditory cortex (PAC) in the left and the right hemisphere (see Figure 2.2), which apparently respond differently to speech and tonal pitch preferences. The left PAC reacts specifically to speech-sound characteristics and the right PAC to tonal pitch (Zatorre et al., 2002). This implies that the left PAC is faster because perception and recognition of speech sounds (i.e., phonemes in a sequence) requires a system with a time resolution of 20-50 milliseconds (Friederici, 2017, p. 23). The right PAC, therefore, acts slower and is able to deal with suprasegmental information (i.e., prosody), which requires a system with a time resolution of 150–300 milliseconds.

The data from this research provide strong empirical evidence to support the view that specific brain regions can be separated from each other at different neuroscientific levels, and inputs to the system can modulate where these processes take place, which should correspond to an associated response time. Therefore, it seems plausible to predict that if the input can be held constant, the resulting difference in processing will be as a result of language ability. If these two variables can be held constant, then the word complexity or other language features like writing and orthography would be the cause of processing fluctuations.

2.2.2 The Neurological Process of Writing and Processing Orthography

In the past few decades, other functional aspects of the brain have been investigated that provide neurological accounts of what psycholinguists have been measuring for many decades now, the associated delays with short- and long-term memory, and their relation to language (i.e., perception of words from script and sound). The following summary of advancement in language-specific domains of brain activity coincides with the findings of other studies of cognition and psycholinguistics (i.e., the times and delays that are mentioned in this section form a theoretical basis for the expected response times for lexical and non-lexical items, mentioned later in this thesis).

Event-related brain potential (ERP) research (see Friederici, 2011, 2017) provides a language-specific neurological framework that forms a starting point for this thesis. This model is limited, however, to the recognition of sounds as words and neglects the influence of orthographic information (see Chéreau et al., 2007 regarding the influence of orthography on audio priming). The ERP effect (see Figure 2.2) correlates with the identification of phonemes in the N100 region; this region relates to a negativity of around 100 milliseconds after stimulus onset (Obleser et al., 2006). This phenomenon is specific to language in general as is a similar ERP component that happens shortly after the 100 milliseconds, that is, the mismatch negativity (MMN) component which Näätänen et al. (1997) found to discriminate between acoustic and phoneme categories. For a review of recent studies investigating phoneme perception from single phoneme and syllable stimulus material see Phillips (2001) and Winkler et al. (2009). Also, the effect of declarative/procedural memory on N400, LAN, and P600 responses in L1 and L2 language processing was presented in Ullman (2016).

Other studies investigate language-specific representations at the phoneme and syllable level (Dehaene-Lambertz et al., 2000; Phillips et al., 2000). Phillips et al. (2000) discuss the effect of presenting a *deviant* stimulus while the subject is attending another task. The characteristic response to many-to-one deviant stimuli is typically in the 150-300 milliseconds latency range. This example of MMN has been located in the supratemporal auditory cortex through dipole modelling (see Alho, 1995 for a review of localisation evidence). Mismatch responses may be elicited by both attended and unattended stimulus contrasts. Simple sequences (e.g., pure tones, contrasts in pitch, intensity, duration, and inter-stimulus intervals) elicit a mismatch response, as do contrasts that are close to the threshold of perceptual discrimination (Kraus et al., 1993; Sams et al., 1985). Many studies using ERP measures have focussed on unattended contrasts, but a number of recent studies have produced

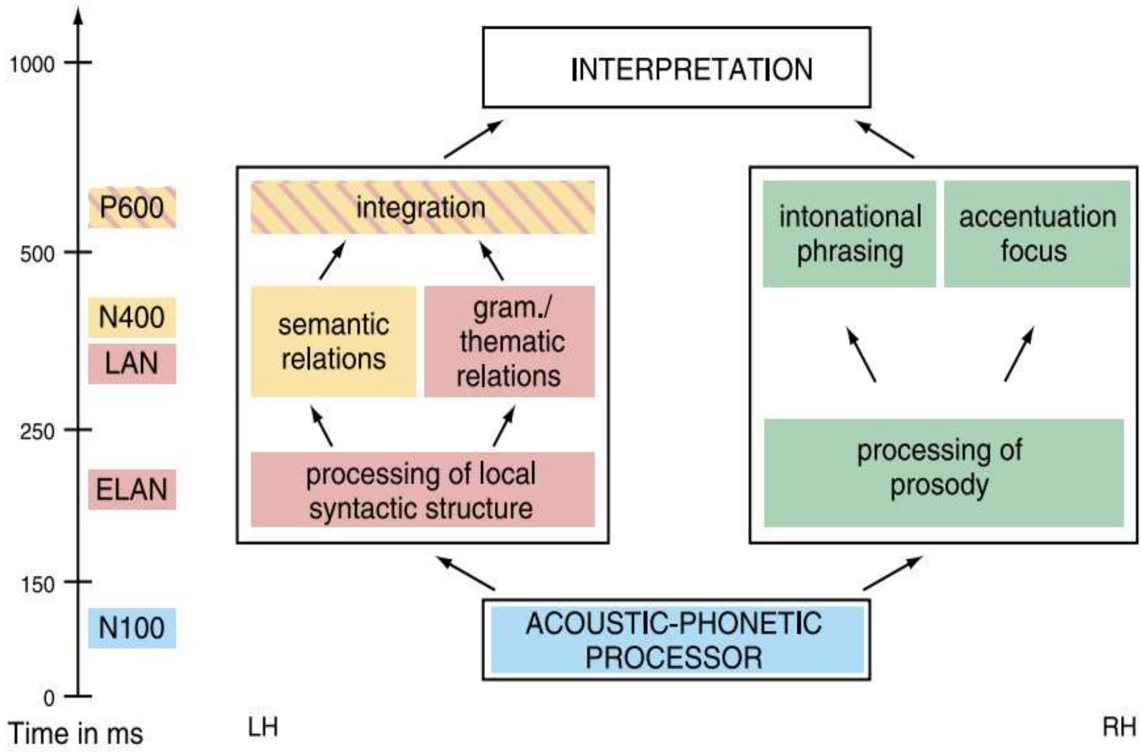
MMN responses by attended sound contrasts (Alho et al., 1998; Dehaene-Lambertz, 1997; Woldorff et al., 1998). The presence of *deviant* stimuli is apposite for the present research because it implies that the availability of phonetic representations between two similar orthographies, like *romaji* and English may generate a mismatch response under certain *deviant* conditions.

This theory of *deviant stimulus* phonetic mismatching generating an MMN response is language-dependent, to some extent. Sharma et al. (1993) used two pairs of stimuli from a synthetic /da/-/ga/ continuum, which contrasted only the F_2 and F_3 onset values; for end-point stimuli, F_2 were 1700 Hz and 2800 Hz for /da/, and F_3 were 1640 Hz and 2100 Hz for /ga/; transition durations for F_2 and F_3 were 40 milliseconds (Sharma et al., 1993, p. 66). This study and others (e.g., Maiste et al., 1995; Sams et al., 1990) found an increase in the mismatch response when the acoustic contrast was augmented by a phonetic contrast. However, Maiste et al. (1995) pointed out that mismatch responses to phonetic contrasts were no larger than those of other acoustic representations. This means the mismatch generator may be sensitive to phonetic representations, but in the existence of contrast at multiple levels, the amplitude of the mismatch response may be obscured. However, a number of other studies have reported the effects of phonetic representations in mismatch responses.

Dehaene-Lambertz (1997) presented French participants with streams of CV syllables where acoustic deviants were introduced that either crossed a phonetic boundary or remained within the same category. Two phonetic boundaries, one present and the other one absent in the subjects' native language, were explored. In short, two sounds that fall in the same native category are extremely difficult to distinguish, and deviants that crossed the native boundary induced MMN, 280 milliseconds after syllable onset. Friederici (2011) interprets this data to suggest that during speech processing, the input signal is directly parsed into the language-specific phonological format of the L1, native language. These results are interpreted in the present study to indicate that, where *romaji* maps directly onto English phonemes: the MMN will not be induced; English deviants that are non-existent in Japanese, should invoke some deeper processing and consequently result in extreme delays; and where there is a mismatch, we should see delays of 100 to 280 milliseconds.

Figure 2.2

The Auditory Language Comprehension Model for Language Processing



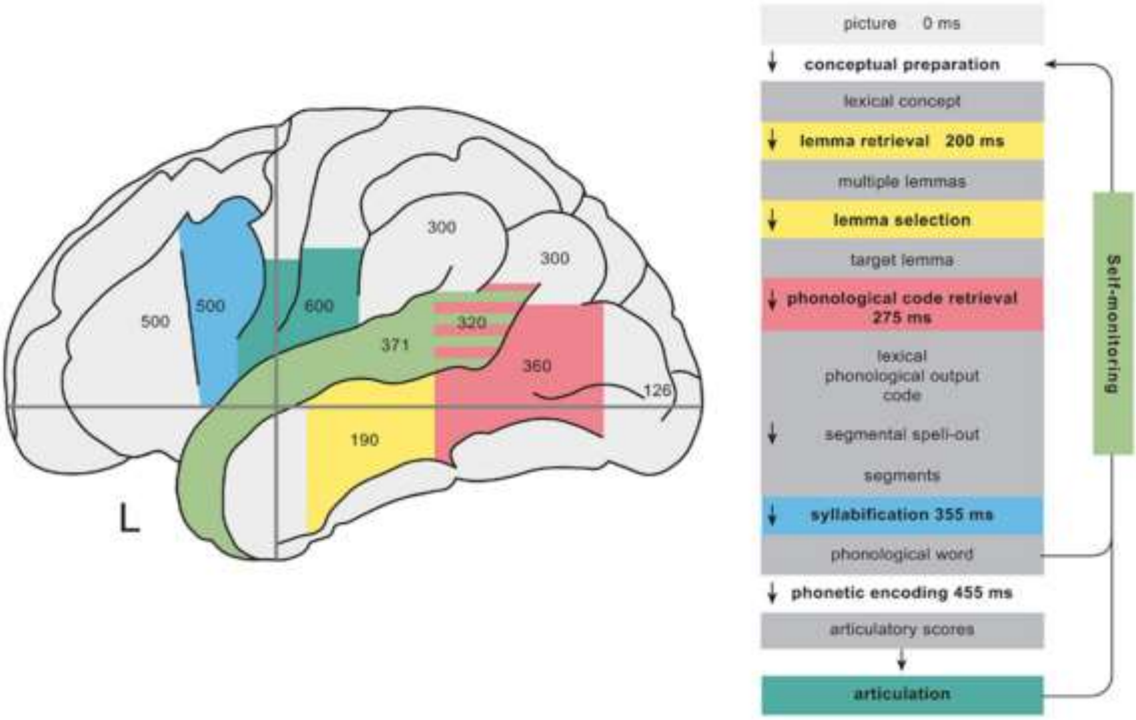
Note. From "The brain basis of language processing from structure to function" by A. D. Friederici, 2011, *Physiological reviews*, *91*(4), p. 1377. (https://doi.org/10.1152/physrev.00006.2011)

Figure 2.2 and Figure 2.1 together provide a model of where and why delays are expected in various portions of the brain. The processing delays are not just biological, but a part of efficiency, access to information, where it is stored, and this was influenced by, or influences, the development of the brain and is specific in some regards to left-handed or right-handed individuals.

Other studies have, likewise, found language-specific domains in the brain, with similar associative delays (see Figure 2.3). ELAN - Early left anterior negativity (120-200 milliseconds) is believed to reflect initial syntactic structure building processes; centroparietal negativity between 300-500 milliseconds (N400) reflects semantic processes, and a late centroparietal positivity (P600) is taken to reflect late syntactic processes. Moreover, delays in the time window between 300 and 500 milliseconds, have been associated with: syntactic features that mark the grammatical relation between arguments and verbs, the assignment of thematic relations (who did what to whom), and language formation. Similar LAN response times are also associated with violations of subject-verb agreement (e.g., singular versus plural) in an inflected language like German, (Penke et al., 1997), Italian (Angrilli et al., 2002), and Spanish (Silva-Pereyra, & Carreiras, 2007), and in fixed word order languages like English where delays are less dependent on semantics, as found in Osterhout and Mobley (1995), but not in others (Kutas & Hillyard, 1983; Osterhout & Nicol, 1999). The assumption of this thesis is because, without context, the reader depends on the words on the page as they read. Also, for Japanese, the likelihood of observing this effect increases with the amount of morpho-syntactic marking (Friederici & Weissenborn, 2007), which should be present when reading *kanji* (see the discussion in Chapter One). These findings would indicate that using translation tests from *kanji* (which is common in Japanese early English testing) as an indication of orthographic influence could introduce variability, which should be meticulously controlled, and in the present study, the use of sentence/phrase translations would need to be avoided.

Figure 2.3

Areas of the Brain Associated With Language-Specific Functions



Note. From "The Potential for a Speech Brain–Computer Interface Using Chronic Electrocorticography" by Q. Rabbani, G., Milsap, and N. E. Crone, 2019, *Neurotherapeutics, 16*(1), 146. (https://doi.org/10.1007/s13311-018-00692-2).

The model for language processing in the brain (Friederici, 2011) would suggest that the two areas of the brain are assumed to be the neural network responsible for initial local structure building processes, which takes between 120 to 200 milliseconds to process. This pathway may be responsible for supporting adjacent structural dependencies but, moreover, semantic and syntactic relations in a sentence are processed between 300 to 500 milliseconds after the stimulus onset, possibly in parallel systems, activating separable left-lateralised temporo-frontal networks. This processing would no doubt interfere with the processing of word-level semantics because word-level semantic processing alone involves a large neural network involving numerous brain areas and connections (e.g., the middle and posterior parts of the middle and superior temporal gyrus, including the angular gyrus and frontal association areas, see Binder et al., 2009b; Démonet et al., 2005). This means that there should be a considerable cognitive burden and measurable delays in the presence of previous knowledge of scripts and the absence of orthographic implicit knowledge. Therefore, it should be reasonable to assume that there should be a measurable difference in reading and writing responses depending on if individuals have acquired knowledge and if it is processed (slower), proceduralised (partially processed and faster) or implicit (it has entered the mental lexicon for immediate retrieval).

2.2.3 The Neurological Writing Centre

The writing centre of the brain has long been assumed to be dominant in the left hemisphere for right-handed people, which is now recognised as the Exner's area. The Exner's area is positioned in the posterior portion of the middle frontal gyrus; it works in conjunction with the left superior parietal lobule to control the generation of script (cf. not to be confused with "generation effect", a cognitive function discussed later). With only little practice, or in developing writers, the inability to generate scripts cannot be assumed to be a motor problem. Lesions in the left superior parietal lobule, for example, leave aural spelling and language functions intact; but when asked to write, directions of letter tails and even entire words can be omitted, a condition known as pure agraphia (see Auerbach & Alexander, 1981).

Also, while an individual might be able to write from dictation, they will still find it difficult to copy written text (Yaguchi et al., 2006). This is not to be confused with the cognitive and language development problems that early beginners exhibit while copying texts. The reason that letters can still be produced from sound is, the left parietal region has, therefore, been attributed to providing graphic images for letters while the left premotor region organises graphic motor images (Katanoda et al., 2001).

Another area of the brain that is attributed to writing is the Graphemic/Motor Frontal Area (GMFA). The GMFA allows an orthography to be transferred into specific hand-writing movements (Roux et al., 2009). The GMFA also coordinates the interface between semantic, syntactic, and orthographic representations of words via their physical appearance, including upper- and lower-case letters, cursive versus printing, as well as the individual nuances that make each person's handwriting unique. Individuals with lesions or other problems in this area of the brain find handwriting difficult and less fluent. While the ability to compose sentences and generate ideas is generally left intact, it is the transcription process that is affected, making it tremendously difficult. Therefore, writing at the letter level requires the integration of several diverse neuronal pathways that depend on memory, first language ability, and other developmental factors, more than mere motor skills. The use of first language priming and responses that are not script dependent (e.g., decisions tests) that require a non-language response, like checking a box or circling a word would be useful in diagnosing individuals that have some underlying symptom that requires attention. Therefore, results that indicate problems of this magnitude would warrant exclusion from the present test.

Research on the brain structures is somewhat limited in what it can tell us about the thinking (i.e., cognition) required for writing. Neurological research inherently remains limited and focuses primarily on those structures that govern the physical representations of sounds and letters. From the perspective of placing pen to paper and spelling, the practice of writing draws on a variety of cognitive processes, including planning, problem-solving and long-term memory functions. Even at the script level, the writing process involves long term memory, and other writing processes (for more details of the entire writing process see Flower & Hayes, 1981).

At the script level, problems with orthographic processing can limit students' access to language-specific vocabulary, academic texts, and influence their reading choices, thereby limiting their access to language-rich input, essential to the development of competent development compositional writers. Therefore, it is crucial to understand what is happening at the letter level and cognitive psychology holds some clues to modelling these problems.

2.3 Cognitive Framework

Cognitive psychology accounts for the mental processes responsible for transformation, reduction, elaboration, storage, recovery and the usage of sensory information (Neisser, 1967). Cognition differs from the neurological accounts of language processing in that cognition is concerned more with what is happening with the information entering, stored, and processed in the brain. More specifically, cognition is concerned with what is being processed more than where it is processed in the biological brain. Cognition accounts for the facilitation, inhibition and transfer of information, the accumulation and recall of information, and the processing of memory, regardless of language. These mental processes have been identified to influence and be influenced by a learner's environment and experiences (Ellis & Wulff, 2019) as they develop. This process also affects, and is affected by, the time and timing of these experiences, that is, any individual's age of acquisition (see Barry et al., 2001; Chen et al., 2020; Genesee et al., 2006).

This section discusses the development and application of various models, effective in explaining the cognitive processes responsible for understanding how developing learners produce spelling from words, sounds, and pictures. After introducing these theories of cognitive processes essential to this thesis, various models that are useful in understanding the cognitive processing that is unique to how native Japanese beginners process their writing system and how it is influenced by and has an influence on learning English.

2.3.1 Background

The developmental accounts of reading and writing skills in different orthographies vary as a function of common underlying cognitive processes, function of orthographic transparency as the script dependent hypothesis predicts (Geva, 1999), and other phonological and orthographic interactions, which the central processing hypothesis accounts for. Due to the complex and dynamic nature of language development, particularly when two or more languages are involved, the relationships among the components of literacy are not static (Genesee et al., 2006, p. 7) and naturally change with the learner's age, levels of second-language oral proficiency, cognitive abilities, and previous learning, which involve theories of language usage. These theories converge on the general idea that early literacy development is somewhat related to cognitive maturity and, in dual/multilingual language development, the order of learning affects transfer (Genesee et al., 2006), and interference from similar scripts in contrasting areas in the two similar orthographies (Share, 2004).

2.3.2 Theoretical Models for Processing Language

A starting point for studying the orthographic processes surrounding writing first assumes that similar processes and pathways are used for both reading and writing (Breadmore et al., 2019). Models of visual word recognition assume that skilled readers process the scripts on the page via two distinct routes: a direct lexical-route, which bypasses *phonological recoding* and an indirect route, which uses language rules, semantics, and other cognitive processes (Coltheart et al., 1993, 2001; Dijkstra et al., 1999; Perry et al., 2007). Similarly, Katz and Frost's (1992) ODH further postulates that there are different routes for fluent reading that are dependent on the nature of a particular orthography; a slower, less efficient route for the processing of unfamiliar and irregular scripts and a lexical route for familiar and regular items, as found in shallow orthographies like *romaji*.

The dominant theoretical framework for explaining the mental processes involved in reading aloud, writing, and spelling in this thesis is the dual-route framework (Barry, 1994; Tainturier & Rapp, 2001). The dual route model (DRM) postulates that the "choice" of route may be influenced by the relative grapheme-to-phoneme transparency of a writing system (Frost et al., 1987), which is analogous to orthographic influence. Both orthographic Influence and various renditions of Coltheart's DRM (Coltheart, 1978, 2005; Coltheart et al., 1993, 2001) have been applied to reading aloud and word reading (see Bonin et al., 2015; Castles et al., 2006), spelling/writing (Barry, 1994; Harada, 2003; Hoxhallari, 2006; Kandel et al., 2011; Tainturier & Rapp, 2001), both reading and spelling (Apel, 2011; Masterson & Apel, 2007; Sheriston et al., 2016; Zarić et al., 2020), and specifically for Japanese (Harada, 2003; Kess & Miyamoto, 2000, p. 98).

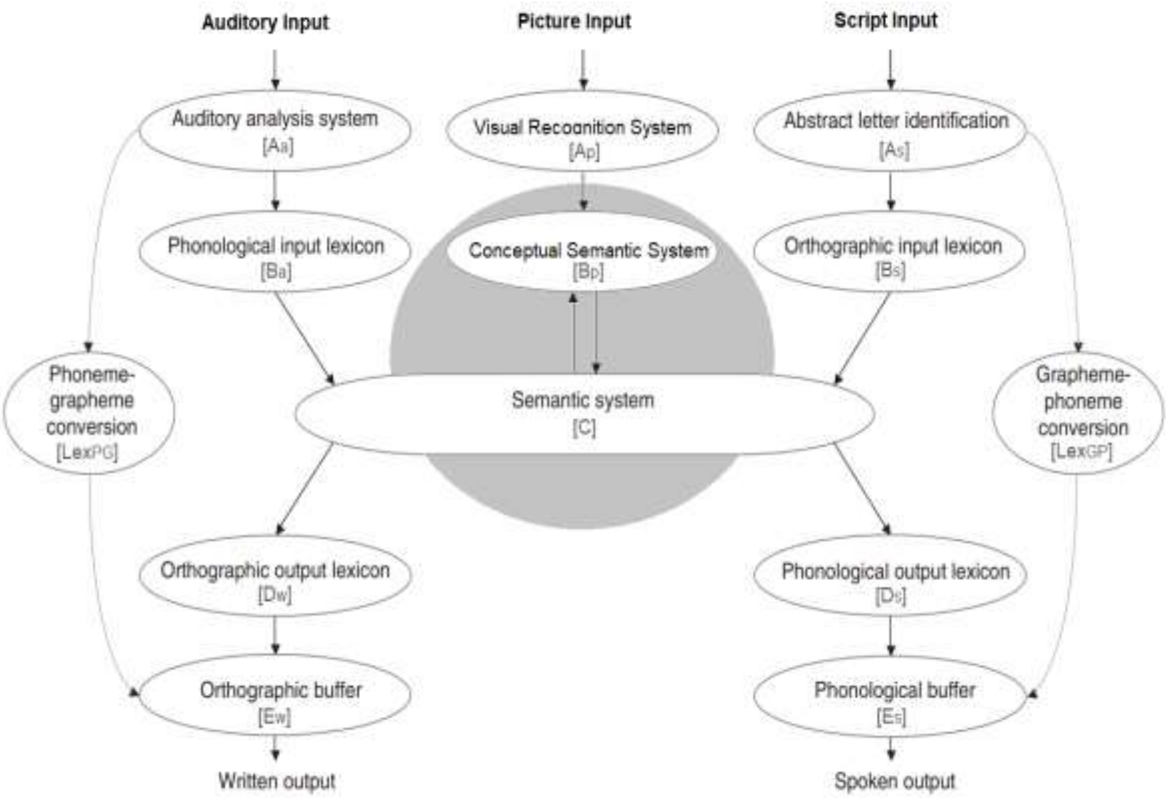
The following section presents the DRM and how it can account for variations in input types and lexicality. Input types are the stimuli and primes that include pictures, audio. Accounting for variation includes understanding the predictability of familiar words, the influence of context, and visual complexity. Using stimuli that are not influenced by these variables are expected to be more reliable than merely reading words or naming progressively more complex pictures, or transliteration, which has been used in the past (Ellis et al., 2004; Goswami et al., 1998; Landerl et al., 1997; Seymour et al., 2003; Thorstad, 1991; Wimmer & Goswami, 1994).

2.3.3 Spelling from Pictures, Script or Audio via Lexis or Processing

The dual-route paradigm has also been applied to explaining the cognitive process of spelling from pictures (Turgeon & Macoir, 2008), dictation and phonetic naming, and nonword priming (Basso, 2008). As explained previously, unfamiliar, new, or unique stimuli are connected with previous knowledge and processed into meaning. The route for spelling and writing non-lexical items via processing (see Figure 2.4, route A-B-C-Dw-Ew) incorporates a semantic system (see Figure 2.4, area C), which understandably takes time and cognitive resources to process. In this process, spelling is generated based on rules that map individual phonemes to letters or groups of letters.

Figure 2.4

Lexical and Semantic System Model for Input Conversion to Script or Speech



Note. Main diagram adapted from Basso, A. (2008). "Recovery and treatment of acquired reading and spelling disorders" by A. Basso, as cited in B. Stemmer & H. A. Whitaker (Eds.), *Handbook of the Neuroscience of Language* (p. 418). (https://doi.org/10.1016/B978-008045352-1.00041-0). Picture input processing adapted from "Classical and Contemporary Assessment of Aphasia and Acquired Disorders of Language" by Y, Turgeon & J. Macoir, 2008, as cited in B. Stemmer & H. A. Whitaker (Eds.), *Handbook of the Neuroscience of Language Handbook of the Neuroscience of Language* (p. 6).

The grey area suggests a wider semantic connection to produce spelling from pictures.

For familiar items, the lexical route employs long-term memory and the process of looking up the spelling in one's mental dictionary. This route (see Figure 2.4, route A-Lex-E) relies on spellings that have been memorised in previous encounters during reading or other activities. These lexical items are memorised as whole words (Treiman, 2017, p.3). This route is stored in faster-acting areas of the brain (see section 2, this Chapter) and is, therefore, quicker and usually more accurate, albeit influenced by native language and other salient features of the language.

The two routes (i.e., auditory and script input see Basso, 2008; and input from pictures see Turgeon & Macoir, 2008) are considered essential for measuring the influence of orthography between *romaji* and English, namely:

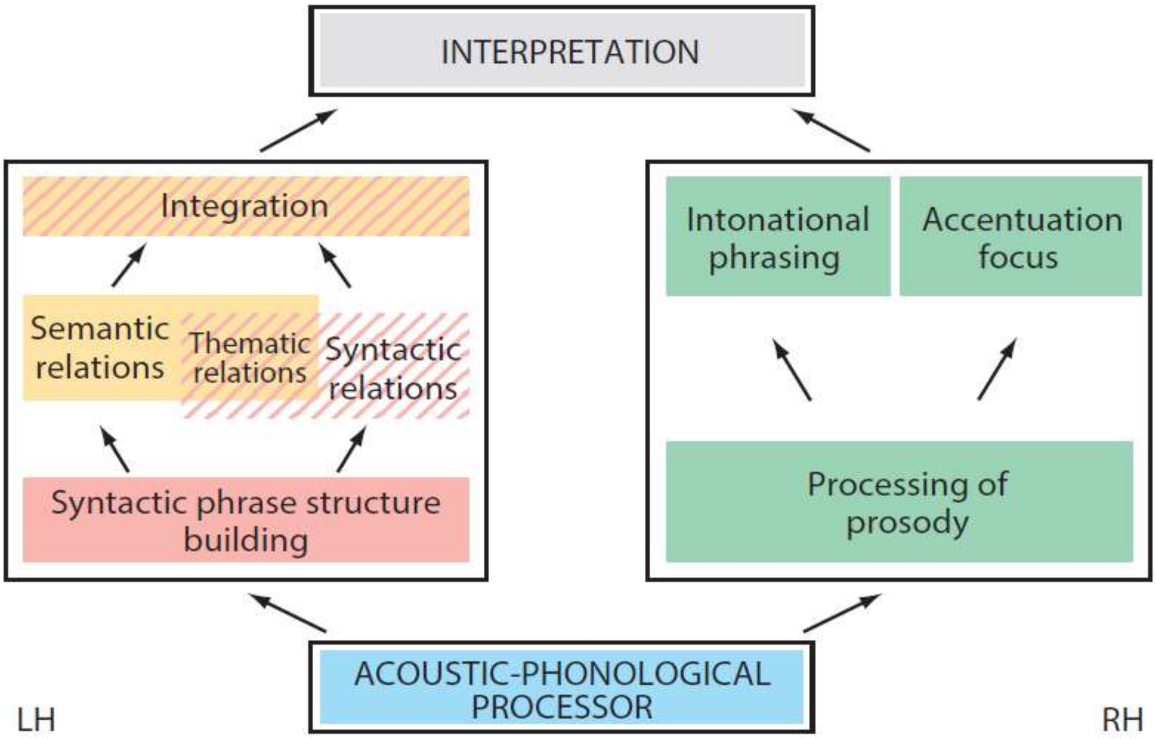
- spelling from pictures and pictograms (route Ap, Bp, C, Dw, Ew),
- Spelling from script input (route As, Bs, C, Dw, Ew), and
- Spelling from auditory input (route Aa, Ba, C, Dw, Ew)

By modulating the use of real words with pseudowords and nonwords, it is predicted that sub-word processing will be available and parts of words (i.e., chunks) will be processed through GP lexis and others through the semantic path. This pathway is purely conceptual and requires multiple processes running in parallel.

The cognition model of audio processing (Friederici, 2017, p. 16) illustrates more precisely, the complexity of processing. The model (see Figure 2.5) employs three different sub-processes during the comprehension of auditory input to interpretation.

Figure 2.5

A Cognitive Model for Auditory Language Comprehension



Note. From "Language in Our Brain: The Origins of a Uniquely Human Capacity" (p. 16), by A. D. Friederici, 2017. MIT Press.

The various sub-processes, illustrated in different colours, are assumed to take place in the left hemisphere (LH) and right hemisphere (RH). These different cognitive processes are assumed to generally run partly in parallel, albeit in a cascaded manner (Friederici, 2017). In this model, each subsystem presents its output to the next subsystem almost immediately, thereby causing several subsystems to work in parallel. Each of the subsystems corresponds to local cortical networks in specialised brain areas (Friederici, 2011), which together form large-scale dynamic neural networks supporting language comprehension (Friederici & Singer, 2015). In the context of the cognitive model of auditory language comprehension, a first step toward comprehension is access to the lexicon and the information encoded in the lexical entry (Friederici, 2017).

Evidence from the past four decades (Corkin, 2002; Flower & Hayes, 1981; Friederici, 2017) also converges on the idea that visual and auditory inputs and spoken and written responses each have different cognitive and neurological processes, each with their own associated delays in processing. This neurological and cognitive account of how word frequency, word length, the type of priming (i.e., pictures, aural, reading, etc.), and the type of response can affect the accuracy, fluency, and response times has been reflected in recent psycholinguistics research (Chen et al., 2015; Ellis, 2019; Ellis et al., 2004; Ellis & Wulff, 2019; Hoxhallari, 2006; Hoxhallari et al., 2004; Li & D'Angelo, 2016).

The dependent variables in the previous studies involved the processing of whole words and phrases. The present thesis, however, is centred around the effects of orthography at the sub-word level of reading, transcribing, and spelling. This means letter familiarity, phonemic chunks, and age-specific high-frequency and familiar words will be most influential. Therefore, a novel model for studying sub-word cognitive processes for spelling and letter writing would need to be designed (see Chapter Three) designed to investigate the less than trivial task of writing and spelling.

2.3.4 Conceptual Models for Understanding Cognition

Other models and renditions of the DRM have been tried and tested over the years. A single-route method was presented by Seidenberg and McClelland (1989, 1990) that models the print to speech path. This single route is limited in that it can only account for how *skilled readers* read exception words aloud. The reading of exception words (i.e., words with illegal spellings) is an interesting issue when it comes to understanding facilitation, where facilitation does not exist between two languages. For example, if a Japanese child is presented with the English exception-word *elephant* for the first time, it should appear to the Japanese mind as a nonword. With only Japanese phonology and even advanced knowledge of *romaji,* a reader may by chance deduce the sound of the word *elephant* from the script, but only they can mediate the ‘ph’ grapheme, final position consonant ‘t’, and if they can understand the letter ‘l’. All of these graphemes and phonemes are illegal representations in the Japanese language (see Table 1.2). Therefore, *elephant* is processed differently as a nonword for Japanese, until it is learned to be read when it would then be stored as a sight-word or an exception-word in that individual's mental lexis. Seidenberg’s single-route model, cannot account for how skilled readers read nonwords (i.e., legal representations of words that are not yet in a language corpus), nor can it explain the visual LDT and issues to do with dyslexia (Coltheart et al., 1993). The DRM, on the other hand, accommodates explanations for all of these and many more reading and writing paradigms and has, therefore, remained the tenable model of both skilled reading and learning to read in this thesis.

Similar to the DRM, the Dual Route Cascaded Model (DRC) presented by Coltheart et al. (2001) is considered the most reliable computational explanation of the tasks of reading in humans (Coltheart, 2005). The DRC also demonstrates that reading via the non-lexical route makes no reference to this lexicon, instead, it involves making use of rules relating segments of orthography to segments of phonology (i.e., GP mapping). In reality, processing is never absolutely one route or the other; evidence about the parallel and cascaded processing of words was presented earlier (see Friederici, 2017). While the DRC model is merely a computational simulation of a cognitive process, it has been widely successful in simulating numerous effects in rapid automatic naming (RAN) experiments and lexical decision tasks (LDT) (Chang, 2003).

The DRC model was evaluated by Coltheart et al. (2001) to investigate if it was analogous to the reaction times of humans reading aloud using particular sets of stimuli. The following list of similarities (see Table 2.1) were summarised in Coltheart (2005, p. 15).

Table 2.1
Similarities Between the DRC and DRM

Items of similarity in simple terms
1. High-frequency words are read aloud faster than low-frequency words.
2. Words are read aloud faster than nonwords.
3. Regular words are read aloud faster than irregular words.
4. The size of this regularity advantage is larger for low-frequency words than for high-frequency words.
5. The later an irregular grapheme–phoneme correspondence is in an irregular word, the less the cost incurred by its irregularity. So CHEF (position 1 irregularity, "ch" /ʃ/) is worse than SHOE (position 2 irregularity, "oe" /uː/), which is worse than CROW (position 3 irregularity, "w" is silent).
6. Pseudo-homophones (nonwords that are pronounced exactly like real English words, such as brane) are read aloud faster than non-pseudo-homophonic nonwords (such as brene).
7. Pseudo-homophones derived from high-frequency words (e.g., hazz) are read aloud faster than pseudo-homophones derived from low-frequency words (e.g., glew).
8. The number of orthographic neighbours a non-pseudo-homophonic nonword has (i.e., the number of words that differ from it by just one letter), the faster it is read aloud.
9. The number of orthographic neighbours a pseudo-homophone has does not influence how fast it is read aloud.
10. The more letters in a nonword there are the slower it is read aloud; but the number of letters has little or no effect on reading aloud for real words.

Note. Adapted from "Modeling Reading: The Dual-Route Approach" by M. Coltheart (2005). Blackwell Publishing.

While the DRC and DRM provide a convenient system to analyse the processes of lexical access or GP conversion (GPC) by some other process, the DRC is less useful for illustrating the cause of delays between faster lexical access and non-lexical processing of unfamiliar words, which also include new or nonword. The present research, however, is more interested in the cause of errors from orthographic influence at the subword level.

2.3.5 DRM at the Subword Level

The DRM is also analogous to early spelling development. Reliable knowledge of basic letters and their sound correspondences and the ability to segment spoken words into phonemes are both essential for efficient spelling. It is only after some time and considerable practice that children build up a store of memorised spellings and become able to use the lexical route in any given orthography. Therefore, it might be reasonable to assume that the DRM could account also for early spelling development. In fact, there is evidence that phonemic and graphemic blocks first enter the lexis before sight words are remembered, therefore, presenting the notion of a partial entry into the lexis, until the complete word is available by sight.

There are two alternate ways of coding from print to sound (see Forster & Chambers, 1973). Marshall and Newcombe (1973) propose that the slower-procedural route consists of reading "via putative grapheme–phoneme correspondence rules" (Marshall & Newcombe, 1973, p. 191). The other faster direct-route involves reading via semantics, which is conceptually not unlike that suggested by Forster and Chambers (1973). The semantic-route implies previous knowledge, which highlights the influence of previous knowledge, and the influence of L1 on subsequent language acquisition.

When children begin to spell, they rely largely on the non-lexical route (Sprenger-Charolles et al., 1998). At this stage basic letters and phonemic blocks (e.g., 'sh' in English and '*shi*' for Japanese) may begin to be stored and, with practice, connect with larger units, thus adding to the lexical library. Assuming that smaller units get replaced with larger units fails to explain an individual's ability to read nonwords like *nabe* or *sloppendash or* pronounce irregular or inconsistent words like *knife* or *Wednesday*. The ability to read nonwords demonstrates the availability of a route using decoding from word parts, assembled from known or learned symbols-to-sounds (i.e. grapheme-to-phoneme associations) and the ability to read irregular words implies the presence/availability of another reading route where words cannot be decoded entirely by matching symbols and sounds (Ellis et al., 2004; Stemmer & Whitaker, 2008). This means that smaller and smaller grapheme chunks and phoneme chunks are relied upon when decoding novel words. The relationship between Japanese PG chunks and writing accuracy are investigated in this thesis.

To process novel encounters like *pint* and *colonel* (as opposed to unique spellings like *photo, knife*, or *climb*), Luzzatti (2008, p. 212) suggest the existence of two complementary reading routes, a lexical and a sub-word level (SWL) procedure. The SWL procedure implies the application of orthographic to phonological conversion rules, which allow literate individuals to convert letter strings into corresponding strings of phonemes. This lexical route is only activated for familiar words (Forster & Chambers, 1973, p. 627). This lexical route only allows individuals to read regular words (i.e., words with a shallow orthography like *cat* or *town* in English or *ken* or *tomato* even in Japanese) and regular pseudowords like *mable* (En) or *kematon* (Jp). The lexical procedure provides literate individuals with processing that is quicker, consumes fewer cognitive resources and activates the underlying conceptual knowledge automatically. The lexical route is obviously faster and assumes that the processing of a lexical string of letters is based on the retrieval of stored knowledge from the orthographic input lexicon and the phonological output lexicon.

These theories suggest that activation of the lexical route can only be assumed with orthography that has already been learned, is not vague, and does not conflict with other knowledge. Conflicts include other spellings for example using 'z' in the word "*specialize*" to conform with American English, or homonyms like *write* and *right*, or *light* and *right for* Japanese EFL students, and other homophones and homographs. For Japanese, these conflicts also occur with confusions between orthographies within a writing system (refer to section 1.4.3), and conflicts from previous knowledge (e.g., keyboard entry shortcuts before formally learning correct spelling). One example of this will become evident in the results of this study (i.e., '*ti*' instead of '*chi*' for the Japanese phoneme /ʧɪ/). Therefore, the lexical route is only available when reading regular orthographies, or words that have become sight words. In all other cases, unique and irregular spellings will employ the SWL procedural route. However, until words are stored as complete items, some researchers (see Tainturier et al., 2013) have considered different ways in which the routes may interact.

2.3.6 The Unique Japanese Mind

The unique cognitive processes that L1 native Japanese utilise to process their writing system involves a tertiary route. This *triadic-route* connects *kanji* directly with meaning and language production, thus providing an even more efficient process, bypassing semantic processing (Besner & Smith, 1992). This section explains the operation of this triadic-route and its relation to the influence of English orthography on the Japanese mental lexicon, which, in turn, elucidates why this phenomenon is less influential in other language combinations.

The Japanese writing system is unique because it is, in fact, three functionally and orthographically different writing systems working within a single writing system.

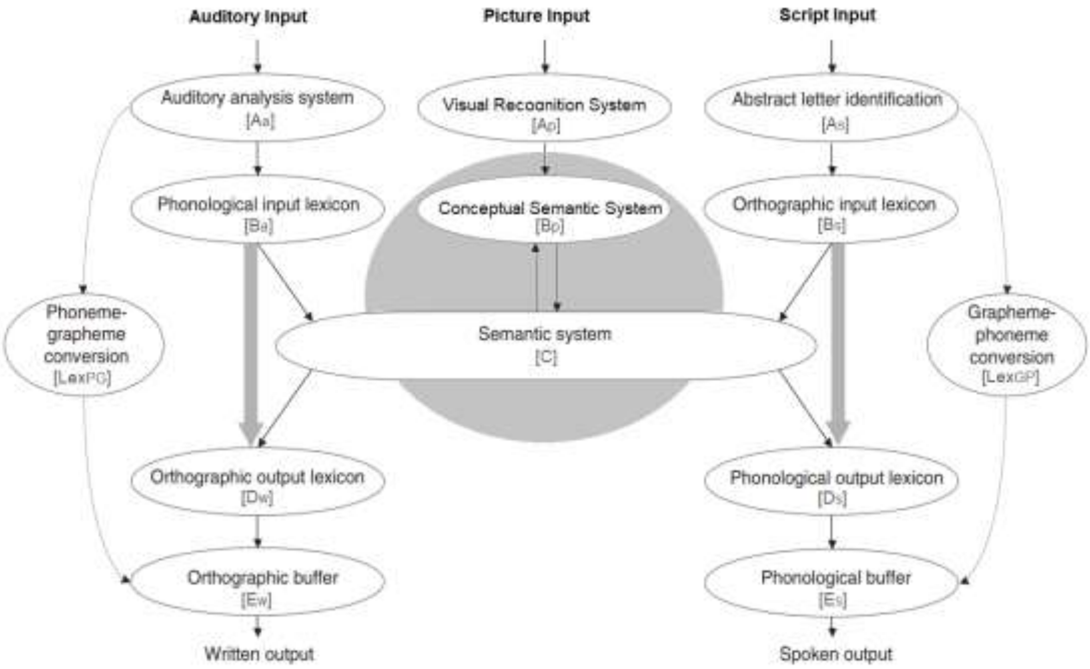
The fundamentally dominant orthography *kanji* is introduced from an early age and practised with meticulous care and attention for the majority of an individual's academic development. *Kanji* that are learned earlier in school are used later as the root components called bushu [部首], in more advanced *kanji* (Rose, 2017). By the time Japanese school children reach Grade-5, they should have mastered nearly 500 unique *kanji* (Appendix H), some with additional meaning and phonology, through repeated systematic practice in reading, writing, and exposure through other content in the school curriculum. Research has indicated that extensive exposure to any particular script such as this, appears to mould the brain for reading in that script (Baker et al., 2007; Nakada et al., 2001; Tan et al., 2003). If this is true and the difference in reading a new script is inhibitive, then it would be reasonable to suggest that learning this new script might be especially difficult for Japanese.

While the dual-route model adequately accounts for the cognitive processing of single orthographic languages and how a new language orthography connects with previous knowledge and enters the mental lexicon, it fails to account for one important factor regarding Japanese *kanji*. Japanese *kanji* is different from other scripts in that it is a picto-morphographic script. For L1 readers, the meaning of *kanji* can be directly accessed from print, and access to phonology follows access to meaning (Wydell et al., 1993). Alternate views to this are specific to early development (Feldman & Turvey, 1980), aphasia (Sasanuma, 1975), and the association of logographic symbols with word naming and meaning (Shimamura, 1987).

Besner and Smith (1992) suggest that when *kanji* is learned, the script provides sufficient information to bypass the reliance on semantic information (see Figure 2.6, areas Bp and C). Semantic information includes contextualised phonemic knowledge, literacy background, and some level of mastery in the orthography as semantic representations. Semantic representations relate to how words and meanings are related in conceptual structure, how these meanings are represented and related, and how these principles can be transferred or held, in different content domains (Vigliocco & Vinson, 2007, p. 2).

Figure 2.6

The Unique Model for Processing Orthographic Information for Japanese



Note. The Japanese Triadic-Route, showing the two conventional paths of visual processing and the third, *triadic-route* available for processing *kanji* (thick grey arrows), which bypasses the semantic system because the *kanji* provide the semantic information (e.g., meaning, context, image). From "Basic Processes in Reading: Is the Orthographic Depth Hypothesis Sinking?" by D. Besner & M. C. Smith, in R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology, and meaning. Advances in psychology* (Vol. 94, p. 46). (https://doi.org/10.1016/S0166-4115(08)62788-0)

Most language learners are already equipped with thousands of hours of highly contextualised literacy preparation by the time they come to learn how to write (Adams, 1990). Contextualised knowledge is superior to mere definitional instruction, which merely attempts to explain and define vocabulary. Contextual literacy preparation can be generated through explicit or intentional instruction (see Alemi & Tayebi, 2011), which includes a direct intervention in how to train and explain to learners how to develop lexical knowledge (Rosado & Caro, 2018). Other forms of contextual literacy preparation include acquisition [of vocabulary] through “altercation” (Graves, 1987; Nagy et al., 1987; Rosado & Caro, 2018). Nagy et al. (1987) delineate the categories of contextual acquisition into previous knowledge and encounters, learning on the basis of previous knowledge, and no concept where the reader needs to acquire new knowledge to understand the text on the page. This thesis investigates this process at the sub-word phonological, graphical, and lexical chunk level of word recognition and spelling because chunks should be retrievable from pre-existing lexis, similar to *kanji* radicals.

For transparent orthographies and in the advanced lexical development of sight words, research from eye-movement studies (Chaffin, et al., 2001; Williams & Morris, 2003, as cited in Morris & Williams, 2003) converge on the acceptance of a faster-lexical and slower procedural/semantic route for resolving the meanings, sounds, and spellings of unique or long words, and trying to resolve meaning from non-words. Interestingly, novel words in these eye movement studies did not differ from low frequency/unfamiliar words, suggesting directed attention to the unique encounter. However, Morris and Williams (2003) found that the novel words in these tests conformed with English orthography, which returned similar results.

In a study using unique real words, Just and Carpenter (1980) found that larger novel words were processed into chunks of previous knowledge. For example, the word *thermoluminescence* could be dissected into its morphological constituents to deduce meaning (i.e., *thermo* meaning heat and *luminescence* referring to giving off light). A similar example in Just and Carpenter (1980) produced delays in the range of 900 to 2500 milliseconds. These delays indicate that processing is formulated from previous lexical and semantic knowledge-based on word chunks, which supports the suggestion that semantic/contextual instruction aids reading comprehension (Rosado & Caro, 2018) and subsequently, spelling performance in EFL, ESL, and L1 contexts.

The present thesis expects that spelling can only be reliable if these items have been stored in the mental lexicon. Otherwise, sub-word chunks, based on high-frequency phonemes effects, would be enlisted, and errors would be based on the GP/PG orthographic understanding of these smaller units. A native language example of using smaller grapheme knowledge with previous semantic and morphological knowledge is illustrated in how Japanese students implicitly learn new and novel encounters with complex *kanji* from pre-existing knowledge of *kanji* “chunks” (i.e. radicals).

As Japanese students gradually build enough familiarity with sets of basic *kanji* and their components, they then rely heavily on *kanji*’s symbols for meaning. For these sight-words, familiar words, and high-frequency words, the direct route through the orthographic and phonological lexicon (i.e., route Bs-Ds) should take around 30 milliseconds to complete, similar to the DRM mentioned earlier. This tertiary, “triadic-route” suggests that the meanings of some *kanji* can connect directly with meaning and speech production (see Figure 2.6, route As, Bs, Ds, Es), or aural input can connect directly with the phonological output lexicon to produce writing (see Figure 2.6, route Aa-Ba-Dw-Ew). This triadic-route should be more efficient, faster, produce relatively more accurate spelling responses, and consequently be less cognitively demanding than the conventional DRM accounts of processing or retrieving information. However, due to the inconsistent GP correspondences of *kanji* in general, it is unreasonable to assume that meaning and pronunciation from *kanji*, or production from sound or images to writing *kanji* takes any single or predictable route at any given stage of orthographic development.

According to Harada (2003), these routes for processing to and from scripts are “neither mutually exclusive nor inherently prioritized” (p. 108). Depending on the context and other factors, a route can interact with other semantic lexical knowledge and other priming factors like prosody, lexical and phonological neighbours, and other influences mentioned later in this Chapter. Additionally, these cognitive processes and pathways always tend to move toward more efficient areas of the brain to facilitate efficiency, which accounts for how the lexical and triadic-route are enlisted. These routes, however, are not independent but run partially in a parallel, cascaded manner (see Friederici, 2011, in section 2.3.3). This is true for both *kanji* and the other Japanese scripts, *kana*. *Kana* is tremendously transparent and connects easily with phonemic knowledge. Therefore, *kana* should be able to rapidly enter the lexical network, presenting minimal interference or detrimental influence. In fact, these scripts support learning *kanji*. However, this account cannot be assumed for alphabetic scripts like *romaji* and English.

In general, similarities between L1 and L2 scripts are facilitative, and differences produce interference (Cook & Bassetti, 2005; Koda, 2005). Interference initiates the requirement for further cognitive processing and the formation of neurological connections with semantic knowledge and the recall and processing of long-term memory (Chen et al., 2015, p. 17). Hepburn *romaji* (i.e., *hebonshiki*) is a tremendously transparent alphabetic writing system that connects almost transparently with Japanese phonology. For Latin-based, transparent orthographies, *hebonshiki* is easily learned, because the consonants and vowel names and sounds have an almost one-to-one GP/PG mapping. However, English alphabets employ a complex set of relationships between letters and sounds (Gough et al., 1992), and do not map completely with the GP correspondences of *romaji* (see Table 1.3). Additionally, English syllables can comprise a tremendous array of letter combinations. Therefore, processing of English words and spelling in English should present a considerable cognitive burden for Japanese students. Meanwhile, *romaji* should be accommodated in the Japanese mental lexicon expediently and with relative ease because of its consistent GP mapping and pre-existing phonological knowledge. Neither, however, could ever be represented in the triadic-route because alphabets lack semantic information, and new and unfamiliar words are void of content. While this cognitive phenomenon may not be influential to reading alphabets, it is estimated to be influential to the stimulus that uses *kanji*. Accounting for this influence will be discussed in Chapter Three.

2.3.7 Cognition Conclusion

The models presented in this section provide a conceptual understanding of how language scripts and spelling are learned and processed in the brain, and how new knowledge becomes implicit. This implicit knowledge uses processing pathways based on orthographic rules (unreliable and slowest) and semantic and lexical information (reliable and fast), which takes time and practice to establish. *Kanji*, on the other hand, provides meaning and thus uses a unique path that bypasses the reliance on semantic knowledge or orthographic processing. These processes are to some degree, readily transferable for alphabetic processing in *romaji*; the availability of any of these cognitive processes for English is questionable and the focus of this thesis.

The cognitive challenges that spelling in English presents, together with the incomplete mapping between English and *romaji* means that individuals should show evidence that the ability to spell reliably from *romaji* and the transfer of skills based on *romaji* orthography, which is linked almost transparently with Japanese phonology, defies evidence to the contrary, presented in this Chapter. Expecting students to continue learning under this assumption may result in “L1 entrenchment” in the areas where the transfer is ineffective or contradictory. These obstacles to transfer are less than trivial (Ellis, 2008, p. 107). If this is valid, there should be evidence of L1 entrenchment in individuals with *romaji* skills, based on Japanese phonemic/graphemic blocks. Alternatively, if the understanding or learning of *romaji* is weak, then L1 entrenchment should not present any issue through orthography, only phonology. To reliably study these influences, the confounds to orthographic understanding and spelling need to be addressed.

2.4 Language Framework - Confounds to Orthographic Knowledge

To document precisely all possible developmental accounts of orthographic knowledge would be likened to describing the most intricate workings of the human mind and the history of every event that has ever influenced the mind of every individual (e.g., Huey, 1908, p.6). The "obvious" reason is usage-based (Ellis & Wulff, 2019, p. 41); every individual experiences their language with different backgrounds and experiences and at different times and rates (Wagner & Barker, 1994). Thus, the usage-based theories presented in this section account for the variation and interference in orthographic knowledge development.

This section starts with general theories applicable to learning all scripts and then shifts to address what interferes with the development of implicit orthographic knowledge. The effect of age and sequencing on learning is presented following the effect of frequency. Frequency effects are discussed in light of the profound influences that age and development have on lexical entry. These influences include the effect of orthographic and phonemic neighbours, word concreteness and salience. These effects are considered general to either language independently. The following section focuses on the orthographic effects that are transferred or inhibited when studying two languages.

2.4.1 General Language Influences

The general language influences presented in this section are concerned with first language effects and are independent of script type. Only essential theories particularly influential to this study were included. These theories included children’s language development and the stages in beginning to spell that influence orthographic development. Confound to orthographic development are then discussed followed by the effect of age and subsequent encounters with new words. The influences that affect word frequency are then discussed. The final section is concerned with the effects of concurrent learning of contrasting orthographies.

2.4.1.1 Children’s Language Development

Children’s early language and orthographic development theories suggest that intellectual development reflects an increasing sophistication of children's thought (Piaget, 1936, as cited in McLeod, 2018). According to Piaget, these stages of sophistication range from sensory development in infancy through to advanced abstract reasoning starting in their teens. While this view recognises that every child's development is unique and determined by biological maturation and interaction with the environment, many have come to realise that these theories are merely vague explanations of the mechanisms underlying developmental change (Binder et al., 2009a) and they underestimate youngsters’ cognitive capabilities (see Miller, 2002, 2011).

In early childhood, perception and production of phonology and subsequent development of orthographic knowledge are shaped by the child’s linguistic environment. The development of speech perception arguably starts before birth and infants respond to linguistic input from a very early stage (Fromkin et al., 2013. p. 400). Accordingly, these early stages of speech perception are what enables humans to interpret and understand the individual sounds used in language and within words, the early development of implicit phonological awareness. Even though numerous cross-sectional and longitudinal studies (see Smit et al., 1990) have indicated that the majority of healthy children can produce nearly all of the sounds of their native language correctly before they enter elementary school at the age of 5 or 6 years old (Schellinger et al., 2016), phonological awareness remains in a state of continual development, even after school age.

Variations in phonology are also influenced by an individual's social environment. Native language phonology is often influenced by ethnic background, social class, mixtures of language in individuals, dialects, pidgins and creoles, and other linguistic factors including slang and jargon. These influences are rarely often evident in additional language acquisition (Reinecke, 1938), however, acoustic elements have been found to affect phonological development and orthographic knowledge. Acoustic elements include biological factors that affect tone (e.g., age, vocal area size and shape) and age-specific environmental factors including family, motherese, the teacher, media, or “noticing” at some particularly important time in a child’s learning development. Prosodic patterns are also developed in infancy particularly from words spoken by parents and later by teachers. Prosodic patterns are not merely individual phonetic segments of speech; they also include properties of syllables as well as larger units of speech such as linguistic functions like intonation, tone, stress, and rhythm (Kuhl et al., 2007). It is important to recognise these variations to phonological awareness because they affect resultant speech production and subsequent orthographic processing, writing, and spelling (Krashen, 1989), even at the phonemic or sub-phonemic level (Schellinger et al., 2017).

2.4.1.2 Stages in Beginning to Spell

The development of children’s spelling skills and orthographic knowledge are also a progressive, increasingly sophisticated process of understanding how the sounds of words can be represented by letters or letter groups. Several models have been presented to explain the specifics of this developmental progression (see Ehri, 1992; and Frith, 1985). Some whole-language advocates (Cornett & Blankenship, 1990; Dahl & Scharer, 2000; Goodman, 1979, 1986, 1989; Smith, 1992), view speaking and reading as involving equivalent "natural" processes for all children. Others (see Adams, 1990; Blachman, 1984) have found that the consciousness of words as single units in a phrase should not simply be assumed (Hempenstall, 1997). Some suggest that words and their parts are a collection of specific visual images for every word (see Frith, 1982 for an argument). However, this does not account for the developmental models suggested earlier in cognitive and neurological accounts.

According to Ehri (1999), reading development is a progressive series of discrete steps: (i) pre-alphabetic, where one or more visual cues of the word are remembered; (ii) partial alphabetic, where one or few letters, which correspond to the appropriate sounds detected in pronunciations, are used to recognise a written word; (iii) full alphabetic, where connections are created between graphemes in spelling and phonemes in pronunciation of the words; and (iv) consolidated alphabetic, where written words become sight words, which means that letter patterns recurring in different words become consolidated into larger pronunciation units (e.g., syllabic and sub-syllabic units).

Ehri's (1999) progressionalist epistemology claims that finer-grained representations get recognised and processed into words only after multiple or intensely attended words become sight words. In the initial, preliterate stages of spelling, children's attempts at writing are merely a mixture of letters and numbers jumbled together. The relationships between phonemes and graphemes bear little correspondence with the words they are supposed to represent. The following stage is considered to be when a child's spellings represent the complete sound structure of a word. These early attempts at spelling are affected by both letter-name knowledge and children's phonological knowledge (Lehtonen, 2005), which are also affected tremendously by an individual's linguistic environment. At this "phonetic" stage, children still fail to consider conventional orthographic constraints of their language. These constraints are the rules that govern legal letter positions, the types of letters that can appear adjacent to each other, are yet to become implicit.

Alphabetic languages require readers to learn to abstract linguistic units and match phonemes to graphemes. A more recent version of this "script dependent hypothesis" emerged with the conceptualisation of alphabetic languages as differing in their "orthographic depth" (Frost & Bentin, 1992; Katz & Frost, 1992; Peereman, 1992; Turvey et al., 1984). Accordingly, alphabetic orthographies differ in how systematically spelling and pronunciations can be mapped onto each other. A shallow orthography allows a simple one-to-one correspondence between letters and sounds. Conversely, deep orthographies such as English employ a more complex set of relationships between letters and sounds (Gough et al., 1992, as cited in Taylor & Olson, 1995) while abiding by similar alphabetic principles. The effects of orthographic depth on beginning readers has been recognised by educators for several decades (Gillooly, 1973).

By the time most children in Japan enter elementary school, they already possess rudimentary *hiragana* skills which are usually fully developed by the end of the first term. This is typical of scripts with shallow orthographies (Ellis et al., 2004; Kess & Miyamoto, 2000). For similar reasons, *romaji* should be acquired in a similar duration when it is introduced in the third or fourth grade. During these stages of literacy development, phonemic awareness and orthographic knowledge continue to evolve and as a consequence, larger than letter size graphemic chunks and complete, even irregular "sight-words" become stored in memory. These three stages are not simply sequential but are considered to be a "cascade" of implicit and increasing explicit knowledge of phonemes and spelling (Ellis & Cataldo, 1990, 1992).

Interestingly, the amount of orthographic information that is required for reading and consequent accurate writing is directly related to the size of basic grapheme-to-phonology units and the consistency of their mappings in different orthographies (Chen et al., 2015, p. 81). By the time Japanese students have reached the fourth grade, they should have developed an advanced understanding of the phonological system of their native language. By this stage, most healthy Japanese L1 students should have access to at least four orthographies related to their native language, Japanese (e.g., 日本語, in *kanji*; にほんご, in *hiragana*; ニホンゴ in *katakana*; and "Nihongo" in *romaji*). The *kana* should have completely developed and *kanji* is perpetually being developed to complement that *kana* typology.

This variety of native language typology and phonology should provide a tremendous amount of orthographic information to the Japanese mind from an early age. Hence, L1 phonemic and graphemic information should be well established in the PG and GP Lexis (see Figure 2.4, LexPG and LexGP), and this information will be based on the Japanese V, CV, and CCV structure.

The parallel letter recognition model indicates that the letter groups within a word are recognised simultaneously, and that [even partial] letter information alone may be used to recognise the words (Larson, 2004). For these reasons, it should be reasonable to assume that L1 Japanese at this level of development would be able to recognise the individual sounds of each letter within a Japanese V, CV, or CVV graphemic chunks. However, to subtract individual consonant sounds in the absence of a real word in lexis, or subtract a vowel from any phoneme chunk would require considerable effort.

In order to spell a novel word, children need to be able to map the phonological form of the new word to an orthographic form. Traditional stage models of literacy development (e.g., Frith, 1985; Marsh et al., 1981) claim that children first use single phoneme-grapheme correspondences when spelling new words. According to this view, the word "bat" would be segmented into the phonemes /b/, /æ/ and /t/, and these would be mapped to the corresponding graphemes (“b”, “a”, and “t”). Alternatively, it is also possible to spell a new word using a combination of lexical knowledge (i.e., the spelling pattern of a familiar word) and phonological knowledge (i.e., the phonological similarity between a familiar and unfamiliar word). This traditional stage model appears to support the notion that spelling is learned from the finer features (i.e., letters to syllables and chunks) up to complete words. On the other hand, the psycholinguistic grain size theory (Ziegler & Goswami, 2005, 2006) predicts that children are initially sensitive to larger phonological units, and with experience, become aware of finer “intra-syllabic” units for distinguishing similar sounding words (i.e., more experience develops more specific sensitivity).

The fifth-grade individuals investigated in this thesis cannot be assumed to have fully developed alphabetic orthographic knowledge. Goto (2020, in Appendix O) found that *romaji* was rarely tested, nor was it necessary (cf. this may have changed due to the requirement to operate computers in elementary school). Therefore, orthographic knowledge of *romaji* should be assumed to be in its embryonic-stage, and significantly different between individuals. On the other hand, English orthographic knowledgeability should be assumed to be only in the early embryonic-stage and be influenced by *romaji* because English reading and writing were yet to be introduced at investigating the present thesis. One exception would be if individuals have been taught privately or some other exposure to English scripts. In that case, those individuals would have a more mature understanding of English orthography. Therefore, the traditional stage model and the psycholinguistic grain size theory should only provide minimal variation between individuals because the influence of native phonology and script should be predominantly similar. Rather, any significant variation should be from the effect of learning order, or the influence between the two orthographies, *romaji* or English.

As children master complex, phonological and orthographic rules that allow them to read and spell by using direct lexical access, and word shape. As skills are acquired word length and semantic relations can cue word access, and spelling retrieval, of even less frequent words, due to the elevated-attention hypothesis (Glanzer & Adams, 1990). These skills are, however, at the extremes of this research, which focuses on beginners, who are yet to acquire these more advanced reading and retrieval systems.

The critical element in this cognitive account is that individuals do not make an explicit choice, but both processes are activated (depending on experience) and the process that is completed first controls the output generated (Forster & Chambers, 1973, p. 632), based on previous experience and influenced by other orthographic confounds to lexical development.

2.4.2 Confounds to Lexical Development in Single and Multiple Languages

The ability to spell starts with the mapping of sounds to letters, however, these mappings are stored in "immediate" lexical memory depending on regularity and frequency. Regularity is influenced by orthographic complexity and at the letter level, visual complexity. The ability to store regular items is also a function of frequency and other factors like salience and concreteness.

2.4.2.1 Orthographic Depth Complexity

Mapping of sounds to letters and letters to sounds are tremendously affected by the depth of the orthography and the complexity and regularity of orthographic units. As mentioned earlier, shallow orthographies are stored earlier than more complex, deep/opaque orthographies. This ODH hypothesis comes from three types of evidence. First, learners of transparent orthographies are better able to read nonwords. Learners of German (Wimmer & Goswami, 1994) and Spanish (López & González, 1999) are better able to read nonwords than are learners of English (Rack et al., 1992). Second, learners of transparent and opaque orthographies produce different patterns of reading errors.

Adherence to an alphabetic decoding strategy produces errors that are mispronunciations, whereas orthographic reading strategies generate visually similar, real-word substitution errors. The majority of the reading errors of German (Wimmer & Hummer, 1990) and Welsh (Ellis & Hooper, 2001) children were nonwords, whereas young English-speaking children made frequent reading errors that were actual words (Seymour & Elder, 1986; Stuart & Coltheart, 1988). Furthermore, English children tend to make more whole word substitutions than those in the compared transparent Welsh orthography (Ellis & Hooper, 2001, p. 585).

Finally, there is a stronger relationship between word length and reading latency in transparent orthographies. Ellis and Hooper (2001) showed that word length determined 70% of the difference in times to read words in Welsh, but only 22% in

English, suggesting that Welsh pronunciations were assembled using a left-to-right parse of the written string, with longer words consequently requiring more time to recognise. Such findings support the hypothesis that transparent orthographies promote faster rates of reading acquisition and encourage an alphabetic reading strategy, which can take longer to process.

Previous research assessed the effects of orthographic depth within alphabetic languages. Nick Ellis and his cohort studied various scripts between languages, and within a language with multiple scripts, Japanese. That study (Ellis et al., 2004), investigated the effects of orthographic depth on children between six and 15 years old reading aloud: transparent syllabic Japanese *hiragana*; alphabets of increasing orthographic depth (Albanian, Greek, English); and notoriously orthographically opaque Japanese *kanji*. The present thesis builds upon this research to investigate the effect of orthographic depth between transparent alphabets of *romaji* and English. The expectation was to find similar results, even within individuals. Ellis et al. (2004) reported that transparent orthographies (e.g., *hiragana*) should be read more accurately.

The difference between the present study and the study by Ellis and his cohort is that *hiragana* is well represented in the Japanese mental lexicon and alphabets are not. In fact, previous knowledge of Japanese writing alphabets indicates that students are confused about *romaji* and English alphabets. Therefore, the results should be predominantly influenced by familiarity with native language orthography. Ellis et al. (2004) also reported that in deeper orthographies a greater proportion of errors should be non-responses, and more substantive errors tend to be whole word substitutions. From these findings, Ellis deduced that orthographic depth affected both rate and strategy of reading, which is expected to therefore affect the ability for recognising words and spelling.

2.4.2.2 Orthographic Regularity

Orthographic regularity is estimated by the relative frequency of a combination of letters in a given text (Chetail, 2015). For example, the combination "SA" occurs more frequently than "JA" and the trigram "CHA" is more frequent than "PSA" at the beginning of a word. Orthographic regularities have also been referred to as statistical redundancy (e.g., Massaro et al., 1979), graphotactic or orthotactic regularity (e.g., Pacton et al., 2005), orthographic typicality (e.g., Vinckier et al., 2007), and sequential or spatial frequency (e.g., McClelland & Johnston, 1977). Regularity is inversely related to complexity, and all these marginally different types of orthographic regularities (e.g., Andrews, 1992; Conrad et al., 2009; Seidenberg, 1987) are generally referred to as Orthographic redundancy. Orthographic redundancy is present in both English and Japanese languages, however, orthographic redundancies in English are tremendous. Nearly 12 million different 5-letter words can be made from the 26 letters in the English alphabet, compared with the roughly 10, 000 words that exist (Smith, 1988, p. 126).

Wimmer and Goswami (1994) suggest that English children use a larger-grain phonological access strategy based on onset/rime, whereas children beginning to read a more transparent orthography by using finer-grained grapheme-phoneme conversions (cf. Austrian children start similar to the Germans, but begin to use the onset/rime strategy later on). In a phoneme-grapheme study, Landerl (2000) examined English-speaking children who were taught exclusively via a phonics approach. Landerl reports that nonwords were read much better in her study (Landerl, 2000) than the children in the Wimmer and Goswami (1994) study, who were not taught via a phonics approach. Landerl's study found that German-speaking children had substantially higher scores for pseudoword reading tasks than English children, supporting the earlier study by Wimmer and Goswami that transparent orthographies, like *romaji*, should support decoding of words using their finer-grained, limited constraint orthographic knowledge. These studies suggest that children learn to read faster in shallow orthographies (i.e., *romaji* or German) than those learning to read in deer/opaque orthographies, like English.

Hoxhallari (2006) suggests that deep orthographies encourage word-level (e.g., sight words) orthographic representations, and in extremely (i.e., bi-directional) transparent orthographies like Turkish (which has no silent letters). Just like Turkish, Japanese has agglutinative morphological compounds. For example, from the word /taberu/ ‘eat’, a derivation in meaning, not to eat would be /tabemassen/, and didn’t eat is eat+not+past V (i.e., /tabe/ + /na/ + /katta/). This level of processing should, theoretically, raise awareness of phonemic/graphemic chunks, thereby compromising or mitigating the strategic concentration of onset and rhyme that English readers normally enlist when recognising words (Ellis & Large, 1987; Wimmer & Goswami, 1994). Therefore, due to these agglutinative morphological compounds (see Hoxhallari, 2006), native Japanese should depend more on the finer grained analysis of words and pseudowords, albeit based on the V, CV, and CCV structure.

These predictions have been tested in studies involving children learning to read in diverse languages and writing systems. For instance, Korean children develop sensitivity to both syllables and phonemes, and the skills to manipulate phonemes and syllables are strong predictors of their word reading ability (McBride-Chang et al., 2005). Their phonological sensitivity clearly reflects the dual-unit (syllable and phoneme) representations in the Hangul script, where individual symbols, each representing a distinct phoneme, must be packed into blocks to form syllables. Similarly, Japanese children should, therefore, naturally group their *romaji* according to phonemic chunks, segmented predominantly by vowels, due to the high volume of CV combinations. The presence of CVV should cause more errors because the sounds are difficult to represent in *romaji*.

2.4.2.3 Visual Complexity

Visual complexity strongly influences the initial stages of reading development and the perceptual learning of grapheme forms. Visual complexity influences the development of orthographic representations in the mental graphemic library, thus contributing to difficulty in learning to read (Chang et al., 2016). If a learner is struggling to recognise letters, and cannot trust their phonemic representation or visual correctness, then cognitive processing demands prevent the words and letters from being retained, recalled from short-term memory, or memorised in the mental lexicon. According to Bowers and Wolf (1993), if letter identification proceeds too slowly, as indexed by slow naming speed performance, letter representations in words will not be activated quickly enough to induce sensitivity to commonly occurring orthographic patterns.

Visual complexity includes both the shapes and directions of letters and the visual confusion they may cause when placed together or differently in visually similar words or nonwords like *skill* and *shill*, or *bike*, *pike* and *dike*. The visual complexity of letters is problematic for various reasons. Naturally, some *kanji* are tremendously complex with many readings. though, there is another problem which is similarities, even with simple *kanji*, *kana*, or alphabets. In fact, reading problems and problems and disabilities are more prevalent among those learning to read alphabetic languages than among readers of logographic languages (Geva, 1999). These script dependent problems are primarily perceptual.

Perceptual complexity likewise has a strong influence on cognitive demands responsible for an individual's processing capacity. Consider each letter in English. If attention is not given to each part of a letter and its direction, confusion can easily result in spelling or pronunciation errors. If letters are confused by displacement (e.g., horizontal displacement b/d, p/q, vertical displacement b/p, d/q, or even rotational displacement b/q, and d/p), the perceptual load of letters hinders recognition efficiency (Pelli et al., 2006; Vogel et al., 2001; Xu & Chun, 2006). Several studies support this interpretation of the effect of visual complexity and the difficulty it poses on "perceptual load" in a variety of different language orthographies (e.g., for Kannada, Nag et al., 2014; and for Urdu, Rao et al., 2011). Chang et al. (2016) found that visually complex orthographies are processed less reliably and efficiently, adding pressure when learning to read, which adversely affects the transfer of items into the orthographic lexis.

Another visual complexity is the number of graphemes that are any language's orthographic inventory. Orthographies with visually complex graphemes, such as Chinese and Japanese, understandably contain a larger grapheme inventory, making learning substantially more difficult (e.g., Nag, 2011; Nag & Snowling, 2012; Nag et al., 2010). The grapheme inventory size for Japanese is tremendously large. The grapheme inventory ranges from thousands of morpho-syllabic *kanji*, down to just over fifty *kana*, and further down to roughly 20 alphabetic *romaji*; a few less than the 26 letters of the English alphabet. The inventory size has a strong influence on the pace at which orthographic knowledge is developed (Nag, 2007), but also the cognitive demands on the learner. Therefore, the alphabetic inventory size differences between *romaji* and English should be the root cause of confusion. It must be in the mismatch of GP mappings or in the additional letters that English utilises.

Proof of the influence of visual complexity on orthographic depth comes from two contrasting results. Rao et al. (2011) reported that while Urdu was the participants' native language, and the language in which most of their schooling took place, responses to the deep orthography of Urdu were consistently slower and more prone to error than for the more transparent and less visually transparent Hindi (Abdelhadi et al., 2011). This is interesting because Ellis et al. (2004) found that word length affects latency less in deeper orthographies than in more shallow orthographies; one reason to account for this discrepancy is that two orthographies were not as visually contrastive when compared to those in the latter study by Rao et al. (2011). The Ellis study also found that the greater the proportion of errors in the deeper orthography were no-responses, and the more the substantive errors tended to be whole-word substitutions rather than nonword mispronunciations. Rao et al. (2011) suggested that the differences in their study are due not only to orthographic depth but also because Urdu is visually more complex than Hindi. The present thesis accounts for this discrepancy naturally by using only alphabets. Any discrepancies should, therefore, be accountable to the gap in orthographies or the recognition of letters in recognisable phonemic chunks.

2.4.2.4 Larger Than Letter Processing - Chunks

Visual complexity is not only associated with the shapes of letters but also can be associated with letters in sequence. At the opposite end of sight words is the process known in cognitive psychology as chunking. “Chunking” is an effect of the efficiency that results in fluency and is the re-coding of smaller units of information into larger, familiar units (Thalmann et al., 2019). With practice, familiar letter combinations are stored as whole images of the word (re. word shape) in the language lexis. Just like small sight words, or *kanji* with various radicals, with practice, the whole item is stored as a whole and reproduction is usually precise and only modulated by orthographic or phonemic complexity. By chunking grouped information, short-term retention of the material is improved, thus bypassing the limited capacity of working memory (Thalmann et al., 2019). This effect is supported by the findings of the word length effect. The word length effect is the finding that short items are remembered better than long items on immediate serial recall tests (Neath et al., 2003). When the lists comprise items that vary only in pronunciation time, the result is referred to as the word length time-based effect.

Just as a single *kanji* can be made of many simple radicals, the end result is a character that is not easily distinguishable from its parts, and phonemically not related to the associated phonemes of the radicals. for example, 麻 (asa/ma) is made from the radical 广 (madare) and two 木 (ki) which transfer to the meaning forest 林

(hayashi); and 痳 (rin), is different because the first, hanging-down radical 疒 (yamaidare) is graphically similar, less frequent (i.e., rare), and visually more complex. Even though each of these *kanji* is made of three (possibly two for Grade-2 students, refer to Appendix-x) radicals each, albeit the first radical in each is different) (source: *kanji*alive.com). English too can group letters together, thereby making it visually complex to read, for the novice reader. A similar effect is also evident at the larger grain size of the script patterns, including phonemes, chunks and words.

Evidence of letter confusion is common in nearly all scripts, particularly when the PG correspondences are not well understood or distinct in the language. Examples of this are in Korean /t/ and /d/, and /k/ and /g/; in Japanese the use of /n/ in spelling and in speaking aloud, it is often voiced as /m/ when followed by a labial like 'p' or 'b' (e.g., half (En), |hanbun| /hambun/). The examples in English, and French for that matter, are copious. However, the examples in the present study aim specifically at letters that cause both phonemic and graphemic confusion. Simply these include directional problems (e.g., s-z, p-q, b-d, and j with し/shi/, and 's' - 'z'). Other examples that are tested implicitly are where there is no graphemic facilitation in the language (e.g., 'l', 'q', 'v', and 'x'); and where there are conflicts in PG mappings (e.g., 'a'-'u', 'r'-'l', and to some regard 'g'-'d'-'z').

In Japanese, *romaji* is chunked into phonemic blocks or chunks. A chunk is a collection of basic familiar units that have been grouped and stored in a person's memory. These chunks can be retrieved more easily due to their coherent familiarity (Tulving & Craik, 2000). It is believed that individuals create higher-order cognitive representations of the items within the chunk. The items are more easily remembered as a group than as the individual items themselves. These chunks can be highly subjective because they rely on an individual's perceptions and past experiences that can be linked to the information set. The size of the chunks generally ranges anywhere from two to six items and differs based on language.

Japanese *romaji*, groups letters into V, CV, and CVV chunks. Evidence suggests that native Japanese map these letter combinations into single graphemes with relative ease due to the influence of their native language phonology (see Table 1.2). From the evidence provided so far in this thesis, one reason this "chunking" is a product of the way and sequence, *romaji* is learned in Japan. Japanese students learn native phonology early and these phonemes are associated with *kana* in the first year of school. Alphabets are then introduced to children, generally three years later, after these phonemic chunks are firmly established. While Japanese can recently name the individual letters of *romaji* using English names (cf. naming used to be limited tremendously by the limitations of Japanese phonology), the letters are usually encountered in the groupings mentioned above. For example, if a Japanese person is asked to perform a phoneme deletion test, they struggle at the single letter level. (i.e., remove the /k/ from *shinkansen*). Japanese need to enlist some cognitive processing which may elicit a response error. English speakers on the other hand can process the word as a whole and at the letter level with greater ease and readily produce the reply /shinkansen/. Therefore, when students first encounter English words, they become sensitive to the uniqueness and similarities, not of the letters, but of phonemic chunks.

2.4.3 Age of Acquisition Effects on Orthographic Knowledge

Every individual's literacy development is different because every encounter, every background and individual's experience, age, and contact with scripts are naturally different in duration, sequence, timing and intensity. The influence of these variations on orthographic development are discussed in this section.

2.4.3.1 Age of Acquisition

It is widely accepted that the onset age of acquisition (AOA) (Johnson & Newport, 1989) has a tremendous influence on acquiring native-like acquisition. Younger learners are more adept than older learners at learning an L2 (see Major, 2014) for various reasons. With regard to cognition, AOA is related to the age of an individual and the development of their mental lexicon (Meschyan & Hernandez, 2002). However, the interest in the present thesis is the interference from previously established and sometimes "fossilised" knowledge that inhibits transfer.

Lexical development has been measured using lexical decision tests, for example, in young adults (Gerhand, & Barry, 1999). Using repetition priming in picture naming tasks other researchers (Barry et al., 2001) found that AOA of lexical-phonology (i.e., immediately retrievable phonemes that are recognised 'instantly') affected the type of lexical retrieval. Lexical retrieval is of particular interest because the level of lexical-phonological interaction with new elements is different for words that were acquired later, which accounts for unique instances where *romaji* cannot simply be transferred to English and the syllable level but not at the finer-grained letter level.

2.4.3.2 Effect of Natural Sequence and Practice on Lexis in *Romaji* and English

The relationship between *romaji* and English and the cognitive processing of these orthographies in written and spoken forms are remarkably different. *Romaji* is consistent, transparent, and consequently a shallow orthography. English alphabets comprise many inconsistencies, and the GP correspondences of letters are complex which explains why the English orthography is referred to as an opaque or deep orthography. Words in *romaji* can be read using a GP conversion process. However, this shouldn't ignore the possibility that familiar words in *romaji* cannot be recognised as complete items, which assumes lexical storage. English, however, is known to exploit this dual process (see Buetler et al., 2014). The first, *sub-lexical PG conversion process* allows for the reading of regular words like "KIT" and "SAT"), and also new or pseudowords like "LIT" and "ZAT". However, the dominant process for recognising familiar words, the *lexical process*, facilitates the reading of irregular words accurately, like "TWO" and "KNIFE". It has been argued (see Tainturier et al., 2011) that the sub-lexical process may be sufficient in highly transparent languages such as *romaji* for learned and well-practised (i.e., familiar and frequent) graphemes almost instantly, appearing as if they are lexical. If this is true, then, damage to the sub-lexical process would prevent eventual lexical entry, and result in more severe deficits in transparent languages due to the underdeveloped alternative lexical processing ability.

To test this hypothesis, Tainturier et al. (2011) compared Welsh and English oral reading and written-word recognition and comprehension in seven bilingual stroke participants with comparably impaired pseudoword reading in English and Welsh. Performance was remarkably similar across languages. Irrespective of the language tested, words were read more accurately than pseudowords. Lexical decision and word comprehension were as accurate in Welsh and in English, and when imageability effects were present they were of a similar size in both languages. This study does not support the hypothesis that orthographic transparency determines the nature of cognitive reading processes, but rather suggests that with practice, readers develop a slight vocabulary through reading experience irrespective of orthographic transparency. Therefore, experience and practice, development, and word frequency, are in fact, influential.

2.4.4 Frequency Effects on Orthographic Knowledge

Word frequency has been widely accepted to have effects on word acquisition and recognition (e.g., Brysbaert et al., 2011; Rudell, 1993). Familiarity and associated memorisation are generally recognised to be positively affected by higher word frequency as a consequence of more frequent exposure (Laufer, 1997). The frequency of exposure is naturally affected by age and developmental progress, which is a consequence of access to reading material, usually through school curricula or society, the greatest influence being from what is provided at home. High-frequency words and frequent exposure provide support for lexical access, a phenomenon called the 'word frequency effect' (Segui et al., 1982). The frequency effect is, however, not necessarily the major cause of lexicality, the acquisition of lexical knowledge.

The effect of word frequency on the acquisition of lexical items is not simply based on the number of encounters with a unique item (word). Lexicality has been found to be somewhat modulated by orthographic depth. As mentioned earlier, the encounters with consistent graphemes and phonemes help items move from the procedural route of decoding (see Figure 2.4) to the much more efficient lexical route. Word frequency and lexicality (i.e., word/nonword judgments) effects in word recognition are larger with 'deep' orthographies (e.g., unvocalised Hebrew and English) than with 'shallow' orthographies like Serbo-Croatian. Peereman (1989) illustrates this phenomenon simply (see Peereman, 1992, p. 64). Latencies for frequent irregular French words were marginally less than regular words (480 milliseconds compared with 475 milliseconds). However, "rare" irregular words in deep orthography were significantly (> 10%) hampered (480 milliseconds for regular rare words and 545 milliseconds for irregular rare words). This implies that irregularity and frequency can in fact aid lexical entry, but infrequent encounters with words, and possibly sub-word components deny the lexicality of words.

Furthermore, Peereman (1992) reviewed studies concerned with the differences in the way orthography (i.e., Chinese, English, French, and Serbo-Croatian) encodes the phonology and the degree to which phonological processes are exploited. Peereman concluded that if the relationships between the graphic representation of words and their pronunciation is unambiguous, the reader will exploit phonological representation, regardless of orthography. However, this effect ignores the cognitive processes of salience and language-dependent processes of concreteness and other influences.

According to Tagashira (2001), word concreteness is inversely proportional to vocabulary forgetting. This notion is supported in cognate pair research (De Groot & Keijzer, 2000). Other researchers have "stumbled upon" similar phenomena, but have not yet established a cause particular to the finer-grained effects of word processing. Finer grained effects have, however, been found to be influenced by the salience of words and their parts, orthographic neighbours (Boot & Pecher, 2008), and the effect of noticing and practice.

2.4.4.1 Frequency Effects of Noticing and Practice

Word frequency is affected when a learner practices reading and reviews the reading in some manner, and more so when attention is raised through correction. According to DeKeyser (2009) ambiguity can also assist lexicality. When an item is noticed as incorrect, the correction process increases attention and provides greater exposure to the word, which increases psychological and physical encounters with words and, consequently, the partialisation and frequency of encountering these parcellated chunks. Furthermore, Burt and Tate (2002) found that errors and corrections added to spelling accuracy in a similar fashion to word frequency.

On other, non-spelling tests, Funnell (1992) found that while children had difficulty discriminating between the correct and incorrect spellings of words that they were unable to spell to dictation, they were more successful at classifying these same words in the written form. Furthermore, Campbell (1987) found that when students were presented with a word they could spell "consistently well", they could detect misspellings of the same word only "reasonably well", which is a consequence of the increased frequency with the word in its correct form. Interestingly, words that were occasionally misspelled could not be classified reliably as correct or misspelt. If Campbell's participants were able to reject a significant majority of their own misspellings, then this would have provided evidence of a superior reading lexicon. The contrastive findings of these two studies suggest the existence of an internal connection between a separate reading and writing lexicon (see Holmes & Carruthers, 1998, p. 267) and also, the knowledge of a correct spelling helps recognise new words, but the lack of knowledge of a word leaves the mind amiss for concrete word image.

2.4.4.2 Orthographic Neighbours

This thesis predicts that orthographic neighbours should show a greater influence on accuracy than word frequency. An orthographic neighbour is any word that can be created by changing one letter of the stimulus word, preserving letter positions. Laxon et al. (1988) demonstrated that words with many orthographic ‘neighbours’ are spelled with greater ease and correctness than words that do not share similar letter patterns with many other words. For example, orthographic neighbours of *sand* include: *band*, *send*, *said* and *sane*. Orthographic neighbourhood (N) size effects have been extensively studied in English consistently producing a facilitatory effect in word naming tasks (Chang et al., 2016). Forster and Davis (1991) found that substitution priming effects vary as a result of a target word's neighbourhood density. Van Heuven et al. (2001) demonstrated that target word neighbourhood density is generally confounded with the number of orthographic neighbours that are shared by primes and targets (i.e., the ‘shared neighbourhood’ effect, see also Davis, 2003, as cited in Grainger, 2008; Grainger & Jacobs, 1999; Hinton et al., 1998). Current models of visual word recognition, however, usually assume that word identification is activated through a candidate set of orthographically similar units (see Coltheart et al., 1977).

The effects of phonology on building the orthographic lexis have already been discussed. Of all the linguistic factors that make certain kinds of words easier or harder to spell than others (see Archibald, 2021; Treiman, 1997, p. 315), the effect of phonological and graphemic neighbours is of greatest interest to this study. In a study of eight-to-nine year-old English-speaking children, Nation (1997) studied spelling performance as a function of the size of an item’s phono-graphemic neighbourhood, in particular the number of words that share its rime (vowel final consonant unit). For example, *pick* has a large rime neighbourhood, with 22 other monosyllables including *click*, *kick*, and *quick* sharing the -ick spelling. However, in the case of *disk*, there are only two other monosyllables (*risk* and *whisk*) that share the /isk/ – isk correspondence. Nation (1997) found that both words and nonwords with more common rimes are easier for children to spell than those with less common rimes.

The way Japanese phonemes are taught and mapped to *romaji*, exploits this effect. A student can either use the onset or rhyme to remember the alphabetic representation of their native Japanese phonology, presented in the same order as represented by *kana* (see Table 1.3b in Appendix A). In *Hepburn romaji* there are only a few exceptions, “chi”, “tsu”, and “shi”. These irregularities are both visual and phonological. They all have three rather than two graphemes and the additional grapheme carries more complex phonology than their neighbours (cf. “chi” in fact is tremendously different because it is represented with “ch”+”i” not “t”+”i” like its neighbours “ta”, “te”, and “to”). This problem is not trivial. Perea (1998) found that “some” neighbourhoods were more inhibitory than others, depending on the position (i.e., in the middle or toward the end of the word, but not the last letter. Perea studied eye movements, using a masked priming test. Rescanning was initiated because participants initially thought the words were the same, however, they realised the word was different and had to analyse the finer-grained features of the word to identify the difference. The interesting point of this rescanning concept was that the rescanning was of a mask like #####, displayed for 500 milliseconds. Therefore, the rescanning was of a memory trace and not of any letters remaining on the screen. This implies that irregular forms are noticed and may not be concrete enough to be counted and stored in lexis.

Other models of word recognition predict that neighbours of target words will be activated during word processing. However, evidence from semantic decision tests (Boot & Pecher, 2008) indicates that this recognition and familiarity of words is not always supportive. In both serial models and cascaded models of word recognition, a competition or selection process takes place between orthographically similar words. Serial models (e.g., Forster & Hector, 2002) assume that the meaning can only start after a word's lexical entry is first selected among competitors. Cascaded models, on the other hand, (e.g., Coltheart et al., 2001; Grainger & Jacobs, 1996; McClelland, 1979; McClelland & Rumelhart, 1981) predict that semantic features of neighbours may be activated before the target has been uniquely identified. The caveat “may” is used here because, in orthographies that are poorly acquired, this activation could be random between individuals, even at the same AoA.

Several studies have investigated the influence of orthographic neighbours in lexical decision tasks and semantic categorisation tasks (Boot & Pecher, 2008; Bowers et al., 2002; Carreiras et al., 1997; Forster & Hector, 2002; Forster & Shen, 1996; Pecher et al., 2005; Rodd, 2004; Sears et al., 1999). Studies using lexical decision tasks have consistently shown that orthographic neighbours facilitate the recognition of words (Andrews, 1992), which supports the common belief that during word recognition, both the target word and its orthographic neighbours are activated, which in turn influences the responses to the targets. This implies that there should be some effect on the frequency of neighbours. However, the competition process at the word level predicts that orthographic neighbours will *interfere* with word recognition rather than assist recognition.

To remove the effect of neighbourhood priming of unique words in the LDT, semantic categorisation tests have been employed. Semantic categorisation tasks rely more on retrieval of the unique meaning and identification of a word before its meaning can be retrieved (Forster & Shen, 1996; Sears et al., 1999). This means, to effortlessly resolve the meaning of a word, lexical competition has to be resolved. In the absence of lexis, we would expect to see delays, errors of inconsistency, or guessing. If guessing requires spelling, the errors and delays should be more pronounced. Boot and Pecher (2008) presented neighbours that were congruent (i.e., from a similar category) or incongruent (i.e., from an opposing category) in a long-term priming paradigm. Target performance was better when primes were congruent neighbours than when they were primed by incongruent neighbours. The same effect was found for rhyming and non-rhyming primes. This result was interpreted as cascaded models allowing semantic information to become activated before lexical selection has finished.

2.4.4.3 Neighbourhood Effect Across Languages

The effect of existing language on additional language learning is reasonably well established. Children's awareness of the sounds of their native language develops gradually. This gradual development is important in acquiring literacy (Ellis & Large, 1987), particularly at the segmental levels of onset-rime and phoneme. However, there is considerable evidence that when reading and subsequently writing in a second language, a reader's first language may be involved Chen et al. (2020). For word reading, the question is how and at what level: lexical, pre-lexical, or both.

Chen et al. (2020) conducted three experiments: an implicit reading task (colour judgment) and an explicit reading task (word naming) to test whether a Chinese meaning equivalent character and its sub-character orthography are activated when first language (L1) Chinese speakers read L2 English words. Because Chinese and English have different spoken and written forms, any cross-language effects cannot arise from shared written and spoken forms.

Importantly, the experiments provide a comparison with single language experiments within Chinese, which show cross-writing system activation when words are presented in alphabetic Pinyin, leading to activation of the corresponding character and also its sub-character (radical) components. In the present experiments, Chinese–English bilinguals first silently read or made a judgment about the meaning of an English word. Immediately following, they judged the colour of a character (Experiments 1A and 1B) or named it (Experiment 2). Four conditions varied the relation between the character that is the meaning equivalent of the English word and the following character presented for naming or colour judgment. The experiments provide evidence that the Chinese meaning equivalent character is activated during the reading of the L2 English. In contrast to the within Chinese results, the activation of Chinese characters did not extend to the sub-character level. This pattern holds for both implicit reading (colour judgment) and explicit reading (naming) tasks, indicating that for unrelated languages with writing systems, L1 activation during L2 reading occurs for the specific orthographic L1 form (a single character), mediated by meaning. We conclude that differences in writing systems do not block cross-language co-activation, but that differences in languages limit co-activation to the lexical level.

2.4.4.4 Salience

At the greater than single letter level of priming, the effect of salience requires attention. Salience refers to the property of some stimulus, which makes it prominent, obvious, or stand out from other stimuli (Schwieter & Benati, 2019). This could be a word, a letter with a unique position or shape, even some unique grapheme or phonetic sound. The consequence is that salient features are more likely to be perceived, attended to, and entered into subsequent cognitive processing and learning. Therefore, salient items would not depend as much on frequency. While salience can be evident in the linguistic units it takes into consideration (i.e., phonological, morphological, syntactic or semantic information) (Divjak, 2019), it is determined independently by physical attributes, the environment, and by an individual's knowledge of the world.

As we experience the world, we learn from it, and our resultant knowledge values some associations higher than others (James, 1890, p. 82). This psychological salience is evident in the words hotdog/ホットドッグ/Hottodoggu, and sushi/寿司. These words both mean different things to different people, depending on their cultural and linguistic experiences (Ellis & Wulff, 2019). Therefore, salient items are attended to in terms of "richness", which can in some instances be more influential to knowledge than word frequency. Researcher (Ellis, 2006; Rescorla & Wagner, 1972; Wulff & Ellis, 2018) proposes that if two words are encountered with the same frequency, the less salient cues are less readily learned than the "rich", highly salient ones. This could be attributed to the fact that experience also adds subconsciously to the frequency of attending to words and their spellings.

At the sub-word level, the units of perception are subjective and cannot simply be measured in physical terms or from corpus word frequencies. Miller (1956) defines the subunits of sentences and words in short-term memory as chunks. The process of organizing or grouping input into familiar units or chunks and subsequently processing these chunks with attention and repetition, create the formation of familiar units (Miller, 1956, 1994). These familiar units are then stored in the mental lexicon for rapid retrieval. The salience of chunks and the consistency of the chunks between languages are therefore assumed to be more important than word frequency. This also implies that if a GP or PG chunk is salient, in one language, it should transfer to the additional language.

2.4.4.5 Sub-Word Level Frequency Affects From Previous knowledge

The effects of previous knowledge on sub-word level processing include, salience, orthographic and phonological neighbours, word concreteness, and the effects of noticing. These encounters with already established orthographic knowledge either support or conflict with the acquisition of new spelling (see Nation, 1997, as cited in Treiman, 1997, p. 321). In Japanese, there is tremendous previous knowledge of phonology to support the learning of *romaji* (i.e., rhythm, phonology, and context). For example, when a Japanese person encounters the cardinal number for one, "ICHI" should be segmented into syllables "i" + "chi". However, Japanese would have no reason to further subdivide the sounds into the English or Latin derivation of "i" + "ch" + "i". Furthermore, without some other experience with another language, young Japanese would not be able to explicitly understand the orthographic conventions of representing the English phoneme "ch" /ʧ/ with the two letters "c" + "h". Additionally, keyboard entry drills confound this knowledge, because "chi" can be typed with "t" + "i". This thesis posits that Japanese phonemes and graphemes do not provide any significant benefit to novel encounters with new English words, especially where there are conflicts with pre-existing knowledge of lexicalised items of phonology, which would be the case with individuals with substantial *romaji* ability.

2.4.4.6 Different Frequency Effects for Beginners

Measuring the effect of orthographic depth on various languages has depended on the use of word frequency lists for many years (e.g., Ellis et al., 2004; Hoxhallari, 2006; Hoxhallari et al., 2004). The general approach involves selecting words from frequency bands of hundreds or thousands in a national corpus (e.g., COCA, https://www.wordfrequency.info/samples.asp) or academic word lists (e.g., AWL in Coxhead, 2000). Then a researcher would select words according to a secondary criterion (e.g., word-length, syllable-count, etc.) according to the specification of the study. By doing this, lexical frequency profiles can be utilised to estimate the size of a second language learner's productive vocabulary (Laufer & Nation, 1995) in a natural usage setting. However, lexical frequency profiling from national corpora is not so reliable for preliterate or beginners, because these corpora are appropriate to literate individuals, usually in an older age bracket, and subsequently with substantially larger language lexis (for an analytical critique of lexical frequency profiling see Edwards & Collins, 2011). In the context of the present thesis, general word frequencies lists would serve merely as a guide because word frequencies are affected by visiting new words in readings and lessons at school, the noticing of errors and attending to these errors through corrections and homework.

2.4.4.7 The Relationship Between Word-Frequency and Word-Length

Word frequency is statistically constructed and inversely proportional to word length and it is somewhat correlated with word complexity (see Piantadosi et al., 2011;

Sigurd et al., 2004; Strauss et al., 2007). This relationship is explained by Zipf's Law of Brevity and the "principle of least effort" (Zipf, 1935, 1949) and is a consequence of morphology. The morphology of high use vocabulary adopts the deterministic description of human behaviour, which is the principle of least effort. This is evident in the neurological and cognitive accounts presented earlier; the mind is always occupied in the expenditure of the least amount of average work (Zhu et al., 2018).

In a recent study of 16 languages, Vorholt (2019) found word frequency to be a reliable predictor of word length in the majority of the samples. Additionally, word complexity has been found to affect word frequency (Piantadosi, 2014; Piantadosi et al., 2011). In this study of 10 languages varying considerably in orthographic depth (i.e., Czech, Dutch, English, French, German, Italian, Polish, Portuguese, Romanian, Spanish, and Swedish), the results indicated that the average information content of words is a much better predictor of word length than frequency.

High-frequency words are shifted through neurological processes into the faster-acting regions of the brain. Cognitively these areas of storage are in the mental lexicon (see Figure 2.4, GPLex and PGLex). Letters, chunks and even complete words may eventually be stored in this area. Interestingly, some familiar words (e.g., short high-frequency words like “a”, “the”, and “I”, and low frequency, highly context-specific words like elephant and escalator), are not even recognised as groups of letters at all but are recognised by their visual shape (De Saussure, 1922/1983, p. 34), much like the ideograms mentioned earlier in this thesis. There has been limited research in Japanese education regarding the effect of word shape in beginners who have limited word-level knowledge, and possibly only GP mappings of *romaji* level phonemic chunks (cf. Hiyoshi, 2005 studied the effect of word shape in junior high school students).

According to Ellis (2008), acquisition is an “associative learning of representations that reflect the probabilities of occurrence of form-function mappings” (p. 94). The frequency of meeting a language item is a key determinant of acquisition. In the context of the present thesis, these “meetings” are at the phoneme/grapheme chunk level and rarely occur in isolation. These meetings develop the implicit rules of language in an individual's mind and are affected by, and affect subsequent meetings with other languages. The sum total of this knowledge is assumed at all levels from phonology, through syntax, to discourse. The knowledge of the language helps form structural regularities (Ellis, 2008), even in exceptions like “climb”, “Wednesday”, and “thoroughfare”. Therefore, it is reasonable to assume that learning one alphabet before another, regardless of orthographic regularity, will have a measurable effect on determining a word from sight, or even spelling, which is the focus of the following section.

2.4.5 Orthographic Development - Summary of Language Influences

This section attempted to recognise the influence on orthographic development. These influences are neither simply inhibitive or supportive, but have been found to account for the efficiency of transfer. The section discussed maturation and implied that learners are more inept at receiving more difficult language mechanisms as they develop sophisticated thought. Developmental accounts (Binder et al., 2009a) are influenced tremendously by environmental factors, the most prominent being those in the home or in school (Reinecke, 1938). Influences to tone, intonation, stress were also identified (Kuhl et al., 2007) so that they might be negated in the research design (see Chapter Three this thesis).

2.5 Interlanguage Transfer and Interference

Interlanguage transfer traditionally refers to a form of language that shares the features of two or more languages in an individual. Early research by Corder (1967) speculated that interlanguage transfer is a cognitive skill shared in developing first and additional languages. In the present thesis, interlanguage transfer is associated with the active and independent learning within the mind, as it associates with its preconceived generalisations while grappling with a new language (for a similar view, see Frith, 1978). These preconceived generalisations are influenced by background knowledge, cross-linguistic variations, and differences in orthography.

Although language transference and interference (see Galasso, 2002) have both been covered in the literature to a considerable extent (e.g., for reading comprehension, see Sadeghi & Everatt, 2015), attention to transfer between non-native scripts has been underrepresented in research (Hipfner-Boucher & Chen, 2015). The present thesis posits that the phonological units of *kana* to *romaji* are transferred and connected with V, CV, and CCV graphemic chunks. This chunking then causes interference with the development of English orthographic knowledge. The present thesis investigates this inhibitory effect and attempts to identify where, when and why some graphemic chunks cause problems. This section discusses the present body of knowledge concerning transfer, and the known influences that could affect the reliability of the present thesis.

2.5.1 Positive Transfer

Relative to phonological and morphological awareness, cross-language transfer of orthographic processing has received little attention in the research literature (Chen et al., 2015, p112). Previously, the transfer of orthographic processing was previously only considered as a strictly language-specific skill (Abu-Rabia, 2001). However, the potential effects of the transfer of orthographic processing have been studied in terms of the role that orthographic proximity and grain size (i.e., lexical versus sub-lexical units) play in facilitating or constraining its transferability (see Chen et al., 2015, p. 112).

Reading success and the subsequent acquisition of orthographic understanding has been found to be somewhat dependent on the degree to which any two writing systems share certain features (Brown & Haynes, 1985; Liow, 1999). Brown and Haynes (1985) were among the first to find that similar features reinforce and generalise the understanding of certain language features, the present study looks more specifically at what restricts the transfer of features, and suggests ways to reduce this restriction.

Positive transfer has often been associated with the notion that *romaji* naturally/implicitly supports or facilitates English reading and writing skills (for a pre-cognitive/neuro-psycholinguistics understanding, see Yamada et al., 1988). This assumption has become a cornerstone of English foreign language teaching in Japanese education (Akatsuka et al., 2015; Maruyama, 2010; Matsuura, 2005). In these studies, high-similarity words that did not correlate with the *romaji* scores, two variables appear to have had an influence: a meaning- preserving strategy, and knowledge of individual *romaji*.

The Noticing Hypothesis underpins the explanation of various ways in which SLA can both support input and fail to reflect input (Ellis, 2002, 2008). In simple terms, people learn about the things that are salient and what they attend to. The alternative is that people do not learn much from things they do not, or cannot, attend to (Schmidt, 2010). In fact, failing to notice cues because they are not salient, and failing to notice that cues need to be processed in a different way from that relevant to L1 is detrimental to SLA (Ellis, 2008), and a cornerstone for debunking the belief that *romaji* facilitates English alphabetic knowledge.

2.5.2 Concurrent Learning of First and Second Languages

It should be evident by now that issues in word recognition and spelling are much more complicated than those in L1 reading and writing. The FL is influenced by L1 knowledge and as the FL is learned, it, in turn, influences how the L1 is processed; evidence of this effect was presented in the neurological studies and cognitive methods reviewed earlier. Han (2015) lists a number of factors that have been taken into consideration for FL word recognition research and are particular to the present thesis, namely, the L1 orthographic background, the FL experience, and the FL print input properties. These three factors centre around word recognition and reading experience and consequent writing ability.

Various theories have been offered and tested in order to understand the extent to which concurrent learning affects orthographic processing. One way is to analyse the prevalence of reading difficulties (for English/Italian see Lindgren et al., 1985; and for Chinese, Japanese, and English see Stevenson et al., 1982) in concurrent language learning. Others have studied the similarities in basic underlying processes in cross-linguistic studies (e.g., Peereman, 1992, the effect of processing regular and irregular words). In the past few decades, a number of studies have examined specific cross-language transfer effects (e.g., Akamatsu, 1999; Geva & Siegel, 2000; Koda, 1989; Wade-Woolley, 1996; Wade-Woolley & Geva, 1999). These studies, however, tended to focus on adult learners who are literate in their L1. Only a few studies have examined the development of L2 reading in children, and there has been a dearth of research on the parallel development of L1 and L2 reading (Durgunoglu & Hancin-Bhatt, 1992; Verhoeven, 1990), the role of underlying individual differences in cognitive processes, and the extent to which the rate of acquisition of decoding skills in L1 and L2 is affected by orthographic features and by language proficiency.

Many researchers (Akamatsu, 1999, 2005; Chikamatsu, 2006; Koda, 1996, 2005; Yamashita, 2013) have indicated that L1 orthographic effects have a lasting impact on FL word recognition. One argument for the transference of *romaji* to English debate could be centred on the “procedural-divergence” and “qualitative-differences” in FL readers word identification behaviours (Koda, 1996, p. 454). If the L1 and FL orthographies are similar, word recognition skills are accelerated, but where the distance between the orthographies are great, there is a plethora of evidence to suggest that the difference adversely affects transfer (see Han, 2015, pp. 63-64 for a bibliography of research regarding transfer).

The problem with the assumption that *romaji* facilitates English is that facilitation is associated with quantitative and qualitative experience with the L1 orthography (Nation, 2013), and neither is perfect (Siyanova-Chanturia & Omidian, 2019). Japanese students in Grade-5 could be accredited with mastery; at the word level, there is little resemblance to Japanese and English words due to the CV and CCV structure of *romaji*; and finally, at the sub-word, orthographic level, the orthographies are extremely contrastive, *romaji* is tremendously transparent and maps almost flawlessly with the Japanese mora represented by *kana*, and English is phenomenally opaque with almost countless grapheme to phoneme contradictions. Therefore, there are few quantitative or qualitative similarities between *romaji*.

Orthographic transfer is more likely to occur if learners do not view the two languages as significantly different from each other (Kellerman, 1977). For example, the existence of cognates in two languages may not be a sufficient condition for the transfer of cognate knowledge to occur; a belief on the part of the learner that the two languages are similar may be necessary (but probably not sufficient) as well. However, language transfer is also associated with the hindrance of understanding or production of new forms (see Yu, & Odlin, 2016).

Another finding refutes the *romaji* facilitation of English assumption. Through L1 reading experience, readers have modularised the optimal cognitive processing strategies for a particular orthography, which may be hard to modify in word recognition when they read in a foreign language (Akamatsu, 1999). Empirical studies by Akamatsu (2005) and Chikamatsu (2006) appear to support this view. Akamatsu (2005) compared the performance of the naming accuracy and latency of reading normal English words and visually distorted English words (e.g., time vs. tImE) between proficient and poor Japanese EFL learners. Proficient readers were slower and less accurate in pronouncing the visually distorted English words than the normally displayed English words. The researcher interpreted this finding as that “the nature of L1 orthography affects L2 word recognition processes so deeply that L2 reading proficiency could not influence L1 orthographic effects on the efficiency of processing the constituent letters in an English word” (Akamatsu, 2005, p. 253).

In another study on word recognition other than in English, Chikamatsu (2006) compared native English speakers learning Japanese at higher and lower proficiency. The higher proficiency group showed decreasing reliance on L1 word recognition strategies in reading *katakana* and *hiragana* only in the single word recognition task, but not in the contextual word recognition task. These studies jointly tell us that even at a more advanced level, FL readers’ word recognition may remain affected by their L1 word processing strategies (see Hickok & Small, 2015). One method of testing this will be discussed in the following Chapter using pseudowords (i.e., words that obey the language’s orthographic principles) and nonwords (i.e., illegal representations of a word) in a Tachistoscopic Identification test.

Other constraints on transfer relate to the notion of markedness. Linguistically, unmarked features are those that are universal or present in most of the world’s languages. These unmarked features are believed to be more available for transfer than typologically unusual features (Eckman, 1977, 1984; Hyltenstam, 1984, as cited in Genesee et al., 2006). In most languages, for example, final consonants are devoiced; thus, the devoicing of final consonants is an unmarked feature. In English, final consonants may be voiced or voiceless. In Japanese, however, the final phoneme is usually a voiced vowel. Therefore, it is natural for Japanese to add a vowel to English words (e.g., dog - /dogu/, hat - /hato/, bus - /basu/, etc.). This is one example of first-language transfer (Genesee et al., 2006). This hypothesis predicts that if presented with an English word, beginners may add a vowel to the end of an English word with a consonant stop when spoken, but there is little evidence that this occurs in spelling. The lexical access route of spelling from PG mapping could be interpreted to predict that an individual, with no knowledge of English orthographic rules, would make this error and add a vowel at the end of an unfamiliar word. However, if the prime were spoken correctly, or the individual could recall the approximate pronunciation of English, this error may be avoided. This is one of the areas of interest in this Thesis.

The interdependence hypothesis, Cummins (1981, 2000) has postulated that acquisition of first and second languages is developmentally interdependent; that is, development of the first language can influence and, in particular, facilitate the development of the second language. This hypothesis usually focuses on the greater than word-level constructs of language learning, however, the evidence that follows indicates that for beginners, this interdependency is present at the phoneme and grapheme level.

In a study investigating the ways in which children use orthographic, phonological, and morphological information in spelling double consonants (geminates) in Finnish, Lehtonen (2005) reported that children start appreciating the phonological role of geminates during the second half of their first year at school, whereas English-speaking children learn it only in the sixth grade. Finnish is an important study because like *romaji*, it is almost a perfectly transparent orthography, and geminates dictate the phonetic rhythm, or the *mora* in Japanese. For example, in English changing the length of the “a” in *bat* and *bad* does not change the meaning, and in Finnish and Japanese, it does (Treiman, 1993).

One reason is simply the predictability of phonemic blocks or the grain-size of phonemes. To account for the differences in the average ages at which children with L1s with a variety of scripts and orthographies can recognise words effectively, Ziegler and Goswami (2006) proposed the Psycholinguistic Grain Size (PGS) theory of reading. The PGS theory implies that children learning shallow orthography tend to rely on graphene phoneme (GP) correspondence rules (Helms-Park et al., 2016). The PGS theory has been tested in multiple settings and ages of development (Ellis et al., 2004; Hoxhallari, 2006; Hoxhallari et al., 2004). Most teachers in Japan would agree with Ellis et al. (2004), that students without learning problems can read and write transparent *hiragana* by the end of the first term of elementary school. This means that students' PG representations and phonemic level understanding of words should be reliably developed by the time they have reached the fifth grade (i.e., the developmental age of students in this study).

2.5.3 Learned Transference

The view taken in this thesis is that transfer, first and foremost, occurs naturally and should not necessarily be the focus of teachers, but merely a tool for facilitating efficient learning. This view is supported by the unsupervised success of study abroad programs and the suggestions of enlisting parents to implement L1 to L2 transfer practice in the home. However, there is a neurological foundation for the support of the natural approach. Second language acquisition models like MacWhinney and Bates's competition model (MacWhinney, 1997) holds that four properties of neural networks are important in second language acquisition: competition, gradience, emergence, and transfer. The assumption in this traditional connectionist model is that all mental processing utilises a common, interconnected set of cognitive structures. Therefore, the first thing individuals experience when learning a new language is a prodigious transfer (and interference) from L1 to L2. This is also the case when two or more languages come into contact (Murphy, 2003), although hybrid and morphological items can also inhibit or support transfer (De Angelis & Selinker, 2001; Dewaele, 2001; Ringbom, 2001).

According to Brysbaert (2003), bilingual visual word recognition transfer is only limited to the extent that L2 characteristics are not present in L1. So the L2 provides the filter, and all the aspects of the first language that can possibly transfer to L2 will automatically transfer. This assumption is widely believed in Japan, and rightly so. However, it comes at a cost, which will bring us again to the pinnacle of the significance of this thesis.

If the second language learner truly has as much of the L1 as the L2 can accommodate, then learning begins with a parasitic -lexicon, -phonology, and -set of grammatical constructs. Every second language learner could agree with this experience. However, applied to the issue of learning an additional script, then an additional orthography of the same script, the follow-on of this parasitic influence should be evident. This effect is most prevalent in beginners, in a pre-lexical stage. Therefore, if L1 and L2 are written in the same alphabet, it seems reasonable to assume that all L1 grapheme-phoneme conversions that can be used for the new language, will be used. Brysbaert (2003, p. 15) assumes that this L1 GP conversion will also be of profit to the learner, as it is rarely the case that languages with the same alphabet have a completely incompatible letter-sound mapping. However, this assumption has been extrapolated in the case of *romaji* to English conversions.

Many letters have a similar pronunciation (e.g., the "b" is pronounced the same in English, Dutch, and French). This information is of immediate use to the beginning language learner. Other letter combinations (graphemes) only exist in L2 and can easily be added to the stored information because they do not contradict existing knowledge (Brysbaert et al., 1999). This means that already from the beginning of the language acquisition process, a great deal of the phonology of the new language is available to the reader (Kinoshita & Lupker, 2004). The Japanese *romaji* alphabet, however, has far fewer supports for English phonology. In fact, many significant vowels and consonants are contradictory. In addition, English has 26 alphabets that have multiple phonemes and the Japanese *romaji* alphabet has only 21 letters and basically 51 phonemes.

An extremely important fact is, the most difficult parts of the new phonology to acquire are those letter-sound correspondences that contradict existing ones (Kinoshita & Lupker, 2004). In the beginning, these conflicting correspondences are likely to give rise to L1 generalisation errors, but gradually they become incorporated in the network, just like inconsistencies within a language become incorporated, until in the end the letter-sound mappings of the new language are not only mastered but also start to have an influence on the letter-sound conversions of the native language (because of the competition process).

2.5.4 Taught Transference in Japan

In the native language classroom, transference of language features is an important tool for removing redundancy from the teaching syllabus and helping students connect with schemata, lexis, previous knowledge, other learning skills, etc. However, it is generally beyond the skills and training of most teachers, and in larger classrooms, it is usually not feasible to teach children to recognise relationships between words and alphabets in an effort to reduce the gap between the native language and script and the second language (Hipfner-Boucher & Chen, 2015).

Some common suggestions include encouraging students to reflect on their first and second language learning and encouraging their parents to adopt practices that highlight the L1 and L2 connections (Hipfner-Boucher & Chen, 2015). However, teachers in Japan are relied upon to teach, or students are sent to *Juku* (night school), parental involvement is rarely enlisted. Other suggestions include immersion programs. However, these programs have been particularly unsuccessful in Japan, due to the still rare opportunities to practice English in public. Another approach is 'study abroad' programs; which are, in fact, the most successful approach to date, they have become particularly expensive, and since COVID-19, logistically impossible.

2.5.5 Language Acquisition Interference and Orthographic "Gap"

Although it is generally thought that words which are difficult to learn are also hard to retain (Tagashira, 2001), much of the research on vocabulary acquisition neglects the processes that are responsible for the measured performance in the post and delayed post-tests, and fails to grasp the depth and meaning behind this statement (Tagashira, 2001). What is not mentioned is the dependence on semantic knowledge and the cognitive "rules" governing the storage of information and how it enters into the mental lexicon. In basic terms, what the mind can trust to be used later, will be stored for later, and what is difficult to learn is not easy to forget (i.e., usage-based influences on frequency), but the difficulty to process and the lack of semantic activation, jeopardises the storage of information, and this also implies orthographic information. In the right conditions, this is true. With the benefit and presence of previous knowledge and when time is given to reflect or process the difficult information, the metalinguistic processes that are employed, help generate a greater learning effect. These neurological and cognitive issues were covered earlier in this Chapter. However, there is a tertiary reason that new orthography can cause problems in orthographic understanding. There is a third argument that some have exploited and that is, what is learned under difficult conditions is hard to forget.

One of Krashen's (1985) input-hypothesis theories posit that acquired knowledge from input processing underlies implicit, spontaneous oral production. However, metalinguistic knowledge is consciously learned and can only be accessed when there is sufficient time and a focus on form (Ranta, 2008). For example, syntactic and phonological awareness are two types of metalinguistic abilities that demonstrate the ability of the language learning mind to reflect on and manipulate the structural features of the spoken language like phonemes, words, structural representations of sentences, and sets of interrelated propositions (Tunmer, 1997). The assumption in this and other examples of meta-knowledge is there must already be explicit knowledge (Ranta, 2008). This learning is both in the presence of lexical knowledge and dependent on lexical knowledge. The effect of relying on conscious knowledge comes at a cost; processing time is increased in difficult situations. According to

Schneider et al. (2002, p. 440), this delay is one possible reason that retention and transfer suffer less when the learning process is slowed.

2.5.6 Script Dependent Interference

The effect of scripts on central processing and on orthographic understanding can be regarded according to two broad hypotheses. According to the script dependent hypothesis, children will encounter more difficulties in English due to its irregular orthography. However, this thesis suggests that for beginners, complex native phoneme to grapheme conversion should also be the predominant area of problems and second, where there is a conflict in PG mappings between the languages, and thirdly, where the second language has no support from the first language. The central processing hypothesis supports this influence from phonology together with the influence of orthography. The CPH predicts that the cognitive and linguistic processes for reading in any language depend on phonological processing abilities (Adams, 1990; Wagner et al., 1994), efficient use of orthographic information (Assink & Kattenberg, 1994; Berninger & Abbott, 1994; Bowers et al., 1994; Geva et al., 1993; Jackson & Biemiller, 1985; Stanovich et al., 1984) and verbal memory capacity (Daneman & Carpenter, 1980; Geva & Ryan, 1993; Siegel & Ryan, 1989).

Geva and Siegel (2000) deduced that the processes behind basic reading skills in L1 and L2 will correlate, even when the corresponding orthographies vary in complexity and regularity. This notion appears to contradict the assumption presented in the present thesis. However, this surely is predominantly true only regarding the transfer of developed reading skills, and not only recognising phonemes and graphemes and word chunks. In fact, Geva and Siegel (2000) suggest that children who experience difficulties in acquiring basic decoding skills in one orthography will experience difficulties in another orthography as well and that the individual differences in reading ability in either language may be “predicted by a common set of underlying cognitive constructs” (p. 5), thus supporting the hypothesis that the “Gap”, that is the distance between the two orthographies, will cause considerable errors in cognitive processing.

Even if individual differences in underlying cognitive constructs can explain L1 and L2 reading performance, orthographic complexity may be reflected in the rate of development. The complexity of learning the orthographic rules of English takes time to learn and is far from being complete even up to middle school in native English (Berninger & Abbott, 1994). These issues specific to the collection of knowledge in the learning process are detailed in regards to previous knowledge, generative effects of semantic and lexical knowledge, and the residual influences of native language orthographic knowledge on the acquisition and activation of additional language.

2.5.7 Generative Effects - Semantics and Lexical Knowledge

Generative effects imply the existence of previous memory traces in semantic memory. These memory traces in semantic memory enhance activation of the semantic features comprising a word's representation in the subjective lexicon (Gardiner & Hampton, 1985). This "generation effect" (Slamecka & Graf, 1978) is attributed to traces of words and events in, and in activation of, semantic memory (see also Jacoby, 1978). Slamecka and Graf (1978) found a large generation effect in recognition memory, cued-recall, and free-recall learning, and the effect did not extend to the stimulus word but was restricted to memory for the response word.

The generation effect is sensitive not only to the availability of lexical items but the status of the item to be remembered. McElroy and Slamecka (1982) showed that there was no generation effect in memory for pronounceable nonwords using a generated (or read) letter transposition rule. They proposed that semantic memory involvement was necessary for the generation effect to emerge. According to the lexical activation hypothesis (Gardiner & Hampton, 1985), a generated task leads to enhanced activation of semantic features, which consequently increases the likelihood of gaining access to the trace in the future, which can be measured using a Stroop Test. In the absence of trustworthy lexical knowledge, however, this transfer or generation effect should not be assumed.

There are two consequences of the generation effect and both are concerned with language transfer and influence. Previous knowledge is necessary for generation and transfer is less likely to occur in the absence of previous lexical knowledge. The inferential hypothesis is then that a conflicting memory trace inhibits the transfer or activation of semantic or lexical knowledge, thus making the acquisition of new and unique items less probable. The conflicting memory trace could be either PG or GP correspondences. The implications of these theories also suggest that where there is no, or conflicting previous knowledge, the generation of correct forms will be erroneous. These and other hypotheses are detailed in the following section.

2.6 Summary of Hypotheses and Research Questions

2.6.1 Summary of Hypotheses

The literature review provided in this Chapter has addressed a broad range of theories and identified an underlying gap in our knowledge of the orthographic depth and the influence between two orthographies in individuals. The majority of the literature identifies that L1 orthography should have both supportive and detrimental effects in L2 spelling as was found with L2 reading and word recognition (Chikamatsu, 1996; Koda, 2000; Mori, 1998; Muljani et al., 1998). These studies suggest first and foremost that both processing skills and strategies are transferred from the first language to the second language. Also, the nature of L1 orthographic properties (e.g., orthographic depth, representational units) has a “major impact on the cognitive processes that are used in reading a second written language” (Akamatsu, 2016, p. 494). These authors suggest that this impact does not necessarily imply that L2 learners will encounter insurmountable difficulty in acquiring skills or strategies, but it does imply the impact of inconsistencies between the two languages. Therefore, if this is true, writing performance will exhibit qualitative differences between similar word complexities and lengths, depending on the orthography and the relationship between phoneme and grapheme chunks.

Other theories raise doubts about the effect of age, learning order, and the influence of previous knowledge. The cognitive foundations of language development address the fundamentally human aspect of literacy development. Literacy was found to be somewhat related to cognitive maturity and that the order of learning affects transfer (Genesee et al., 2006). Also, interference from similar scripts should be expected in contrasting areas in the two similar orthographies.

Some cognitive models regard reading development as a series of discrete steps; they propose that initially children read and spell in a logographic manner; and that after adopting an alphabetic decoding strategy, children master complex, phonological and orthographic rules that allow them to read and spell by using direct lexical access. Developed readers also use different strategies, and familiarity with longer words gives way to word shape. More experienced, usually older, children tend to rely on larger units for spelling.

Hoxhallari (2006, p.227) found that whole words were remembered more with age, regardless of orthography, and therefore the number of nonword errors decreased. However, in transparent orthographies like Albanian (see Hoxhallari, 2006, p. 147), Chinese *pinyin*, and Taiwanese *Zhu Yin Fu Hao* (Holm & Dodd, 1996, as cited in Wang et al., 2003, pp. 134-135), individuals rely on a phonological recording strategy from phonemes to graphemes for spelling, regardless of literacy experience. This confidence in applying PG conventions, even in non-alphabetic scripts like *hiragana*, promotes fast acquisition (Ellis et al., 2004, p.443). Knowledge of letter names and their highly consistent sound correspondences allow Albanian and Welsh children to spell with high accuracy (Hoxhallari, 2006, p. 277); the same is expected with Japanese children if they have a developed understanding of a single writing system of *romaji*.

Overall, many authors have published research about the effects of orthography on literacy and language processing and orthographic influence (Chen et al., 2015, 2020; Chikamatsu, 1996; Joshi & Aaron, 2005). Each of these authors has expressed the need for further reinvestigation into the influence between orthographies, particularly in multilingual individuals. Some articles have identified the concept of inhibition (Dewaele, 2001; Dixon et al., 2010) and others have come tremendously close to suggesting that the gap between two language orthographies is the probable cause for learning problems (Chen et al., 2020; Dong et al., 2021; Zarić et al., 2020). To date, this thesis is possibly the first thesis to investigate the influence of learning two similar alphabets with contrasting orthographies and provide any plausible hypothesis for identifying the position of conflicts to orthographic knowledge.

2.6.2 Formal Hypothesis and Research Questions

The general prediction in this is that grade-5 students who have little English orthographic understanding and mixed orthographic knowledge will be influenced by orthographic complexity (Geva & Siegel, 2000) and environmental influences (Nation, 1997) like familiar proper names and typing practice on keyboards that is inconsistent with *hebonshiki*, from generation effects (Jacoby, 1978; Slamecka &

Graf, 1978), and the effects on phoneme/grapheme chunk frequency (see Section 2.4.4, Ellis, 2002, 2008; Schmidt, 2010).

The following formal research questions are formulated from the hypotheses presented so far in this literature review.

1. To test the reliability of the stimulus material (i.e., primes) in each test in the series: Is there any significant variation (i.e., a non-correlation) in errors between the students or the groups of students for each variable and each test?
2. To test *romaji* ability: What is the average score for each group and the overall group? (English spelling could not be tested; students became uneasy from writing in alphabets and it was deemed that any testing of English spelling would be futile.)
3. Using non-words in both languages, what is the orthographic preference and implicit orthographic knowledge of both Japanese and English?
4. To find the most influential confound to orthographic knowledge: What is the most significant linear relationship between accuracy and word stimuli (i.e., is it word frequency, word length, syllable count, or orthographic complexity)?

2.6.3 Incidental Hypotheses and Research Questions

The effect of orthographic depth has been found to be influenced separately by the "complexity of print-to-speech correspondences and the unpredictability of the derivation of the pronunciations of words on the basis of their orthography" (Schmalz et al., 2015, p. 1614). These researchers argue that the definition of orthographic depth needs refinement, particularly in the specific mechanisms by which language-level orthographic properties affect cognitive processes underlying reading. The present thesis is one endeavour to support this investigation.

De Groot and Keijzer (2000) found that words were easier to learn and less susceptible to forgetting than non-cognates and abstract words, and word frequency had little effect. At the word level, salience between the meanings of a word in both languages affected the accuracy. Additionally, the general rationale behind the study of orthographic influence falls upon input-driven perspectives of language acquisition. Two of Krashen's five input hypotheses (Krashen, 1982, 1985, 1992) are crucial to this study of orthographic knowledge and interference, based on input-driven perspectives of language acquisition: The learnability of an item is largely dependent upon the amount of experience a learner has with it and with similar items.

Theory suggests that learning a second language orthography is influenced by the first language, and the second language influences the native language. According to the theory presented in this Chapter, the influence should be directional (Genesee et al., 2006; Joshi & Aaron, 2005) and will change in the course of development, and learning order (i.e., *romaji* before English or visa-versa). The placement of influence and interference should occur where the two alphabets conflict, either graphically or phonologically. Due to the CV structure of Japanese phonemes, these features are not only at the phonemic or graphemic (i.e., single letter) level, but are also in letter sequences that make up syllables, morae, and words, which all must be taken into consideration.

The incidental hypothesis presented in this section also suggests that concreteness at the orthographic level is also less dependent on word frequency, and more dependent on orthographic reliability. Therefore, the incidental research questions are as follows.

1. Is word complexity inversely proportional to writing accuracy?
2. What are the greatest causes of errors at the finer-grained phonemic/graphemic level of word analysis?
3. What is the cause of any relationship between PG complexity, PG frequency, and accuracy?
4. What is the relationship of PG problems between the two language orthographies?
5. Is there evidence to indicate that unique letters and phonemes in English conflict significantly with those of Japanese?

The evidence provided through answering these incidental research questions are expected to identify that the gaps and contradictions between two orthographies are the major cause or language learning problems. This result would provide sufficient evidence to formulate the Orthographic Gap Hypotheses (OGH) (see Section 6.4).

2.7 Conceptual Framework for Measuring Orthographic Knowledge

This section discusses models and techniques that have been effective in exploring the cognitive processes responsible for understanding how developing learners produce spelling from words, sounds, and pictures. The research discussed previously in this Chapter covered various neurological and cognitive processes that are foundational to understanding the storage and migration of orthographic knowledge into the mental lexicon. Additionally, a select group of effects to orthographic knowledge development were presented; without accounting for these variables that affect every individual's phonological lexis, any research would be problematic (see Schellinger et al., 2017).

Inclusion criteria for this section included tests that used primes that were sensitive only to word complexity, length, and orthographic complexity. Due to the undefined orthographic knowledge of *romaji*, and the preliterate, embryonic stage of English orthography, tests could not only assess spelling from sounds or pictures but from script input. The script input had to be able to assess lexical and procedural knowledge. Furthermore, the pending closure of schools due to the Corona Pandemic meant the eventual design would have to depend on the error analysis from group responses (cf. the original design was to measure errors, error types, and response times). Therefore, the final inclusion criteria include concepts that can return results merely from error analysis under controlled timing conditions. The cognitive theory presented earlier indicates that measurement should be possible if priming can be controlled to the threshold time between 30 and 300 milliseconds (see Sections 2.2 and 2.3).

2.7.1 Introduction to Psycholinguistic Concepts

Early studies of word associations by Francis Galton (1879, 1883, 1907) and slips of the tongue by Meringer and Mayer (1895, as cited in Harley, 2001) '*primed*' an explosion of research in the field of psycholinguistics almost half a century later (see Harley, 2001; Levelt, 2013). A common approach to psycholinguistic testing is to measure the response to some type of "*priming* methodology" (Harley, 2001, p. 11). The limitations of these early methods were kinaesthetic in nature: response delays, motor problems (e.g., eye coordination and muscular control), and other influences include motivation, fatigue, attention, and the choice of priming that neglected AoA and target language influences. Recent attempts to study *in vivo*, the psycholinguistic processing in the healthy brain include computerised imaging methods (e.g., EEG, MEG, MRI, and fMRI, in Section 2.2) that are beyond the scope of this thesis. Nonetheless, accounting for or limiting the influences of these extraneous variables is important in providing more reliable insights into studying the influence of learning *romaji* before English in this thesis.

The fundamental psycholinguistic guiding principles are that implicit knowledge of orthographic rules words is stored in lexical memory, and responses to stimuli should be almost "instantaneous" (i.e., under the 300 milliseconds) and require minimal cognitive effort or processing. Also, these words should be accurately recalled from lexis, and spelling mistakes will be unique to orthography. For lexical items (i.e., words, chunks, or letters), a prime should "pre-activate" memory to prejudice the expected result. However, where there are no reliable traces in memory, there is nothing to pre-activate (Scott, 2021), so a prime is of little effect. The responses will be a result of guessing or processing some other memory of what was perceived, which utilises the procedural route based on rules of phonology and orthography. This processing results in delays and inconsistent error types depending on previous knowledge, and the predominant orthographic rules.

2.7.2 General Approaches to Psycholinguistic Research

Empirical studies of speech have guided many of the conceptual approaches in measuring language cognition. However, when we spell and write, generally more time is available to process words and meaning. Therefore, the general approach for written responses is to limit the time to respond, thereby forcing errors related to fluency, which is dependent on the speed and reliability of memory traces. The consequence of this is that lexical access can be distinguished from procedural processing, simply by analysing the errors (see Joshi & Aaron, 2005).

The traditional approach to measuring orthography is to present a prime, and then measure the time it takes to start a response, then log any errors (e.g., Ellis et al., 2004; Hoxhallari, 2006). There are scores of experimental methods (for example, see Kilpatrick, 2015, pp 19-20), each having its own particular characteristic applications, and most measure similar phenomena. However, each priming method usually has some advantage over another or negates some cognitive process. The following sections introduce two general methods that have been useful in understanding OI, but were unable to be utilised given the limited access to students, as explained in Section 4.1.

2.7.2.1 Masked Priming

The masked priming paradigm developed by Forster and Davis (1984) is sometimes referred to as a 'sandwich' technique because the prime is sandwiched between a forward pattern mask and the target stimulus, which acts as a backward mask. For example, a mask is presented followed quickly by a prime, then a target as follows:

1. Mask (500 milliseconds) #####
2. Prime (50 milliseconds) horse
3. Target (500 milliseconds) HOUSE

The prime is virtually invisible. The concept is based on the assumption that the prime never reaches the conscious mind, but there is a measurable effect on the target (Forster, n.d.). Another form of prime is "*form priming*" (e.g., 'nature' and 'mature'). Masks can sometimes be another word or set of letters that will either facilitate or hinder the speed or accuracy of recognising the target word. The idea is to eliminate the 'frontal lobes' of the mind and access semantic understanding. The limitation of this approach is the semantic knowledge of students at this age, and their lexical knowledge of alphabets, in general, are vastly different. Masked priming should be useful in modulating the lexical effect of frequency (see Forster & Davis, 1984), word or chunk familiarity in *romaji* and English, any results would be too random to provide any reliable results.

2.7.2.2 Stroop Paradigm and Development

The Stroop Test (Stroop, 1935, 1992) has remained among the most widely cited studies in experimental psychology. It has led to countless replications in the fields of behaviour, applied psychology, cognition, and others (see MacLeod, 1991, for an extensive bibliography on other studies). The Stroop test generally involves an input prime (a word, a picture, or an action) which is confounded by some supportive (congruent) or conflicting (incongruent) visually associated, and often masked, prime (see Pardo et al., 1990, p. 257). Using the Stroop tests for spelling responses, however, is unrealistic. Usual Stroop responses are spoken or some other non-linguistic response like pressing a button (O or X), or selecting a corresponding response (e.g., R for red, B for blue, etc.). While the Stroop test is a tremendously useful tool in measuring lexical memory, the function of writing makes any results less than useful, due to the time taken to respond.

Stroop responses from research on the Japanese language have produced intriguing results. Hatta (1985) investigated the effect of script on reading mechanisms. This test led to the hypothesis that second language influence and lexical access are a confounding influence on the Stroop results. Likewise, Hatta and Ogawa (1983) found that Japanese *hiragana* and kata*kana* are not processed identically; the lexical representations of the two systems do not completely overlap but share partly some common aspects in the processing of information (Hatta, 1985, p. 356).

The advantage of using the Stroop Test is that it does not rely tremendously on contextual knowledge. Nomura (1980) created a test of the effect of word frequencies from a Japanese journal corpora (i.e., 29.9% *kanji*, 50.1% *hiragana*, 9.6% *katakana*, 0.4% alphabetic scripts). The accuracy of recognising these words was tremendously dependent on the contents of the printed materials (Hatta, 1985, p. 356). Their Stroop test was based on an earlier study on the difference between bilinguals (Dyer, 1973; Preston & Lambert, 1969; Vaid, 1981, as cited in Hatta, 1985), and both tests failed to distinguish between the influence of word frequency and its influence from development.

The Stroop test is less than appropriate in the present research. According to the evidence presented earlier, this test returns little difference in language development and word frequency, or in the case of the present thesis, includes sub-word-level familiarity. The Stroop Test also requires contextual knowledge and the present thesis is more interested in the fluency of sub-word components. Logistically, it would have also been unrealistic to collect data from 100 participants in a supervised test, and the Stroop Test would have required a rest period before other tests. Also, the testing centres would only allocate 30 minutes for each group. Therefore, another approach had to be adopted.

2.7.3 Experimental Psycholinguistic Approaches

This section discusses first, the general approach used in the majority of studies presented earlier, namely the LDT and NAM tests. The LDT and NAM tasks are ubiquitous tools for investigating how morphology, semantic information, lexical neighbourhood, and other linguistic factors affect identification.

The LDT serves as an ideal basis for conducting psychological tests because it is especially easy to administer for reading (Lieber et al., 2014), and it is both scalable and adaptable. The present study required students to write responses, not say them, so the collection of data and its analysis could be similar to previous studies, therefore adding justification to any results. In fact, the LDT is capable of being administered online for collecting reaction times for tens of thousands of words (e.g., Balota et al., 2004; Ferrand et al., 2010; Keuleers et al., 2010, 2012).

The LDT has also been used with priming experiments of various types. Primes are generally chosen according to their type of test, morphology, phonemic understanding, lexical access, imageability, and so on. When studying visual lexical decisions (i.e., the pre-programmed, easily recalled image of a word or its parts) primes are presented for a very short duration (e.g., 60 milliseconds), often preceded by a mask of random letters or hash marks, before the target word is presented. In this case, participants usually are not aware that a prime word was presented. In the present test, the prime duration was extended to 300 milliseconds, to allow a chance to 'learn' the word. The rationale was that *romaji* and English are not native languages, and therefore, the whole word would not be in the lexis anyway, while phonemes or syllables might be. The longer prime presentation duration would give the participant access to phoneme level lexis to spell the word (viz. according to the evidence in neurological and cognitive studies present earlier in this Chapter).

There are confounding factors that make masked priming unsuitable for the present study. One noteworthy argument (Norris & Kinoshita, 2008) is that in classical masked priming where two primes are presented in close proximity, orthographic information becomes blurred. Therefore, latencies are more likely to be a product of the distance (or difference) between the two primes. Norris and Kinoshita (2008) also showed that priming effects can be task-specific: present in visual lexical decisions, but absent (for the same stimuli) for a 'same–different' task. This implies that the effects of priming need not be an automatic consequence of the structure of the mental lexicon, but arise "online" depending on the demands of the task. To mitigate these confounds, other approaches were investigated.

So far, it should be apparent that the mental lexicon can be measured by LDT and NAM, because individuals need to use immediate lexical access to respond quickly. The problem presented in the present study is that students have substantial semantic and contextual knowledge in *kanji* and *kana*, but not in alphabets. Therefore, it would be ineffectual to test the lexical ability for writing, because the test would only measure visual word recognition. This would be useful for identifying advanced readers who had lexical, and spelling, knowledge, but neglect useful responses from lesser developed spellers. To level the playing field, nonwords could be used, and this is the case in the TACHiD test, explained later. The problem then is to elicit a written response without an audio or word prompt. The most likely solution is to use pictures and other stimuli that do not depend on the orthography under test.

2.7.4. Rapid Automatised Naming (RAN)

The RAN has been the centre of numerous studies into lexical access for some time now. Rapid automatised naming (RAN) usually requires individuals to name visually presented stimuli such as colours, objects, digits, and letters, as fast as possible. Even though RAN stimuli are void of orthographic priming, RAN has a reliable predictor of reading in every language that has been studied thus far (Compton, 2003; De Jong & Van der Leij, 1999; Landerl & Wimmer, 2008; Moll et al., 2014; Nag & Snowling, 2012; Taibah & Haynes, 2011; Vaessen & Blomert, 2010; Ziegler et al., 2010).

The reasons why RAN predicts reading success was of interest to Kirby et al. (2010). If RAN involves lexical retrieval, then there should be substantial correlations for RAN with LDT and NAM (Papadopoulos et al., 2016). High correlations would support the hypothesis that naming non-orthographic items reflects retrieval directly from the mental lexicon (Georgiou et al., 2008). Therefore, under time pressure, individuals may not be able to spell what they can name, a proposition integral to the present study.

A further proposition is that RAN performance is based on an output from working memory and is, therefore, not directly affected by lexical factors (Arnell et al., 2009). According to Bowers and Wolf (1993), if letter identification proceeds too slowly, as indexed by slow naming speed performance, letter representations in words will not be activated quickly enough to induce sensitivity to commonly occurring orthographic patterns (i.e., lexis). Orthographic processing, on the other hand, occurs when groups of letters or entire words are processed as single units rather than as a sequence of grapheme-phoneme correspondences (e.g., Ehri, 1987). Naming pictures, therefore, levels the playing field by removing the advantage of whole word recognition. For this reason, Manis et al. (2000) showed that RAN was a unique predictor of orthographic processing.

In the traditional RAN task, participants are presented with line drawings or photographs, and are asked to say out loud, as quickly and accurately as possible, what the picture denotes. In this task, the input is non-linguistic, and hence the response variables, like naming latency and accuracy, gauge the costs of preparing for speech without contamination from linguistically mediated comprehension. This same rationale is exploited for writing. However, unlike previous tests that have studied spelling (e.g., Ellis et al., 2004; Hoxhallari et al., 2004) the time to complete the response is limited to 3 seconds. For longer words this was extended to up to five seconds so a response could be obtained.

The RAN task has two disadvantages, surrounding language; only nouns, verbs, and adjectives that can be presented as pictures are available and the temporal information obtained is restricted to the onset of articulation (Lieber et al., 2014). Additionally, there have been cultural variations in results that indicate the processing of some images is also dependent not only on language, but the understanding of the item presented. The solution chosen for the present study was to use familiar pictures, based on the availability of material in the students' curriculum. Additionally, the artwork, isometrics, and dimensionality are held at a constant, as much as possible.

The remaining problem is, then, how to determine letter and grapheme level orthographic knowledge. By using audio as a stimulus, the RAN theology can be utilised to establish letter writing ability (see the current study RAN letter naming). To establish grapheme, syllable/mora, and word level orthographic knowledge, the Tachistoscopic identification (TACHiD) test was employed. Therefore, the current study depends predominantly on the RAN tests approach to determining lexical ability, in the absence of orthographic priming. To address this question, as well as the questions related to the other components and correlates of reading ability that we have mentioned, this paper links what is known from laboratory experiments on word identification to what is known from standardised assessments of reading ability.

2.7.5 Method of Measurement

Understanding the nature of cross-language influences and the conditions that affect their expression is important for designing pedagogical interventions that facilitate the successful acquisition of reading and writing skills in English as a second language. Since the development of language is different for every individual, it would seem preposterous to assume there could be any single factor that affects language acquisition. The theory presented so far has discussed the areas of the brain that are responsible for various cognitive processes, which are also dependent on memory traces and language development. These processes give justification for why cognition is slow or fast, procedural or lexical, and supports why we expect time delays in these various cognitive processes. The theory of language also indicates the influences of language orthography, age and order of learning, and familiarity within and between languages. Therefore, it is elementary to expect the need for a series of tests to measure these influences. The following research questions helped to guide the choice of tests and the hypothesis of the results that are expected (Table 2.2).

Table 2.2

General Questions to Guide Conceptual Framework

1. How can we measure alphabetic skills in pre-literate/emergent learners and determine the difference between letter writing level errors and spelling errors based on PG mapping/transference?
2. How do we establish transliteration from native-phonemic and -graphemic knowledge into *romaji*?
3. How can we measure the difference between memory of word familiarity, PG transference and orthographic knowledge?
4. How can the difference between orthographic depth, orthographic complexity, and orthographic knowledge be assessed?

Spelling knowledge can be tested by using words of decreasing frequency. Researchers have found that writing accuracy is somewhat related to word frequency. Many researchers have banded word frequencies and selected words from these bands to avoid priming between stimuli, and control for other factors, including the age of acquisition and orthographic complexity.

The challenge then is how to present the primes and measure the response under controlled circumstances. Ellis et al. (2004) used a limited time sequence and measured the response to primes using a stopwatch. At a fundamental level, this approach is feasible, however, unreliable without the addition of some significant technology. Also, the present research was forced to be conducted in groups, and the analysis of video evidence to record times would have taken teams of assistants' hours to transcribe. However, Joshi and Aaron (2005) indicated that errors and response times are closely correlated. The one condition is that the response time has to be held constant. Earlier in this Chapter, the neurological and cognitive theories suggest that under three seconds is where the brain is more likely to be accessing memory and beyond that time, self-correction and processing/calculating a response is facilitated. Therefore, the general approach in presenting primes and assessing cognition is achieved by presenting the prime in under 300 milliseconds and allowing only 3 seconds for a response.

2.7.5.1 Measuring Transliteration From Native PG Knowledge Into *Romaji*

The problem with any spelling test is how to present primes as not to affect the accuracy of measuring the result. The RAN test is one method that involves measuring the naming-accuracy and naming-speeds of letters, digits, pictured objects, or colour patches (Denckla & Rudel, 1976, as cited in Moll et al., 2009). From the previous theories behind neuro-psycholinguistics, the effect or semantics, and the imageability of primes would influence results. Therefore, while word frequency banding was used, and the length and complexity of words (i.e., syllables and uniqueness of letters) was taken into consideration, the primes were divided into neuro-/cognitive genres. The purpose of this thesis was not to study the effects of various genres with word length, but to hold the participants thinking on a single genre, but leave the other variables of word length/complexity to change. These bands and the choice of primes are detailed in the following Chapter.

2.7.5.2 Measuring Word Familiarity, PG Transference and Orthographic Knowledge

Word familiarity has been found to influence response times, in fact, it is the major reason for high-frequency words to be read with greater speed and accuracy, regardless of word length. Various methods have been used to remove this effect including mixed case, letter reversal, and masked fonts (re. Like a Venetian blind). However, the use of non and pseudowords has also been effective. Nonwords should cause greater problems than pseudowords, for at least two reasons. The parts of the word may be orthographic exceptions, and the word cannot be a lexical entry. The brain needs to process the new occurrence and check the mental dictionary, or orthographic library for acceptance. This is one way of removing or modulating the familiarity of finer-grained chunks within the word.

One widely accepted approach to measuring this level of cognitive knowledge is the TACHiD test (Miller et al., 1954). This test can assess with tremendous reliability any traces of phonemic and graphemic chunks, from a variety of languages within a single individual. Traditionally the TACHiD test was conducted using an apparatus for use in exposing visual stimuli, such as pictures, letters, or words, for an extremely brief period. It was used chiefly to assess visual perception or to increase reading speed. It is this increased reading speed which is desired to reduce the opportunity to process words and force the influence of word recognition. This concept was in fact used in all the tests. The exposure time was limited to 300 milliseconds. Buetler et al., 2014 reflects this modulation of the routine non-lexical pathways in pseudoword recognition (see section 4.5.2, this Chapter). The process of selecting primes and the delivery of this test are detailed in the following Chapter.

2.7.5.3 Measuring Orthographic-Depth, -Complexity, and -Knowledge

While orthographic depth can be measured in numerous ways, it is common to record response times and/or errors against stimuli of varying length, frequency, or complexity. It is difficult to find any single method of distinguishing between these three variables. While a commercially available Test of Orthographic Competence (TOC) will give an indication of any single orthographic ability, there are two tests that are useful in assessing both explicit and implicit knowledge of orthography, regardless of language, or language combinations.

Orthographic Decision Task (ODT) uses both real- and nonwords to assess an individual's understanding of orthographic rules. In this test, primes are presented for a brief, 300 milliseconds and participants are given 3 seconds to decide if the presented word is Japanese or English. Japanese primes are taken from the *kanji* list in Chikamatsu et al. (2000) and modified into pseudo-and nonwords. The same is done to English words taken from Wang et al. (2005).

In the present study, both tests are used, and the variables are designed from real words to test the effect of orthographic complexity and transfer. The combinations of primes are mixed in a process of elimination to stress the explicit knowledge of orthographic rules. In some cases, both words could be either language pseudowords, thereby eliciting a preference. Other primes are more obviously illegal combinations, thereby accessing implicit understanding of orthography. In some cases, neither prime is a legal possibility in a given language, once again eliciting an explicitly processed deliberate response. This logical process is similar to that explained in the TACHiD test.

The other test of orthographic understanding is the ORT. This test asks students to recognise two words, which word is Japanese. A total of 38 word pairs were presented, the first set of 18 were to test Japanese recognition, followed by the remaining 18 for English.

2.7.5.4 Response Time Decision

During the early stages of reading, words are primarily decoded phonologically. Following print exposure, children begin to recognise familiar spelling patterns. With increasing exposure, the reader may automatically recognise these familiar patterns. Unfamiliar orthographic patterns, however, would still be processed phonologically. Furthermore, for transparent moraic systems like *romaji*, unfamiliar words should be spelt using phonology, but accurately because the phonology and alphabetic combinations are reliable. This assumption underlies the approach taken in the TACHiD tests.

It is reasonable to assume that the duration of time that a prime is presented would influence the memory trace and accuracy of reproducing the target. Understandably, if the word is unfamiliar it should take longer. In simple terms, if we present a prime long enough to be memorised, the possibility to write the word accurately should be improved. This assumption, however, is only partially correct. One example (Burt & Tate, 2002) tested university students' spelling of low-frequency words from dictation and subsequent lexical decisions to them. In one experiment, lexical decisions were slower on words that were previously incorrectly spelled and repetition aided the spelling of these previously incorrectly spelled words. This finding is also similar when nonwords are repeated. In a second experiment, the latency advantage for items spelled correctly was replicated when words were presented for a shorter duration (i.e., 200 milliseconds) and also in a spelling recognition task. This is assumed to mean that familiar words are less affected by prime duration. In a third test, masked identity and form priming effects were similar for both correctly and incorrectly spelt words. This result is especially relevant because it implies that learning history with a word's orthography underlies word frequency and item spelling accuracy effects and that a single orthographic lexicon serves visual word recognition and spelling (Burt & Tate, 2002).

This study, therefore, serves as a conceptual guide to the timing and style of testing. The importance of not repeating primes is an essential consideration in many orthography studies (e.g., Ellis et al., 2004; Hoxhallari, 2006). Priming, that is the presentation time of the stimuli, was chosen to be slow enough to give memory traces a chance to be primed, but not enough time for words to be copied, and therefore, not adversely affecting word frequency effects.

CHAPTER THREE
ORTHOGRAPHIC UNDERSTANDING AND INTERFERENCE TEST MEASUREMENT RATIONALE, PROCEDURE, AND PRELIMINARY RESULTS

3.1 Introduction to Test Material Development

This Chapter details the theory and process of measuring how language learners have constructed their knowledge of their native orthography and the target language. The purpose of this Chapter is to detail the development of a procedure for investigating the effect of learning English reading and writing from Grade-5, starting from Spring 2020. The processing of scripts requires learners to be able to put their knowledge to use during real-time processing. The sophistication of psycholinguistic and neurolinguistics methods has advanced significantly over the past 20 years. The knowledge of cognitive and language processing has subsequently allowed for a deep understanding of these processes. A number of techniques have been used that are familiar to language research in general. Measuring the responses of self-paced reading and cross-modal priming rely on speed responses, for example, a button-push or pointing to a picture or word, a spoken response, and in the current section, handwritten spelling and non-spelling responses.

The underlying psycholinguistic processes involved in the real-time processing of linguistic material are: a slower response indicates difficulty in lexical access, or some other processing of ambiguous, or visually complex input, at certain points in a word. A variety of options were initially chosen for possible inclusion in the present study. Eye-tracking during reading could have been useful to examine lexical processing in a similar way to add detail to the study of the comprehension processes via the examination of specific eye-movement measures (see Roberts, 2019).

Other neurological methods have been useful in investigating the types of information that are being used and applied during the language learning process. For example, electroencephalography (EEG) can be used to measure certain types of violations and/or unexpected linguistic material (syntactic, semantic, pragmatic). These processes elicit different types of event-related potential (ERP) components in the EEG signal, both in terms of polarity (negative versus positive) and timing. The theory behind this was presented in Chapter Two, however, one particularly pertinent example (see Roberts, 2019, p. 209) is the negative waveform that may be elicited from difficulty with the integration of semantic knowledge with a current/new linguistic element. Even at the sub-word level, the EEG signal would provide a negative-going waveform with an onset of about 400 milliseconds, a so-called N400 component. The EEG technique therefore provides highly reliable time-sensitive data, but not topological information. Functional magnetic resonance imaging (fMRI) is more effective in measuring the topological, or neural networks, that are activated under certain experimental methods.

This Chapter details the theoretical rationale and procedure for selecting the tests and the development of their primes for measuring orthographic depth, interference, and transfer between two orthographically contrasting alphabets, *romaji* and English. Generally, material and test methods rarely transfer equally between languages, across age groups, or between genre and priming methods (i.e., pictures, words, audio, etc.). This Chapter discusses the theoretical literature that is specific to the understanding of the design, procedures, and materials, developed specifically for this thesis. The Chapter concludes with a summary of the primes and their correlation with word complexity.

The results suggest that the primes were ordered in the appropriate sequential stages of difficulty, as was hoped for in other earlier studies (Ellis et al., 2004; Hoxhallari, 2006) that merely used word frequencies and word length as a guide to the word span tests.

This Chapter provides a framework for selecting word primes based on word -frequency, -complexity, and orthographic complexity. A correlation test between the two school groups will be used to verify the reliability of the primes. Additionally, these primes were useful in identifying orthographic influence (interference and facilitation) and making rational assumptions to support the Orthographic Gap Hypothesis presented in the main study. This Chapter concludes with suggestions for the selection of additional primes and other modifications to support future replication, particularly to understanding the directionality of influence in learning English earlier in the dual alphabetic orthography acquisition process.

3.2 Background

Cognitive research often requires tests methods and material to be selected and processed according to stringent criteria and specific experimenter defined characteristics; not simply taken from other sources and applied to new research (Noda, 2003, p. 223). A widely adopted approach to cross-language psycholinguistic research is to use words from corpora, particularly from age or contextually appropriate corpora, normalised for word frequency and length. While testing methods for measuring responses to words and picture primes vary considerably, the conceptual methods applied in this thesis included some form of error analysis and the recording of durations between the presentation of a stimulus and the onset of a response.

The approach in this thesis was different to previous examples because these individuals were tested in groups, and the response time was limited. This novel approach was chosen for several reasons. By reducing and regulating the time to respond, the chances of copying between individuals and making corrections were removed. Also, limiting the response time (to 3, 000 milliseconds) removed the dependency on measuring the time between priming, response onset, and completion. By limiting the response time to three seconds, problems (i.e., see Ellis et al., 2004) associated with timing accuracy and allowing students to take their time to answer difficult questions were removed. Limiting the time forced students to respond and make errors, an approach that has been found to be correlated with durations (see Joshi & Aaron, 2005).

The material selection for priming was a significant research undertaking because priming materials, such as pictures, colours, words, and pseudowords cannot simply be migrated from one language test into the same test in another language. Transliteration, translation, context, word length, frequency, and complexity, simply do not cross over from one language to another. One method to solving this problem is to use primes from similar experiments, another is to select material from normative databases (see Sanfeliu & Fernandez, 1996).

Another approach in cross-language experimental research is to follow the methodological approaches of previous researchers. Some have simply translated the material (Derrah & Rowe, 2015; McDonald & Asaba, 2016), for example, from

Sasao and Nakata's Japanese translation and Nguyen and Nation's (2011) Vietnamese translation, as cited in Lucovich (2014). This approach lacks consideration of the effects of word-length and visual complexity (see McLean et al., 2016 for the rationale for editing mere translations), and other confounding variables (for a comprehensive background to the complexities of cross-language research, see Ellis et al., 2004).

A more widely accepted approach is to draw the material from different language corpora (e.g., Ellis et al., 2004; Hoxhallari, 2006; Hoxhallari et al., 2004). In these studies, the stimuli were matched for word frequency and word length. While these approaches generally solve the problem of comparing psycholinguistic phenomena between languages, they are limited in their specific consideration of phonemic complexity, corpora, word-length, orthographic complexity, and they neglect age of acquisition and developmental level; in the present thesis, these two variables are particularly influential.

Other studies have solved the problem using objects or picture priming. However, picture recognition does not always translate evenly across the language barrier; "object names that are very common in one language may not be so in another, or objects that have a specific name in one language may have a generic name in another" (Sanfeliu & Fernandez, 1996), and so on.

The present thesis, therefore, documents a deeper analysis of the effect of priming, particular to Japanese learning *romaji* before English. Some of these considerations have largely been neglected in previous research. The variables include age of acquisition and its effect on lexis and word frequency, school curriculum and materials, native language phonemic frequency and fluency, word length, and orthographic/phonemic constraints. These confounding variables, if left ignored, would account for considerable variation in results if the primes were simply selected on criteria of previous research.

The aim of the tests was to collect as much information as possible about the cognitive processing of two vastly contrastive, non-native alphabetic orthographies. Although *romaji* is based on the Japanese phonetic alphabet (i.e., *kana*), *romaji* letters are not formally taught or assessed. English, on the other hand, is not based entirely on Japanese phonemes; some phonemes are phonetically and graphemically different, and some are non-existent. Therefore, if the tests accurately measure the language cognition then these gaps should be evident in the results. To achieve this aim, a series of tests were used to activate different cognitive processes.

This Chapter details the rationale behind selecting the primes for each test and predicts the expected results from these theoretical foundations. This Chapter then details the process of how primes were chosen, how they were allocated to each test, how they were modified for the nonword tests, and how the order of words was chosen.

The hypothesis for the test of prime selection relevance follows Ellis et al. (2004), Hoxhallari et al. (2004), and Hoxhallari (2006), justification based on their reading span. The response accuracy should be a function of word complexity, which includes word-frequency and word length. These results are discussed in the final section of this Chapter.

3.3 Approaches - Theoretical Rationale

The relationship between writing, spelling, recognising words, and implicit and explicit knowledge of spelling rules is not immediately obvious. In general composition, writers have substantial control over their choice of words, and for beginners, their vocabulary is an indication of their lexis, spelling ability and communicative competence. Writers also have the benefit of time, and access to technology to help these writing attributes. However, in a spelling test, this element of control is lost (Croft, 1982, p. 716); the writer is forced to rely on lexis, word image, and phonemic-graphemic accuracy. PG accuracy is affected considerably depending on word familiarity, phonemic complexity, and orthographic knowledge. A series of five different tests were used in an attempt to separate these three variables to reveal the influence of orthographic letter knowledge, transfer, and interference. The procedure for selecting primes for these tests will be covered in the next section.

In general, naming is a commonly used technique to measure efficiency in GP and PG mappings. In naming tests (e.g., Balota et al., 2004), participants are usually asked to pronounce visually presented words or nonsense letter strings. Many researchers have reported that word frequency affects reading ability. For example, Frost et al. (1987) reported that Hebrew readers were affected by word frequency to the greatest extent, followed by English and Serbo-Croatian readers. These differential results imply that word frequency is linked to varying amounts of lexical information that are necessary for the extraction of phonological information in the three writing systems. (Chen et al., 2015).

Due to the variation between languages, and age of acquisition, and other education factors, this Chapter also explains in detail the selection of words for the series of tests that were required for the novel approach presented in this thesis.

3.4 RAN Theory - Picture Naming

Picture naming is a process that is not entirely distinct from recognising visual stimuli like *kanji*, colours, shapes, or discrete items like pictures of a bus, a butterfly, or an astronaut. The task of naming these kinds of objects has been hypothesised to consist of three major processing components: object recognition, object comprehension, and lexicalisation (Warren & Morton, 1982). Assuming a visual stimulus is recognisable and familiar, the object activates a level of visual or structural recognition. Seymour (1979, as cited in Barry et al., 1997) suggests that known objects are each represented by a "pictogen", which are analogous in word recognition to Morton's "logogens". *Kanji*, therefore, rests somewhere between the two. For native Japanese, some *kanji* is processed similarly to the object that it represents. This is not true for all *kanji*. However, for early beginner level and high-frequency *kanji*, this general assumption holds true.

Familiar objects activate corresponding stored functional and associative knowledge. Associations in semantic representations permit items to be comprehended. From this comprehension, a response is primed, and it is from here the required output (i.e., spoken, written, categorisation, selecting, etc.) then influences the resultant speed or accuracy of the response (e.g., in a Stroop-test, the response can be a spoken or non-verbal response). In a classic picture naming test, the response is also verbal or selecting a picture or pressing a button. The present test, however, requires the participant to spell (i.e., write) the answer. This response stage is a result of the lexicalisation processing components mentioned earlier.

Some research has suggested that object naming is achieved without activation of an object's semantic representation (Kremin, 1986; Ratcliff & Newcombe, 1982). However, most theories support the notion that the pathway to spoken forms is first primed from phonemes that are activated via semantic representations (see Figure 2.4, Picture Input). This sequential analogy of word generation is supportive of the notion of semantic activation and lexicalisation (Barry et al., 1997). Lexicalisation may be achieved directly by using semantic codes to directly activate a phonological output lexicon (Humphreys et al., 1988; Morton, 1985). In shallow orthographies the phonological lexicon is converted directly to script, however, in opaque/deep orthographies additional processes are employed to produce spelling, hence the measurable delays in responses in these less predictable, opaque orthographies.

An alternate framework for word retrieval suggests that lexicalisation is achieved in two steps (Garrett, 1980; Kempen & Huijbers, 1983; Levelt, 1989), that is, *lemma selection* and *lexeme retrieval*. Butterworth (1980, 1989) and Butterworth et al. (1984) presents lemmas as a semantic lexicon made of non-phonological, word-specific representations that are organised by meaning. Lemma selection, however, requires an abstract representation of a word, which is not phonologically specified, as a mediator between conceptual/semantic and syntactic information and phonology. Lexemes, on the other hand, are representations of the phonological forms of words, which, once activated, are then encoded for articulation or processing into written form. It stands to reason, therefore, that pictures and word primes should require different processes, and as a result, take different times to produce in spoken or written form.

Naturally, speaking takes a finite amount of time and writing takes considerably longer, which consequently makes the measurement of lexical knowledge problematic. Writing is a physical process that requires additional motor skills and takes longer than speaking because letter sequences need to be scribed or printed by some procedure. One way to account for this different physical restriction is to have students say the word before spelling it, and measure the times between spoken onset and writing onset. However, there is no evidence to support any reliability in this approach. Another approach for measuring semantic and lexical knowledge is to categorise the pictures. Categorising pictures takes less time than naming or spelling words (Potter & Faulconer, 1975), suggesting a different route than that for word recognition. Either way, using words as primes can bypass the necessity to semantically mediate production (Barry et al., 1997; Morton, 1985) and would, thereby, render this study futile. Therefore, the present method assumes that by demanding only writing production, the cognitive process is more specifically focussed on orthographic knowledge and word spelling knowledge.

Therefore, primes in RAN test in this thesis use *kanji*, colours, numbers and shapes, pictures with audio, and the names of alphabets to provide the necessary stimulation to semantically mediate phoneme to grapheme production, before writing (Brooks, 2015). Although these primes are not words in actuality, the criteria for selection and inclusion were the same as for written words, simply because the output required written word production. Each category of words has a slightly different priming effect that has not been covered in great detail in the literature on orthographic depth, or cross-language facilitation. In all of the tests mentioned thus far, the focus has predominantly centred on word frequency. In the present study, however, each genre of words is presented together in separate sets, to further prime the semantic areas, and reduce the influence of confusion. I.e., the genre serves as a positive semantic prime.

3.4.1 The Choice of Categorising

Evidence of word genre stimulating semantic priming was studied in masked priming experiments (Rastle et al., 2004). Rastle et al. (2004) studied morpho-orthographic segmentation in visual word recognition. They broke the words down into syllabic segments (e.g., corn + er and deal + er) and presented these primes as words, thereby bypassing the lexicalisation stages mentioned earlier. For word recognition, there would certainly be a measurable benefit of lexical access, and word familiarity. However, this morpho-orthographic segmentation process is insensitive to semantic factors; it simply cannot capture the “morphological relationship between irregularly inflected words and their base forms (e.g., fell–fall, bought–buy)” (Crepaldi et al., 2010, p. 83).

Most theories of morphological processing proposed that complex words are decomposed into their constituents only if the complex word is related in meaning to its stem (e.g., Giraudo & Grainger, 2001; Marslen-Wilson et al., 1994; Plaut & Gonnerman, 2000). Evidence from visual priming (Rastle et al., 2000) suggests that morphologically-complex words prime their stems only if they are semantically related (e.g., *government* primes *govern,* but *department* does not prime *depart*). With only a limited number of exceptions (Diependaele et al., 2005; Feldman et al., 2009), these studies suggest that semantically-transparent pairs like darkness–DARK and pseudo-morphological pairs like corner–CORN prime the target much greater than non-morphological primes like brothel–BROTH, because '-el' never functions as a suffix in English and should therefore not be in the semantic knowledge, unlike brother-BROTH. From this evidence, many have also concluded that these observed priming effects cannot be attributed simply to orthographic overlap (Devlin et al., 2004; Kazanina et al., 2008; Longtin et al., 2003; Marslen-Wilson et al., 2008; Rastle & Davis, 2008; Rastle et al., 2004).

Evidence that was available during the early development of this thesis (Crepaldi et al., 2010), suggests that genre has an influence on priming. Words alone, with no semantic connection, either fade in memory or fail to prime. This is important because similar primes (i.e., lexical, semantic, and visual similarities) should be avoided to prevent learning from the test because previous test targets have been found to prime subsequent test results (Crepaldi et al., 2010). Three experiments that measured the effect of priming between unrelated words with irregular inflections but similar orthographic patterns (Crepaldi et al., 2010) found that 'fell' facilitates the semantically connected word 'fall' more than the orthographically-, and somewhat phonologically-, matched word 'fill'. No priming was found "when [semantically] unrelated words showing the same orthographic patterns were tested (e.g., tell–tall vs. toll–tall)" (Crepaldi et al., 2010, p. 83).

This evidence suggests that without semantic priming, subsequent primes may not be influenced. On the other hand, if semantic knowledge is language-dependent, then the lexis is also language-dependent and, therefore, primes a language-dependent phonology. This may cause concern whether *romaji* facilitates English at all. However, the written primes take a different route to language production, which will be covered in the TACHiD test (see Section 3.5), which uses words, and pseudowords to prime written production.

3.4.2 RAN - Picture Naming Prime Selection

The RAN test is designed to test lexical knowledge and spelling ability. To achieve this end, primes were selected from word lexis and matched for the age of acquisition. AoA was a previously neglected variable, and in most of the studies, the issues requiring attention are mitigated in some fashion or another, usually by testing fluency of developed learners, not developing learners (for an example of how AoA was somewhat neglected, see Ellis et al., 2004). Selecting primes for use with developing learners, however, requires attention that has been neglected in many earlier studies because developing learners do not have the same access to words that are represented in national corpora, usually based on the literate population. Additionally, many of the earlier English cross-language studies neglected the much larger ESL community, the members of whom have a somewhat different vocabulary (see Granger et al., 2015) than that reflected in national corpora. Therefore, the methodology for selecting stimuli for the present study was based on word frequency, albeit with consideration to students' native language acquisition at school, for spelling Japanese words in *romaji*, and based on the textbook for English words, remaining mindful that pre-2020 Grades 5 and 6 English text-books are, for the most part, void of text. Therefore, pictures, colours, figures, and alphabet frequencies were used.

With the procedure for word selection justified, the next task was to choose the genre and what order the genre should be presented. The genre was also built upon the framework of frequency and task familiarity.

3.4.3 Kanji and Kana Selection

Elementary school children in Japan spend a substantial amount of time learning *kanji*. In fact, *kanji* and *kana* are the scripts that facilitate the entire curriculum. Children start learning 80 of the easier *Joyo kanji* toward the end of the first grade (Ellis et al., 2004), and continue to learn progressively more complex *kanji* as they progress through school. The sequence of learning *kanji* in the curriculum is standardised, and by the end of elementary school children are expected to have mastered just over one thousand unique *kanji* characters (Harris & Hatano, 1999, p. 217), and are expected to master the complete set of *Joyo kanji* by the end of the third year of junior high school (i.e., in Grade Nine).

Hiragana and *katakana*, on the other hand, are mastered at different ages and at different rates. *Katakana* are predominantly used to represent the phonemes of foreign words and, therefore, require extra time to master. The acquisition of *hiragana* orthography (see Harris & Hatano, 1999 for a detailed explanation) is theoretically learned in three phases (Frith, 1985). First is the logographic phase, where individual letters are learned on appearance, like picture naming. Second is the alphabetic phase where individual letters (shape recognition) can be attended to. The third phase is where orthographic strategies can be utilised to break words down into smaller units or recognise words as whole items (lexical access). These strategies for mastering *hiragana* are usually completed by most healthy individuals early in the first year of Elementary school.

Due to this familiarity with early level *kanji* and *hiragana*, these familiar items are included in the first set of primes. These primes were ordered in word frequency, AoA order and *romaji* word length. Word length is important for shallow orthographies because it is influential to speed and under timed responses ability to complete. Through this careful selection criteria, each *kanji* and *kana* can be assumed to be present in every individual's mental lexis. Therefore, these primes are useful in establishing, with some degree of certainty, *romaji* writing ability, because the *kanji* and *kana* complexity and familiarity will not modulate the cognitive demands on transliteration to *romaji*.

3.4.4 Colour Selection

By the time a student enters grade five in elementary school, they should have acquired a firm understanding of the *kanji* that represent each of the fundamental colours used in this test. Therefore, colour primes were ordered in word frequency and *romaji* word length. Word length is important for shallow orthographies because it is influential to speed and under timed responses ability to complete.

RAN tests are predominantly used for language processing issues and test an individual’s ability to name a series of items. RAN tests have been effective in assessing the recognition of primes, and the existence of lexical knowledge. The effectiveness of using words as primes in a RAN test has been contested in the past, and this section elucidates that word primes in RAN tests bypass the very part of language cognition that is being attempted to measure, that is lexicalisation and its connection with phonology in an individual's mind.

The success of the RAN in standardising results is reflected in its use in the Comprehensive Test of Phonological Processing (CTOPP). Tests between transparent alphabetic orthographies and English (Moll et al., 2009) provide specific evidence to this anecdotal assumption and subsequent empirical/experimental research. Therefore, the following two sections detail the three tests that were adopted and developed to measure implicit and explicit knowledge of *romaji* and English for the present thesis.

3.5 TACHiD - Tachistoscopic Identification

The Tachistoscopic Identification (TACHiD) test (Miller et al., 1954) controls the amount of letter information presented to the observer; this is usually achieved by controlling the exposure duration of a word. Words of varying familiarity are used and the familiarities are measured as a function of letter sequence. The most random words are first order (i.e., there are no familiar letter clusters) up to fourth order, which are words with 4-letter familiar sequences. The number of letters that are identified usually increases when the stimulus sequence provides a context, through a recognisable phonetic pattern. This recognisable pattern is indicative of lexical access and is assumed in the present test to indicate native language and second language familiarity. The speed of reading, and the accuracy or reproducing this memory trace into writing is, therefore, assumed to be a function of familiarity with the language. The TACHiD test will, therefore, be used to verify familiarity with *romaji* or English and hopefully provide an index of familiarity for later trials in the future. Therefore, words that follow a CV structure, should be more easily remembered by native Japanese.

The tachistoscope is a device for presenting a visual field to an observer for a carefully controlled time interval. The earliest examples were predominantly mechanical. These, however, could produce neither the briefness nor the accuracy of exposure required. In consequence, modern tachistoscopes are generally electronically controlled. The range of exposure timing in modern tachistoscopes extends from one millisecond upwards at virtually any required interval of or above one millisecond (Taylor & Maslin, 1970).

Early efforts by psychologists to assess attention in the context of intellectual or other cognitive testing typically relied on tests such as digit span, which provided a useful measure of attentional focus and span, but did not address other important elements of attention, such as the patient's' ability to selectively attend to information or to sustain attention (Cohen, 2018). Sustained attention was particularly difficult to assess using traditional paper-and pencil tests, as it required the measurement of signal detection performance over extended periods of time. Psychologists typically relied on behavioural observation or analysis of patterns of inconsistency in test performance over time to derive evidence of sustained attention problems. The development of the tachistoscope for rapid presentation of visual stimuli with controlled timing provided a means of circumventing this problem (Cohen, 2018)

Tachistoscopes can be used to increase the speed of the recognition of visual stimuli, to present an image too quickly to develop a conscious perception (subliminal), or to help determine which elements of an image are memorable. The device has been used in research in perception and visual attention and in commercial marketing where it has been used to gather information about preferences and the memorability of product packaging even when the stimulus is subliminal (Correia, 2018).

Early work by Wilhelm Wundt laid the foundation for psycholinguistics. Although Wundt did not have the benefit of the linguistic insights that give the modern field its power, he developed an early theory of speech production and used reaction time and other experimental measures that are still the basis of much psycholinguistic research. According to the structure of language and its mental representation, every human language is hierarchically organised and can be described in terms of its component subsystems (Ratner & Gleason, 2017, p. 2). These systems include phonology, the lexicon, morphology, syntax, and pragmatics and discourse (see Ratner & Gleesson for further detail regarding the neurological and behavioural rendition of this “hierarchical” framework).

To study the ordinarily preconscious stages preceding the conscious percept, percept-genesis makes use of the technique of information reduction. The same stimulus is presented repeatedly at successively longer exposure times by means of a tachistoscope. Each time, the subject reports what has been seen, verbally and perhaps with a simple drawing. The shortest time used may be of the order of 10 milliseconds. Such trials are continued until the subject is able to give a report of stimulus contents at an intersubjective level. The longest times used in a percept-genetic serial are about 2500 milliseconds (Westerlundh, 2004, p. 96).

"Percept-genesis" (Kragh & Smith, 1970, as cited in Westerlundh, 2004) refers to the micro-development of “percepts”. The percept-genetic theory of perception is micro-genetic. A general definition (Hanlon & Brown, 1989) of “micro-genetic” refers to the structural development of cognition (i.e., an idea, percept, or act) through qualitatively different stages. The temporal period of this development extends from the inception of the cognition to its final representation in consciousness or actualisation (expression) in behaviour" (Westerlundh, 2004, p. 91).

A deficit in phonological awareness is assumed to hinder the acquisition of phonological coding, leading to deficits in nonword and word reading accuracy as well as phonological errors in spelling. The cognitive mechanisms via which a RAN-deficit affects literacy development are less well understood. Slow naming speeds prevent the precise integration of visual information about letter sequences in words and, therefore, inhibit the build-up of an efficient orthographic lexicon (Bowers & Newby-Clark, 2002). The deficit may not necessarily be located at the formation of visual inter-letter associations (Wimmer et al., 2000) but could also be located at the formation of associations between the phonemes triggered by graphemes or at the formation of associations between the graphemes of the written word and the segments of the phonological representation (Moll et al., 2009, p. 2).

3.6 ODT - Orthographic Decision Tests

The orthographic decision test (ODT) is a non-verbal response test that arguably bypasses the PG and spelling requirement of the previous tests. As the name suggests, a prime is presented and the individual is required to select what looks like *romaji* or English. The present test uses both real and pseudowords that contain orthographic constraints of one language or the other. In some cases, words could be either, and, therefore, indicates a language preference according to familiarity, that is usually lexical.

Before testing spelling, two non-verbal tests of explicit and implicit knowledge of orthography will be conducted. Implicit knowledge of orthography should yield quicker response times and greater accuracy. The first of these tests is an Orthographic Decisions Test (ODT). The ODT measures orthographic understanding, ability, preference, and can be used to assess errors in reading and later in spelling. A word, or orthographically possible nonword is presented for 300 milliseconds. The participants have three seconds to decide if the word is *romaji* or English and respond on the response form. This test is effective in measuring orthographic transparency effects, and the awareness of the structure of the spoken language (i.e., the development of phonological skills is significantly affected by the transparency of the orthography). Individuals from an opaque language background should be able to process the second language's transparent orthography accurately, but onset and duration should be greater, at least until lexical access to the second orthography is established.

3.7 ORT - Orthographic Recognition Tests

The second non-verbal test of explicit and implicit orthographic knowledge is the Orthographic Recognition Test (ORT). The ORT indicates an individual's knowledge of orthographic rules. The distinction here is that it is limited to letter combinations and not phonemes and is fundamentally void of lexical access, uses explicit reasoning, and in some cases 'gut-feelings' of implicit rules, because it uses nonwords. The primes are presented randomly for each language with an indication of the language under test. For example, (Japanese) '*xenon*' - 'x' cannot be in Japanese *romaji*; the correct response would be 'X' (i.e., not possible). Then, for English, '*xteng*' - 'x' cannot precede 't' in the English onsets position, but it can be positioned at the end, in the rhyme, like in the word, '*next*'. The response for this would not be 'OK', but 'X' (i.e., not possible). The response and delay are normally recorded. However, in the present test, response times could not be used. Instead, fixed times are given for the response and errors are recorded. This task is useful in indicating cognitive understanding of the legal representations of words (Wang et al., 2005). This test is similar in most respects to the previous test, however, it uses nonwords. The words will be displayed on a computer screen for two seconds as with the previous test. Non-responses will also be recorded and become part of the analysis.

3.8 Prime and Test Procedure - Considerations

This section discusses the development of the primes and test methods that were necessary for the measurement of orthographic depth, interference, transfer, and the eventual development of the orthographic gap hypothesis (OGH). This section provides a background setting to the general problem of changing the type of prime and changing the application procedure. Then the hypotheses of what each prime and test type should measure according to the processing differences between pictures (i.e., words, numerals, shapes, aural stimuli) for writing are presented. The differences in processing decision tasks and how they are different for pictures, words, and non-words.

The reason this Chapter is important to this and subsequent studies into orthographic influence, transference, and interference is discussed. The Chapter concludes with a summary of the primes and their expected correlation with errors. The results suggest that the primes were ordered in sequential stages of difficulty, as was hoped for in other earlier studies (Ellis et al., 2004; Hoxhallari, 2006) that merely used word frequencies and word length as a guide to the word span tests.

3.8.1 Prime and Stimuli Selection

It is common in psycholinguistic studies to use primes that are drawn from national corpora (e.g., Ellis et al., 2004; Hoxhallari, 2006) or established lists like Snodgrass and Vanderwart (1980) picture lists to estimate productive language (e.g., Laufer & Nation, 1995). The shortcomings of these approaches to the present research were discussed earlier (see section 2.4.4). The primes in the present study, however, had to be relevant to these children's developmental age, and chosen according to this age specific word frequency, and then graded according to word complexity.

Primes were chosen specifically to facilitate or have a negative influence or gap in phonology and orthography that are different to *romaji* and English. Usually phonology and orthography are similar, but in *romaji* and English they are different because phonological and orthographic gaps are not correlated. For example, there is phonology that does not exist in Japanese but the orthography exists and is possible. Another example is the word “year” in English is possible because we can pronounce the sounds |ya|, |yi|, |yu|, |ye|, and |yo|. However, Japanese phonology is void of |yi| and |ye|. Therefore, this presents a phonological and graphical challenge to Japanese students. In English there is a similar problem. For example, in English the two words, “rice” and “lice” are not distinguishable in standard Japanese. Japanese can spell “rice” - “ri” is in the Japanese *romaji* alphabet, but the phonology is different. “ri” is pronounced similar to |li| (i.e., Japanese *romaji* is void of “L”). These are some obvious examples of where the phonological and orthographic gap causes conflict. The interest in this thesis is the effect of phonological gaps on orthography but the main focus is on orthography.

3.8.2 Converting Words to Pseudo-Words

There are apps for jumbling words and their letters (e.g., https://www.wordgenerator.net/fake-word-generator.php), but the results are not sensitive to orthographic frequency and phonetic frequency nor orthographic possibility. Using an app makes it difficult to control these randomisations within orthographic possibilities. The ODT also required nonwords that were breaking orthographic rules in both languages. For example, in the English test, orthographic rules can be flouted by using "TS" at the beginning of a word, but this combination is an orthographic possibility in Japanese, but not in English.

3.8.3 Selecting Priming Sequence

Word frequency (Zipfs' law) was the first variable considered in the sequence of ordering primes. Word frequency, according to Zipfs' Law, dictates that smaller words are usually high in frequency and easy to write. So, on the task dependency scale, to get students into the habit or act of writing, smaller words were presented first. Also, high-frequency combinations were given so possibilities were presented first. That way, the students were encouraged to continue the test. Words toward the end of the test, and never two in a row, were challenging. Impossible words were rarely presented following each other because students of this age and developmental process (beginner) needed to remain encouraged to continue. In fact, Japanese education dictates that English education must remain positive. Therefore, impossible words were intermixed with less challenging primes. Third, last words in every test were always tremendously challenging; the second last word was possible; last words were almost always impossible to complete. Consequently, the first word of the following test was always easy and simple to write, to encourage participation and repair the negative effect.

3.8.4 Selecting Test Order

The DRM is an illustration of the influence that various stimuli have on cognition. The order of primes in every test was chosen with purpose. Every effort was made to provide variation in complexity, so as to invite both challenges and encouragement through the provision of less complex challenges. The first prime in every test required rudimentary skills to write, and the final prime in each test set was designed to present a considerable challenge.

The order of priming genre was not left to chance but based on first, contextual salience (i.e., regular, high-frequency *kanji* and *kana*). Also, the choice was to modulate processes that stimulate different input areas of the brain. *Kanji* was first because of the strong association with reading and writing and the *kanji* that was chosen was, for the best part, reliably represented by a single phoneme. Colours were tested later in the sequence because spelling colours from visual priming requires greater cognitive processing and there are fewer cues to phonology. The numbers and shapes access procedural knowledge, and shapes and numbers test other attributes about development and any disabilities. Spelling ability was tested using the oral naming of items with rare and confusing alphabets. "Rare" because students had little practice in writing in *romaji* and there is an orthographic gap. Phonemic tests were conducted using letter combinations that sound similar to Japanese. For example, "A" and "I" sound similar when set apart for Japanese but "AI" is easily distinguished and they are high-frequency letters. So, this is the test for basic writing and listening ability. Any students who failed this test would be removed from the research. However, no students were found to fail this test and, therefore, all students' results remained in the study.

TACHiD tests phonemic reading ability and spelling ability are an indication of lexical knowledge and recall. This is an implicit test of orthographic knowledge. ODT and ORT are both explicit tests of orthographic knowledge. Showing explicit and implicit memory (Graf & Schacter, 1985; Schacter, 1987, 1994) is based on the way previous knowledge and experience is revealed. Explicit memory involves "direct, intentional, and conscious retrieval of some previous experience" (Treiman, 1997, p. 485) (e.g., in tests of recall or recognition). Implicit memory of previous experience and knowledge is revealed through tests that produce enhanced performance. Also, priming of perceptual identification (Jacoby & Dallas, 1981) or word fragment completion (Graf & Mandler, 1984) tasks requires no conscious or intentional attempts to remember the original experience. Therefore, if explicit knowledge is primed before implicit knowledge, we no longer have a valid implicit knowledge test (Ellis, 2005). Treiman (1997) investigated the type of priming and the effect of the duration of exposure on spelling.

Finally, the importance of providing clear directions to students during the test cannot be understated. Failing to provide clear, and simple directions to the test have a tremendous influence on reliability (Treiman, 1997, p. 345).

3.9 Prime and Test Verifications

The present test required the selection of primes that could be used to determine the alphabetic lexical knowledge of Japanese students with rudimentary *romaji* skills and little to no English reading or writing ability. The primes include pictures, alphabets, and pseudowords. The selection procedure was sensitive to word frequency, phonemic and graphemic frequency combined with AoA, and each prime was graded for word complexity. Word complexity is dependent on word length and phonemic and graphemic complexity, thereby providing the capacity to measure the orthographic gap hypothesis presented in this thesis.

3.9.1 Conceptual and Theoretical Frameworks

This section uses a hybrid approach to creating a list of primes. One popular approach for picture naming has been to utilise the Snodgrass and Vanderwart (1980) picture list, albeit standardised for such variables as familiarity and visual complexity. Word frequencies were used merely as a guide in this study because these alphabetic pre-iterate students could not be assumed to have the lexical ability of adults. Therefore, the school textbook corpus was used, and the learning order was prioritised. That is most recent items were assumed to be higher frequency because they are presented repeatedly in present lessons, items learned earlier were assumed to be possibly lexical retrieved, and later items in the book were assumed to be not yet taught. Therefore, these items would have to be processed, or constructed by guessing or some phonological to grapheme conversion.

3.9.2 Procedure

The approach was guided by earlier works by Barry et al. (1997). Independent measures and tests were conducted to verify the validity of the primes used in the current thesis. Many tests for RAN use the black and white line drawings of familiar objects. In recent years, pictures with greater detail, 3D imaging, and colour have been used, but lack the necessary validation within and between languages. Therefore, pictures that reflect the level of drawing clarity in student school books, and animation were used. All items were rendered to similar shading, line width and detail. Each picture, however, was matched to orthographic specifications, using the following procedure.

Word frequency measures, both written and spoken, were taken from the Celex database (Centre for Lexical Information, 1993, as cited in Barry et al., 1997). Major determinants of picture naming speed were the frequency of the name, the interaction between AoA and frequency, and name agreement. The main effect of the AoA of the name and the effect of the rated image agreement of the picture was also significant on one-tailed tests. Spoken name frequency affects object naming times mainly for items with later-acquired names (e.g., Barry et al., 1997).

3.9.3 Material

Picture Naming Tests were divided into genre-specific categories, containing a test stimulus, followed by six primes, presented in progressive complexity. These words were chosen initially from the school's Japanese textbooks for Japanese, and the English textbook. The words were then tagged with corpora and word statistic information that indicated word frequency, syllables, and complexity. Complexity includes letter recognition/confusion, combination complexity, and syllable length. These complexities become important in the final iterative analysis of orthographic influence and the OGH presented later in this thesis. Finally, these words were then illustrated as easily recognisable, line drawings to provide consistency of pictorial representation, as was originally deemed necessary in Snodgrass and Vanderwart (1980).

Nonwords were also necessary for the orthographic decision and recognition tests, and the TACHiD test. These words were constructed from the students' developmental corpora. Once again from familiar words learned earlier, familiar words that are presently being learned, and words that should be learned in the future. Substantial effort was taken to arrange words in a fashion that would not flout the orthographic rules of the language under test. This means the nonwords were legal orthographic possibilities. Nonwords and words for the orthographic decision and recognition tests were similarly chosen, however, illegal orthographic representations were constructed in order to test the implicit orthographic understanding of Japanese represented in *romaji* and English. This test is also used as an English ability test.

The stimuli were then arranged into presentation software (Google Slides), in the same order as the complete test (see Appendix K). Each set started with an introduction slide that explicitly and implicitly reminded the participant of the language that was under test. The languages were not jumbled to avoid confusion. For adults, this would be preferred, but young learners do not have the resources to draw from to start predicting the test. Also, the number of primes was small, and the graduation of difficulty was great enough to stifle semantic or other interference.

All stimuli were presented for only 300 milliseconds and students were given a limited time of 3 seconds to respond. The first item was always followed by a short break to test that students were writing in the correct area of the response form. Usually, the last stimulus was beyond the level of students, so a little extra response time was allowed, so that errors could be assessed.

3.9.4 Prime Statistics

This section provides a preliminary test based on word/phoneme/grapheme frequency, AoA, orthographic complexity, word length, and syllable/mora count. The purpose of providing this data is to allow for prime effect prediction and analysis. Also, the list also provided further evidence that normative data of cognitive stimuli cannot be taken into another language directly; object names that are very common in one language may not be so in another, or objects that have a specific name in one language may have a generic name in another (Sanfeliu & Fernandez, 1996), and the word frequencies, word lengths, and word complexities are not similar (Ellis et al., 2004).

Another test of consistency (Snodgrass & Vanderwart, 1980) was from word complexity to picture recognition. If the pictures were hard to understand, the prediction is that the results would be adversely affected, beyond the orthographic exceptions. For example, if an apple returned more errors than an elevator, then there would be a serious problem in the test, because apple is also occasionally referred to in its foreign lone word equivalent, アップル (Jp). The letter 'l' is absent from *romaji* but it is present in both words with the vowel 'e' following. Also, 'v' is non-existent in *romaji*, therefore, "elev\ator" should return greater errors. Needless to say this example serves as an illustration of the considerations to the present consistency tests for the black and white images presented in the RAN tests.

3.9.4 Predictions and Prime Specification Test

Word accuracy should be inversely correlated with word complexity with a CI of 90% or better. Any variation from this correlation will be a result of some other confound, for example visual representation confusion; orthographic familiarity; and/or conceptual translation between words normally written in another script type (e.g., *kanji* or *kana*).

Prime specification testing was suggested in Gregg et al. (2008). The main interest was that every prime in the series of tests returned a similar characteristic. The prime specification test was incorporated into the main test. The method and results are in the following two Chapters showing that less familiar words should be associated with greater errors. This was merely used as a general test of usefulness for the present test.

3.9.6 Summary of Controls

This study aims at assessing how bilinguals select words in the appropriate language in production and recognition while minimizing interference from the non-appropriate language. Two prominent models are considered which assume that when one language is in use, the other is suppressed. The Inhibitory Control (IC) model suggests that, in both production and recognition, the amount of inhibition on the non-target language is greater for the stronger compared to the weaker language. In contrast, the Bilingual Interactive Activation (BIA) model proposes that, in language recognition, the amount of inhibition on the weaker language is stronger than otherwise.

When a speaker of more than one language (i.e., a bilingual) processes a language, words from the non-relevant language might be activated and interfere. This interference may occur during speaking, but also during writing, listening, and reading. The ability to confine mental processing to the relevant language is called “language control” and is essential for successful communication, particularly with mono-lingual individuals (see Mosca, & de Bot, 2017 for a comprehensive list of research on language control). These authors have committed most of their attention on language production, while much less attention has been devoted to language recognition (e.g., Grainger & Beauvillain, 1987; Orfanidou & Sumner, 2005; Thomas & Allport, 2000; von Studnitz & Green, 1997, 2002; Wang, 2015).

Moreover, language production and recognition have been often investigated separately, resulting in a lack of clarity in whether the two processes rely on the same or different mechanisms. The present paper focuses on bilingual language control in recognition and production.

While language control comes at a cost, there are also “costs” involved in language switching. To measure switching costs and study how bilinguals control their languages, a language switching paradigm is required. The language switching paradigm includes two types of trials, repetition trials (stimuli in the same language as in the preceding trial, e.g., L1-L1) and switch trials (stimuli in a different language compared to the preceding trial, e.g., L2-L1). Responses on switch trials are usually less accurate and slower compared to repetition trials, and this difference is referred to as a language “switching cost” (Meuter & Allport, 1999). Therefore, the grouping of primes in the nonword tests avoids switching. These considerations are incorporated into the method explained in the following Chapter.

CHAPTER FOUR
METHOD

To examine the orthographic influence of learning *romaji* before English, a series of five tests were administered in February 2020 to five groups of Japanese public elementary school students (N=134) in their third term of Grade-5. Students responded to a variety of priming and stimulus materials on a paper writing response form. Visual primes were presented on a screen at the front of the room. The test duration was approximately 30 minutes.

The educational setting and testing opportunity that was provided had a tremendous impact on the eventual approach, research outcomes, and subsequent theory that was necessary for inclusion in this Thesis. The educational setting was before the change of curriculum in Japanese schools, set to commence in term-1 of the year 2020. Therefore, these Grade-5 students had undefined *romaji* orthographic knowledge, and almost one year of English CLT experience, albeit void of reading and spelling. Therefore, these individuals are assumed to be provided limited knowledge of the English alphabet, the letter names and sounds, or orthographic conventions. The only knowledge that could be assumed is that which could be transferred from the limited, usually unsupervised practice they received during their *romaji drills*. Also, the tests had to be completed in large groups, in the home-room (MA-ES) or special purpose classroom (FV-ES), with a licensed Japanese teacher present.

This study employed no controlled or explicit determination of L1 and L2 preference or ability. Instead, the tests assess first and additional language knowledge using covert analysis. These assessments were later used for making inferences about students' language learning backgrounds and consequential performance. From these covert data, the majority of the students were found to be L1 Japanese with little knowledge of English spelling or reading, except that which could be employed from L1 *romaji*. Therefore, most of the participants have had two years of *romaji* practice and have acquired Japanese phonemes. The ability to produce these phonemes using *romaji*, however, is questionable, because *romaji* is not tested in school.

4.1 Participants

Participants (N=134) were all in the second term of the 2019 fifth-grade and were aged between 11 and 12 years old. Both schools had a longstanding relationship with the researcher, which helped the facilitation and necessary ethical clearances required of this research. Ethics approval was first obtained to conduct this research from the University of Southern Queensland (see Appendix L).

Participant selection was left up to each schools' administration, for various reasons. First and foremost, Japanese public schools are responsible for student wellbeing, education, and safety; it is an unacceptable practice for individuals or organisations outside of the educational boundaries to approach students or parents. Additionally, allowing the schools to manage participant enlistment mitigated the influence of the researcher in attracting students and consequently skewing the student demographic because the researcher was considered "*ikemen*" (i.e., a popular attraction). Therefore, students were kept unaware of the identity of the researcher, until they arrived at the classroom and met the researcher.

4.1.1 School and Participant Demographics

Participants were from two Japanese public schools in neighbouring cities in southern *Kana*gawa-Ken, Japan. Both schools had no recognised extensive reading program in Japanese or English. English posters, books, and signage in the classroom and school grounds were sparse. English words like principal, toilet, library, and Japanese Kanji that would be met in the school grounds, were intentionally omitted from the data set. From the written results, some students were recognised as non-native Japanese, but their results indicate that only a few had outside English schooling. Finally, students who were recognised "gamers" responded with mixed results, some positive and others poor. These observations were left in the data set because determining this random and negligible environmental effect would be beyond the scope of this study.

The first school tested, Fuji View Elementary School (FV-ES) was assumed to be a stratified sample of students, whose parents showed general interest in English education and this research. Group-1 (FV1, n=15) were tested before lunch and Group-2 (FV2, n=28) were tested in the afternoon, soon after midday recess. On the following day, the second school (MA-ES) provided consent for the entire Grade-5 student population to be tested. This population was divided among three 5th grade home-room classes (MA1, n=30; MA2, n=29; and MA3, n=32).

To test the assumptions of stratification, gender bias, and identify any possible need for data manipulation, the general ability for each group was gleaned from the raw data collected from the RAN test results (see Table 4.1).

Table 4.1

Student Demographics – Gender, Average Age, and Ability Between Groups

	Populations (n)	Spelling Level (RAN) %	**Spelling (RAN-List) %**
FVES	Total (G1, G2, G3)	Total (G1, G2, G3)	Total (G1, G2, G3)
Boys	17 (6,11, -)	64.86 (73.42, 60.2, -)	72.44 (79, 68.87, -)
Girls	26 (9,17, -)	75.5 (69.09, 78.89, -)	79.32 (68.23, 85.2, -)
Total	43 (15,28, -)	71.29 (70.82, 71.55, -)	76.6 (72.54, 78.78, -)
MAES	Total (G1, G2, G3)	Total (G1, G2, G3)	Total (G1, G2, G3)
Boys	47 (15,16,16)	47.46 (32.32, 57.44, 51.66)	57.07 (42.16, 62.11, 66.01)
Girls	46 (16,14,16)	52.21 (52.61, 55.44, 48.98)	54.77 (53.4, 56.05, 55.03)
Total	93 (31,30,32)	49.81 (42.8, 56.51, 50.32)	55.93 (47.96, 59.28, 60.52)
Totals	Total (FV-ES, MA-ES)	Total (FV-ES, MA-ES)	Total (FV-ES, MA-ES)
Boys	64 (17,47)	52.08 (64.86, 47.46)	61.15 (72.44, 57.07)
Girls	72 (26,46)	60.62 (75.5, 52.21)	63.64 (79.32, 54.77)
TOTAL	136 (43,93)	56.6 (71.29, 49.81)	62.47 (76.6, 55.93)

Note. These results are drawn from the RAN test raw student data. List is the Listening test.

These data are available <here Demographics>

Table 4.1 provides a record of the orthographic knowledge of alphabetic scripts in the minds of Grade-5 Japanese elementary school students, before the introduction of English writing in elementary school. The gender bias is slightly skewed in favour of girls and the results also indicate that girls were slightly better at spelling than boys in all cases. The important factor is that the results are not significantly centred around one group of students, their classes, nor is there any significant influence of gender in this sample. However, these demographic results indicate the stratification of the FVES group. As mentioned earlier, because this group were volunteers, their interest was assumed to be an influence on ability.

4.2 Inclusion / Exclusion Criteria

Non-participants, and over performers were originally planned to be excluded from this study. The original inclusion criteria were for students to be void of any substantial contact with English education because the plan was to study the effect of learning *romaji* before English. However, due to local, Japanese constraints on the collection of private information, asking for information about private tutoring was forbidden. Therefore, the test had to include the covert collection of English ability via the data collected from the series of tests. The English ability test was integrated into the RAN Listening-test and TACHiD-tests.

Excluding non-performers was also redundant. The schools took responsibility for enlisting participants and as a requirement of local guidelines, all students had to have equal opportunity to any perceived benefit. Just before data collection, COVID-19 sanctions and restrictions were pending, which eventually prohibited students from attending school. Therefore, the test had to be modified to include the analysis and discussion of the data collected in groups, from the entire population of participants. Therefore, the original study of merely measuring orthographic difference was extended to analyse the influence of orthographic knowledge and the dependency and inhibition of orthographic knowledge in both directions and study the influence of order of acquisition.

4.3 Material

Various materials were developed specifically for this research (cf. Chapter Three details the development procedure). The age and developmental considerations of the participants required a specific list of stimuli, based on corpora for this group, and not on the general corpora for Japanese society, or other publicly available data. Second, the impact of the pending closure of schools from COVID-19 influenced any access to participants, privately or otherwise. This necessitated a significant change in the data collection method, and consequently the eventual materials that were required for this study. The tests had to be simplified considerably for those participants, while retaining the valuable characteristics for the collection of valid, cognitive and psycholinguistic data. The use of surveillance equipment and the associated data was also reduced; this data was only used for confirmation and checking consistency (see Table 4.2).

Table 4.2
Equipment and Material List for Measuring Orthographic Influence Between English and Romaji

Item	Purpose and Use
Presentation Slides	Total set of test slides used as primes (see Appendix K <here>).
Response Forms	One A4 size paper response page folded in a booklet form (see Appendix M available <here>).
Video Equipment	Two video cameras and three smart phones were used to record student writing responses, and ambient classroom audio (data stored <here> and is available by request).
Audio Recorders	Two Sony IC Recorders, ICD-UX 560F were positioned, one with the presenter, and another for classroom ambience. Used for cross checking any anomalies in timing or extraneous events (data stored <here> and is available by request).
Consent Form	Parent or responsible adult signed consent forms (stored in the researcher's vault and not available to the public).

Note. Copies of the data from these devices are available through the links provided in the text, the Appendices, or by contacting the author.

Audio recorders were used to monitor presenters' voices, delivery cadence, and timing. The reason for this is to confirm the reliability of the delivery. Cameras were used to monitor students' handwriting to also validate timing and monitor corrections or copying. The video evidence was originally proposed to measure response times. However, the test was changed such that the data analysis depended on errors more than response times, thereby making the stored camera data (available here) redundant.

A comprehensive set of pallets of primes is provided in Appendix-4. Access to the raw student data response form (i.e., with student writing samples) is provided in Appendix-5. Other video and audio data are available on request from the author (see the title page of this article).

4.4 Procedure

Two schools were tested in February of 2020, on consecutive days. The strict teaching schedule in Japan means it is reasonable to assume that progress through the curriculum was at a similar rate between the classes and schools. Therefore, it was feasible to assume that the students' progression, learning stage, and the teaching methods were also similar between the two schools. These assumptions were confirmed in consultation with the curriculum administrators and teachers in each school.

The series of tests were delivered in one, 30-minute sitting. The participants attended the tests in classrooms, each group at different times, in separate sittings. Each test was replicated as close as possible, and audio recordings were collected to validate the consistency in test delivery between each sitting. Students were seated in groups of approximately six, such that they could see the primes/stimuli-material with little effort. The stimulus materials were projected onto a screen at the front of the classroom; the audio primes were given in Japanese by the native female Japanese assistant and in English by the male researcher. Each test was given as consistently as possible as to remove any variability.

Every stimulus was preceded with an audible prompt to encourage students to raise their heads and look at the screen. Each visual stimulus was presented for 300 milliseconds on a screen at the front of the class. Students had at least three seconds to write their response on the A5-size response booklet. For more complex words, greater writing times (up to five seconds) were allowed so students could provide their procedural, lexical, or attempted understandings of spelling. At the completion of each test sequence, students were required to put-down their pencils and not erase their responses. However, corrections including striking-through or crossing out wrong responses and re-writing were encouraged. The response devices were recovered immediately after the final test.

Each test (see Table 4.3) was preceded by instructions given in English by the native English-speaking researcher, followed by Japanese instructions delivered by the native Japanese research assistant. Students were repeatedly encouraged to ask for assistance or halt the test if at any time they felt stressed or needed to rest. The total time allocated to complete the total series of tests was approximately 30-minutes.

Table 4.3

Test Phases, Test Types, Prime Types, and the Linguistic Features and Language Tested

Name, Type of Test	Type of Prime	Type of Test	No. of primes
RAN (Jp) <Visual Primes>	*kana*/*kanji*	Phonemic Lexical Jp Spelling	Japanese (n=7)
<Audio and Visual Primes>	Colours	Visual / Phonetic Jp Spelling	Japanese (n=7)
<Audio primes only>	Math Numbers and Shapes	Visual, Lexical, Fluency	Japanese (n=7)
<Audio and Visual Primes>	Pictures	Lexical, Fluency	Japanese (n=7)
<Audio primes only>	English Alphabet*	Aural, Naming	English (n=7)
TACHiD (Jp/En) Tachistoscopic Identification	Letter combinations	Word shape and phonetic knowledge	Mixed Japanese and English (n=14)
ODT Orthographic Decision Test	Legal orthographic combinations	Phonetic Lexical Knowledge, Orthographic Understanding	Mixed Japanese and English (n=18)
ORT Orthographic Recognition Test	Japanese Nonwords	Orthographic Rule Knowledge	Japanese (n=18)
	English Nonwords		English (n=18)

Note. * English Alphabet includes phonetically similar letter combinations that cause confusion in Japanese; the items were read aloud to test listening and writing skills of English orthography (e.g., A/I, D/Z, etc.).

Any variations between each test (e.g., disruptions, technical problems, or other issues), were noted and summarised in the results, Chapter Five. Each test slate is available <here> (see also Appendix K), and the list of primes, and expected results are detailed in Chapter Five. The following sections detail any differences of each test with the overall procedure discussed earlier.

4.4.1 RAN - Rapid Automated Naming

The Rapid Automatic Naming (RAN) test is similar in most regards to the classic picture naming test. In fact, this test does contain pictures. The difference is the participant needs to recognise the prime and respond with the name of the prime. In the present test, a prime is presented for 300 milliseconds and the participant must write their response on the first page of the response device (see Figure 4.1) in *romaji*.

Figure 4.1

RAN Test Response Device for Picture Naming Audio/Visual Primes

Note. Page-1 is on the first page of a 4-page booklet. Page-2 is on the reverse of the first page. This document can be retrieved from <this link>. Copyright 2019, Dusza.

The RAN test comprises five sets of seven slides (N = 35, primes). Each set has a title slide that gives the presenter (researcher) a chance to explain the subsequent test (see Appendix 4.1 for the complete set).

The Japanese students/participants are given instructions in Japanese only, similar to the following.

“During the next test you will see (a *kanji*, a colour, a number or shape, a picture). After you see the picture, write the name of the picture *in ROMAJI!* For example, if you see a ‘banana’, you write /ba/, /na/, /na/ (Jp), as soon as you can… Please don’t erase your answer. If you make a mistake just strike it out and try again. If you want to stop, please say wait, or raise your hand… Are you ready? Ok, here comes the first one. Are you ready? … ready, go… ready, go… [until the last slate]. Ok, pencils down. Well done!”

A similar procedure is used for the fifth RAN test, which uses audio primes. During this test, participants hear phonetically similar alphabets (i.e., alphabets that are often confused when seen or named apart). The instructions are given in Japanese, and are not completely the same as the previous.

“During the next test you will hear the name of English alphabets. You will hear two alphabets. Please write the alphabets when you hear them. For example, if you hear ‘t’, ‘s’ then you should write the letter ‘t’ and the letter ‘s’, as soon as you can. Are you ok? ...Please don’t erase your answer. If you make a mistake just strike it and try again. If you want to stop, please say wait, or raise your hand… Are you ready? Ok, here comes the first one. Are you ready? Ready… ‘A, I’; ‘D, Z (i.e., long /zee/ name, not /zed/)’; …, ‘B, P’. Ok, pencils down. Well done!”

After each section, students should put their pencils down to avoid making corrections, or copying. This requirement is a data integrity issue. Students then wait for the next set of instructions for the TACHiD test.

4.4.2 TACHiD - Tachistoscopic Identification

The Tachistoscopic Identification TACHiD test is sensitive to an individual's familiarity with letter sequences. The TACHiD test in this thesis comprises 14 randomly sequenced, research problem-specific (see Chapter Three) pseudowords. The format for presentation and response is identical to the picture primed RAN test presented previously (see Section 4.2.1). The prime is preceded by an attention phrase (e.g., a series of beeps or “Ready, go!”). The prime is presented for 300 milliseconds and the participant is given 3000 milliseconds to write their response. The participants' responses are written by hand on the response device (see Figure 4.2).

Figure 4.2

TACHiD Test Response Device for Pseudoword Naming


英語とローマ字のクイズ・チャレンジ
(2020 5 年)

	レベル 1	レベル 2	レベル 3
1			
2			
3			
4			
5			
6			
7			

Page - 3

Note. Page-3 is next to page-2, inside the 4-page booklet. Only level-1 and level-2 were tested, because of time limitations. This document can be retrieved from <here>. Copyright 2019, Dusza.

4.4.3 ODT - Orthographic Decision Test

The Orthographic Decision Test (ODT) requires participants to choose which language is presented, based on their knowledge of their understanding of orthography of the language presented. The test comprises 18 randomly-sequenced, task- and language-specific, real- and pseudowords. The procedural formats for presentation and responses are identical to the picture primed previous test; however, no spelling is required. This therefore acts on short term memory, lexical memory of known letter sequences, or attempted mapping with phonemes. The prime is preceded by an attention phrase, which corresponds with the prime number, counted in Japanese (e.g., for the first prime, "*ichibanme*", for the second prime, "*nibanme*", and so on). The primes are presented for 300 milliseconds and the participant is given 3000 milliseconds to circle if the word looks Japanese (日), or English (英) on the A5 size, paper response form (see Figure 4.3).

Figure 4.3

Response Device for ODT, ORT-1 (Jp), and ORT-2 (En)

英語とローマ字のクイズ・チャレンジ
(2020 5 年)

選びなさい 日本語/英語			日本語に似てる言葉を選びなさい (丸をつけてください)		英語に似てる言葉を選びなさい (丸をつけてください)	
1	日	英	beffu	beff	shen	hsen
2	日	英	darru	daru	rour	ruor
3	日	英	yaki	yiki	taiy	taly
4	日	英	foxsu	fokusu	fehs	fesh
5	日	英	takoyyaki	takoyaki	drater	adrter
6	日	英	windo	wando	bwey	ebwey
7	日	英	umaaru	umarru	ngyen	nguni
8	日	英	biznessu	buzinesu	absovle	absolver
9	日	英	yesukami	yasukami	resilca	rselica
10	日	英	sudhaka	sudohaka	dgedo	dodge
11	日	英	byakun	bykun	libyrar	bylriar
12	日	英	shishuu	sishu	quaff	ffaqu
13	日	英	bemnei	benmei	thrawn	warthn
14	日	英	repna	renpa	voil	viol
15	日	英	zoku	zokyu	wizened	zewined
16	日	英	ganko	gaknyo	susurrus	srusrus
17	日	英	enpitsu	tsuenpi	chimiecr	chimeric
18	日	英	denseisa	desnaise	continue	cotniune

Page - 4

Note. ODT response device (Column-1) Participants should indicate Japanese (日), or English (英). ORT (Japanese and English) Participants choose which word looks like the language corresponding to that column. Page-4 is on the last page of the 4-page booklet. This document can be retrieved from <here>. Copyright 2019, Dusza.

4.4.4 ORT - Orthographic Recognition Test

The Orthographic Recognition Test (ORT) requires participants to choose which word belongs to the language. This process differs considerably from the ODT mentioned previously. The test comprises 18 randomly sequenced, scientifically constructed, task- and language-specific, real- and pseudowords. The procedural formats for presentation and responses are identical to the previous tests; however, no spelling is required. The prime is preceded by an attention phrase corresponding to the prime number, counted in Japanese (e.g., for the first prime, "*ichibanme*", for the second prime, "*nibanme*", etc.). The primes are presented for 300 milliseconds and the participant is given 3000 milliseconds to circle which word looks like the language under test, on the response device (see Figure 4.3, Columns 2 and 3). For ORT-1, the language under test is Japanese and for ORT-2, the orthography under test is English.

4.5 Summary

The material and procedure detailed in this chapter were used to measure the orthographic knowledge and influence of *romaji* and English. The primes were specifically designed to test students' rudimentary writing ability (i.e., putting pen to paper and forming the shapes of letters), their ability to recognise phonemes and transcribe them into *romaji*, and their ability to choose and categorise words according to a language's orthographic rules. These tests were recorded on A5 size paper response devices that were scanned and stored <here for FV-ES> and <here for MA-ES>. These results were coded and presented in Chapter Five.

CHAPTER FIVE
RESULTS

5.1 Introduction

Results presented in this chapter are from an investigation of the influence between *romaji* and English orthographic understanding in Japanese natives who have learned *romaji* before English. The data were collected from Japanese Grade Five students' responses to a series of tests, specifically designed to measure the effects of various inputs on the cognitive skills required to respond by spelling or explicitly decide on an orthography. Participants (n=134) were from two schools (FV-ES, n= 43; and MA-ES, n=91), all aged between 11 and 12 years old, in Grade-5 of the second term of 2019. The results demonstrated the mapping between PA skills to *romaji* helped form a finer-grained ability to analyse words from phonemic memory and from sight. This recognition was not based entirely on alphabetic principles, nor sight word principles because the visual primes were both nonwords and pseudowords; recognition tended to be more dependent on Japanese V, CV, and CCV, phonemic- and graphemic-chunks. Surprisingly, this ability appeared to assist in the memory and accurate spelling of pseudowords, even those that were written within English graphemic constraints. These findings indicate more precisely the facilitation effects that *romaji* can have on learning English from phonemes. However, the results also indicate that attention is necessary for the area of "Orthographic Gaps". The definition of this theory and its implications for early orthographic development will be discussed in Chapter Six.

This Chapter is organised into two parts. Part-I presents the hypothesis-driven data for each test and Part-II is concerned with the incidental findings from investigative and interactive analysis of the results for the hypothesis-driven results in Part-I. As two sample populations comprised five groups in total, the data are presented to investigate and illustrate the effect of every prime on each of the groups and the total population.

Each section is presented in the same order as the sequence of tests (i.e., RAN-Visual, RAN-Audio, TACHiD, ODT, ORT). The purpose for choosing this sequence is not only fundamental to interpreting the results, but in justifying the progressive collection of evidence to either refute or accept the hypotheses tested in each section and to justify any exclusion of data from any individual prime, test, or participant.

Each section in both Part-I and Part-II commences with an abstract, followed by a brief introduction to the test, the descriptive data followed by a visual representation of the raw data, and then a brief discussion and interpretation of the results explaining their explicit connection with the hypothesis under test. Part-II, however, is based on incidental results and inferential data analysis. Part-II concludes with sufficient evidence to suggest that orthographic depth is not the only phenomenon responsible for errors in L2 orthographic development. The discussion surrounding the inferential hypothesis of the cause is the focus of Chapter Six.

5.1.1 Hypotheses Under Investigation

The data were derived from a series of five tests, designed specifically to distinguish various cognitive abilities of young children who have learned their native language and *romaji* before starting to learn English. Therefore, these results should generally be skewed towards greater errors in English, and indicate greater fluency in *romaji*. Table 5.1 lists the simple hypothesis questions, the test type of data that is collected and the resultant application of this data. By the nature of design, each test can be used to measure more than one cognitive process. This redundancy formed part of the verification process, which is only explicitly detailed where necessary.

Table 5.1

Data Collection Plan - Alignment With Research Questions

Research Stage (In Order)	1. RAN	2. Pic/List	3. TACHiD	4. Ort/Odt
Type of test (The last stimulus was presented for > 3 milliseconds)	Reading Writing	AV Recognition	Phoneme Familiarity	Ortho - Knowledge
Simple Hypothesis Questions				
1. Does word-length complexity modulate accuracy/fluency?	O	O	O	
2. Does word frequency affect accuracy/fluency?*	O	O	O	
3. Is there any evidence of orthographic facilitation?	O	O	O	
Verification Questions				
4. What are the unexpected outliers of the previous tests?	O	O	O	O
5. Is there any evidence of orthographic influence in outliers?	O	O	O	O
Empirical Hypothesis Questions				

7 Error types: lexical, phonemic, graphemic, orthographic complexity, etc?	O	O	O	O
8 Learning English & *romaji* simultaneously is complimentary or not?	O	O	O	O
9 Weaker links hypothesis evidence?	O	O	O	O
10 Learning *romaji* first facilitates EFL orthographic ability?	O	O	O	O

Note. Original data is available <here>,

(https://docs.google.com/spreadsheets/d/1mtZ_BwtdRpQ4RBBWoji_rqDAQ6W4BDEXtdy6oAGHfqI/edit#gid=1069227684)

Accuracy and fluency are a result of the limited time given for the test. If words are accurately spelt but incomplete, it is assumed to be less fluent (e.g. astronaug_ _). This means the student has a good grasp on the spelling of the word but simply started too late to think of the word or was writing too slow. For the sake of this research, it is considered a fluency problem more than an accuracy problem. If the spelling is wrong, or letters are missing, then it is an accuracy problem. A deeper analysis of letter fluency could indicate the difference between writing fluency, start time (i.e., lexical access or processing), etc. However, this was not performed in this study.

RAN - Rapid Automatised Naming (Spelling): Lexical Ability, Word Frequency Effects, Orthographic Interference

Pic/List - Similar to RAN, but uses a picture and/or audio stimulus.

ODT/ORT - Orthographic Decision/Recognition Test: Recognition of Orthography Acceptance/Preference/Rejection

TACHiD – Miller et al. (1954), Tachistoscopic Identification: Test of familiar word sequences, measures native language preference and additional language development

*Habitual information is that which any healthy person should be capable of communicating (e.g., Name, age, school, residence, etc)

*The use of ‘log freq’ is to measure between different individuals from different backgrounds. Using current texts would seem more prudent in the present study. However, to compare with individuals with other L1 backgrounds, in subsequent studies, the log frequency word list remains useful.

PART-I Raw Data Analysis

Part-I presents and discusses the data taken directly from the written responses from each test. Each test is presented in chronological order. Each section commences with an abstract, followed by the hypothesis under test and the theoretical rationale for each test. The original written response data (available <here>) were transcribed into quantitative values for each test. The results for each group and the total population are presented on the same graphs, followed by an interpretation and discussion of the results, based on the hypothesis under test. Inferential results are presented in Part-II.

5.2 Test-1: Rapid Automatised Naming (RAN) Task - Visual Stimulus Priming

The Rapid Automatised Naming (RAN) test, also referred to as the picture and object naming task, has been used with early literate students as a reliable predictor of reading and spelling (Hoxhallari, 2006). Snodgrass and Vanderwart (1980) are synonymous with providing a standardised set of pictures that have been tested for reliability over the decades, with only a few variables that affect their accuracy. One is cultural, for example, East Asian students may be less familiar with sheep and some pictures of herbs, and therefore affects word frequency tremendously. Another variable is word length and orthographic complexity. For example, *dog* presents little problem for Japanese, because in *romaji* it has the same word length (i.e., *inu* - Jp). However, *bat* is *koumori* (Jp) and *elephant* (En) is *zou* (Jp), which are orthographically different in both complexity, syllable/mora count, and word length.

In regards to genre, items that are learned in or before early elementary school cause little variability in results between languages. The only exception was found in alphanumeric items by Hoxhallari (2006, p. 264), in his study of Albanian, English, and Welsh children. Hoxhallari found that alphanumeric characters yielded different results, suggesting that different orthographies may be influential in stimulating responses. Due to the frequency of the primes and their familiarity were similar, the fluctuation was interpreted to be a result of the sample size being too small and different between the languages. It is feasible to assume, therefore, that if the stimuli are familiar and controlled for length and complexity, then the variation in response should be related to the orthographic properties of the written word (viz. Hoxhallari, 2006).

The RAN test comprised five categories, *kana*/*kanji*, Colours, Geometry and Numbers, Pictures, and finally, English Alphabet Names and was presented in five stages. Each stage was preceded with an explanation of what was required in the test and concluded with a brief one-minute rest. Each category is designed to test distinctly different aspects of language and cognition (see Chapter Two).

The reason for grouping tests into genres is not simply to discover or study the effect of genre on cognition, but to control the influence of genre on word length and complexity, which incidentally affects response accuracy. For example, if the results of the colour test are poor for some students, then they could be assumed as being colour blind and, therefore, would need to be removed from the test. If the numbers were neglected, then the student may have some problem with dyscalculia, which would incidentally normally be diagnosed and treated by the age of the participants in this study. If this problem or other genre-specific problems were evident, then the individual would need to be removed from this entire study. There was no evidence of these extraneous problems. However, while a few students chose not to respond to various sections of the test, there was little reason to exclude any data from the responses presented in this Chapter. A complete summary of the RAN data are provided in Table 5.2

Table 5.2

RAN Visual Primes Test Descriptive Statistics for Each School

		FVES1 (n=15)			FVES1 (n=28)			MAES1 (n=30)			MAES2 (n=29)			MAES3 (n=32)			Total (N=134)
Prime	Response	Mean	SD	CI*	Mean	SD	CI*	Mean	SD	CI*	Mean	SD	CI*	Mean	SD	CI*	Mean
の	no	4.75	1.04	0.69	4.86	0.76	0.37	3.15	2.36	1.09	4.57	1.36	0.65	4.89	0.71	0.32	4.36
本	hon	4.22	1.75	1.16	4.27	1.57	0.76	2.62	2.33	1.08	3.28	2.12	1.02	2.75	1.97	0.90	3.28
ず	zu	3.95	1.91	1.27	2.86	2.46	1.20	2.36	2.34	1.08	3.18	2.32	1.11	3.16	2.31	1.05	2.98
車	kuruma	3.00	2.36	1.57	4.00	1.86	0.91	2.32	2.15	1.00	2.87	2.33	1.11	2.60	2.26	1.03	2.90
生	nama	3.80	1.90	1.26	3.23	2.26	1.10	1.91	2.38	1.10	2.95	2.27	1.09	1.91	2.31	1.05	2.59
数	kazu	3.73	1.79	1.19	3.70	1.92	0.93	1.97	2.29	1.06	3.09	2.38	1.14	1.81	2.32	1.06	2.71
小学校	shougakkou	1.53	1.73	1.15	2.57	1.45	0.71	1.39	1.65	0.77	1.71	1.56	0.75	1.22	1.52	0.69	1.66
赤	aka	4.14	1.19	0.79	3.32	1.76	0.86	3.21	2.34	1.08	4.16	1.76	0.84	3.48	2.27	1.03	3.56
緑	midori	2.93	1.53	1.02	4.29	1.38	0.67	2.07	2.08	0.96	3.04	2.10	1.00	2.83	2.18	0.99	2.99
黄色	kiiro	3.20	1.90	1.26	3.86	1.80	0.88	2.39	2.24	1.04	2.84	2.18	1.04	2.44	2.29	1.04	2.86
オレンジ	orenji	3.61	0.83	0.55	2.04	1.67	0.81	1.90	1.78	0.82	1.97	1.83	0.88	2.03	1.75	0.80	2.14
ピンク（桃色）	pinku	3.61	2.00	1.33	3.02	2.02	0.98	1.88	2.03	0.94	2.33	2.16	1.03	1.88	2.04	0.93	2.38
茶色	chairo	1.87	1.74	1.15	1.58	1.68	0.82	0.65	1.20	0.55	1.55	1.35	0.65	1.19	1.60	0.73	1.29
紫	murasaki	3.80	1.74	1.16	3.79	1.84	0.89	2.11	2.38	1.10	2.82	2.24	1.07	2.29	2.25	1.02	2.82
二	ni	4.27	1.39	0.92	4.83	0.95	0.46	2.75	2.40	1.11	3.95	1.96	0.94	3.44	2.22	1.01	3.74
丸	maru	3.93	1.94	1.29	4.79	0.96	0.47	2.30	2.28	1.05	3.06	2.36	1.13	3.02	2.27	1.03	3.30
六	roku	5.00	0.00	--	4.83	0.77	0.38	2.92	2.26	1.04	3.12	2.27	1.09	2.88	2.26	1.03	3.54
四角	shikaku	3.53	1.25	0.83	3.79	1.07	0.52	2.19	1.87	0.86	2.67	1.85	0.88	2.44	1.83	0.83	2.80
二十三	nijusan	2.13	1.55	1.03	3.25	1.32	0.64	0.90	1.27	0.59	1.47	1.50	0.72	1.78	1.75	0.80	1.85
三百	sanbyaku	1.93	1.71	1.14	2.00	1.87	0.91	1.06	1.63	0.75	1.90	2.06	0.99	1.38	1.60	0.73	1.60
百十二	hyakujyuuni	1.87	1.60	1.06	1.32	1.42	0.69	0.84	1.29	0.60	1.43	1.52	0.73	0.91	1.23	0.56	1.19

Note. A score of 5.00 = 100%. CI = Confidence Interval for each group for any given prime

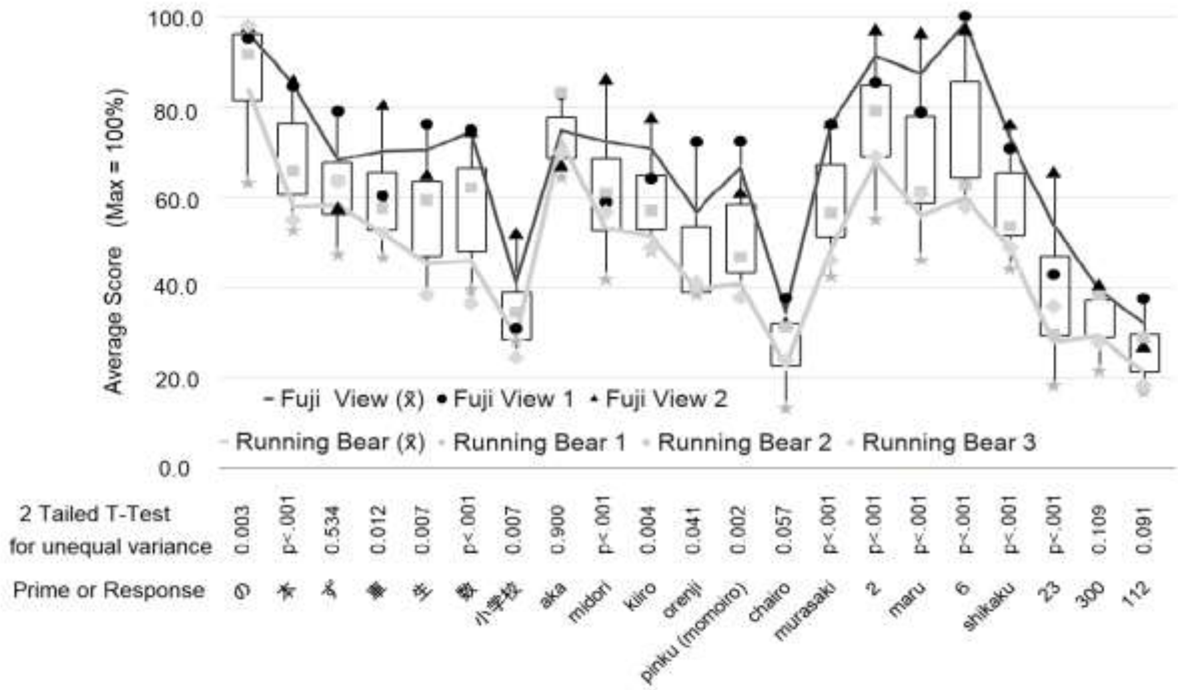
The scores reported above support the general theory that longer words are less accurate than short words. Additionally, the non-standard spellings of some words resulted in lower scores (e.g., 茶色 / chairo) and rare alphabets like “z” also affected scores, reasons for this will be presented in-depth subsequently.

5.2.1 Writing Accuracy - Picture Naming of Kanji/Kana, Colours, and Math Items

According to Ellis et al. (2004), word frequency and orthographic depth have a direct bearing on reading accuracy. The present study adopted a similar approach using RAN test data as an indication of general native language vocabulary range and spelling ability (see Figure 4.4).

Figure 4.4

RAN-Picture Romaji Word Spelling Results



Note. RAN-Picture *romaji* word spelling results showing the total correctly written word for each test prime normalised for each group population. Box plots are for the entire population. Lines indicate school averages. Each group is indicated with a distinctive icon. The box represents the average +/- the SD. Data is available <here>.

At first glance the word frequencies, and word complexities appear to be consistent for the three genres, and correlated between the two groups. This means, the first item was successfully completed by the majority of the students and as word complexity increased, the errors increased (i.e., accuracy declined). The other data of interest was the difference between schools, and school groups. The FV-ES groups consistently performed better than the MA-ES group ($p < .001$). The third important result is the correlation between the two schools. The means for each prime were tested (i.e., 2- tails, 2-samples, unequal variance) between each school. The FV-ES groups (dark line) results were significantly higher and correlated ($r(19) = .87$, $p < .001$) with the MA-ES groups, which is interpreted to indicate similar language ability variations based on the knowledge of native language Japanese items. This evidence supports the prediction that the FV-ES volunteer group would be better at English because their parents had an interest in the study (see Section 4.1.1). According to variance with prime, the results of both schools were similarly correlated.

Each prime was of interest to investigate the influence of language ability on word frequency and complexity. In most cases, the significance between FV-ES and MA-ES were significant except for 'zu' ($p = .53$), 'aka' ($p = .90$), and 'sanbyaku' (i.e., 300 in English) ($p = .11$). The reason for these results having a low probability is simply a mathematical anomaly. That is, when the means of a set of data are close, the probability that the two sets are different is seriously compromised. In other words, when the means are distant, given the standard deviations are similar and not large, then the *p* value will increase. While high and low *p* values indicate only the probability of differences, they are used here for identifying items that require closer attention and investigation.

The Japanese word for red, '*aka*', is a high-frequency word in elementary schools, although in the national corpus it is much lower (赤 = 33.84). In schools, the *kanji* for 'red' is taught from Grade-1 (see *kanji* word list Appendix H), and red, yellow, blue, and white are often used in daily activities, clothing, and to signify classrooms and team names. With its simple phonetic structure, short word length (n=3), low syllabary/mora count (n=2), and distinctive alphabetic grapheme, *aka* should obviously be a *kanji*/*kana* sight word and consequently be a well-established phoneme. Additionally, the PG mappings for *romaji* are highly reliable. The vowel “*a*” in Japanese is encountered first in the *romaji* alphabet, and *ka* is likewise first in the set for that sound. In fact, ‘*k*’ is the first consonant encountered in the *romaji* alphabet. Finally, the word shape hypothesis, discussed in Chapter Two, suggests that lower case letters would present an easier recognisable spelling. Historical evidence (see Fisher, 1975, as cited in Larson, 2004; McInnis, 2008; Smith, 1969; Woodworth, 1938) have suggested that the salient features in words (i.e., word shape and lower-case preference) improve word reading speeds and consequently accuracy.

Evidence of this assumption is indicated by both groups responding accurately, the scores were high and close together. For example, the Japanese word ‘*sanbyaku*’, on the other hand, is a compound word made of ‘san’ (i.e., three) and ‘hyuku’ (i.e., hundred). In Japanese speech, when ‘n’ is followed by ‘h’, the sound is changed to ‘b’. This morphology is reflected in the orthography and, therefore, spelled with a ‘b’. This adds one more level of orthographic complexity to the word. On another front, while these two-word parts are both high-frequency, the word is still quite complex. First, the length (n=8), the mora (n=4), and the length of the phoneme sequences are also not consistent (i.e., /sa/, n=2; /n/, n=1; /bya/, n=3; and /ku/, n=2). Additionally, there are two directionally confusing alphabets, ‘s’ and ‘b’ (i.e., these two letters are often directionally challenging for beginners). Therefore, the score for both classes is low and similar. The response for ’112’ is also problematic for similar and additional reasons (i.e., uu problems, numerical confusion between 12 and 20, and concreteness/cognateness)

The Japanese word for ‘brown’ (i.e., ‘chairo’, in *kanji* ‘褐色’) was also poorly responded to. There were two predominant reasons for this poor result. The first reason was a result of the poor representation of the colour during the presentation. During the presentation, the colour was not clearly brown. This colour perception problem caused delays and a poor number of responses (i.e., 69 students did not respond). The second reason was to do with *romaji* orthographic complexity. Many students (n=34) used ‘nonstandard’ or keyboard entry spelling (i.e., ‘ty’ for /cha/). As a result of coding, using ‘ty’ was awarded only three points. The other error was a language choice. Some students (n=14) neglected, or chose to not write ‘*iro*’. ‘*Iro*’ means ‘colour’ in Japanese, which is important when spelling *kanji* ‘褐色’, because ‘cha’ alone means ‘tea’. Therefore, these students' attempts at this word were semantically incorrect, resulting in a score of only one. This point scoring system was adopted to indicate these types of problems throughout the transcription process.

This section analysed the accuracy of written responses from the RAN, visual priming tests. The effect of these elements - word frequency, corpus frequency, learner development, recognition - was introduced. Additionally, the stratification of the FV-ES group and the consequential influence of convenience sampling (see Ary et al., 2010, p. 155) was confirmed; students who volunteer, are usually more interested in the content of the research and, as a result, their performance is different to that of a normal population (e.g., the MAES group) or a probability sample.

The RAN test, in conjunction with the ODH, was useful in predicting writing ability, and the strategy that is used for lexical access (see Ellis et al., 2004, p. 446). Ellis and Hooper (2001) were able to establish that in opaque scripts, like English, children would be unable to respond, simply because the phonemic lexis did not exist. Transparent words, and consequently words that are already remembered as whole word-shapes in either orthography, would be associated with fewer nonresponses or whole word substitutions.

5.3 RAN - Pictures and Names of Alphabets With Phonemic (Aural) Priming

Naming pictures and hearing sounds is a different cognitive process to reading scripts, naming colours, and recognising numbers. In this test, there are no visual cues to prime the response. In this test, the individual must hear the word in their mind, and therefore, the phonological process of word construction is more prominent. The picture primes affect the response similar to the classic "Stroop test", albeit every prime in this test is supportive. Therefore, after the name is read, students should have confirmation of the word they have constructed from the visual prime (e.g., the "bus" picture is supported with /*basu/* spoken in Japanese). For the alphabet recognition test, no visual prime was given. Students are assumed to have entered this test with some experience of these letters from the previous stimuli and responses, especially from previous *romaji* training. The only exceptions are the letters that do not exist in the Japanese alphabet, or are contradictory to English (i.e., those in the orthographic gap like l, q, v, x, and l/r, a/u).

A set of highly recognisable picture primes (N=7) from the students' present word vocabulary were presented briefly for 300 milliseconds with a corresponding audio prime, spoken by a native Japanese research assistant. By choosing easily recognisable pictures and supporting the presentation with a non-confusing audio indication of the result, students' dependence on decoding the picture and choosing a lexis was assumed to be significantly reduced, and the dependence on aural input was increased. The dependence on individual lexis was, therefore, theoretically facilitated, and students could, in the absence of understanding the picture, theoretically spell the word from the sound/s.

In the second test, a picture of a dog listening to a phonogram was displayed, to imply listening only. A sequence of seven-paired alphabets was presented, two phonetic neighbourhood letters (e.g., 'a/i'), two graphemic neighbourhood letters (e.g., 'p/q'), and pairs of orthographic gap pairs (e.g., 'l/r') were presented by the researcher at three-second intervals.

The results of both aural tests (see Table 5.3) showed some again some relationship to word frequency, complexity, and length.

Table 5.3

RAN Aural Primes Test Descriptive Statistics for Each School

		FVES1 (n=15)			FVES1 (n=28)			MAES1 (n=30)			MAES2 (n=29)			MAES3 (n=32)			Total (N=134)
Prime	Response	Mean	SD	CI	Mean	SD	CI	Mean	SD	CI	Mean	SD	CI	Mean	SD	CI	Mean
バス	basu	4.13	1.46	0.54	4.38	1.22	0.45	1.91	2.20	0.82	2.81	2.29	0.85	2.88	2.21	0.82	3.07
トマト	tomato	4.61	0.83	0.31	4.47	1.48	0.55	2.27	2.40	0.89	3.51	2.09	0.77	3.30	2.09	0.77	3.47
チョウチョ	choucho	2.00	1.46	0.54	1.64	1.42	0.53	0.97	1.27	0.47	1.57	1.55	0.57	1.45	1.36	0.50	1.45
ジテンシャ	jitensha	2.20	1.52	0.56	2.43	1.83	0.68	1.37	1.65	0.61	2.47	1.95	0.72	1.94	1.73	0.64	2.04
カバ	kaba	4.20	1.66	0.61	4.44	1.29	0.48	2.24	2.22	0.82	2.58	2.22	0.82	2.82	2.24	0.83	3.10
ハート	ha-to	3.67	1.35	0.50	3.61	1.29	0.48	2.37	2.16	0.80	2.61	2.12	0.79	2.03	1.92	0.71	2.71
ウチュウヒコウシ	uchuuhikoushi	2.60	1.80	0.67	3.14	1.46	0.54	1.20	1.77	0.66	1.87	1.72	0.64	1.29	1.53	0.57	1.91
a, A, a, ?, i, x	A	3.80	1.82	0.67	4.36	1.19	0.44	4.13	1.38	0.51	3.73	1.74	0.64	4.18	1.42	0.53	4.01
i, I, a, ?, ?, x	I	3.87	1.68	0.62	4.54	1.10	0.41	3.63	1.75	0.65	4.03	1.59	0.59	4.16	1.51	0.56	4.01
d, D, b, p, t, x	D	3.47	1.88	0.70	3.96	1.37	0.51	2.67	2.12	0.79	2.80	1.97	0.73	3.26	1.84	0.68	3.16
z, Z, zi, d, g, x	Z	3.27	2.31	0.86	4.00	1.83	0.68	1.70	1.91	0.71	3.17	2.05	0.76	3.56	2.04	0.76	3.09
g, G, g, d, j, x	G	3.20	1.86	0.69	3.36	2.16	0.80	2.17	2.29	0.85	2.83	1.95	0.72	3.10	2.06	0.76	2.87
j, J, j, g, ?, x	J	3.33	2.06	0.76	3.54	1.90	0.70	2.33	2.07	0.77	2.90	2.04	0.76	2.61	2.04	0.76	2.85
r, R, r, a, ?, x	R	4.07	1.67	0.62	4.18	1.68	0.62	2.63	2.20	0.82	3.03	2.01	0.74	2.74	2.25	0.83	3.19
l, L, L, r, ?, x	l*	3.33	2.06	0.76	3.64	1.95	0.72	2.50	2.26	0.84	2.33	2.19	0.81	2.65	2.14	0.79	2.79
q, Q, p, ?, ?, x	q*	2.80	2.14	0.79	3.36	1.77	0.65	2.20	2.01	0.74	2.83	1.86	0.69	3.16	2.05	0.76	2.84
p, P, q, b, ?, x	P	3.40	2.03	0.75	3.75	1.58	0.58	2.87	1.74	0.64	3.13	1.93	0.71	3.45	2.05	0.76	3.27
m, M, n, w, u/?, x	M	3.73	1.87	0.69	4.00	1.68	0.62	2.23	1.94	0.72	2.47	2.21	0.82	3.52	1.88	0.70	3.09
n, N, m, u, ?, x	N	3.60	2.03	0.75	4.07	1.68	0.62	2.30	1.99	0.74	2.23	2.24	0.83	3.03	2.04	0.76	2.94
b, B, d, p, q/?, x	B	3.60	1.99	0.74	4.07	1.46	0.54	2.90	2.07	0.77	3.03	1.94	0.72	3.74	1.59	0.59	3.41
p, P, q, b, d, x	P	3.67	1.95	0.72	3.86	1.43	0.53	2.97	2.04	0.76	3.33	1.95	0.72	3.61	1.76	0.65	3.42

Note. CI* = Confidence Interval for the class for any given prime. l* and q* are not in the *romaji* alphabet.

The results from the aural test more precisely reflected the word frequency and word length results of previous researchers like Ellis et al. (2004), and Hoxhallari (2006). In their studies, as was the case of many studies before them, the effect of word length on writing accuracy was significant. However, the interesting phenomenon was that of how students interpreted the sustain, or the double vowel in "チョウ", which can be represented in some *romaji* cases with a line over the "o" or in Hebonshiki, should be an "o" followed by an "u". This was not only a phonetic or orthographic problem. In the first half of the word for astronaut (i.e., ウチュウ, the spelling should be "uchuu". This prime also, was not well attended too. Reasons for this are that more complex rules are not explicitly taught in most Japanese Schools (see Goto, 2020, in Appendix O). For letter names, the outcome was similar.

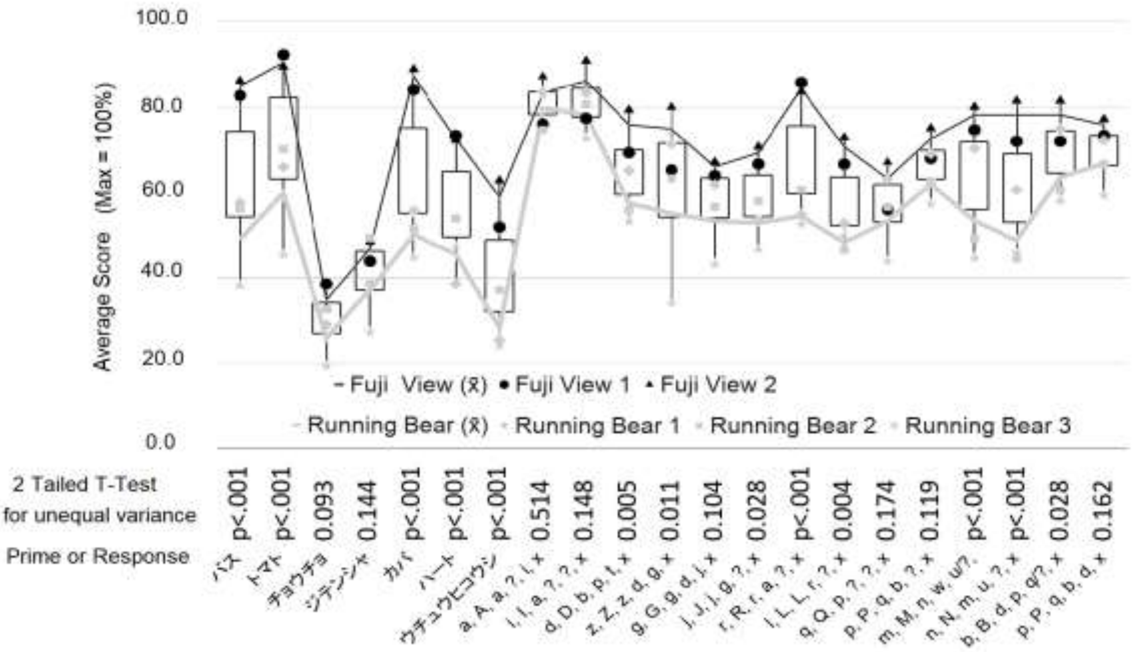
Like English, *romaji* consists of five vowels and most of the consonants have similar orthographic rules. This fact is, moreover, a coincidence between Latin and English, because *romaji* was designed to represent the former, transparent Latin GP rules. In this test, these similarities seem to transfer consistently even from letter names to spelling. The letter "a" and "i" are purposely used and partnered; the phonemes for both letters are introduced early in the Japanese (i.e., *kana*) alphabet list and the names (i.e., "a" = /eɪ/, and "i" = /aɪ/) often get confused, albeit when said apart/separately in spelling words for example. Another often confused set of letters are those of "d" (/diː/) and "z" (/ziː/) ($\bar{x}$ = 3.16 and 3.09, respectively), and "g" (/ʤiː/) and "j" (/ʤeɪ/) ($\bar{x}$ = 2.876 and 2.85, respectively). It is also worth noting that "g" is a complex orthographical problem because the letter name and the sound in Japanese are distinctly different. The letter "g" can accept two sounds as in the names George /ʤɔːʤ/ and Grover /grəʊvə/. This extra level of processing increases cognitive burden, and arguably influences the accuracy of producing a reliable response for the subsequent prime, "j".

The interesting discovery from these RAN alphabet spelling results is that the difference between the two orthographies had the greatest detrimental effect on accuracy. In the areas where the Japanese understanding and use of Roman letters conflict with how English letters are used, accuracy was compromised. This phenomenon is one of the inferential discoveries discussed in greater detail later in this Chapter. Simply, where letters are not used at all (e.g., "q") naturally there is the least knowledge and experience with the letter name ($\bar{x}$ = 2.84). One would expect a similar or worse error for “l”. However, even though “l” is both absent and conflicts with phonemic production, the awareness of Japanese to this language disparity is explicitly reiterated throughout a student's English learning experience, so the chance to learn is increased (Norris & Ortega, 2000, p. 500). This test also attempts to compensate for the phonemic problem by simply saying the name of the letter “L” (/ɛl/).

The results from the RAN Picture/Audio Prime Test were also presented in a box plot to investigate the spread of results between classes, and the effect of selective sampling (see Figure 5.1).

Figure 5.1

Test 2: RAN Picture/Audio Romaji Normalised Writing Results



Note. The means for each class are indicated and the means of the two schools are drawn with lines to indicate skew. Test item numbers were presented in word-length and word-complexity order as indicated. Each group (N=5) class is indicated with a distinctive icon. The box represents the average +/- the SD. FV-ES groups (dark line) average results were higher but more poorly correlated (r(19) = .49, p < .001) than the MA-ES groups.

The current test reflected similar attributes to the RAN, picture naming test. First and foremost, there was a vast difference in levels between the stratified FV-ES group, and the MA-ES school. This significant difference in results was assumed to indicate that the FV-ES group had greater access to English language education and familiarity with foreign items and alphabets than the MA-ES group. This is useful later in the iterative analysis, particularly when considering the orthographic distance and learning order.

5.4 Tachistoscopic Identification (TACHiD)

The Tachistoscopic Identification (TACHiD) test (Miller et al., 1954) has been widely used to test the limits of human visual perception. The test has been conducted in the past using various stimuli including shapes, colours, letters, words, and numbers. In fact, every test conducted in this Thesis uses a similar approach. The TACHiD test identifies the presence of visual traces of orthographic information in memory. In the present test, these visual traces are the alphabetic combinations that are stored in the long-term memory of Japanese students who have learned *romaji* for two years in grades 3 and 4, however, they have not yet formally learned English reading or spelling. The test is also sensitive enough to return reliable results for those students who have had some English education and can, therefore, process English phoneme and word-level letter combinations. These long-term memory traces should be either at the Japanese phoneme level or greater. There is little expectation that the recognition of English phonemic chunks would be available to the students who have had little to no English experience.

5.4.1 Introduction

This TACHiD test comprises a series of fourteen slides (see Appendix 4.2) with pseudowords made of random letter sequences arranged in various phonetic orientations, according to either Japanese or English. Some sequences were intentionally orthographic impossibilities in either language (e.g., 'LR' is illegal in English and Japanese). Other combinations are rare in words that are not blends, for instance, 'yw' in many blends like keyword, skyward, with one archaic/obsolete exception "*ywis*" (ywis, n.d.). Others are not English, but possible in other languages. For example, '*koh*', which is popular in Malaysian proper nouns (koh, n.d.).

5.4.2 Hypothesis

Students with only *romaji* orthographic knowledge should:

a. perform better with mora-based primes,
b. responses should be phonemic substitutions, and
c. make fewer orthographic mistakes.

Students with English and *romaji* ability should make:

d. mistakes based on word segmentation,
e. orthographic mistakes based on language level confusion, and
f. have better all-round results based on lexical and phoneme level syllable/mora recognition

Students with little alphabetic knowledge should make errors that correspond more with

g. word complexity,
h. word length, and
i. the gap between Japanese *romaji* and English (i.e., letters and GP combinations that are not existent in both languages)

5.4.3 TACHiD Test Results Across all Groups

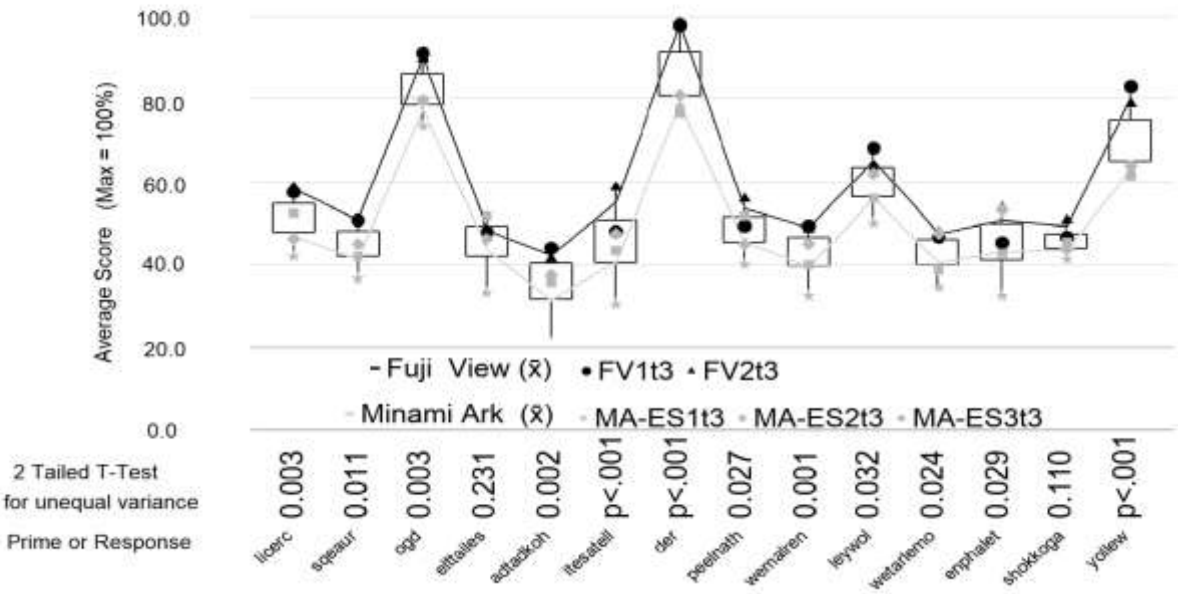
Naming recognisable patterns of letters is dependent on a variety of factors, namely, orthographic and phonemic possibilities. Short words, with consistent GP mappings are expected to be recognised quicker through access to stored lexical memory and, therefore, written more accurately than words of similar length and with inconsistent phonemic chunks (e.g., /mo/n/te/s/so/ri/ is easier than /ri/n/te/s/so/mo/, which in turn should be easier than /n/ir/mto/es/os/). It should be made clear that this chunking is dependent on, and significantly influenced by, L1 and additional language knowledge, and dependent on these PG mapping onto the script in the test (re: word concreteness across languages, see Troche et al., 2017)

The results from all groups were studied to identify any inconsistencies in testing or ability between the five groups (see Figure 5.2). The first remarkable feature is that the MAES group was considerably poorer than the FAES group in all cases. Additionally, in all cases, the dependent variable was influenced by the prime in the same direction. The effect of word length on accuracy is also immediately obvious.

Three letter words ‘ogd’ and ‘der’ were most easily remembered, possibly through sight and short-term memory. Both words are nonwords but “*der”* is an English pseudoword (i.e., a graphemic possibility). The former, *‘ogd’* has three possible conflicts of Japanese orthography (CV x 2 and VCC shape) and ‘der’ has only one, it is missing a ‘u’ at the end, which would normally form a common word meaning leave (i.e., 出る, deru). Nonetheless, the orthographic possibility rule holds true, because the highly irregular “ogd” scored less than “der”.

Figure 5.2

Test-3: TACHiD Letter Sequence Recognition



Notes. Primes presented for a limited period (300 milliseconds), showing the total correctly written word for each test prime normalised for each group population. The means for each class are indicated and the means of the two schools are drawn with lines to indicate skew. Test item numbers are illustrated above in the same order as the test. Each group (N=5) class is indicated with a distinctive icon. The box represents the average +/- the SD. The FV-ES groups (dark line) consistently averaged higher were significantly correlated ($r(12) = .98$, $p < .001$) with the MA-ES groups. Data is available <here>.

If word length and orthographic complexity are significant, then the opposite should also hold true. Longer words and those with more exceptions, or “orthographic gaps” (see explanation later) should result in more errors. The most extreme result was in response to the intentionally unique prime “watermelon”, which was derived from the real English word. The longest two stimuli are the pseudoword “wetarlemon” and the nonword “*wemalrenot”*. Both are orthographic possibilities however, the former is more like the original and, therefore, stimulate lexical and/or semantic memory (i.e., “*wetar*” is a cognate prime of water, with wet and water being the semantic prime and the vowel priming through short term memory and water being derived from elimination of possibilities from a/e.) The second part of the word is an English fruit, lemon, which is also familiar with Japanese, and therefore could prime “melon” (i.e., as a semantic cognate). However, the letter ‘L’ is not in the Japanese alphabet. This problem is also intentional in the latter prime, “*wemalrenot*”. This intentional addition of lowercase “L” in both primes is assumed to present a similar negative effect and therefore cancel any variability between the two words (i.e., at least for this letter). However, the latter yields a weaker response. In English “*wemal*” has no semantic or phonemic cognates, and in Japanese, it is illegal to end a word in any consonant, except ‘n’, and the former has not flouted this rule. Another reason is, if graphemic chunks can be used, the latter is made of more chunks (i.e., we + mal + re + ot, or in Japanese, an even more conflicting set of phoneme and grapheme conflict of rules, ‘we’ is illegal, ‘ma’ is acceptable, ‘l’ is completely absent, ‘re’ is acceptable, and ‘ot’ is a compound conflict, namely and illegal combination and a consonant stop). Also, “*we*” is not a phoneme in Japanese and is therefore an illegal orthographic combination. Therefore, word length and complexity appear to be influential, even in Japanese beginners. For these reasons, phonemic and graphemic level familiarity and complexity are assumed to significantly determine word accuracy.

Since word length and complexity appear to be influential, the next area of interest is the effect of complexity over word length. One prime that fulfilled this purpose was Number-5, ‘adtadkoh’. The complexity of this word is not only alphabetic or simply orthographic; this prime is also visually complex. Please notice, there are no tails in the word to bring attention to possible phoneme chunks, and the stems of the letters were chosen such to conceal the number of letters (i.e., “dt” and “dk” stems are back to back). In both English and Japanese this word is tremendously complex with multiple illegal/rare phonemic pairs (see thefreedictionary.com) ‘dt’ and ‘dk’ and ending with an ‘oh’, which is rare in English (oh = 466 and koh = 11) and is illegal in Japanese. In fact, this word is more recognisable to English than Japanese because with a little analysis, the word could be broken into parts, “ad” + “tad” + “koh”. (i.e., “ad” is a familiar onset [n=3385], “tad” is much less familiar in the contents of a word [n=904], and “koh” is a non-English rhyme [n=11]). Therefore, due to the probable lack of semantic or lexical knowledge, this word should be nearly impossible to remember in the mere 300 milliseconds presentation (see Chapter Two for an explanation of this neurological phenomenon).

If these preliminary indications are accurate, these results can be interpreted as while word length is influential to spelling accuracy, word complexity and visual complexity are of greatest concern. These two factors are somewhat dependent on previous knowledge, and therefore semantic and lexical knowledge. Therefore, the deciding factor between two similarly complex words is the gap between the two orthographies, and in Japanese, this is particularly easy to identify, due to the limited number of orthographic possibilities, which are dependent on the limited phonemic constraints of the language.

If the contrast in results are dependent on orthographic constraints, then it would be necessary to test if this knowledge is implicit or explicit, and then study why. The following two tests are useful for investigating these orthographic understandings.

5.5 Orthographic Decision Test (ODT)

The Orthographic Decision Test (ODT) is designed to test students’ implicit knowledge of *romaji* and English orthography. This particular ODT test is also designed to indicate the preference of one orthography over another. In simple terms, the words presented in this test assesses an individual's understanding of orthographic rules based on experience with familiar PG mappings and in some cases traces of sight words or chunk-sized representations of familiar letter combinations. The ODT compares the processing of visual input of letters to the rules stored in an individual’s mind and elicits a response. The response required for this test was for students to indicate their choice by writing a circle (or checkmark) on the language (i.e., Japanese or English) that the word most looks like.

For dual-, multi-, and pluri-lingual individuals, this implicit knowledge is a complex system of rules that might be likened to the complexity of studying universal grammar (UG) of similarly language blessed individuals. Unlike UG studies, however, the present study is testing language learners at the rudimentary level, that is, beginners who have only a meagre knowledge of alphabets. The participants in this test have not yet formally learned English reading or spelling. Therefore, there should be a measurable difference in the preference for alphabets based on phonemic knowledge of Japanese and not English because most of these individuals will have gained some *romaji* ability from the two years of limited practice they have received earlier in grades 3 and 4.

5.5.1 Introduction

The ODT comprised a series of eighteen slides (see Appendix 4.2). To elicit a decision, each slide displayed two buttons; a legacy from the interactive version of this test. Instead of an online response device, students were given a paper response device to mark their decisions in Japanese or English. Some of the words were neither English nor Japanese, thus forcing students to use a cognitive process to eliminate one orthography (e.g., NGYEN cannot be *romaji*, so English would be the better answer). Some words (e.g., Foxsu) looked and "sounded" Japanese but contained illegal letters for *romaji*, once again forcing the English response. The opposite is true (e.g., HARO) which is a familiar word in *romaji* that sounds English; this prime should elicit a Japanese response, due to its perfect *romaji* representation.

5.5.2 ODT Hypotheses

1. Students with only *romaji* orthographic knowledge should:
    - show a preference for Japanese with words that are possible in both languages (e.g., SHE, KEN, BUFOU), and
    - be sensitive to words that don't look like *romaji* CV combinations and, therefore, reject them (e.g., FORT, NAHS) as Japanese and choose English.
2. Students with English and *romaji* ability should:
    - make mistakes based on word recognition (that is they read the word wrong) because of familiarity, and
    - in general, struggle more with words that are neither English or Japanese, then decide on *romaji* rules to reject the Japanese option and choose English.

3. Students with little alphabetic knowledge should make errors that correspond more with:
    - word complexity,
    - word length, and
    - the gap between Japanese *romaji* and English (i.e., letters and GP combinations that are not existent in both languages).

5.5.3 ODT Results Across all Groups

This ODT presented a combination of both pseudo- and real- words, thereby avoiding the influence of word frequency and lexical access via word shape recognition. Rather, the results are expected to be more an indication of orthographic knowledge and graphemic constraints. A fundamental explanation for this is, if an orthography has become implicit knowledge, the rules of that orthography should be the deciding factor in accepting or rejecting a word or learning that word as a unique addition to a language. One simple example would be the phoneme ‘xy’. The phoneme /xy/ is a novel grapheme within the English alphabet graphemic constraint boundary. However, /xy/ exceeds the graphemic constraints of Japanese for two reasons. The letter ‘x’ is not in the *romaji* alphabet, because there is no phoneme (cf. pinyin includes these combinations within its graphemic- and phonemic- constraints). However, the concept of /xy/ is fundamental to Japanese language (i.e., xy means wood and the *kanji* ‘木’, which is ‘moku’ in *romaji*, is learned in grade-1 and is a high frequency *kanji* radical). Therefore, the results should not simply reflect ability in alphabetic scripts based on word frequency and familiarity; results should be indicative of, and be more affected by, the interpretation of the text. This interpretation includes an implicit understanding of spelling and familiarity based on lexical knowledge (Danjon & Pacton, 2009; Samara & Caravolas, 2014).

The responses data from all groups (Table 5.4) were first analysed to identify extreme or unique results of any level of confidence. Two confidence interval tests were used. One was the degree to which a response was consistent with a prime, based on proportions. These results were then compared between classes based on the average score. A confidence interval based on the standard deviations of these groups scores were calculated for each prime. By doing this, the accuracy and reliability of the prime in eliciting a response could be established. Alternatively, if the confidence interval was too great, then this means some other variable would be at play, possibly AoA, or word length, frequency, or some other factor (see Table 5.4).

One important point to raise is for primes that could be either Japanese or English (i.e., “she”, “ken”, and “shun”). These primes were designed to investigate a knowledge or preference for one language over the other. The prediction was that “she” would be less likely to be chosen as Japanese, because it is rare; “ken” would be chosen as Japanese because the state where the research was conducted had the same suffix (i.e., ken) and shun would be chosen according to preference.

Table 5.4

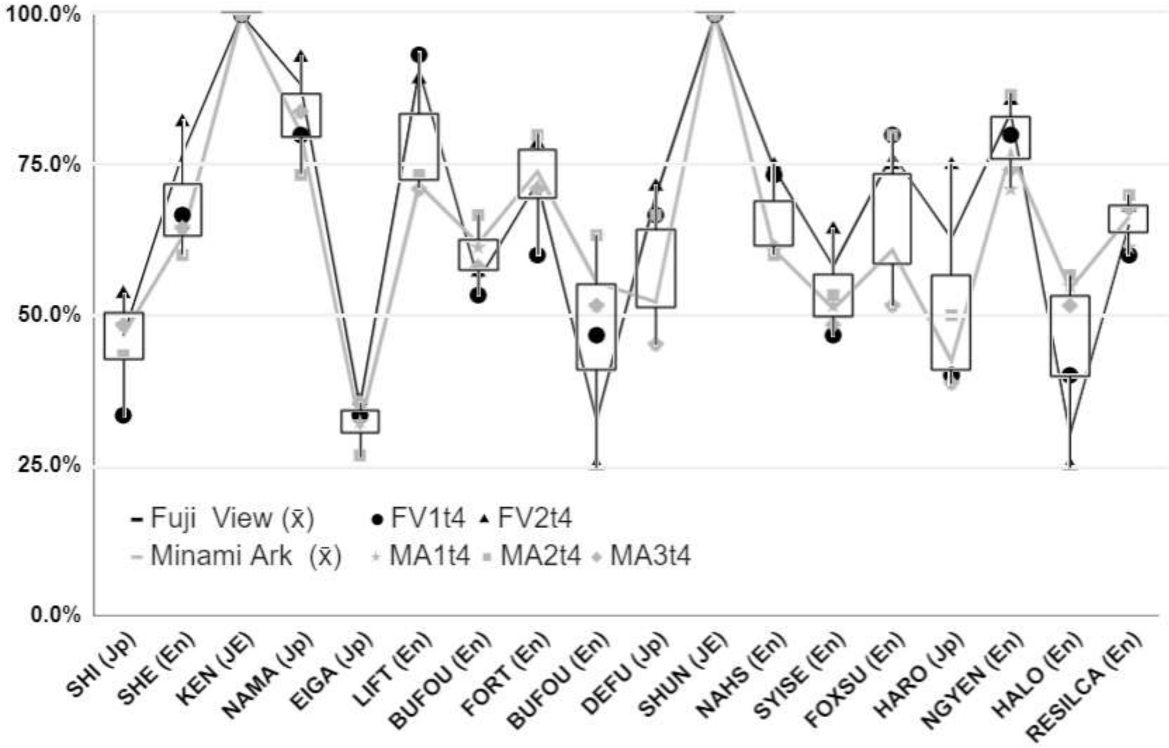
ODT Raw Data Indicating Proportions of Correct Answers and CI

		FVES1 (n=15)			FVES1 (n=28)			MAES1 (n=30)			MAES2 (n=29)			MAES3 (n=32)			Total Means (N=134)					
Prime	Reply*	Correct	Jp Pref	En Pref	Correct	Jp Pref	En Pref	Correct	Jp Pref	En Pref	Correct	Jp Pref	En Pref	Correct	Jp Pref	En Pref	Correct	Prop	CI-Pro*	Mean	SD	CI-dev*
shi	Jp	33.3%	33.3%	66.7%	53.6%	53.6%	46.4%	48.4%	48.4%	51.6%	43.3%	43.3%	56.7%	48.4%	48.4%	51.6%	46.7%	46.7%	11.1%	45.4%	7.7%	15.8%
she	Jp/En	100%	33.3%	66.7%	82.1%	17.9%	82.1%	64.5%	35.5%	64.5%	60.0%	40.0%	60.0%	64.5%	35.5%	64.5%	71.1%	71.1%	10.1%	74.2%	16.7%	34.4%
ken	Jp/En	100%	86.7%	13.3%	100	82.1%	17.9%	100	64.5%	35.5%	100%	70.0%	30.0%	100%	64.5%	35.5%	100%	100%	0.0%	100%	0.0%	0.0%
nama	Jp	80.0%	80.0%	20.0%	92.9%	92.9%	7.1%	83.9%	87.1%	12.9%	73.3%	76.7%	23.3%	83.9%	87.1%	12.9%	83.0%	83.0%	8.3%	82.8%	7.1%	14.6%
eiga	Jp	33.3%	33.3%	66.7%	35.7%	35.7%	64.3%	32.3%	38.7%	61.3%	26.7%	26.7%	73.3%	35.5%	38.7%	61.3%	32.6%	32.6%	10.4%	32.7%	3.7%	7.6%
lift	En	93.3%	6.7%	93.3%	89.3%	10.7%	89.3%	71.0%	29.0%	71.0%	73.3%	26.7%	73.3%	71.0%	29.0%	71.0%	77.8%	77.8%	9.2%	79.6%	10.8%	22.3%
bufou	Jp/Fr	53.3%	46.7%	53.3%	57.1%	42.9%	57.1%	61.3%	38.7%	61.3%	66.7%	33.3%	66.7%	58.1%	38.7%	61.3%	60.0%	60.0%	10.9%	59.3%	5.0%	10.3%
fort	En	60.0%	40.0%	60.0%	78.6%	21.4%	78.6%	71.0%	29.0%	71.0%	80.0%	20.0%	80.0%	71.0%	29.0%	71.0%	73.3%	73.3%	9.8%	72.1%	8.0%	16.4%
bufou	Jp/Fr	46.7%	53.3%	46.7%	25.0%	75.0%	25.0%	51.6%	48.4%	51.6%	63.3%	36.7%	63.3%	51.6%	48.4%	51.6%	48.2%	48.1%	11.1%	47.6%	14.1%	29.0%
defu	Jp	66.7%	66.7%	33.3%	71.4%	71.4%	28.6%	45.2%	51.6%	48.4%	66.7%	66.7%	33.3%	45.2%	51.6%	48.4%	57.8%	57.8%	11.0%	59.0%	12.8%	26.3%
shun	Jp-En	100%	46.7%	53.3%	100%	46.4%	53.6%	100%	35.5%	64.5%	100%	36.7%	63.3%	100%	35.5%	64.5%	100%	100%	0.0%	100%	0.0%	0.0%
nahs	X	73.3%	26.7%	73.3%	75.0%	25.0%	75.0%	61.3%	38.7%	61.3%	60.0%	40.0%	60.0%	79.2%	50.0%	50.0%	65.2%	65.2%	10.6%	66.2%	7.3%	15.1%
syise	X	46.7%	53.3%	46.7%	35.7%	35.7%	64.3%	38.7%	48.4%	51.6%	46.7%	46.7%	53.3%	37.5%	50.0%	50.0%	40.7%	40.7%	10.9%	41.3%	5.1%	10.4%
foxsu	Not Jp	80.0%	20.0%	80.0%	75.0%	25.0%	75.0%	51.6%	48.4%	51.6%	80.0%	20.0%	80.0%	50.0%	46.9%	53.1%	65.9%	65.9%	10.5%	67.6%	14.8%	30.4%
haro	Jp	40.0%	40.0%	60.0%	75.0%	75.0%	25.0%	38.7%	38.7%	61.3%	50.0%	50.0%	50.0%	38.7%	38.7%	61.3%	48.9%	48.9%	11.1%	48.5%	15.6%	32.0%
ngyen	Not En	80.0%	20.0%	80.0%	85.7%	14.3%	85.7%	71.0%	29.0%	71.0%	86.7%	13.3%	86.7%	74.2%	25.8%	74.2%	79.3%	79.3%	9.0%	79.5%	6.9%	14.2%
halo	Not Jp	40.0%	60.0%	40.0%	25.0%	75.0%	25.0%	54.8%	45.2%	54.8%	56.7%	43.3%	56.7%	51.6%	48.4%	51.6%	46.7%	46.7%	11.1%	45.6%	13.2%	27.2%
resilca	X	60.0%	40.0%	60.0%	67.9%	32.1%	67.9%	61.3%	38.7%	61.3%	70.0%	30.0%	70.0%	67.7%	32.3%	67.7%	65.9%	65.9%	10.5%	65.4%	4.4%	9.1%

Note. CI(prop) is the Confidence Interval for the proportion of correct answers, regardless of choice. CI(devs) is the Confidence Intervals for the deviations of each group's total scores. If the deviations are low then the prime is assumed to have a similar effect across the classes, otherwise, the prime is affected by some other factor than orthography. Jp or En means the response should be predominantly Japanese or English respectively. Jp/Fr means the response looks not Japanese but it is French. This tests English conflict and Japanese knowledge of orthography. X means neither Japanese nor English and the reply shows a preference, forcing processing of orthographic understanding.

Figure 5.3

Test-4: ODT Analysis of Japanese and English Orthographic Knowledge



Notes. Test item numbers are illustrated above in the same order as the test. Each group (N=5) class indicated with a distinctive icon. The box represents the average +/- the SD. The FV-ES groups (dark line) had higher average scores with a strong correlation (r(16) = .81, p < .001) with the MA-ES groups. Data is <here>.

The reliability of each prime to elicit a similar response is illustrated in Figure 5.3. Each prime was presented for (300 milliseconds) and response times were limited to 3000 milliseconds. These results indicate a significant effect of each prime and its reliability to replicate that effect in each group (r(16) = .81, p < .001). These results indicate a divergence from the influence of mere word-frequency or alphabetic knowledge, which was the significant influence in the previous RAN tests.

This ODT is also useful in detecting a preference for English or Japanese, depending on the sequence of letters. It is not intuitive to assume that the FV-ES group is better at English than the MA-ES from the average result. These responses indicate that grapheme awareness is no longer based merely on word frequency or word complexity, but is affected by some other influence (i.e., orthographic understanding). The Fuji View group chose according to rudimentary English lexical, and superior Japanese lexical knowledge. The decision process can be illustrated by referring to Table 5.5 to reject or accept an orthography that is different between the two groups.

Table 5.5

ODT Indicating Lexical and Orthographic Possibilities

Prime	Lexis		Ortho.		Rejt	Pref.		Notes
	Jp	En	Jp	En	Acpt	Jp	En	
shi (Jp)	O	X	O	O	O	MA		In the absence of prime FV1 chose English
she (En)	X	O	X	O	O		FV	
ken (JE)	O	O	O	O	O[a]		FV	[a]This was entered manually
nama (Jp)	O	X	O	O	O	FV		
eiga (Jp)	O	X	O	O	O	FV		
lift (En)	X	O	X	O	XJp		FV	
bufou (En)	X	X	?	F	XEn		MA	
fort (En)	X	O	X	O	XJp		MA	
bufou (En)	X	X	?	F	XEn		MA	
defu (Jp)	X	X	?	O	O	FV		
shun (JE)	O	O	O	O	O[a]	FV	-MA	Shun/ʃʊn/ in Jp is a Hf name Shun /ʃʌn/ is a LF verb in English
nahs (En)	X	X	X	F	XJp		FV	
syise (En)	X	X	X	O	XJp	MA		
foxsu (En)	X	X	X	XF	XJp		FV	
haro (Jp)	X	X	O	O	O	FV		
ngyen En)	X	X	X	XF	XJp		FV	NGY is an illegal onset in *romaji* and rare in English
halo (En)	X	X	X	O	XJp		MA	L is not in the Japanese Alphabet
resilca(En)	X	X	X	XB	XJp		MA	

Note. The following notes indicate possible reasons behind responses

O - High frequency, well defined rule: XJp - Reject Japanese

X - Rare, or not allowed (pseudoword): XEn - Reject English

? - Sometimes represented but rare: X - Reject Both (Knowledge of either language)

XF - Foreign words only: O - Accept Both (Preference)

XB - Only in blends (not in this position)

[a] This result was manually adjusted from and not part of the algorithm that was used to score other results.

5.5.4 ODT Interpretation of Results

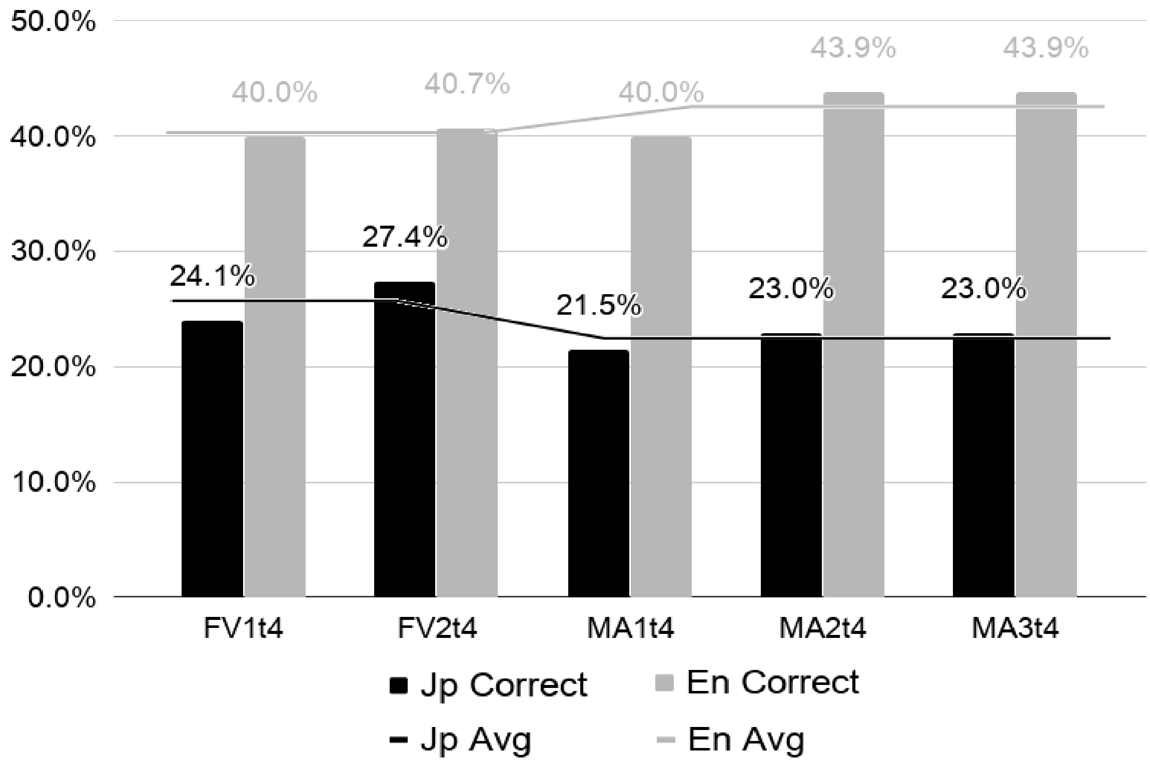
The primes in this ODT were constructed based on graphic constraints, graphemic frequency, and word frequencies in Japanese and English. Arrangements of phonemes were strategically ordered to invite word level “recognition”. Nearly every word is a pseudoword, therefore, word level (i.e., whole word shape) recognition should result in an error, unless the uniqueness of the prime raises the respondent's awareness. To further facilitate this covert manipulation of processing, response times were strictly controlled (i.e., 3000 milliseconds).

The presentation time was only 300 milliseconds. Therefore, students had limited opportunity to grasp the word or to make a decision on its spelling, or analyse the letters as anything other than a familiar sequence. In this manner, it is expected that orthographic and lexical implicit knowledge will be the predominant force behind these tests. The response choices were colour coded and consistently ordered, and coincided with the paper response form (see Appendix 4.2.3). Students had to circle (日) for Japanese and (英) for English. In doing this, the burden to spell the word is removed.

By summarising the results into categories of English and Japanese terms, it was possible to see the effect of general alphabetic knowledge and its effect on English and Japanese orthographic knowledge, as detected by the ODT (see Figure 5.4).

Figure 5.4

ODT Scores for Japanese and English Results



Note. The vertical axis is only 50%. FV group Japanese Orthographic understanding was better than MA group. MA group English Orthographic understanding was better.

The results from the above graphic are counter-intuitive. At face value, we could assume that FV-ES achieved better in the Japanese Orthographic understanding than in the English Understanding. Alternatively, it appears that MA-ES achieved better in the English orthographic test. However, the reasons for this can be better explained after re-considering the results for each prime in the previous Table 5.5.

One of the assumptions presented earlier in this study is that knowledge of an opaque orthography, like the English alphabet, can facilitate the understanding of a transparent orthography (i.e., *romaji*). The present ODT illustrates this through the more accurate recognition of Japanese. That means, in a decision, students who on average had better alphabetic understanding were able to make better judgments about the more transparent Japanese alphabetic orthography, *romaji*. The reason for the higher result in the MA group was possibly a result of guessing.

These results indicate that the MA-ES group were making more general assumptions that the primes were English. This claim can be supported in two ways. The FV-ES *romaji* results were better because MA-ES made a greater number of errors; when they were in doubt, they assumed the prime was English instead of Japanese. Additionally, if we look at the error between the two groups, the MA group was choosing English, when in doubt. There is another reason these results are less than non-intuitive.

With the addition of lexical access, words can be "perceived" according to word shape and familiarity. For example, while the presentation of the word '*elaphent*' can be mistaken for two reasons, both require graphemic knowledge (i.e., the shape of the word) and phonemic knowledge (i.e., the sounds of the letter combinations). This accounts for the results for 'SHUN', 'HARO' and 'KEN'. The FV-ES group chose 'SHUN' as an English word less than MA-ES possibly because the letter combinations were not explicitly written in *romaji* as 'SHYUN' (i.e., the same sound phonetic sound /ʃʊn/ and *kana*, しゅん). The MA-ES group in total had fewer students that had practiced this more advanced *romaji* spelling, and had probably not yet experienced the English version (i.e., the verb 'shun' /ʃʊn/ in English.

The prime 'SYISIE' was neither English, nor Japanese. This prime for non-native Japanese would look like Japanese because it fills the rudimentary V, CV and CCV orthographic conventions. However, knowledge of Japanese phonemes makes this prime an illegal combination. The phonemes for "yi" and "ye" have long been removed from the Japanese writing system. Therefore, by elimination and with some processing, the word should be chosen as looking more English. For "ven" though, only acronyms exist in English (see https://www.thefreedictionary.com/words-that-start-with-syi). The more *romaji*- and alphabetically-adept FV-ES group chose Japanese:

- FV-ES (FV1, n=15, 46.7%; and FV2, n=28, 46.4%; x̄ = 46.5%), and
- MA-ES (MA1, n=31, 35.5%; MA2, n=30, 36.7%; and MA3, n=31, 35.5%; x̄ = 35.9%)

While these results indicate that more students in the FV-ES population (i.e., 46.5%) chose Japanese for the prime 'SHUN' than the MA-ES population (i.e., 35.9%), the difference between the two groups was, however, not statistically significant (Z = -

1.1797, p = .238, i.e., p > 0.05). The lack of statistical significance is expected, because there are various reasons for the interference in results.

The FV-ES group chose the Japanese orthography for “KEN” more than the MA-ES group, possibly for similar reasons. ‘Ken’ as a boy's name is not presented in school texts until after junior high school. This prime had no indication of being a proper noun (i.e., it did not start with a capital letter), so under the strict time constraint of the test, the most frequent occurrence of the letter combination was chosen (i.e., the suffix ‘-ken’). The suffix ‘*ken*’, or ‘県’ in *kanji*, is added to the end of many of the areas of jurisdiction (i.e., prefectures or states) that surround the area of the schools in this study, namely Shizuoka-ken (静岡県), Yamanashi-Ken (山梨県), Kanagawa-Ken (神奈川県), and Saitama-Ken (埼玉県). The results indicate that the FV-ES chose ‘KEN’, more as a Japanese word than did the MA=ES group, who seemed to be more inclined to err on the side of English:

- FV-ES (FV1, n = 15, 86.7%; and FV2, n = 28, 82.1%; $\bar{x}$ = 83.7%), and
- MA-ES (MA1, n = 31, 64.5%; MA2, n = 30, 70.0%; and MA3, n = phonemes 31, 64.5%; $\bar{x}$ = 66.3%)

These results indicate that the two groups are significantly different (i.e., H_o: $P_a = P_b$ was rejected at $\alpha < 0.05$; z = 2.09; p = .036).

5.6 Orthographic Recognition Test (ORT)

The Orthographic Recognition Test (ORT) is similar to the ODT in that it is designed to test implicit orthographic knowledge, and it is influenced by lexical access. The ODT demands the processing of knowledge of experience or rules, therefore, it is somewhat more explicit. The ORT removes the confounds of making guesses and processes of elimination that were discussed in the ODT (i.e., KEN, SHUN, and SYISEI). By removing the burden of having to recognise a language and decide on orthographic constraints, the ORT provides a more accurate representation of orthographic knowledge and its relation to lexical access. Lexical access based on word shape and sight word recognition was controlled by using pseudowords, and hopefully raises attention to phonemic and graphemic chunks within the pseudowords that resemble each other and real words.

5.6.1 Introduction

The ORT contains two sets of eighteen pseudowords (i.e., primes), some of which are similar in appearance to real words. The first set of 18 primes test Japanese orthographic knowledge and the second set of 18 primes test English orthographic knowledge. These primes were specifically designed from the Age-Specific vocabulary in Japanese, and the words in both languages that have been heard in passing from text, television, or other sources up to their present age.

5.6.2 ORT Hypotheses

1. Students with only *romaji* orthographic knowledge should:
    - select words based on Japanese graphemic constraints words with greater accuracy,
    - when a word is either English or Japanese, students will select words in their lexicon as Japanese, and
    - words that are neither English or Japanese will guess English
2. Students with English and *romaji* ability should:
    - make mistakes based on word recognition (that is they read the word wrong) because of familiarity, and
    - struggle more with words that are neither English or Japanese, then decide on *romaji* rules to reject the Japanese option and choose English.
3. Students with little alphabetic knowledge should:
    - make errors that correspond more with word familiarity,
    - choose Japanese if orthographic rules are not flouted, and
    - choose English words if in doubt.

5.6.3 ORT Results Across all Groups

The results from all five groups were visually analysed to assess if there was any skew or significant differences between them (see Figure 5.5 for Japanese and Figure 5.6 for English). The rules for each prime are listed below (Table 5.6 for Japanese and Table 5.7 for English), together with the score for each group and the average percentile for each prime.

Table 5.6

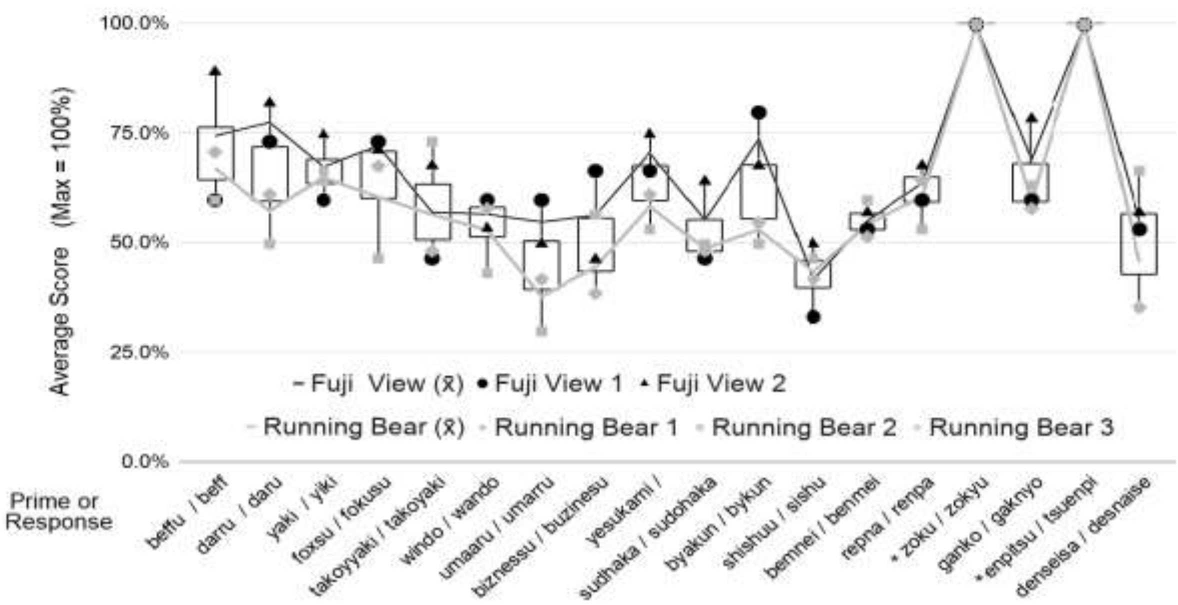
Japanese ORT Rules and Scores

Prime	Response	Rule	FV-ES1t4	FV-ES2t4	MA1t4	MA2t4	MA2t4	Total
			n=15	n=28	n=31	n=30	n=31	N=135
beffu / beff	beffu	CC is illegal	60.0%	71.0%	71.00%	60.0%	71.0%	67.33%
darru / daru	daru	rr is illegal	73.3%	61.3%	61.30%	50.0%	61.30%	60.12%
yaki / yiki	yaki	yi is redundant	60.0%	64.5%	64.50%	66.70%	64.50%	64.49%
foxsu / fokusu	fokusu	x is not in *romaji*	73.3%	67.7%	67.70%	46.70%	67.70%	63.66%
takoyyaki / takoyaki	takoyaki	yy is illegal	46.7%	48.4%	48.40%	73.30%	48.40%	53.74%
windo / wando	wando	wi is an artifact	60.0%	58.1%	58.10%	43.30%	58.10%	55.02%
umaaru / umarru	umaru	rr is illegal	60.0%	41.9%	41.90%	30.0%	41.90%	41.27%
biznessu / buzinesu	bizinessu	zn is illegal	66.7%	38.7%	38.70%	56.70%	38.70%	45.81%
yesukami / yasukami	yasukami	ye is redundant	66.7%	61.3%	61.30%	53.30%	61.30%	60.12%
sudhaka / sudohaka	sudohaka	dh is illegal	46.7%	48.4%	48.40%	50.0%	48.40%	48.57%
byakun / bykun	byakun	CY needs a, u, or o	80.0%	54.8%	54.80%	50.0%	54.80%	56.53%
shishuu / sishu	shishuu	si Kunrei or keyboard	33.3%	41.9%	41.90%	46.70%	41.90%	42.01%
bemnei / benmei	benmei	mn is illegal	53.3%	51.6%	51.60%	60.0%	51.60%	53.66%
repna / renpa	renpa	pn is illegal	60.0%	64.5%	64.50%	53.30%	64.50%	61.51%
zoku / zokyu	zoku	both legal, kyu is LF	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
ganko / gaknyo	ganko	kn is illegal	60.0%	58.1%	58.10%	63.30%	58.10%	59.47%
enpitsu / tsuenpi	enpitsu	enpitsu is HF, tsu is a a nonword	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
denseisa / desnaise	denseisa	sn is illegal	53.3%	35.5%	35.50%	66.70%	35.50%	44.41%

If a failure is counted as 50% or less, there were two important findings. Words with doublets caused the biggest problems (*umaaru, bizinessu, shishuu*). Problems are associated with genuine orthographic mistakes; *sudhaka* is an illegal/nonword and *desnaise* is also illegal. The reasons for the doublets is partially explained by the rareness of double vowels. However, "buznessu" and "sudhaka" were both not recognised as an illegal entry. The regularity of these errors were visually analysed (see Figure 5.5).

Figure 5.5

ORT Japanese Orthographic Knowledge Proportions for all Groups



Note. Students were asked to choose which word "looked" more Japanese. Words that were both Japanese naturally scored 100%. Refer to the text for analysis of the proportions. The primes are considered significantly reliable using a correlation between the FV-ES groups (dark line) had higher average scores with a strong correlation ($r(16) = .92$, $p < .001$) with the MA-ES groups. Data is <here>.

Table 5.7

English ORT Rules and Scores

Prime	Response	Rule	FV-ES1t4	FV-ES2t4	MA1t4	MA2t4	MA2t4	Total
			n=15	n=28	n=31	n=30	n=31	N=135
shen / hsen	shen	hs illegal onset	33.33%	57.14%	51.61%	50.0%	51.61%	50.37%
rour / ruor	rour	ruor is LF	46.67%	42.86%	45.16%	53.33%	45.16%	46.67%
taiy / taly	taly	Italy is HF, taiy is LF	73.33%	96.43%	58.06%	63.33%	58.06%	68.89%
fehs / fesh	fesh	hs rare stop*[1]	53.33%	35.71%	51.61%	50.0%	51.61%	48.15%
drater / adrter	drater	drt is illegal	46.67%	46.43%	32.26%	46.67%	32.26%	40.0%
bwey / ebwey	Both X	bwe is Ugandan	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
ngyen / Nguni	ngyen	ng illegal onset*[2]	53.33%	60.71%	54.84%	63.33%	54.84%	57.78%
absovle / absolver	absolver	vle is rare*[3]	66.67%	67.86%	54.84%	76.67%	54.84%	63.70%
resilca / rselica	resilca	rs is an acronym	40.0%	46.43%	51.61%	56.67%	51.61%	50.37%
dgedo / dodge	dodge	dg start is illegal*[4]	40.0%	39.29%	41.94%	56.67%	41.94%	44.44%
libyrar / bylriar	libyrar	ylr is (Wf 1)	40.0%	46.43%	51.61%	66.67%	51.61%	52.59%
quaff / ffaqu	quaff	qu is a Chinese stop	66.67%	50.0%	48.39%	43.33%	48.39%	49.63%
thrawn / warthn	thrawn	thn stop is illegal/rare	40.0%	50.0%	51.61%	63.33%	51.61%	52.59%
voil / viol	Voil	voil is Lf (Wf 623)*[5]	66.67%	53.57%	38.71%	40.0%	38.71%	45.19%
wizened / zewined	both OK	Test of preference*[6]	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
susurrus / srusrus	susurrus	sr is illegal*[7]	53.33%	57.14%	45.16%	43.33%	45.16%	48.15%
chimiecr / chimeric	chimeric	cr stop is illegal/rare	46.67%	50.0%	32.26%	50.0%	32.26%	41.48%
continue / cotniune	continue	continue is AoA rare*[8]	60.0%	57.14%	61.29%	46.67%	61.29%	57.04%

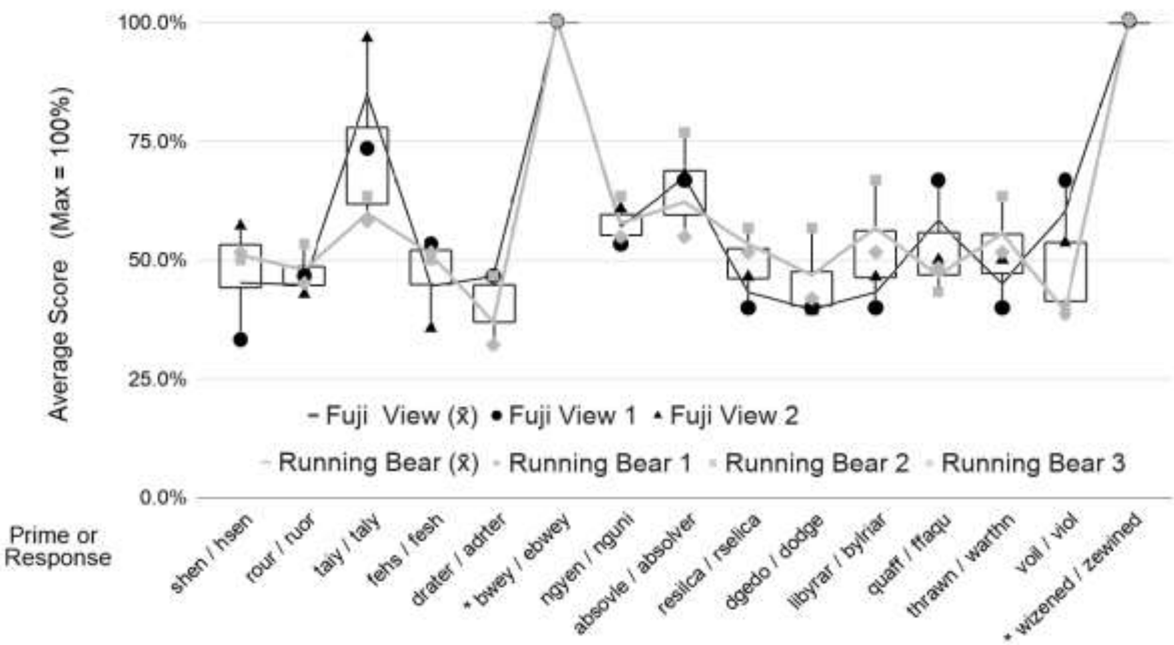
Note. LF = Low Frequency Word and HF = High Frequency Word

1. “fesh” – “hs” is also a test of reading dyslexia; 2, “ngy” is an illegal onset in both languages (Vietnamese name); 3. vle is rare, absolve is a real word (academic, wf 669); 4. While “dg” as a start is illegal, in the word dodge/Dodge, it is popular EME (Wf 8010); 5. “voil” is LF (Wf 623) but as an onset it is frequent (e.g., in violin, violent, violet); 6. This test the contrast between *romaji* and English because “wi” is an illegal grapheme in *romaji*, and “ned” implies a past tense verb in English. The decisions should be weighted “wizened” for English learners, because “wined” (Wf 154) is a less frequent verb than wiz (Wf 628) which may also function as a noun and an adjective; and finally, 7. “sr” is illegal*[7] (in this case a Hindi word) except between prefixes and root words, and “rr” is illegal in *romaji*, therefore, forcing the student to resolve an error.

If a failure is counted as 50% or less, the result is less intuitive if we consider English orthographic knowledge alone. However, if we consider the usual CV final positions of words in *romaji* we find that students chose those occurrences as correct (i.e., dgedo and ffaqu). Other occurrences of poor results are too random to draw any conclusions. However, there was a strong tendency for mistakes to be concentrated around words containing “l” and “r”, namely, rour (46.67%), *drater* (40.00%), *resilca* (50.37%), *libyrar* (52.59%), *susurrus* (48.15%), and *chimeric* (41.48%). Another consideration is letters outside *romaji*. (e.g., q, l, and x), voil (45.19%) is one example. However, this does not explain “taly”. Here, the assumption is that “Italy” is a high frequency word in society and has implicitly positioned itself in the lexis of children.

Figure 5.6

ORT English Orthographic Knowledge Proportions for all Groups



Note. Students were asked to choose which word “looked” more English. Words that were both English naturally scored 100%. The primes are considered significantly reliable using a correlation between the FV-ES groups (dark line) had higher average scores with a strong correlation (r(16) = .83, p < .001) with the MA-ES groups. Data is <here>.

5.6.4 ORT Interpretation of Results

Results from ORT indicate that students' responses were more random than expected. Two plausible reasons explain this, the first is the general lack of alphabetic reading skills of students. At the time of this test, students had little to no access practice or *romaji* reading and English reading and writing had not been introduced. The other reason is, this is possibly the longest period of time these students have ever had to concentrate on alphabetic knowledge and the fatigue was obvious during the test. Therefore, it is assumed that the results from this test are highly erroneous.

The scores in the *romaji* test were greater than those in the English test. By taking the one tailed t-test for increase between the two datasets with independent means, because the 36 primes are not related to each other, we find there is a significant difference at $p < 0.05$, between the scores for *romaji* ($M = 56.46$, $SD = 8.34$) and English ($M = 50.94$, $SD = 7.26$), $t(34) = 2.12$, $p = .021$. The effect size was calculated using Cohen's *d* because the two groups of primes have similar standard deviations and sample sizes. The resultant effect size ($d = 0.706$) indicates that the means of the two tests are medium to large. Therefore, this result should be reliable (i.e., repeatable) in future research if students have similar abilities in *romaji* and English.

The following section uses the evidence presented in the preceding sections to investigate what in fact is the most influential factor in orthographic influence in early development of alphabetic knowledge.

PART-II

Iterative Data Analysis of Real-, Pseudo-, and Non-Words

This section presents the iterative data analysis results derived from the previous hypothetical test data. A progressive analysis of each theory of the theories is investigated and presented. The source data comes from the first three tests The RAN visual prime test, the RAN audio prime test of foreign loan words and the TACHiD test of pseudowords. While the source data in each of the following analyses are the same, the variable of interest in the primes is changed. The overall hypotheses presented in this section are as follows.

1. Orthographic influence in early development is less dependent on word frequency and word length than word complexity.

2. Word complexity is also a result of orthographic distance between the native language and the second or additional language.

After the initial results were analysed, a variety of effects were identified. First, word-length was affected more by word complexity. Corpora word frequency was not as influential as age of acquisition and word familiarity. Word complexity was also analysed to investigate the effect of orthographic complexity, and orthographic familiarity. Orthographic familiarity is assumed to be where there is a similar or one-to-one relationship between the scripts in both languages. Familiarity should be useful for language transference. The results in this section indicate that orthographic complexity was the most influential factor across the tests, and the errors in complexity were consistent with words that had low transference, and high inconsistencies between *romaji* orthography and English.

This iterative analysis takes a data mining technique in investigating cause and effects. Inferential statistics are used to reach conclusions about associations between variables. In the previous sections, descriptive statistics were used to illustrate results, but not necessarily test mathematically any hypothesis, although assumptions were tested in the process. This section is where the hypotheses are explicitly tested. Of course, no single test can truly prove or disprove any particular hypothesis (Popper, 2005), but the scientific method can test doubt and lead to a greater understanding of the phenomenon under test. In the present thesis, the phenomenon of interest is the distance between the two orthographies (i.e., *romaji* and English). This distance is most dependent on where orthography (i.e., individual and chunked phonemes and graphemes) is missing between the two languages, and not simply the transparency or mappings between phonemes, graphemes, or letter complexity.

Iterative sampling involves a process whereby researchers move back and forth between selecting cases for data collection and engaging in a preliminary analysis of the cases sampled. The idea is that what emerges from data analysis will shape subsequent sampling decisions, and in the case of the present thesis, subsequent data analysis is focussed on the orthographic gaps between Japanese and English orthography.

5.7 The Effect of Word Frequency, Word Length, Syllable Count, and Word Complexity

Word length is a general predictor of spelling and reading accuracy, at least in the absence of sight word availability (Ellis et al., 2004). Word length was detrimental to non-lexical items in previous research, and should therefore be evident in these results. If the effect of AoA is ignored, there should also be a relationship between word frequency, word length, and consequently syllable count. According to Zipf's Law of abbreviation (Zipf, 1949, as cited in Webb & Nation, 2017), more frequent words usually undergo some attrition of morphology over time and become shorter. Therefore, it is reasonable to expect some degree of similarity between these three variables. The variability between these results would, therefore, be attributed to either age-specific lexical access or orthographic/word complexity.

The following analysis compares the number of correct responses to real words, pseudowords, and nonwords for each prime (i.e., on the Y-axis) against the prime (along the X-axis). Correct answers are those written with precision and speed. Only correct responses were counted so students who did not respond at all to the tests would be consequently rejected. Since no single student withdrew from the test, the complete set of participants (N=134) are included in the following results. Uppercase and lowercase conflicts were considered an error as are directional problems (e.g., p/q, b/d, also p/b, p/d, and so on).

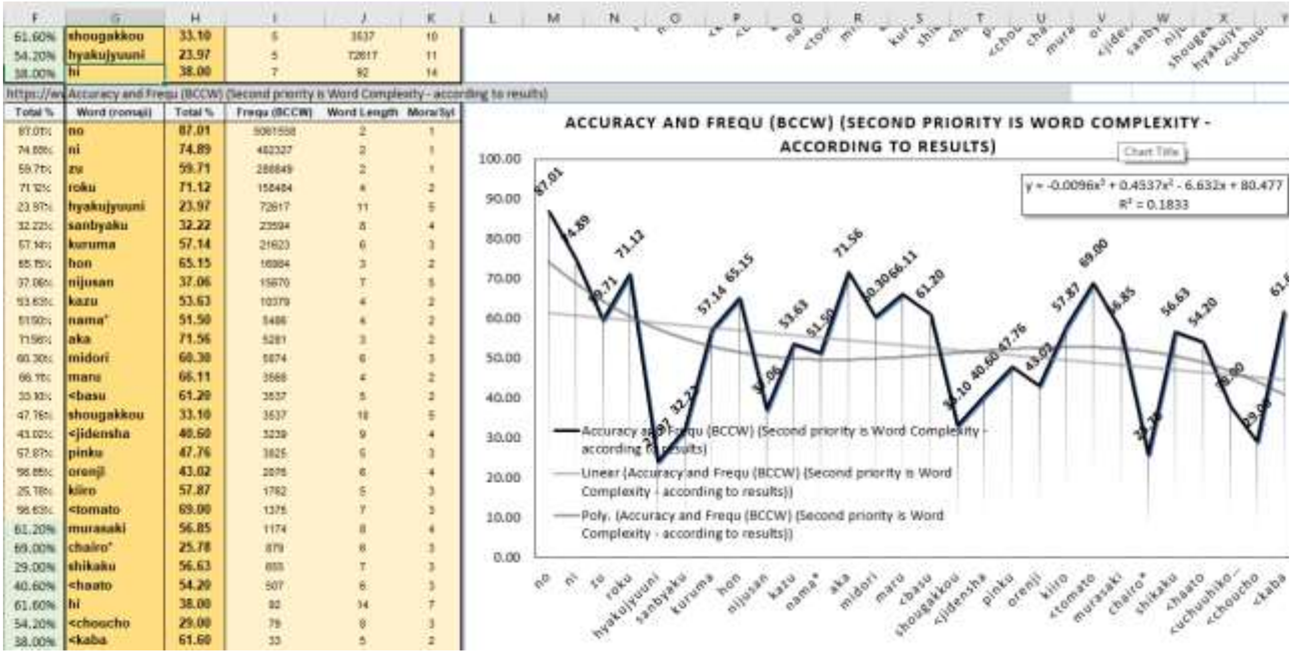
The order of the primes studied in accordance with the three variables of interest in this section, namely Word Frequency, Word length, Syllable count, and Word Complexity. The data from the RAN visual primes, real word test (Test-1) and the RAN audio prime, foreign nouns (Test-2) are presented together, followed by the pseudo-/nonwords (Test-3) from the TACHiD test. Visual data analysis techniques were used to identify outliers in the information and the data was tested using a non-linear regression model. The statistical uniformity, and type of regression is reported and discussed for each set of data.

5.7.1 RAN Test Effect of Word Frequency

Word frequency has been used in the past to standardise orthographic tests across languages. The assumption in those tests is that the lower the frequency the less likelihood of the word being in lexis. While this is useful for cross language tests for different individuals, the following results indicate the variability in the data, especially in beginners (see Figure 5.7).

Figure 5.7

RAN Test Result of Word Frequency



These results indicate that there is very little predictability in the outcomes based on word frequency alone. In the $R^2 = 0.1833$, which is extremely poor.

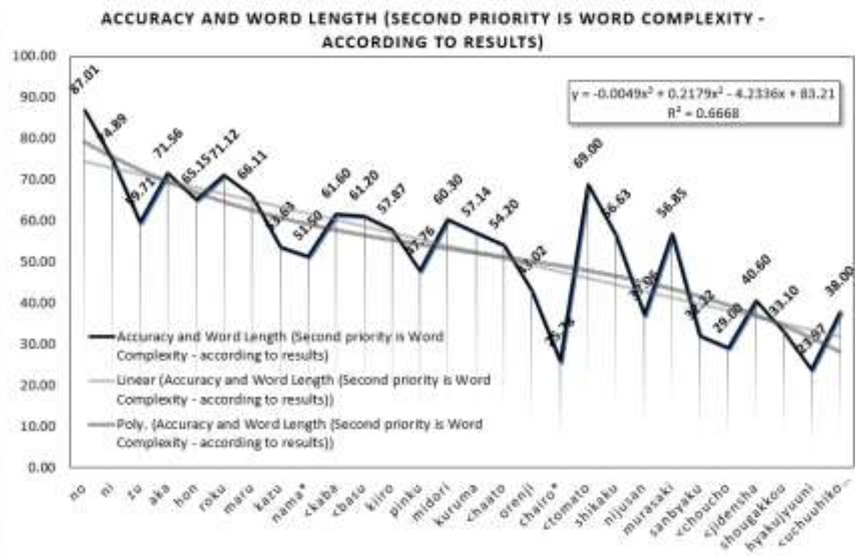
5.7.2 RAN Test Effect of Word Length

According to Zipf's law, word frequency and word length have a somewhat negative but reliable correlation. That means as word frequency increases, the length of the word reduces. Therefore, we would expect to see another poor result (see Figure 5.8).

Figure 5.8

RAN Test Result of Word Length

Word (romaji)	Total %	Word Length	Mora/Syl	(BCCW)
no	87.01	2	1	5061558
ni	74.89	2	1	482327
zu	59.71	2	1	288849
aka	71.56	3	2	5281
hon	65.15	3	2	16984
roku	71.12	4	2	158464
maru	66.11	4	2	3566
kazu	53.63	4	2	10379
nama*	51.50	4	2	5486
<kaba	61.60	5	2	33
<basu	61.20	5	2	3537
kiiro	57.87	5	3	1782
pinku	47.76	5	3	3825
midori	60.30	6	3	5674
kuruma	57.14	6	3	21623
<haato	54.20	6	3	507
orenji	43.02	6	4	2875
chairo*	25.78	6	3	879
<tomato	69.00	7	3	1375
shikaku	56.63	7	3	655
nijusan	37.06	7	5	15879
murasaki	56.85	8	4	1174
sanbyaku	32.22	8	4	23984
<choucho	29.00	8	3	79
<jidensha	40.60	9	4	3239
shougakkou	33.10	10	5	3537
hyakujyuuni	23.97	11	5	72617
hi	38.00	14	7	92



These results indicate that there is very little predictability in the outcomes based on word frequency alone. In the $R^2 = 0.6668$, which is marginally better than the word frequency test but still an extremely poor relationship.

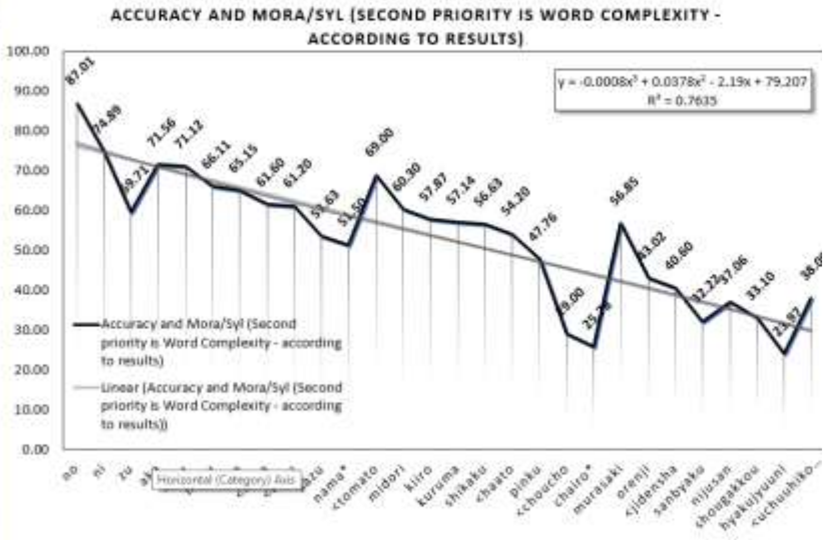
5.7.3 RAN Test Effect of Syllable/Mora Count

The relationship between word length and the number of syllables is much closer in Japanese than English, because of the consistent V, CV, CCV arrangement of Japanese. The assumption in this thesis is that Japanese remember *romaji* in phonemic chunks, and therefore, the representations of the consonant and vowel combinations are stored not as distinct, separate letters but in graphemic chunks that represent the Japanese phonemes. When the results are arranged in syllable/mora count order, the regression model is similar and slightly more accurate than the word length test (see Figure 5.9).

Figure 5.9

RAN Test Result of Syllable/Mora Count

Total %	Word (romaji)	Total %	Mora/Syl	(BCCW)	Length
87.01%	no	87.01	1	5061558	2
74.89%	ni	74.89	1	492327	2
59.71%	zu	59.71	1	288849	2
71.12%	aka	71.56	2	5281	3
23.97%	roku	71.12	2	158484	4
32.22%	maru	66.11	2	3588	4
57.14%	hon	65.15	2	16884	3
65.15%	<kaba	61.60	2	33	5
37.06%	<basu	61.20	2	3537	5
53.63%	kazu	53.63	2	10379	4
51.50%	nama*	51.50	2	5486	4
71.98%	<tomato	69.00	3	1375	7
60.30%	midori	60.30	3	5074	6
66.11%	kiiro	57.87	3	1762	5
33.10%	kuruma	57.14	3	21623	6
47.76%	shikaku	56.63	3	855	7
43.02%	<haato	54.20	3	507	6
57.87%	pinku	47.76	3	3025	5
56.85%	<choucho	29.00	3	79	8
25.78%	chairo*	25.78	3	879	6
56.63%	murasaki	56.85	4	1174	8
61.20%	orenji	43.02	4	2076	6
69.00%	<jidensha	40.60	4	3239	9
29.00%	sanbyaku	32.22	4	23594	8
40.60%	nijusan	37.06	5	15670	7
61.60%	shougakkou	33.10	5	3537	10
54.20%	hyakujyuuni	23.97	6	72617	11
38.00%	hi	38.00	7	32	14



These results indicate that there is a similar fit to the regression model as with word length, with a few outliers. There is very little predictability in the outcomes based on word frequency alone. The reasons for the inconsistent results were mentioned earlier in Part I. Students have little experience writing in *romaji* and the representation of “ou”, and the spelling of “ch” is often reduced to keyboard entry “t”. This has an over-ruling effect on the regression model reported accuracy (R^2 = 0.7635). If these problems were corrected with training, syllable count could be a good predictor of results.

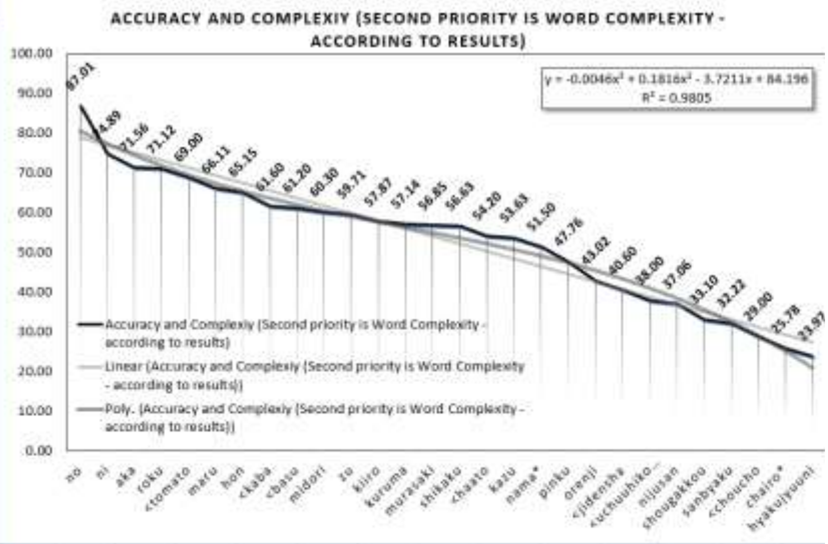
5.7.4 RAN Test Effect of Orthographic Complexity

Orthographic complexity was considered on at least two criteria. First, the combinations of the letters and their consistency with sounds and the written form. For example, the word “chairo” is somewhat complex because the grapheme “cha” is sometimes written as “tya”, and therefore, creates confusion. Also, the word has three syllables and a double vowel. Since this part of the study is through investigative analysis, the words were simply arranged in order of correctness and applied to the regression model. Then the word order was justified or refuted based on orthographic analysis of the word complexity (see Figure 5.10).

Figure 5.10

RAN Test Result of Orthographic Complexity

Total %	Word (romaji)	Total %	Complexity
87.01%	no	87.01	
74.89%	ni	74.89	
59.71%	aka	71.56	
71.12%	roku	71.12	
23.97%	<tomato	69.00	
32.22%	maru	66.11	
57.14%	hon	65.15	
65.15%	<kaba	61.60	
37.06%	<basu	61.20	
53.63%	midori	60.30	
51.50%	zu	59.71	
71.56%	kiiro	57.87	
60.30%	kuruma	57.14	
66.11%	murasaki	56.85	
33.10%	shikaku	56.63	
47.76%	<haato	54.20	
43.02%	kazu	53.63	
57.87%	nama*	51.50	
56.85%	pinku	47.76	
25.78%	orenji	43.02	
56.63%	<jidensha	40.60	
61.20%	hi	38.00	
69.00%	nijusan	37.06	
29.00%	shougakkou	33.10	
40.60%	sanbyaku	32.22	
61.60%	<choucho	29.00	
54.20%	chairo*	25.78	
38.00%	hyakujyuuni	23.97	



These results were arranged in order of accuracy from the RAN tests. Therefore, it is not surprising to witness a significant linear relationship ($R^2 = 0.98$) to the polynomial equations (see Figure 5.13). As mentioned before, the most complex primes were: "*shougakkou"* because of two "ou" and one double consonant occurrence, plus syllable count (n = 3), mora (n = 6), and word length (n = 8); "*sunbyaku"* because "bya" is a complex *kana*/phoneme and some students spell with an m before b, because phonetically this is how the "n" is connected in a blend; then "*chouchou"* as discussed earlier; "*chairo*" was possibly an error due to colour mismatch in the presentation; and finally, "*hyakujyuuni*" is a complex combination of three words to construct the prime, there are two CyV occurrences, and a double vowel "uu", therefore making it arguably a more complex word.

5.8 The Effect of Word Length, Syllable Count, and Word Complexity on Non-Words and Pseudo-Word

Removing sight word influence has been achieved in the past by using pictures, sounds, or mixed case or font variations. Another way that has been tremendously successful in predicting lexical access of less than word-level knowledge is the TACHiD test. Similar to the previous section, the results are analysed in terms of word length, syllable count, and word complexity.

5.8.1 No Need for TACHiD Test Effect of Word Frequency

Word frequency in the real word test was a tremendously poor predictor of results. In this test, there are no word frequencies, because all words are pseudowords or nonwords and therefore, their log-frequency cannot be defined.

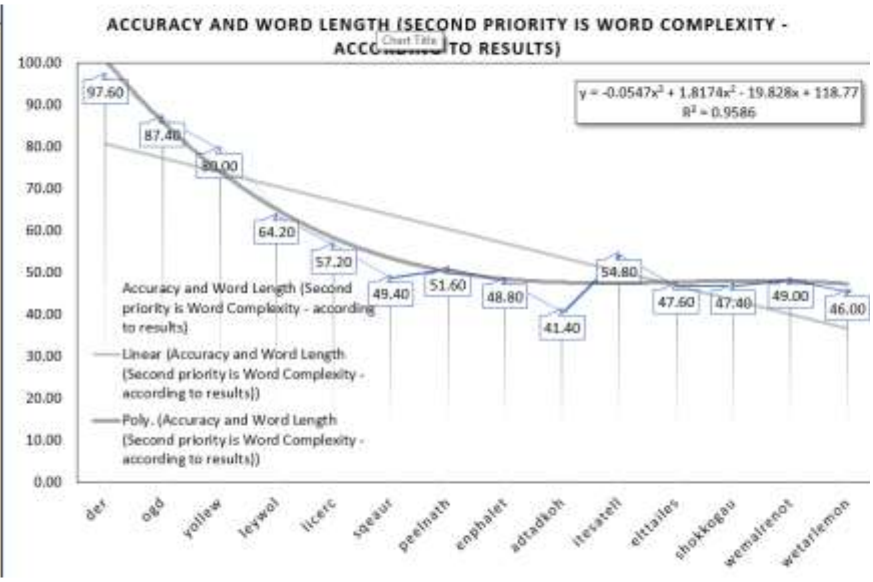
5.8.2 TACHiD Test Effect of Word Length

With real words, the regression model for word length suffered tremendous variability. While there was a general tendency for word length to be inversely proportional to accuracy in real words, for pseudowords the effect was greater, although not significant (see Figure 5.11). This has already been established in the literature. Words that are longer but real have semantic and orthographic neighbourhood effects to support accuracy of spelling. The TACHiD has no benefit of this knowledge therefore, word length is more of a detriment to accuracy.

Figure 5.11

TACHiD Test Result of Word Length

Word (romaji)	Total %	Word Length	Mora/Syllabl	Frequ
der	97.60	3	1	
ogd	87.40	3	1	
yollew	80.00	6	2	
leywol	64.20	6	2	
licerc	57.20	6	2	
sqeaur	49.40	6	2	
peelnath	51.60	8	2	
eophalet	48.80	8	3	
adtadkoh	41.40	8	3	
ltesatell	54.80	9	4	
elttailes	47.60	9	3	
shokkogau	47.40	9	4	
wemalrenot	49.00	10	4	
wetarlemon	46.00	10	4	



The polynomial regression model is significant for word length in the TACHiD test (R^2 = 0.9586). The reason for this is possibly because the word to be written did not depend on PG correspondences, nor are they dependent on any single orthography.

5.8.3 TACHiD Test Effect of Syllable/Mora Count

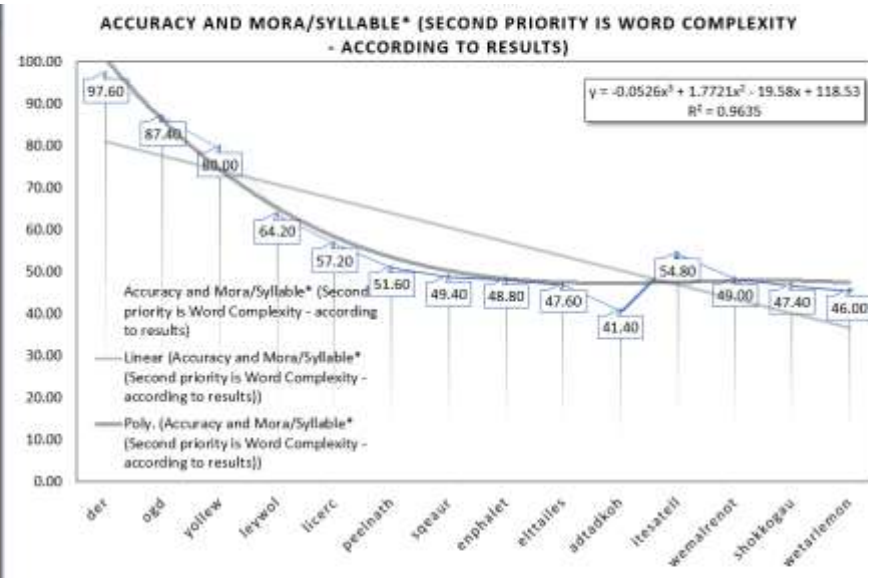
The relationship between word length and the number of syllables is also similar, even with words that have never been encountered before. Although the words in the TACHiD test are not real, an attempt was made at identifying syllables, based on

English rules. The decision for the syllable count is indicated in the table, adjacent to the results (see Figure 5.12).

Figure 5.12

TACHiD Test Result of Syllable/Mora Count

Word (romaji)	Total %	Mora/Syllable*	Word Length
der	97.60	1	3
ogd	87.40	1	3
yollew	80.00	2	6
leywol	64.20	2	6
licerc	57.20	2	6
peelnath	51.60	2	8
sqeaur	49.40	2	6
enphalet	48.80	3	8
elttalles	47.60	3	9
adtadkoh	41.40	3	8
itesatell	54.80	4	9
wemalrenot	49.00	4	10
shokkogau	47.40	4	9
wetarlemon	46.00	4	10



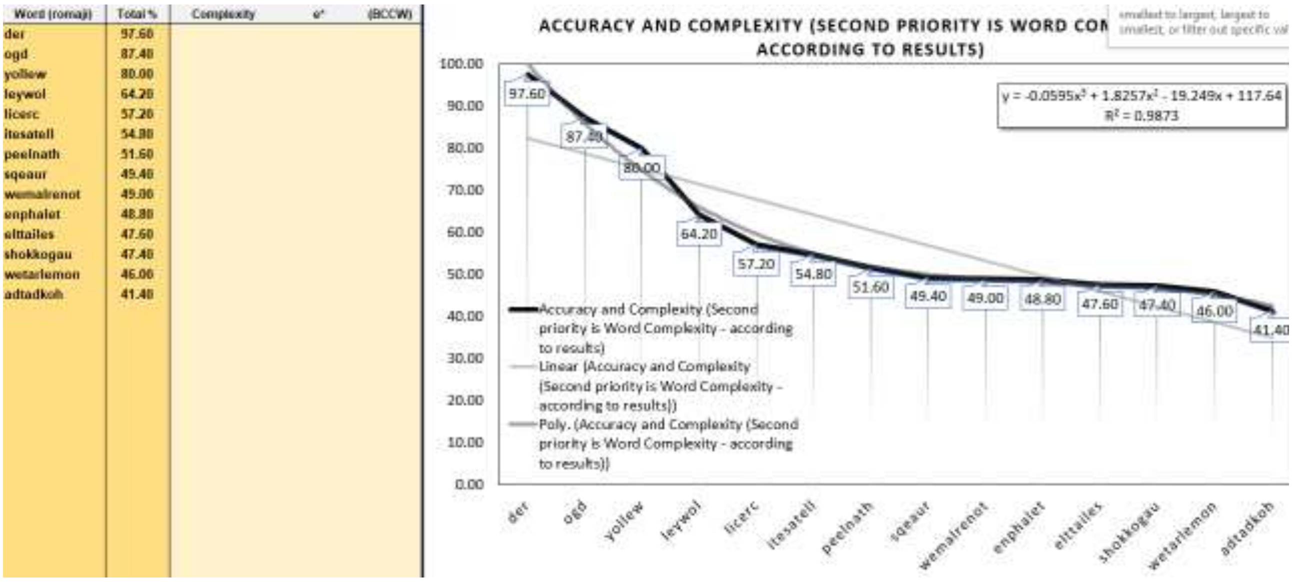
One similarity with the TACHiD test to the RAN test was that the syllable number was a better predictor of accuracy (R^2) = 0.9635.

5.8.4 TACHiD Test Effect of Orthographic Complexity

Orthographic complexity again was analysed from using the result accuracy then making observations on causes and effects of why the words were arranged in such a fashion (see Figure 5.13).

Figure 5.13

TACHiD Test Result of Orthographic Complexity



These results were arranged in order of accuracy from the TACHiD tests. Therefore, it is not surprising to witness a significant linear relationship ($R^2 = 0.9873$), tremendously similar to the RAN test. To enable easier analysis of complexity, primes were grouped into similar pairs. There are relationships between these pairs worth considering. The first two primes "der" and "ogd" both come from real words "red" (wf = 169743, COCA) and "god" (wf = 405340, COCA). The former "der" is already less complex because it is an orthographic possibility in both English and Japanese, although the "r" would normally be followed by a vowel in Japanese. The prime "ogd" on the other hand is illegal in both languages. The pseudowords derived from watermelon were surprisingly in opposite order, albeit for native English speakers. The latter, "wetarlemon" is easy for English speakers to read and remember because of the semantic nature or wet with water and lemon with the fruit melon. However, for Japanese people, this advantage was not available, and wemalrenot was easier to reproduce, albeit only marginally.

5.9 Summary

The results of the series of five tests are presented in this section.

5.9.1 Orthographic Knowledge

Orthographic knowledge was measured through two tests. The ODT required students to decide if a word was English or Japanese. All words were non-words that didn't flout one language's orthographic rules. The results indicated that students with English ability could make more accurate decisions, therefore supporting the test of lexical knowledge. The MA group in general had poorer literacy in both languages. It appears from the results that they chose English when in doubt. Therefore, rendering the test for preliterate learned less than reliable results that were less than statistically significant between the two groups ($Z = -1.1797$, $p = .238$, i.e., $p > 0.05$).

The ORT indicates an individual's implicit knowledge of their orthographic knowledge. Interestingly, the students with less English ability were able to recognise words based on their native language GP mapping (i.e., V, CV, and CVV combinations). The scores in the *romaji* test were greater than those in the English test. By taking the one-tailed t-test for increase of the two datasets with independent means, because the primes are not related to each other, we find there is a significant difference at $p < 0.1$, between the scores for *romaji* ($M = 0.5$, $SD = .0829$) and English ($M = 0.46$, $SD = .0772$), $t(34) = 1.33$, $p = 0\ .0960$.

5.9.2 Incidental Research Questions Results

The incidental hypothesis suggests that concreteness at the orthographic level is less dependent on word frequency, and more dependent on orthographic reliability. The research results are summarised below with the corresponding question.

5.9.2.1 Is word complexity inversely proportional to writing accuracy?

Word accuracy was found to be significantly inversely proportional to writing accuracy ($R^2 = 0.98$). RAN test results indicate that students' knowledge of Japanese orthography was not standardised, and this caused misunderstandings on the functions of letter sounds. One example was the use of “ch” which was transcribed as “ty” in some cases. Some students struggled with longer words, particularly those with the double vowel “ou" and when two vowels were adjacent (e.g., “oo”). The letter “l” was rarely a problem, and in the TACHiD test, it presented few problems. It is important to note that these students had no opportunity to spell from sounds or pictures of English words, and as a result, could not demonstrate their knowledge of the letter “L” and the distinguishing PG representations between “r” and “l”, which is a widely recognised speech problem.

5.9.2.2 What are the greatest causes of errors at the finer-grained phonemic/graphemic level of word analysis?

The greatest causes of errors were long vowels written with double vowels (see Section 1.5); geminate obstruents, represented in *romaji* by double consonants; and diphthongs represented with a “y” in the middle (e.g., *uchuuhikoushi*, *shougakkou*, *sanbyaku*, and *hyakujyuuni*). However, the effect of word length cannot be totally ruled out. Researchers (Ellis & Hooper, 2001; Ellis et al., 2004) have found that word length should have a greater influence on response times in a shallow orthography like *romaji* and deeper orthographies like English.

5.9.2.3 What is the cause of any relationship between PG complexity, PG frequency, and accuracy?

PG frequency appears to have a less negative effect on accuracy than PG complexity. Only through iterative analysis can this be explained. The Japanese phoneme /no/ (87.01%) is a tremendously high-frequency PG combination (see Figure 5.7), and without doubt the highest scoring item. However, it is also only two letters long. To consider this in the RAN test, we need to look at similar length words with different PG frequencies. One obvious place to start is familiar in both languages, the letter “Z”. If we use a pseudo-mathematical process of elimination, /ka/ is higher frequency than /ba/, and /su/ is higher in frequency than /zu/. If we consider all the possible combinations we could predict the order of accuracy, merely on a mathematical process. From highest to lowest we should have: ka, su, kasu, ba, kaba, basu, zu, kazu, bazu. The RAN test in fact orders accuracy (see Figure 5.10) kaba (61.60%), basu (60.30%), and kazu (51.50%). Although these differences are not significant, they are indicative that PG frequency is inversely proportional to accuracy. The PG complexity issue was answered in the previous question with significant results. Therefore, frequency is a weak predictor of accuracy, but complexity is most influential.

5.9.2.4 What is the relationship of PG problems between the two language orthographies?

The main focus of this research is to identify facilitation or inhibition between *romaji* orthographic knowledge and English orthographic knowledge. These phenomena could be studied through an iterative process of visual data analysis under the present testing conditions. The first area to investigate was where facilitation may be present (i.e., Type-0 Orthographic Gap, see section 5.10). The only covert way of measuring this is to analyse the nonword tests in the TACHiD test. Type-0 gaps are words like der (97.60%), ogd (87.40%), adtadkoh (41.40%). Type-1 gaps are a simple gap (i.e., a missing PG representation). The primes in this area are those with "l", "q", "v", or "x" (see Section 1.4.2). There is little evidence to support facilitation or inhibition in this test. This is not to be assumed to indicate anything except, the test is not a valid test for measuring Type-1 gaps.

Type-2 gaps are where there is opposition to facilitation through PG mapping. The most obvious choice is the vowels "a" and "u" (see Section 5.11) where there are inconsistencies between the sounds. "Tomato" is consistent and a useful point of reference because all the language combinations are perfectly matched between *romaji* and English (i.e., Type-0). Once again, there is little evidence in this test to indicate any inhibition. Once again, this is not evidence of the non-existence of a Type-2 error, but merely, the TACHiD is not an appropriate test. Therefore, future research should test these areas between literate *romaji*/English individuals.

5.9.2.5 Is there evidence to indicate that unique letters and phonemes in English conflict significantly with those of Japanese?

It was impossible to ask students to spell in English due to the difficulty they were experiencing in spelling in *romaji*. Most of the students, particularly in the MA group, appeard to have only an embryonic knowledge of English.

5.9.3 Most Significant Influence

The most significant influence, which contradicts previous studies into ODH between languages, is the variability in word frequency, and secondly, the variability in word length results. Word frequency has been used in numerous studies (e.g., Ellis et al., 2004; Hoxhallari, 2006; Hoxhallari et al., 2004) to standardise orthographic studies between individuals from different language backgrounds. For children in particular, high frequency words were used from school texts (Goswami et al., 1998; Seymour et al., 2003), which was the method adopted in developing the RAN test in this study. However, in multilingual studies on individuals, word-length and word frequency need to be used with extreme caution, and previous research should be reassessed on the following grounds in particular. The reason for the variability in these results is assumed to be a result of AoA and the stage of developing orthographic awareness, meaning, some students were more advanced than others at this early development stage. This discussion will be presented in greater depth in the following Chapter.

5.10 The Effect of Orthographic Distance or Gap

The effects of orthographic distance between languages has been of interest to linguists, psycholinguists, and neuro-linguists for some time. However, this distance has centred on the orthographic depth of languages based at the word level, and in cross linguistic studies, standardise on word frequencies, but not between similar scripts in beginners. The present study, therefore, is concerned with this deficit in our knowledge of learning scripts, and defines the distance between orthographies at the grapheme and phoneme level. Modulatory effects of language distance in orthographic transparency have been found in neuroimaging studies between native and non-native languages during word reading (Dong et al., 2021), but nothing has been produced yet at the letter level, and between similar scripts, as investigated in this thesis.

There are three models or types to the similar script orthographic gap hypothesis. The orthographic gap hypothesis postulates that the differences between similar orthographies are more detrimental than orthographic depth. Differences are classified in the following order of importance.

- Type-0: There is nil orthographic difference between the native and second language orthography (i.e., transference should be natural)
- Type-1: The letter is not existent in the native or first language and, therefore, the second language learner must exert some effort to learn an additional letter with a new sound.
- Type-2: Orthographic gaps are where the native script must be relearned to compensate for phonology or visually complex features that interfere with learning the new character and therefore requires considerable effort and guidance to learn.

These three types of orthographic gaps are the strong, foundational problems revealed through inferential analysis in this Thesis. These are the strong forms of the OGH because they are in a single script type. In their most apparent form, these would be comparing between pinyin and *romaji*, or Chinese and Japanese *kanji*, even between Spanish, French, German, and English and possibly between the dialects that use the Bengali alphabet.

The OGH is also applicable to different script types. The weak form of the orthographic gap hypothesis is between different languages and scripts, for example, between Latin scripts which are employed by the majority of the modern world (Vaughan, n.d.). Also, between logograms like Chinese and Japanese *kanji*, and possibly between varieties of Arabic (e.g., Urdu, Pashto, and Kurdish), and Devanagari script used in Hindi, Mepali, and Sanskrit.

If these results are not merely coincidental, then the implications of the present findings warrant considerable attention. Some of the aforementioned, non-Latin scripts have already seen proposals to be made into Latin/Roman based script (e.g., Hindi, in Daniels & Bright, 1996, p. 398), just as Japanese have in the past. The major importance of the OGH is that facilitation should not be the focus of instruction (see Yamada et al., 1988), but rather, removing contradictions, like in the response for “chi” which was written as “ti”. The focus should turn to instructional interventions where type-1 and particularly type-2 differences occur between the two languages.

The result of these theories is that other attributes that are more global in nature, hold second place importance on the ill effects of learning a second language script. Previous researchers have already hinted that when a first language is learned, learning the second language is more greatly influenced. Others have shown that learning opaque orthography helps learning a similar script, but more transparent script; this second effect is of trivial coincidence. If this hypothesis holds true, then the move to introduce the English alphabet before *romaji* would be warranted and the present thesis provides sufficient procedural details to measure this assumption.

5.11 Results Conclusion

This section investigates separately the theoretical orthographic complexity and then the distance between orthographies, the orthographic gap. Orthographic complexity relates to the familiarity and salience of letter shapes and combinations (i.e., “d” and “t” have phonetic similarities in many languages, d and b have a visual complexity, and so on). The orthographic gap is the difference between letters, their sounds, and their presence in either language. For example, “a” in Japanese sounds like /a/ and in English it is more commonly pronounced /æ/ (note, “a” in English has more than seven different sounds). Also, the letters “l, q, v, x” are non-existent in Japanese. Finally, there are other conflicts with Japanese “r” sounding more like English “l” and English “r” is more closely reproduced phonetically with “u” + “w*”. Other problems occur with the absence of many complex phonemes of English like th /θ/ and th /ð/, sh/ ʃ/, w /w/, and others.

CHAPTER SIX
DISCUSSION

6.1 Introduction

6.1.1 Research Aims and Problem Identification

The aim of this study was to investigate the influence of pre-existing knowledge of *romaji* on the acquisition of English orthographic knowledge. While the Grade-5 participants in this study had little to no English literacy, after 2020, Japanese students will commence learning English reading and writing at the same age. The principal hypothesis is that introducing English earlier will influence both *romaji* and English orthographic knowledge. To study this effect required the design and verification of a method that could identify the direction of influence and where these influences were most inhibitive to accurate orthographic understanding.

6.1.2 Key Research Questions, and Finding

The RAN test results were used to verify the tests and primes, and gauge writing abilities between the groups of students, and response accuracy for each prime. The RAN test data suggested that accuracy orthographic complexity was most detrimental, followed by phonemic confusion (e.g., “m/n”), and then in places where English orthography is confusing phonetically (e.g., d/z, and m.n). From these results, it was possible to predict where orthographic influence was most detrimental and calculate the direction of influence (see section 6.2).

Results from the TACHiD test of pseudowords provided results that contradicted previous research, and provided insights into the significance of orthographic complexity in preliterate individuals. Iterative analysis of the TACHiD results suggested that word frequency and word length had no significant relationship to accuracy. However, the iterative analysis identified orthographic complexity as the most significant variable that influenced accuracy.

One of the more important findings to emerge from the results of the series of tests was finding the place and direction of orthographic influence. Previous research has yet to establish a method of recognising the places and directions of orthographic influence. Using iterative analysis and data visualisation, specific areas in the Japanese phonological lexis could be identified, which provided sufficient evidence to postulate the OGH. The emergence of the OGH provides answers to why unsupervised writing interventions are less than successful, because the words are not the cause of errors but orthographic influence is preventing lexical access or incorrect processing of phonemes and graphemes into spelling. Also, left untreated, deficits in high frequency gaps could influence word choice and spelling accuracy, thereby influencing overall academic ability later in school. The remainder of this section details the process of coming to these conclusions.

6.2 Interpretations and Implications

This section provides a detailed interpretation of the significant findings from each test and discusses the practical and theoretical implications. This includes comparisons that either challenge or support existing research regarding orthographic depth and orthographic influence. First, results from each test will be discussed with their implications to research. Then, interactive results are presented according to themes, which lead to the development of the ODH.

6.2.1 RAN Test Results

The RAN test is a reliable predictor of reading and spelling and, in the present thesis, RAN results were used to answer questions regarding the cause of errors. RAN results were also used to verify the reliability of each prime between each group.

Primes were tested for reliability by comparing the correlation between the two groups. The results ($r(19) = .87$, $p < .001$) indicate that there is a similar average response to each prime across the five groups. This indicates that in a similar educational setting, the test should return similar results. Moreover, the five groups came from two different schools. The participants in the FVES school were predicted to have some knowledge of English spelling because they were volunteers, and their families were interested in English education. The results were consistent with this prediction for every prime. This means that the RAN test should remain a reliable predictor of spelling accuracy *and* be sensitive to the cause of errors, that is the placement of errors in orthographic knowledge.

Some primes returned extraordinary results. For example, “shougakkou”, “chairo”, “sanbyaku”, and “hyakujuuni” were all responded to poorly ($\bar{x} < 35\%$). There are two predominant reasons for this. Theory suggests that diphthongs, geminates, and prolonged sounds (often represented with macrons) are the positions that cause the majority of misspellings. To illustrate this point, compare “shougakkou” (i.e., length

= 10, mora = 5, diphthongs = 1, and geminates = 0, long vowel = 2) with "hyakujuuni", a word of similar statistics (i.e., length = same, mora = same, diphthongs = 0, geminate (y) = 1, and long vowels = 1). Both words have similar statistics, the only difference is "shogakkou" is an age-specific high-frequency word, but not necessarily in *romaji*. As mentioned earlier, the Japanese mind can derive meaning and sound directly from the *kanji*, which would lead to quicker processing times and therefore, less cognitive load, providing a marginally better result. However, there is another explanation. Numbers require the processing of a unique script that is coded into a unique sequence, which is then processed into a word. These processes take a finite amount of time and cognitive effort. For this reason, the response for the last prime (i.e., 112) was poorly attended to, not because of word frequency. Therefore, word frequency is not significantly detrimental to writing accuracy, but processing is.

The realisation that processing is more detrimental than word frequency and word length will become important in the following sections. Processing need not be simply linguistic or based on script. Another example of this was for the word "chairo". The colour "chairo" (i.e., brown) was difficult to distinguish from pink or orange, and therefore, took considerable time and effort to process. However, there is evidence to suggest these visual problems were not the cause for errors. For example, the Japanese *kana* for "ch + V" can simply be typed on a keyboard using "t + V". This means an orthographic convention is being corrupted by environmental issues, namely, the keyboard entry method. If this is true, then other instances should bear the same detrimental effects. In the Picture/Audio prime RAN test, the words for butterfly (chouchou) and astronaut (uchuu hikoushi) were two of the three words with the poorest results. Two important implications stem from this effect. First, a lack of guided education in the conventions of spelling can lead to misrepresentations in PG mappings in students' orthographic knowledge. The second implication is, the RAN test is sensitive to measuring spelling conventions, and the explicit production of orthographic knowledge of lexical items.

The RAN test contributes three items of value to the body of knowledge. First, the RAN test is a reliable predictor of orthographic knowledge even in early writing development in transparent languages, and it is also sensitive to orthographic complexity. Second, the RAN test in this thesis is reliable and should be effective in replication studies. Finally, the approach of using limited time primes and limited times from responses was effective in measuring cognitive burden, proceduralised responses, and lexical access. The RAN test, however, is not as efficient for measuring implicit and explicit knowledge as the following tests.

6.2.2 TACHiD Test Results

The Tachistoscopic Identification (TACHiD) test (Miller et al., 1954) was used to test visual perception (i.e., implicit memory) of familiar letter sequences. The TACHiD test is usually a test of implicit knowledge. Implicit memory of previous experience/knowledge is revealed through enhanced performance. Therefore, this test is attempting to determine the extent of lexical (i.e., implicit) knowledge. The primes in this test were arranged to elicit a response that indicated orthographic preference (i.e., *romaji* or English) particularly for students with little alphabetic knowledge.

One hypothesis is that *romaji* literate Japanese will recognise letter chunks based on Japanese phonology and be able to respond to longer words that obey these PG rules. Additionally, familiarity with alphabets will result in better overall performance. This would imply in this study a reflection of superior alphabetic maturity/intelligence.

The test was first validated for priming consistency between the groups. The correlation result between the means of the two schools ($r(12) = .98$, $p < .001$) indicates that the test was a reliable indicator across the groups and for primes. Although the results were correlated, the average score for the MAES was considerably lower. Each prime in this test had a specific and interrelated purpose. For example, word shape complexity was assessed by the prime “adtadkoh”. This word is visually difficult to acquire in the short display duration of only 300 milliseconds because the tails of the letters are joined, also, k and h are presented in sequence, and the letter sequences are neither English nor are they based on Japanese orthography. However, the phonemic chunks are more likely to elicit a response from the English lexis (viz. “ad” + “tad” + “koh”. (i.e., “ad” is a familiar onset [n=3385], “tad” is much less familiar in the contents of a word [n=904], and “koh” is a non English rhyme [n=11]).

While the prime “adtakoh” is visually complex, it is similar in length to others with similar word lengths and syllable counts that scored significantly higher (“adtadkoh”, 35%; “elttailes”, 45%; “enphalet”, 45%). These results indicate that orthographic complexity is not only based on PG mapping but also the visual word complexity. However, word complexity is only problematic in unique encounters (i.e., new or low-frequency words) or when two words share similar visual attributes.

The implications for learning are that if the encounters can be increased through meta-cognitive activities (e.g., problem-solving, discussion, reflective thinking, and reporting). Activities such as these help increase the frequency, which can help shift words into the mental lexicon (see Laufer & Nation, 1995). Therefore, being able to identify areas where two orthographies clash visually will allow for interventions and material to be designed that will help students learn words that would normally thwart literacy in specific areas.

6.2.3 ODT Results

The Orthographic Decision Test (ODT) is designed to test students’ implicit knowledge of *romaji* and English orthography, and indicate the preference of one orthography over another. The Orthographic Decision Test (ODT) requires participants to indicate which language is presented, based on their knowledge of their understanding of orthography of the language presented. Words presented in this test assesses an individual's understanding of orthographic rules based on experience with familiar PG mappings and in some cases traces of sight words or chunk-sized representations of familiar letter combinations.

This test was expected to elicit responses based on the presence of *romaji* and/or English knowledge (for details, see section 5.5.2). The theory behind the test is, choices will be based on the implicit orthographic knowledge of the more influential script. In this manner, preference and influence of prior and additional knowledge can be detected, based on the implicit understanding of spelling and familiarity based on lexical knowledge (Danjon & Pacton, 2009; Samara & Caravolas, 2014).

The first step was to check the consistency of the test between the two school groups. The results were significantly positively correlated between the two schools ($r(16) = .81$, $p < .001$). The effect of word shape recognition and word frequency were removed by using pseudowords. This means letter and chunk frequency should remain as the prominent contributing factor to results. The first area of interest was the unexpected response from the FV group. The FV group were assumed to have some external experience with English. This meant their explicit understanding of English was influencing their choice. The MA group were guessing. Anything that didn't "look" Japanese was chosen to be English, thus skewing the responses for English words.

The next area of interest was in the selection of language based on no possible choice. For example, the prime "SYISIE" is illegal in both English and Japanese, however, the prime does fit the Graphemic combinations of geminates "SYI" and double vowel "SIE" (cf. "yi" is a redundant/non-existent grapheme combination in Japanese). The more alphabetically-adept FV-ES group chose Japanese for this response; however, the result is not significant.

- FV-ES (FV1, n=15, 46.7%; and FV2, n=28, 46.4%; $\bar{x}$ = 46.5%), and
- MA-ES (MA1, n=31, 35.5%; MA2, n=30, 36.7%; and MA3, n=31, 35.5%; $\bar{x}$ = 35.9%)
- The result lacks statistical significance ($Z = -1.1797$, $p = .238$, i.e., $p > 0.05$)

The dual-language choice test (i.e., KEN and SHUN) indicated that environmental factors were more influential with experience. Shun is a popular Japanese name and at this age of development, these students would not have ever experienced the English verb, "Shun"; therefore, choosing the Japanese response. The FV-ES group chose KEN to be Japanese, possibly due to its familiarity with the curriculum and in society. Ken is a common name in the English book and can be visualised in *romaji* due to its transparency from Japanese phonology. Also, "ken" is attached to the names of 43 of the 47 prefectures in Japan, and this school group comes from one of the 43. Therefore, Ken is heard frequently (e.g., possibly every day in the news or advertising). This effect on the environment was significant (i.e., H_o: $P_a = P_b$ was rejected at $\alpha < 0.05$; $z = 2.09$; $p = .036$).

- FV-ES (FV1, n = 15, 86.7%; and FV2, n = 28, 82.1%; $\bar{x}$ = 83.7%), and
- MA-ES (MA1, n = 31, 64.5%; MA2, n = 30, 70.0%; and MA3, n = phonemes 31, 64.5%; $\bar{x}$ = 66.3%)

In summary, the ODT tested the explicit orthographic knowledge of *romaji* and the effect of English knowledge on the understanding of new and unfamiliar words.

Children with little alphabetic skill tended to reject alphabets as being associated with native phonology in the absence of lexical knowledge. Children with some English ability could resolve complex decisions of nonwords based on graphemic information (i.e., V, CV, and CVV structures) of previous knowledge of the first, more predictable, transparent language. These results indicate that salience affects how knowledge is formed, and it tends to be proceduralised. Also, the knowledge of a second language orthography has less influence when the new words appear to be in the native language orthography (e.g., the nonword "syisei"). The ODT demands processing of experience or acquired rules, as a result, allows for explicit responses, which resulted in guessing in students with less experience. The following tests mitigate the opportunity to make these guesses.

6.2.4 ORT Results

The Orthographic Recognition Test (ORT) is a more implicit test of orthographic knowledge than the previous ODT. The ORT removes the decision-making processes by deciding based on "gut" feelings, which word looks Japanese or English. Also, the language is already decided, the tendency to instinctively choose English (i.e., on the grounds that the word is written in alphabets) is removed. Two tests, one Japanese and one English ORT with 18 primes each were administered to investigate a variety of effects based on preexisting orthographic knowledge of alphabets (see section 5.6.2).

The primes were tested for consistency across the two school groups. The results indicated a significant correlation between the groups for both the Japanese ORT ($r(16) = .92$, $p < .001$) and English ORT ($r(16) = .83$, $p < .001$).

The results from the Japanese ORT revealed that words with double vowels cause the greatest problems. The cause of this problem is possibly orthographic and also due to the not yet established orthographic representations of prosodic patterns. The purely orthographic rule is dependent on the style of *romaji* that a student is accustomed to. Some styles use the macron to indicate the long vowel, in other cases the same vowel is repeated (e.g., the name Hiroo), and in others, the vowel can be followed by an additional "u", as in Toukyou, also written as Tokyo. Prosody in early development is influenced by intonation, tone, stress, and rhythm (Kuhl et al., 2007). In the case where a word stops with a consonant, it is surprising to find students chose incorrectly (e.g., “beffu”, 67.33%).

Illegal letter combinations produced interesting results. Double consonants were similarly chosen inconsistently (e.g., “darru”, 60.12%). Also, in the event where illegal alphabet combinations existed, the results were poor (see Table 5.6). For example, legal pseudo-word “sudohaka” was chosen less than the illegal “sudhaka” (48.57%), and the illegal “biznessu” was chosen in preference to the orthographic possibility “buzinesu” (45.81%). Furthermore, the legal “denseisa” also failed (44.41%) in comparison with the illegal pseudoword “desnaise”. The interesting effect here is not based so much on chunking, but more on the length of the word that required processing. Shorter words with illegal letters yielded more accurate results (e.g., ganko/gakno, 59.47%; repna/renpa, 61.51%; and windo/wando 55.02). This influence of word length was assumed to be consistent with both cognitive and neurological theories presented earlier. For unfamiliar words, word length increases the processing time, and regularity of orthography (i.e., orthographic depth) affects cognitive burden.

These results indicate that word concreteness and salience affect implicit orthographic processing. Although a student may be able to spell a word correctly, the spelling is produced through a procedural and/or cognitive process using semantic knowledge of the language. This explains why measuring lexical access in writing and reading research has been problematic, particularly where response times have not been limited. Allowing students unlimited time to respond allows for proceduralisation, and measuring response times without analysing the types of errors only provides partial answers to orthographic influence.

The test of English orthographic knowledge was lower than the Japanese response. The major contributors to errors were drater (32.26%), chimeric (32.26%, viol (38.71%), dodge (41.94%), and quaff (48.39). From these responses, it should be apparent that children had little to no established rules of English orthography. In fact, the statistics for the English ORT are (M = 50.94, SD = 7.06), compared with the Japanese ORT (M = 59.87, SD = 16.08). The outliers from the data set were “taly” (68.89%) and “absolver” (63.70%). These were the only two results that had some semblance to word frequency, but the result is not significant and could have been a result of chance.

Although the English ORT was a resounding failure in detecting orthographic knowledge, it is not without worth. The participants in this study had little to no English ability. It is possible to deduce from the RAN test and ODT that some familiar phonemes and graphemes existed in the mental lexicon. The reason that those tests could attest to rudimentary English orthographic ability is those tests were more explicit. That means the brain has time to draw information from the semantic network and resolve the problem of recognition. As mentioned earlier, the ORT is a more implicit test of orthographic knowledge and therefore, provides tremendously random responses for English. This implies that students who are now learning English from Grade Five in Japan should provide more accurate responses to both *romaji* ORT and English ORT because their orthographic lexicon should be more developed. Therefore, the same tests should provide more substantial results with greater accuracy. Testing this hypothesis is beyond the scope of this thesis and should be the subject of future research.

6.2.5 Summary of Empirical Results

Since there has been no known study to date regarding the influence between *romaji* and English in early writing literacy, additional efforts have been made to examine the development of this hypothesis in order to provide methodological suggestions for future research and treatment in the following Chapter.

As was revealed in earlier research (Ellis, 2006; Ellis et al., 2004; Hanley et al., 2004; Hoxhallari, 2006; Spencer & Hanley, 2004), beginners of transparent languages, typically aged between 5-7 years of age, perform much better than those of the same age learning an opaque language. However, those studies are biased because it takes at least 3-years to acquire phonemic spelling skills in English. The students in this test should have been fluent in *romaji* (with 2 years of practice) and poor at English, because they had not commenced formal reading or writing yet.

6.3 Iterative Results

6.3.1 Findings: Orthographic Influence of Complexity

The present research argues that writing accuracy in early developing learners, is influenced more by orthographic transparency, consistency, and complexity than word length or word frequency. The results from spelling tests indicate that all students performed better at *romaji* than English, albeit for two overwhelming reasons. *Romaji* is tremendously transparently consistent with the native phonology of Japanese, and not with English. Also, the individuals in this research had little to no training in English. The theory, however, indicates that English ability, even in the absence of social or school educational influence, is beneficial to the foreign language and deciphering *romaji* skills.

This result suggests that *romaji* is in fact supported by foreign language understanding, more than the alternative assumption. That is, there is little evidence to suggest that *romaji* supports English spelling in any significant way. The final iterative results indicate the importance of orthographic neighbours and phonemic frequencies, and the detrimental effects not standardising the early practice of *romaji*.

6.3.2 Findings: ODH Between Languages

Implicit orthographic knowledge helped with identifying words, but not necessarily in spelling words regardless of orthographic depth. It is important to note that inconsistent training was a considerable contributor to errors in *romaji*. The problems with how to deal with inconsistent rules have been a resounding issue throughout this thesis. The inconsistent and sometimes non-existent practice and lack of correction during the introduction of *romaji* during a child’s early language development seem to be detrimental to spelling accuracy and the representations of sounds to spellings (i.e., PG representations), even in English. While the present test was not designed to study this phenomenon, evidence indicates this effect. Therefore, the requirement for treatment or drills is identified. These interventions should help to reduce this problem in preliterate children before the problem becomes fossilised.

These interactions of accurate and inaccurate knowledge should be the source of cognitive and neurological stress, because of the requirement for both the lexical and non-lexical routes of knowledge to construct spellings or readings. This interaction works with both graphemic and phonemic neighbourhoods, even in single languages. Granted, the complex writing system of Japanese has multiple orthographies, but the results indicate that well learned (i.e., high frequency or statistically highly revisited) words and graphemic chunks provide cognitive support for learning larger units and connect with whole words; only in the case of consistency. According to an alternative framework presented by Treiman (2017), spellers acquire multiple sources of information through the use of their statistical-learning skills and through direct instruction. In summary, children learn the spelling of words most easily when different patterns converge on the spelling, and children have difficulty when these patterns conflict with conventional spelling. Hence the justification for investigating the orthographic gap.

When patterns converge, in a single language or in multiple languages, there are grounds for facilitation. This assumption is supported by previous studies; in lexically dense neighbours, where many words can be created using similar chunk/word patterns, individuals can create real-word errors (Ellis et al., 2004). However, when patterns don't converge, the likelihood of learning is reduced, and the case for spelling errors is greater, which was the case with “Ch” “ou" and “oo”. This irregularity does not occur in the native orthography in either reading GP or writing PG. However, the present research indicates that these more complex combinations cause problems with PG re-coding skills in *romaji*, which is a major difficulty for beginning readers in irregular orthographies such as English (Seymour et al., 2003).

Regularity in spelling and phoneme correspondences, therefore, seem to promote facilitation. However, facilitation in nearly any language cannot be taken as a panacea for learning. For example, Lyytinen et al. (2005) describe some features of Finnish orthography that “may” affect the development of early literacy skills. Like *romaji*, Finish GP correspondences are regular and symmetrical at the level of single letter. There are 21 Finnish phonemes 8 vowel phonemes 1 (/i/, /y/, /u, /e, /o/, /ö/, /ä/, and /a/) and 13 consonant phonemes (/p/, /t/, /k/, /m/, /n/, /1/, /r/, /s/, /h/, /j/, /v/ and more marginal /d/ and /η/). Three additional “foreign” consonant sounds (/b/, /g/, /f/) are used in recent loan words. The phoneme /η/ is marked with the letter n when short in front of /k/ (in combination “nk”) and as a bi-graph “ng”, when long (cf. syllables in Finnish are more complex than Japanese, but share many similarities). This means that even when the acquisition of phonological recoding skill is facilitated by a relative transparent orthography, there are obviously other obstacles that hinder mastery of accurate reading and spelling and also fluent reading (Brown & Haynes, 1985).

The results in the present thesis also support the notion that language-related background of developmental reading problems are influenced more by language background than what was previously accepted in theories that emphasise the exclusive role of phonology. The results indicate that the development of the phonological-skill subsets relevant to early reading skills may depend more on the language orthography than what has been generally accepted before (Lyytinen et al., 2005). If this is true, then the predominant focus on facilitation should be reconsidered in favour of understanding the orthographic/phonemic contrasts within and between the native language and the language being learned. Also, facilitation is not a panacea and is considerably dependent on the development of the individual. As the language is acquired, larger chunks become available to the PG path and, therefore, are language-dependent. If these PG combinations are present in the additional language, there may be facilitation; however, where there is conflict, the interference can be the cause of a multitude of errors that need specific attention.

6.4 OGH Discussion - An Iterative Analysis of Sata and Literature

6.4.1 Case 1: Phonemic Facilitation and Absence Needs Consideration

Students who are learning English as a second language (L2) may demonstrate atypical English spellings that are due to the influence of exposure to literacy in their first language (LI). Recognizing the differences in spelling errors based on LI from spelling errors in second language orthography may signal a need for special education services. However, before any diagnosis of dyslexia can be contemplated, the absence of facilitation between the language orthographies needs to be taken into consideration (cf. it is widely accepted that facilitation helps) (Dixon et al., 2010).

Typically developing monolingual children display a pattern of errors that reflects their transition through phases or stages of literacy development (Ehri, 1997; Moats, 1995). Bilingual, or multilingual, children's lexical representations follow a similar pattern with the addition that both, or all, languages, consecutively or simultaneously acquired, impact the representation in the other (August & Shanahan, 2006). Therefore, for children learning more than one language who are learning to read, spell, and write in English, the orthography in LI *must* be taken into consideration when examining their reading and spelling acquisition in English.

Difficulties in phonological awareness and in mapping phoneme-grapheme correspondences should not lead to an immediate diagnosis of some underlying problem like dyslexia in children who are literate in their native language. Rather, children with a LI background can be provided with explicit training in phonemic awareness and the common English spelling patterns corresponding to the phonemes to determine whether additional instruction results in a better grasp of English phoneme-grapheme correspondences (Joshi et al., 2008).

With conventional spelling measures, children may perform well, especially on spelling high-frequency words. However, these children's proficiency with sight-word spelling may mask difficulties in utilizing phonological information to spell or decode unfamiliar words, which in turn may limit their ability to acquire the vast reading vocabulary necessary to become highly proficient English readers and writers.

Readers of a shallow orthography, as in Malay (Dixon et al., 2010) or in the present study, may develop better PA and thus have an advantage in learning the phonetic base of English spelling (Landerl, 2006). Although evidence from the Dixon study on this point was indirect, Malay children were able to spell as many words "correctly" as Chinese children were when phonologically plausible spellings were counted as correct alongside conventionally correct spellings. Thus, it may be advantageous for such children to learn to read first (or simultaneously) in the shallow orthography before tackling the complexity of English spelling. This provides the impetus to teach only one, regulated type of *romaji* during early alphabetic orthographic acquisition (i.e., standardised written *Hebonshiki*).

These findings from Malay may be applicable to children of other L1s with shallow orthographies, such as Spanish or Korean. Results from this study by Dixon et al. (2010) can help teachers and diagnosticians understand the importance of recognizing LI influences on English spelling.

6.4.2 Case 2: More is Needed to Explain L2 Facilitation and Interference

To participate effectively in modern society, people must be good readers and good writers to learn about the world and to communicate with others. These skills are essential for academic and occupational success (O'Brien et al., 2020) and those who are *poor* at reading and writing will, as a consequence, be disadvantaged (Treiman, 2017). Therefore, understanding the nature of writing systems and the typical course of spelling development is an essential foundation for understanding the problems of children who have difficulties in learning to spell that will prevent them from integrating effectively in society.

The article by Treiman (2017) argues that the dual-route models of spelling that underlie much existing research and practice are based on overly simple assumptions about how writing systems work and about how spelling skills develop. Many writing systems include not only context-free links from phonemes to letters but also context-sensitive phonological patterns, morphological influences, and graphotactic patterns. According to an alternative framework, IMP (integration of multiple patterns), spellers acquire multiple sources of information through use of their statistical-learning skills and through direct instruction. Children learn the spelling of a word most easily when different patterns converge on the spelling, and they have difficulty when patterns conflict (i.e., the OGH).

Children do not usually receive explicit teaching about patterns of the sort investigated in the above-mentioned study. It is likely that children acquire the patterns implicitly, through statistical learning. This learning takes time, in part, because many contextual patterns apply to small sets of words. Statistical learning is often implicit, in that people pick up patterns from exposure even when the patterns are not explicitly pointed out to them and in that people may not be consciously aware of the patterns that they follow. This type of knowledge plays an important role in spelling, according to IMP. This explains the variability in tests based merely on word frequency, particularly in the minds of developing learners like those studied in the present thesis.

The idea that many sources of information contribute to spelling has implications not only for the assessment of children with spelling problems but also for the type of instruction that they need. Phonemic awareness and simple sound-to-spelling correspondences are important targets for teaching, as advocates of the dual-route view also suggest, but they are not the only targets. Children must also learn about context-conditioned phonological patterns, graphotactics, semantics, and morphology. This can be done through explicit instruction and by giving children systematic opportunities to observe and induce the patterns.

Examples of treatments and interventions could include presenting children with words that contain ‹c›, ‹k›, and ‹ck› spellings of /k/ or they can generate such words themselves. The teacher can help children to discover, for example, that ‹c› and ‹k› appear in a variety of positions within words while ‹ck› does not occur at the beginning. Spelling instruction is also important because, although children gain some information about words' spellings as a result of encountering them in reading, they do not necessarily encode and remember all of the letters in words (Graham, 2000). Indeed, many of us have read the word necessarily a very large number of times, including in the preceding sentence, but may still have difficulty remembering which consonant letters are doubled and which are not. The studies cited earlier suggest that spelling instruction should target the same skills across the range of abilities. However, instruction should be more intensive for some children than for others, with more opportunities for practice and review.

Writing systems are, in general, complex. However, a few writing systems, like Japanese, are tremendously complex. Dual-route theories of spelling describe the simpler links between sounds and letters that occur in alphabetic writing systems and are useful in providing a framework for understanding the difference between implicit/lexical access and explicit or proceduralised-lexical (viz. Stemmer & Whitaker, 2008), processing of words. However, more complex writing systems that include other types of patterns as well (e.g., context-conditioned phonological patterns, morphological patterns, and graphotactic patterns) require theories about how children learn to spell that account for the full range of patterns, as do theories about why some children have difficulty learning to spell and how we can help them.

6.4.3 Case 3: The Ultimate Finding

There appear to be stages of development before strategies in orthographic processing that are clearly separable. In a study of two kinds of bi-scriptuals (individuals who use two kinds of scripts), researchers (Liow et al., 1999) found that L1 transfer to L2 was stronger in the Malay (transparent orthography) script group than the comparably developed Chinese group. The most important finding with respect to English proficiency was that English appears to influence the letter search functions of the Chinese-English pupils much more than those of the Malay-English. Brown and Haynes' (1985) suggestion that knowledge of script-specific processes could be important in second-language learning supports this finding of influence between English and other orthographies. The extent to which the scripts of a reader's first and additional languages (L1 and L2) differ might have implications for reading progress in the L2.

When the second script (L2) requires totally different component skills (e.g., Mandarin-English and English-Mandarin), the reader would have to learn these from first principles as might be the case in Japanese, because there are significant high-frequency phoneme and grapheme gaps (i.e., orthographic gaps). In these "orthographic gap" areas, the reading process would then be slowed down, and the child's ability to engage in higher-level activities involving word meaning and sentence comprehension would be adversely affected. Alternatively, the highly automated skills from the L1 could interfere with the acquisition of the new skills required by the L2, leading to non-optimal strategies. When the two languages are similar (Malay-English and English-Malay) L2 skills will facilitate reading accuracy (for regular words) in the L1, whilst reading comprehension will necessarily depend on the child's oral language foundation (p. 206).

6.5 Summary and Implications of These Findings

While the FV-ES group was at an obvious advantage, compared with the total population of MA-ES, there were some students who were obviously distressed by writing in *romaji*. This indicated that possibly parents were willing to give opportunity but for whatever reason, the student could not perform. In the few cases at Fuji ES the result was quite distressing and the test had to be paused twice to ensure the individual was willing to continue.

CHAPTER SEVEN
CONCLUSION

This Chapter is divided into three main sections. First, the limitations of this research are explicitly recognised. The reason for this is not only to mitigate any temptation for replication studies to extrapolate these findings but also to provide the boundary from where this study can be used to inform the subsequent study of orthographic influence in Japan. This section is in two parts, the latter highlights some of the current methodological limitations, and makes suggestions to enable further depth in future research.

The second section proposes suggestions on how to move this field of research forward. By further investigating similar changes in education policy, or the effects of mass migrations of cultures, not only across boundaries but in the mass migration on to online CMCs. The detailed rationale and process of this study were designed specifically for that purpose.

The third section and final section provides the recommended approach to incorporate the benefits and findings of this study into present-day and future education, particularly in Japan. These recommendations are based on theoretical foundations developed in this thesis, and the methods and results obtained throughout this study.

7.1 Limitations and Replication Considerations

This thesis studied the effect of learning *romaji* before English reading and writing in Grade Five Japanese elementary school students. The methods, analysis tools and hypotheses presented in this thesis are intended to be replicated, particularly to study the effect of shifting English earlier in the Japanese school curriculum. Therefore, the following limitations are presented to provide reliability in future replications. Limitations include a) changes in environmental factors that impact tremendously on the development of orthographic knowledge (parents/teachers/etc); b) changes in curriculum and education delivery that will influence replication (change of learning order/GIGA project, COVID access to independent material); and c) limitations in the measurement technique.

7.1.1 Significant Learning Lost

The method of measuring orthographic interference in individuals provided in this thesis is intended to support accurate replication in the future; particularly in research that will follow the commencement of early writing education in Japanese schools after the year 2020. From that time, students will have commenced learning to read and write English almost simultaneously with *romaji* in Grade Five of elementary school.

Chapter Two details significant factors, other than orthographic depth, affecting reading and writing fluency. According to some (Trelease, 2013), parents' attitudes to reading, and how they engage with literature with their children from an early age is by far more influential than orthographic transparency and cross-linguistic influence. Lack of access to written materials, lack of parental involvement in promoting literacy, and lack of educational opportunity can prohibit literacy development before any modulating effects of orthographic transparency can take hold (Ellis et al., 2004, p. 456). Surprisingly, economic and social development is more influential than orthographic transparency in determining reading attainment (Lundberg, 2002, as cited in Ellis et al., 2004; Stevenson, 1984; Stevenson et al., 1982). In countries with strong economies and high levels of health and adult literacy, most students become competent readers (Elley, 1994).

The major effect of interest to this study is the effect of learning order, and how educational policy and changes in curriculum affect the way letters, their sounds, and their rules for use are stored in the learners' brains.

The current study is limited in scope because it captures a phenomenon that has become extinct. After this study, Japanese children will experience English earlier and learn to read earlier in school. Therefore, the interference of new and existing alphabetic knowledge is expected to change considerably. However, the conceptual approach and the results should be useful as a baseline for future replication. As a result of these changes, future research is needed in order to discover how this change will influence learning English and *romaji* simultaneously affects orthographic understanding, and consequently phonetical reasoning and lexical access in Japanese students. In the future, and already in some private institutions, English will be learned before *romaji*, thus providing another route for individuals to process alphabetical orthographies, which provides one source of studying this phenomenon.

Regardless of changes to curriculum, the diagnosis of early reading problems should become a priority and a part of the early assessment of all students. The RAN test utilised in the present study is useful in predicting future reading and writing difficulties (Kirby et al., 2010). After "at risk" students are identified, reading and writing treatments could be administered. Finer assessment of rule-based problems can be diagnosed through the TACHiD test, also developed in this thesis.

The identification of orthographic specific problems, and their treatment or interventions are a specialist area. The specific reading and spelling errors are indicative of a variety of problems, which are dependent on a multitude of complex confounds (Treiman, 2017). Therefore, the result and implications cannot simply be extrapolated. However, within this study there are many findings that teachers and researchers would benefit from testing further. With this in mind, the remainder of this section recognises the limitations of this study, and where possible solutions and improvements can be employed to help guide future research.

7.1.2 "Real Life" Application

The validity of research, and its empirical usefulness, are often compromised by confounds beyond the researcher's control. Unavoidable influences likewise confound natural reading and writing performance. For example, task demands and presentation format can affect processing times in isolated word tests and continuous text reading. Additionally, word processing can be modulated by context, and in continuous texts, contextual complexity and familiarity can also modify reading times. However, the TACHiD and orthographic decision/recognition tests utilised in this study provide little contextual information that might be useful for predicting.

Each test set was grouped into a genre and preceded with a genre-specific contextual cue to reduce the influence of the variance of contextual understanding. Without these contextual cues and groupings, word frequency and word length may have been modulated as students realise the test is about a specific genre. Kuperman et al. (2013) indicated that lexical processing in controlled studies with decontextualised target words is a better indicator of word length and frequency effects than natural reading of sentences or texts due to the degree of immediacy-of-processing.

Therefore, lexical processing in controlled studies with decontextualised target words should be a better indicator of lexical access than natural reading of sentences or texts.

This thesis was born from the problems evident in children's spellings in junior high school standardised translation tests, where Japanese words, written in kana or kanji, need to be translated into the 'taught' English equivalent. While these tests are far from natural reading, the primes contain contextual clues from the syllabus, recent high-frequency visits with texts, and materials and exercises in the classroom, all linked with the logo morphographic kanji, which are used as stimuli in those standardised tests. Therefore, variation could be evident when kanji is priming strong contextual cues, providing some advantage to those more adept students. For this reason, multiple genres were used to neutralise the dependence on only using kanji as the prime.

7.1.3 Limitations of This Thesis

This section acknowledges the limitations of this study in terms of access to non-English research and archived research in government databases; access to “ideal” testing opportunities caused by the impact of the COVID-19 pandemic; the lack of prior research on this topic; and the amount of contact with Roman alphabets in these preliterate English students.

Access to literature related to neurological, cognitive, and psycholinguistic research surrounding orthographic influence required considerable effort. One limitation was the restricted access to Japanese research. Japanese research is often stored in private databases in educational and organisational establishments, and the meta-data are often written in Japanese, restricting the responses reported in search engines. However, all efforts to overcome this limitation were accomplished by consulting with Japanese researchers and employing Japanese research assistants to help with sourcing Japanese articles. Also, recent research helped gauge the progress of the body of knowledge regarding orthographic influence. These attempts substantiate the claim that no research to date has studied the written responses of young, preliterate Japanese students.

The impact of the COVID-19 pandemic was significant to this research. Due to the pending closure of schools, it was prudent to take advantage of the opportunity provided to recruit entire groups of students and complete the data collection in two consecutive days. The original design was to monitor the onset and completion times in writing and stroke fluency. These data would have provided further insights into the cognitive influences on writing. However, an alternative approach was adopted, limiting the stimulus time and response time. To justify this approach required the inclusion of neurology and cognition in the literature review. Due to the limited time to respond, writing accuracy might be positively skewed for short words and writing longer words would be more challenging to complete in the same period.

Furthermore, another limitation is the dearth of psycholinguistic research surrounding writing in preliterate learners studying alphabets of contrasting orthographic depth. In the absence of previous conceptual approaches, a novel approach had to be designed specifically for this study. The approach to collecting writing samples, coding the responses, and analysing the data was unique. All results and access to original samples for future verification and replication have been made available to increase data validity.

Finally, this study involved understanding the orthographic knowledge of Japanese students who were preliterate, emergent learners of English. Therefore, it was impossible to test English ability directly. Additionally, this means contact with Roman alphabets would be substantially less than students studying under the new English system that started in 2020. According to usage-based accounts (see Ellis, 2005, 2014), these students should have statistically more contact with alphabets and, therefore, respond in *romaji* and English with less cognitive demand. The influence of earlier exposure will need to be considered in future replications in Japanese schools.

7.2 Directions for More In-Depth Study of the OGH

The role of orthography in reading and spelling has been investigated in this thesis under rigid testing conditions. Japanese students are taught in a somewhat controlled setting, their ages are within 12 months of each other, their access to native lexis through school is also controlled, relative to western standards. Also, the majority of students in Japanese schools are Japanese by nationality, culture and the language they use, in fact it is futile trying to separate these factors from each other (see

Chapter One in this study). Therefore, replication research would first need to appreciate these confounds and expect to find greater variability.

The contrasting areas of orthographic complexity between *romaji* and English has been presented in this thesis. A variety of explanations (see Archibald, 2021) have been proposed for why some sounds are harder to learn than others, but this thesis is possibly the first to present an orthographic rationale behind the problems. This thesis presented historical evidence that Hepburn *Romaji* was first intended for Latin based language speakers to be able to read aloud Japanese language (cf. earlier “failed” attempts at script reform used other, less implicit, alphabet conversions). The present thesis suggests that learning *romaji* first confounds the orthographic problems; the number of Type-2 errors is more when *romaji* is learned before or together with English.

The present study has made efforts to alleviate this mystery, and help dispel the ‘urban myths’ behind the importance of *romaji* in learning English. While it is partially useful, it is only as useful as learning to hold a brush is writing *kanji*. The original purpose of *romaji* has remained and even more so. For foreigners to learn how to read and speak, that is to sound like Japanese, *romaji* remains at the forefront. With the introduction of computers, *romaji* has become essential for computer literacy and fluency. The strict rules of the different types of *romaji* are somewhat relaxed, with most keyboards accepting *Kunreishiki*, *Nihonshiki*, *Hebonshiki*, and some other shortcuts. However, forcing students to learn these relaxed rules while they are developing alphabetic phonetics has also been shown to influence writing accuracy. If *romaji* were to be used to facilitate English, then this relaxed approach to the phonemic and phonetic structure of *romaji* would be counterproductive.

7.2.1 Contribution to Knowledge

At the time of writing, there was little evidence of any research published surrounding the phenomenon presented in this thesis. In particular, there are no records collected on the orthographic knowledge of Grade-5 Japanese elementary school children, other than those collected for this thesis. Therefore, the contribution to the knowledge of this study is significant because it may serve as a baseline to subsequent tests of student orthographic understanding of alphabets after students are introduced to English earlier across Japan.

7.2.2 Replications Study Suggestions for Other Languages and Japanese

There are, of course, other writing systems where similar comparisons should be investigated (e.g., Perfetti et al., 1992) using this triadic route analysis and orthographic gap. The present study looked solely at the orthographic differences between the same two scripts, therefore assuming to some degree, that pre lexical phonology and phonological coding are similar, even though this assumption ignores to some degree, word recognition. The compensation in the present study was through using word frequencies and word lengths to modulate the effect and check for activation. Another mitigation was by using nonwords in the ORD, ODT, and TACHiD tests. However, it is possible to measure the psychometric properties occurring in the brain.

One example (Perfetti et al., 1992) discusses how the phenomenon can be approached using Chinese and Hebrew; the Chinese writing system, on the other hand, does not support pre-lexical phonology because it is graphically unique. This unambiguous lexical meaning provides unique lexical (phonology plus meaning) information, so phonological coding is not necessary (Perfetti et al., 1992). The Hebrew writing system, on the other hand, supports pre-lexical phonology but it does not provide unique lexical information, so phonology is not helpful, because adult level Hebrew is written without vowels which creates serious ambiguities (Perfetti et al., 1992).

This example from cognitive psychology is similar to Japanese *kana* and *kanji*. The *kana* is graphically unique and Japanese *kanji*, unlike Chinese *kanji*, is for the most part, tremendously ambiguous. Studies between these two Japanese orthographies may be better explained using the Triadic route hypothesis than the more simplified ODH or dual-route analogy.

7.3 Developing the field - Future Directions

With these issues behind us, the importance in developing our understanding of alphabetic script interference is important. With much of the world now studying English as an additional/foreign/second language, this field needs to continue to develop. To advance our understanding of multi- and plurilingual orthographic influence, the following suggestions should be approached next.

This section is not exhaustive, as this thesis raises many unresolved questions and potential developments. Topics of interest that could not be investigated in this study include:

1. Learning similar orthographies across languages.
2. Learning how to spell/write across languages with similar scripts and different orthographies.
3. Investigating interference between moraic and syllabic word recognition.
4. Investigating mechanisms for increasing orthography in low frequency graphemes and phonemes, particularly for Japanese beginners.

The importance and approach to each problem will be discussed in order.

7.3.1 Learning How to Spell/Write Across Languages With Similar Scripts, but Different Orthographies

The study of learning how to spell and write across languages has been extensively publicised and researched. However, these methods usually concentrate on the orthographic, phonemic, lexical, or semantic similarities and positive transfer. For example, the "Keyword method" (Atkinson & Raugh, 1975) partially exploits word similarities and metalinguistic understanding (see Burden, 2011; Pressley et al., 1980; Taheri & Davoudi, 2016).

Studies of lexical level transfer between *romaji* and English concentrate on semantic meaning, and not the transference of orthographic knowledge, especially in the skill of spelling. One possible reason for this may be because *romaji* was built upon a transparent writing system and was not designed to facilitate learning English. However, in an effort to enhance students' understanding of English, when the Japanese curriculum changes in the near future, investigating cross-language neighbourhood effects in and how it is enhanced or affected by L1, L2, and additional language lexis (e.g., Meade et al., 2018) could be useful in helping facilitate the quicker acquisition of orthography and reading fluency, which has a follow-on effect for improving writing accuracy and speed.

Studying the interplay between orthography with lexical knowledge and visual word recognition will be useful. Orthographic understanding is generally developed through reading and effective visual word recognition. Skilled orthographic processing is characterised by automatic processing of word recognition (Ehri, 2005) and fully developed orthographic representation (Perfetti, 1992). Given that processing of a word is based on a representation of the word and that repeated processing of the same word results in the development of the representation, it is fair to assume that processing and representation have a highly interrelated relationship (Kida, 2016). To date, there has been little research investigating this relationship between orthographic development and implicit production.

This thesis provides a baseline for future studies into early orthographic knowledge development and influence in individuals. Therefore, if the Japanese public school system introduces English earlier, learning *romaji* should become a by-product of having experience in an orthographically more complex system, English. This would thereby reinforce the original purpose of *romaji* and the new use of *romaji* as a keyboard input orthography for Japanese *kana* and *kanji*.

7.3.2 Investigating Interference Between Moraic and Syllabic Word Recognition

Many studies have investigated the one-way interference between L1 and L2, or L2 and L1 orthographic understanding, for example in multisyllabic word recognition (e.g., Hamada, 2017). However, this study, and others, fail to distinguish between the directional influences, and how these influences change as orthographic knowledge and language competency develops. The outcome of a study of this type would fuel the pedagogical and material development changes that are necessary to help those students who are less than fluent readers, and therefore, do not get the frequency of meeting less frequent orthography in either language (see Section 1.1.4, this study).

7.4 Extending the Present Study

The present study was limited in its approach for several reasons. One limitation was the access to participants, the pressure of the deadline to collect data before the curriculum changed, the “lock-down” and closing of schools, and limited social contact due to COVID-19. Nonetheless, written samples could be collected in groups, and the results led to the development of the OGH presented in this thesis.

The other limitation is that this field of neuropsycholinguistics is in its infancy and there was little justification to acquire access to neuroimaging facilities to help identify the roles of declarative and procedural knowledge in orthographic development.

7.4.1 Neurocognitive Research in Declarative and Procedural Memory Systems

Recently, SLA research has become interested in the neurocognitive processes behind language processing and the roles of declarative memory and procedural memory in developing lexical entry. These two long-term memory systems are arguably crucial in terms of the range of functions and language domains they subserve (Ullman, 2016). These two memory systems also provide a neurocognitive account of understanding the results reported in this thesis and L2 learning in general.

Declarative and procedural memory can complement each other in acquiring the same or analogous knowledge, including sequences and rules, which accounts for the orthographic transfer of similar items. Due to its rapid acquisition abilities, declarative memory may acquire knowledge first, while the procedural system gradually learns analogous knowledge, which eventually moves into the more immediate areas of the brain, where lexical knowledge is stored. This model of neurocognition provides a more dynamic means of measuring orthographic interference than the DRM presented in this thesis and provides a means of measuring the OGH using brain activation models. For example, Ullman (2016) suggests that the learning and retrieval of knowledge in declarative memory may block (inhibit) the learning or retrieval of analogous knowledge in procedural memory. Neuroimaging evidence in humans suggests that learning in declarative memory may inhibit, or at least override, the development of analogous knowledge in procedural memory.

The OGH presented in this thesis supports the notion that declarative and procedural memory may also be present, transitive, and measurable during orthographic knowledge development. According to Ullman (2016), declarative memory is essential for learning and associating arbitrary “pieces” of information and should hold for both L1 and L2. Furthermore, the procedural memory systems (i.e., processed in the P600 region) are partly responsible for the learning and processing sequences and rules in both first and second language. Consequently, particularly probabilistic memory items may depend primarily on this system. Therefore, this system may be vital in learning to predict in any given language, for example, predicting the next item in a sequence or the output of a linguistic rule, or the generation of phonological output from an unfamiliar or unique grapheme or graphemic chunk. Accordingly, procedural memory seems necessary to acquire the implicit understanding of orthographic rules or sequences.

Additionally, the literature presented in this thesis supports the importance of understanding the interface or interaction between declarative and proceduralised knowledge. Most language research on neurocognitive grammatical processing has concentrated on the age of acquisition and L2 proficiency. Both are complex variables to account for; the present thesis discussed these confounds in detail and tested the effect of the amount and type of exposure. The results indicated that the type of exposure is more prominent than the amount of exposure. However, the declarative/procedural model makes provision to delineate the amount and the type of exposure. Therefore, the effect of changing learning order, the interaction between orthographies during the transition between proceduralised learning, and the production of declarative knowledge should be evident in writing results and by measuring brain activity with fMRI and other computational brain imaging methods.

Further research in this area could help determine areas of activation in both healthy and neurologically different learners. These areas of brain activity have been studied for words and context, but not in early learners or preliterate individuals or infants. The implications of understanding how the brain "learns" at these early stages would help with the detection and treatment of language problems and disorders in humans and have implications on developing artificial intelligence and adaptive neural networks in computational models.

7.5 Recommendations for Japanese Schools

The following recommendations could be considered radical. However, radical change is made by leaders who cannot wait for authority and systems to change. There are some 'radicals' in the field, and the contemporary 'recommendations' by MEXT, in fact, provide enough room for some degree of radical change.

The first change would be to accept "a standard" representation of *romaji*, without removing the other approved forms from the society. This is not a "script reform" of any kind. Simply, it means until individuals enter higher education the other, more complex academic forms of *romaji* should not be introduced. This would allow for texts to be standardised to utilise some form of transference in the immediate future, and allow for implicit understanding for native Japanese attending schools that teach

English from Grade-1 or earlier. If this change were introduced, most children would not require the amount of training now required to understand keyboard input for *kanji* and *kana* characters, it would become implicit (i.e., through transference, as indicated in this study).

The second change is hopefully a continuation of the process that has commenced from Spring 2020, and has already been adopted by international schools in Japan and some private elementary schools, that is, teaching English from Grade-1, connected carefully to Japanese culture and curriculum, and the Japanese natural order of learning about the world around them. The benefits of this are numerous, and this study has indicated that it should not hurt the Japanese Mental Lexicon, the Language, or the culture. The question now is, "What kind of English language should we teach these people". Almost a century ago, a similar question was raised by Hoshina Kōichi (see Hashimoto, 2018), who was actively involved in language policy at the time. The language was a simplified version of Japanese, not English, and the time was 1940, a time when Japan was attempting to implement the proposed new vision for Asia under Japan's leadership in 1940.

Japan has regained its position at the forefront of power in Asia, again in competition with China, Korea, and America. The battlefield this time, however, is economics and education. Similar to the early 1940s, diverse opinions remain about the method of implementation of Japanese language teaching of this time, English instead of simplified Japanese, and also about what kind of English should be taught. Again, this study recommends the simplification of *romaji* in use to remove confusion and to provide for less ambiguous letter and word recognition and make way for the implicit learning of *romaji*, while providing improved English education. How this improvement to English education can be achieved is hinted at within the pages of this study, but far beyond the scope of this study.

Decoding skills are important for reading, and reading as an input for spelling is therefore impeded without this skill. Phonics are another important part of reading and spelling. Extensive exposure to a particular script appears to mould the brain for reading in that script (Baker et al., 2007; Nakada et al., 2001; Tan et al., 2003). Research has demonstrated that this type of cognitive specialisation influences subsequent reading acquisition through memory and visual processes as well as phonological awareness (Chen et al., 2015). In general, similarities in L1 and L2 scripts are facilitative, and differences create a few obstacles (Cook & Bassetti, 2005; Koda, 2005). This is where many may assume that *romaji* facilitates learning English. The evidence presented in this thesis indicates that this is true where PG and Grain sizes are similar. However, where the gap is substantial, facilitation cannot simply be assumed.

Recognising, diagnosing, and treating problems particularly where orthographic gaps are detrimental is of great importance. If problems in the Gap are allowed to linger and become fossilised, their influence in subsequent reading and writing could have detrimental consequences. Therefore, it is important to study this effect more, particularly in the amount of repair that is achieved implicitly. Alternatively, treatments and interventions could be administered that can counter the deficit of contact in the gap areas. If in recognising this problem, we choose not to respond, our students could miss the risk, because the dependence on English reading and writing is growing in Japanese education and having a greater influence on job opportunities and promotion.

7.5.1 How to Teach Reading and Spelling

There are copious resources to guide how to teach reading and spelling. In fact, MEXT in Japan provides adequate training, guidance, and material for this purpose. For private establishments, schools that specialise in foreign education, and for Japanese teachers that would like to augment their training Kilpatrick (2015) provides a provocative view on why some things don’t work in the foreign language classroom. Paul Nation (2008) provides advice on teaching ESL/EFL reading and writing, which has been useful in guiding the authors of this thesis in pedagogical solutions to poor reading

The outcomes of the present thesis, however, have a more prescriptive purpose in identifying and treating the problems that underlie early reading development, and any weaknesses in materials, syllabi, and curriculum. The predominant finding surrounds how students encounter infrequent/rare graphemes in both languages, letter combinations that are unique to the foreign language, and be sensitive to foreign language influence on the native script understanding. The important factor is to provide cognate / concrete occurrences linked to meaning and sounds that students can understand and trust. Therefore, standardising *romaji* in primary schools, particularly Hebonshiki, should be effective in removing the negative effects of poor training and the lack of standardisation discussed in this thesis.

7.5.2 How to Increase Frequency of Encounters

If these variables are in fact acting upon new words with rare/low-frequency phonemes, or rare letters, then this could be a more accurate account of why low-frequency words are read slower in both transparent and opaque orthographies. The low-frequency (i.e., unfamiliar) words "conceal" the effects of word-shape recognition. These words are used to "force" individuals to process what they read as a "new-word" (i.e., the PG route). For experienced individuals, processing times for these never seen before words are measurable, in the 10's to 100's of milliseconds (e.g., Ellis et al., 2004). However, the participants in those studies had considerable phonemic or syllabic level recognition skills. The participants in this study should have significantly less, because of their lack of contact with both alphabetic scripts, but remarkably mostly English.

7.5.3 Neurocognitive Treatments and Interventions

The learning context can also affect which system is relied on more. Explicit instruction (e.g., of sequences), or conscious attention to input stimuli and an attempt to understand underlying rules or patterns, can increase learning in declarative memory. Conversely, a lack of explicit instruction, as well as manipulations that reduce attention to the stimuli, or a high level of complexity of rules or patterns (thus decreasing the learner's ability to explicitly detect patterns), can all shift learning toward procedural memory.

7.6 Conclusion Summary

This thesis aimed to investigate the influence of *romaji* on English orthographic knowledge from Grade-5 Japanese elementary school students' written responses. Priming materials and appropriate response devices were first meticulously developed and verified to collect the written results. The reliability of these testing devices was sufficient to suggest that the method for designing primes and testing will be helpful in future replications investigating orthographic influence between alphabets of contrasting orthographic depth in the presence of more advanced knowledge in either or both scripts. Furthermore, these testing methods were effective in detecting a directional influence of pre-existing *romaji* knowledge on the understanding of English based on native level phonemic chunking. This is especially useful in identifying where students are struggling with orthographic processing and developing efficient lexical knowledge of words and their finer-grained constituents.

Results from the TACHiD tests of implicit orthographic knowledge indicated that Japanese students could achieve high rates of nonword reproduction because they did not process the small random letter combinations as individual letters. Instead, Japanese orthography facilitates recognition beyond single alphabetic sequences and does not necessitate a search for larger chunks from pre-existing memory. Instead, the Japanese mind tries to resolve the graphemes into *chunks* based on the native V, CV, and CVV GP mappings, thereby reducing the demand on working memory and providing more accurate reproductions of the stimulus.

The test of explicit orthographic knowledge (i.e., ODT and ORT) indicate that students could recognise more accurately their native language phonology represented by *romaji* than English. Furthermore, students identified English words with Type-II orthographic gaps more accurately than Type-I and Type-III gaps, which supports the implicit version of the noticing hypothesis; learning requires input to be noticed and consciously registered (Schmidt, 1990).

Incidental findings in this thesis led to the orthographic gap hypothesis. The OGH states that the “gaps” between two language orthographies, such as *romaji* and English, should be the places where orthographic lexical development is most at risk. These areas are related to orthographic complexity and are identifiable using the methods described in this thesis. The OGH identifies three types of gaps between orthographies based on the cognitive effort required to resolve them. These differences are between letters, their sounds, and their presence in either language. The results indicate that English orthographic knowledge facilitates *romaji* more than *romaji* facilitates understanding English alphabets and their phonemic and graphemic correspondences. These findings support earlier proposals that "orthographic transparency [adversely] affects the development of reading and spelling abilities" (Hoxhallari, 2006, p. 289).

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APPENDICES

Appendices

This appendix contains the entire documentary evidence to support he thesis study of the influence of *romaji* on English foreign language spelling in Japanese schools prior to change of curriculum in 2020. All original data are referred to by internet links or QR codes because the amount of raw data is beyond the capacity of this document. Data is available for further research, as stipulated in the ethics schedule, detailed later in this appendix. Sensitive information, however, will remain anonymous. The data is owned by the author of this study and is protected under copyright. Therefore, appropriate approval for use and citation is mandatory if data are used or copied in part or otherwise. Simply referencing this thesis should suffice in most cases. Where there are any permissions or concerns, please contact the author, indicated in the opening pages of this thesis. This appendix contains the follow list of items.

Appendix A
Scripts

This section contains a list of scripts mentioned in the body of the thesis. They are listed in English alphabetic order.

Appendix 1.1: Albanian

From Newmark, L., Hubbard, P., & Prifti, P. R. (1982). *Morfologjia*. Stanford University Press.

The modern Latin-based Albanian alphabet is the result of long evolution. Before the creation of the unified alphabet, Albanian was written in several different alphabets, with several sub-variants. The oldest surviving document with Albanian text is from the 15th century and written in the Latin script. Early Albanian writers such as Gjon Buzuku, Pjetër Bogdani, Pjetër Budi, and Frang Bardhi also used a Latin-based script, adding Greek characters to represent extra sounds.

The Albanian alphabet uses Latin letters singly and in combination to represent the 36 Albanian phonemes, ie, the 36 distinctive sound units that compose all the words of the language. The alphabetic order of the letters of the 36 alphabetic units. Each letter may appear in upper case (e.g., **A**BCÇDDh**EË**FGGjH**I**JKLLlMNNj**O**PQRRrSShTTh**U**VXXh**Y**ZZh) or lowercase (e.g., **a**bcçddh**eë**fggjh**i**jklllmnnj**o**pqrrrsshtth**u**vxxh**y**zzh). The diagraphs are also capitalized or lowercase (eg., Dh, Gj. Ll, N], Br Sh, Th, Xh, Zh).

The sound units represented by the letters can be roughly characterized as follows. In pronouncing the name of the letter, as in spelling a word out loud, vowel letters are pronounced with the value of the vowel they denote, while consonant letters are pronounced as a syllable beginning with the consonant phoneme followed by the sound represented by the letter 'e. Table 1.1 provides a rough characterization of the phonetic values of the Albanian letters, in terms of some of their correspondences with English spellings and with IPA (International Phonetic Alphabet) symbols.

Table 1

The 36-Letters of the Albanian Alphabet

Capital letters	**A**	B	C	Ç	D	Dh	**E**	**Ë**	F	G	Gj	H	**I**	J	K	L	Ll	M
Lower case letters	**a**	b	c	ç	d	dh	**e**	**ë**	f	g	gj	h	**i**	j	k	l	ll	m
IPA value	a, ä	b	t͡s	t͡ʃ	d	ð	e, ɛ	ə, ʌ, ɜ	f	g	ɟ	h	i	j	k	l	ɫ	m

Capital letters	N	Nj	**O**	P	Q	R	Rr	S	Sh	T	Th	**U**	V	X	Xh	**Y**	Z	Zh
Lower case letters	n	nj	**o**	p	q	r	rr	s	sh	t	th	**u**	v	x	xh	**y**	z	zh
IPA value	n	ɲ	o, ɔ	p	c / tɕ	ɾ	r	s	ʃ	t	θ	u	v	d͡z	d͡ʒ	y	z	ʒ

Note: The vowels are shown in bold

Japanese kana

From, Rose (2017).

Hiragana and *katakana* are the two syllabaries of the Japanese language. A syllabary is a type of script that represents the syllables of a language (usually an isolated vowel sound, or a consonant + vowel sound). Historically, many writing systems of the world started out as syllabaries and were adapted into alphabets when the need to represent complex consonant structures emerged in a language. English, for example, would not be a good language to represent with a syllabic script due to the complex combination of consonant strings that exist (think of the number of sounds that exist in the single syllable of the word ‘strengths’ in English). Japanese, however, mostly follows a systematic syllabic structure that comprises single consonant and vowel sounds.

In the following description, I have chosen not to use phonetic symbols to describe the phonemes in the Japanese language but instead have chosen the depictions of these vowel and consonant sounds as they appear in *romaji*. This decision was made so that the connection between the phonemes and the writing system is more apparent to the reader, many of whom may not be familiar with phonetic symbols. Only the final consonant of /n/ in Japanese (e.g., in the suffix san) and the glottal stop depicted by a double /t/ (e.g., wakatta) prevent the Japanese language from being perfectly depicted by a pure syllabary. As a result, the Japanese language is composed of five vowel sounds (/a/, /i/, /e/, /o/, /u/) in combination with its consonantal sounds. In Japan, these sound combinations are often depicted in a *hiragana* chart called gojuon (五十音), literally ‘fifty sounds’ of the Japanese language. However, this is a bit misleading as there are actually in excess of 100 such sounds. These sounds comprise of the five vowel The Japanese Writing System 15 Figure 2.1 An excerpt to illustrate the scripts of the Japanese writing system sounds listed above in combination with 14 consonantal sounds /k/, /g/, /s/, /z/, /t/, /d/, /n/, /h/, /p/, /b/, /m/, /y/, /r/, /w/, plus the need for a single consonant /n/ and symbol for a glottal stop. But, not all combinations exist in the Japanese language, such as the absence of a /ye/ and /yi/ sound, and the absence of a /we/, /wi/ and /wu/ sound.

There are also 30 glide combinations of three vowel sounds (/a/, /o/, /u/) with /my/, /ny/, /ky/, /gy/, /hy/, /by/, /py/, /chy/, /jy/ and /ry/. Also, other sounds have shifted over time in vernacular Japanese, such as a /shi/ sound replacing the /si/ combination, a /chi/ sound replacing the /ti/ combination, a /fu/ sound replacing the /hu/ combination and a /tsu/ replacing /tu/. As such, a total of 102 individual syllabic symbols would be needed to represent the syllables of the Japanese language, making it a very suitable language for a syllabary (English would need in excess of 15,000 such symbols to represent all of its syllables).

The *hiragana* and *katakana*, however, reduce this number of symbols to just 46 by adding discourse markers that indicate a change in voiced consonants. For example, the syllables /ku/ and /gu/ are written using the same symbol, with an addition of a diacritic or discourse marker on the latter as in く and ぐ. The same diacritic [``] is also used to change the initial /s/ to /z/, /t/ to /d/ and /h/ to /b/, as in the examples of [sa] and [za], [ta] and [da] and [ha] and [ba]. A different diacritic [○] is used to change the initial /h/ to a /p/ (see Table 1.2).

Table 1.2.1

Fifty Sounds of Japanese: Represented by Hiragana (and Romaji)

Phonemes	–	k	s	t	n	h	m	y	r	other
a	あ	か	さ	た	な	は	ま	や	ら	わ
i	い	き	し*	ち*	に	ひ	み		り	
u	う	く	す	つ*	ぬ	ふ*	む	ゆ	る	を
e	え	け	せ	て	ね	へ	め		れ	
o	お	こ	そ	と	の	ほ	も	よ	ろ	ん
Diacritic``		g	z	d		b				
Diacritic○						p				

Note. Historically there were 50 in the list. However, redundant *kana* were removed so the present day list contains only 46 basic *kana*. Additional sounds (i.e.. /g/, /z/, /d/, /b/, and /p/) are made using the diacritics. From, Rose (2017).

From the previous list of 46 *hiragana*, we can deduce that not all the English alphabets are utilized in *romaji*. There are combinations of *kana* that require unique orthographic representations in both *kana* and *romaji.* To avoid repetition, they are illustrated in the following discussion of *romaji* (see Appendix1.3).

Japanese Romaji

About a decade ago, the University of Tokyo published its first version of a recommended format for Japanese *romaji* notation (Gally, 2009). Written in Japanese, the main theme of the document is reflected in the following paragraph.

When the Japanese words, names of people or places, etc. appear in English sentences, the Japanese pronunciation is written in the English alphabet. The common format must be used consistently. Here, we compare some of the main forms of Japanese Romanisation, and explain in detail one form that we recommend. Instructional formula and Hepburn type There are two main traditional forms of Roman alphabet, called the instructional formula and the Hepburn type, respectively. More detailed information on these formats can be found in the Japan Style Sheet

(Society of Writers, Editors and Translators, 1998). In recent years, a third, informal format has emerged. We will call it the word processor type here. The main difference between the instructional formula and the Hepburn formula is shown in the table below. (Gally, 2009, p. 1)

The fundamental *romaji*, including 濁音 *Dakuon* (e.g., ガ) and 半濁音 *Handakuon* (e.g., パ /pa/), are listed below in Table-1. Table-2 includes the ‘y’ added. When writing Japanese topics for readers, including those who know Japanese, long vowels are indicated by the long vowel symbols, a line above the sustained vowel. This also includes the special case where ‘ou’ sounds like a sustained ‘o’ like in the word こうぞう (神津), /ko u zu/, |Kōzu| (see Table 1.3a).

Table 1.3a

A Summary of Conventional Japanese Long Vowels, Written in Romaji

おかあさん, (お母さん), /o ka a sa n/, |okāsan|, Mother (En)
キーキー, (擬音), /ki i ki i/, |kīkī|, imitation sounds (i.e. Onomatopoeia) (En)
くうかい, (空海), /ku u ka i/, |Kūkai|, Kukai (i.e. Buddhist priest - proper noun)
ケーキ, (No *kanji*, gairaigo), /ke e ki/, |kēki|, Cake (En)
とおり (通り), /to o ri/, |tōri|, Street

Note. Romaji transcription checked by the *Romaji*Desu [online] Japanese Dictionary & Translator.sFrom, http://www.*romaji*desu.com/translator

The convention for writing *hebonsiki* (i.e, Hebron style *romaji*) from Japanese phonemes, represented by their equivalents in *hiragana*, are shown in Table 1.3b.

Table 1.3b

ヘボン式を基本とした推奨形式 [Recommended Hebron-Style], *音節 [Syllable]*

あ	a	い	i	う	u	え	e	お	o
か	ka	き	ki	く	ku	け	ke	こ	ko
が	ga	ぎ	gi	ぐ	gu	げ	ge	ご	go
さ	sa	し	shi	す	su	せ	se	そ	so
ざ	za	じ	ji	ず	zu	ぜ	ze	ぞ	zo
た	ta	ち	chi	つ	tsu	て	te	と	to
だ	da	ぢ	ji	づ	zu	で	de	ど	do
な	na	に	ni	ぬ	nu	ね	ne	の	no
は	ha	ひ	hi	ふ	fu	へ	he	ほ	ho
ば	ba	び	bi	ぶ	bu	べ	be	ぼ	bo
ぱ	pa	ぴ	pi	ぷ	pu	ぺ	pe	ぽ	po
ま	ma	み	mi	む	mu	め	me	も	mo
や	ya			ゆ	yu			よ	yo
ら	ra	り	ri	る	ru	れ	re	ろ	ro
わ	wa			を	o			ん	n

Note. From Gally, T. (2009, p. 2)

The basic CV style can be manipulated to form additional phonemes using the /ya/, /yu/, and /yo/ phonemes (see Table 1.3c).

Table 1.3c

ヘボン式を基本とした推奨形式 [Recommended Hebron-style], *音節 [syllable]*

きゃ	kya	きゅ	kyu	きょ	kyo
ぎゃ	gya	ぎゅ	gyu	ぎょ	gyo
しゃ	sha	しゅ	shu	しょ	sho
じゃ	ja	じゅ	ju	じょ	jo
ちゃ	cha	ちゅ	chu	ちょ	cho
ぢゃ	ja	ぢゅ	ju	ぢょ	jo
にゃ	nya	にゅ	nyu	にょ	nyo
ひゃ	hya	ひゅ	hyu	ひょ	hyo
びゃ	bya	びゅ	byu	びょ	byo
ぴゃ	pya	ぴゅ	pyu	ぴょ	pyo
みゃ	mya	みゅ	myu	みょ	myo
りゃ	rya	りゅ	ryu	りょ	ryo

Note. From Gally, T. (2009, p. 2)

The versatility of Katakan allows for additional, foreign sounds. These phonemes cannot legally be represented by *hiragana*. Therefore, they must be represented in *katakana*, as recorded in Table 1.3d.

Table 1.3d

ヘボン式を基本とした推奨形式 [Recommended Hebron-Style], 音節 [Syllable]

(Special Katakan for Non-Japanese Phonemes)

						イェ	ye		
		ウィ	wi			ウェ	we	ウォ	wo
ヴァ	va	ヴィ	vi	ヴ	vu	ヴェ	ve	ヴォ	vo
				ヴュ	vyu				
		スィ	si			シェ	she		
		ズィ	zi			ジェ	je		
		ティ	ti	トゥ	tu	チェ	che		
		ディ	di	ドゥ	du	ヂェ	je		
ファ	fa	フィ	fi			フェ	fe	フォ	fo

Note. From Gally, T. (2009, p. 2)

In the previous table, foreign words are usually represented by *katakana*. The *romaji* representations above are a suggested standardisation of *romaji* (see Gally, 2009), and are not yet widely accepted in Japanese society or by MEXT. Therefore, the additional letters and blends (i.e, ‘v’, ‘she’, ‘wi’, ‘we’, etc.) will not be considered as conventional alphabets in the present study. Their presence and influence, however, is tested.

Appendix 1.4: English Alphabet

The english alphabet is comprised of 26 Latin base scripts.

Appendix B
IPA Standards for This Thesis

Appendix B-1 IPA Romaji

The 50 Sounds Table (五十音 in Jp) is the basic representation of most *hiragana* and *katakana* charts. It comprises a matrix, with the vowel sounds usually running down the leftmost column and the consonants running across the top (see Figure-1). This is the basis of most common methods for ordering Japanese words.

Figure-1

The Japanese (五十音) 50 Basic Sounds for Kana

		k	g	s	z	t	d	n	h	b	p	m	y	r	w	n
a	あ/ア *a* /a/	か/カ *ka* /ka/	が/ガ *ga* /ga/	さ/サ *sa* /sa/	ざ/ザ *za* /za/	た/タ *ta* /ta/	だ/ダ *da* /da/	な/ナ *na* /na/	は/ハ *ha* /ha/	ば/バ *ba* /ba/	ぱ/パ *pa* /pa/	ま/マ *ma* /ma/	や/ヤ *ya* /ja/	ら/ラ *ra* /ɾa/	わ/ワ *wa* /ɰa/	ん/ン *n** /ɴ/
i	い/イ *i* /i/	き/キ *ki* /ki/	ぎ/ギ *gi* /gi/	し/シ *shi* /ɕi/	じ/ジ *ji* /dʑi/	ち/チ *chi* /tɕi/	ぢ/ヂ *dji* /ddʑi/	に/ニ *ni* /ni/	ひ/ヒ *hi* /hi/	び/ビ *bi* /bi/	ぴ/ピ *pi* /pi/	み/ミ *mi* /mi/		り/リ *ri* /ɾi/	ゐ/ヰ *wi†* /ɰi/	
u	う/ウ *u* /ɯ/	く/ク *ku* /kɯ/	ぐ/グ *gu* /gɯ/	す/ス *su* /sɯ/	ず/ズ *zu* /zɯ/	つ/ツ *tsu* /tsɯ/	づ/ヅ *dsu* /dzɯ/	ぬ/ヌ *nu* /nɯ/	ふ/フ *fu* /ɸɯ/	ぶ/ブ *bu* /bɯ/	ぷ/プ *pu* /pɯ/	む/ム *mu* /mɯ/	ゆ/ユ *yu* /jɯ/	る/ル *ru* /ɾɯ/		
e	え/エ *e* /e/	け/ケ *ke* /ke/	げ/ゲ *ge* /ge/	せ/セ *se* /se/	ぜ/ゼ *ze* /ze/	て/テ *te* /te/	で/デ *de* /de/	ね/ネ *ne* /ne/	へ/ヘ *he* /he/	べ/ベ *be* /be/	ぺ/ペ *pe* /pe/	め/メ *me* /me/		れ/レ *re* /ɾe/	ゑ/ヱ *we†* /ɰe/	
o	お/オ *o* /o/	こ/コ *ko* /ko/	ご/ゴ *go* /go/	そ/ソ *so* /so/	ぞ/ゾ *zo* /zo/	と/ト *to* /to/	ど/ド *do* /do/	の/ノ *no* /no/	ほ/ホ *ho* /ho/	ぼ/ボ *bo* /bo/	ぽ/ポ *po* /po/	も/モ *mo* /mo/	よ/ヨ *yo* /jo/	ろ/ロ *ro* /ɾo/	を/ヲ *wo* /ɰo/	
ya**		きゃ/ キャ *kya* /kja/	ぎゃ/ ギャ *gya* /gja/	しゃ/ シャ *sha* /ɕa/	じゃ/ ジャ *ja* /dʑa/	ちゃ/ チャ *cha* /tɕa/	ぢゃ/ ヂャ *dja* /ddʑa/	にゃ/ ニャ *nya* /nja/	ひゃ/ ヒャ *hya* /hja/	びゃ/ ビャ *bya* /bja/	ぴゃ/ ピャ *pya* /pja/	みゃ/ ミャ *mya* /mja/		りゃ/ リャ *rya* /ɾja/		
yu**		きゅ/ キュ *kyu* /kjɯ/	ぎゅ/ ギュ *gyu* /gjɯ/	しゅ/ シュ *shu* /ɕɯ/	じゅ/ ジュ *ju* /dʑɯ/	ちゅ/ チュ *chu* /tɕɯ/	ぢゅ/ ヂュ *dju* /ddʑɯ/	にゅ/ ニュ *nyu* /njɯ/	ひゅ/ ヒュ *hyu* /hjɯ/	びゅ/ ビュ *byu* /bjɯ/	ぴゅ/ ピュ *pyu* /pjɯ/	みゅ/ ミュ *myu* /mjɯ/		りゅ/ リュ *ryu* /ɾjɯ/		
yo**		きょ/ キョ *kyo* /kjo/	ぎょ/ ギョ *gyo* /gjo/	しょ/ ショ *sho* /ɕo/	じょ/ ジョ *jo* /dʑo/	ちょ/ チョ *cho* /tɕo/	ぢょ/ ヂョ *djo* /ddʑo/	にょ/ ニョ *nyo* /njo/	ひょ/ ヒョ *hyo* /hjo/	びょ/ ビョ *byo* /bjo/	ぴょ/ ピョ *pyo* /pjo/	みょ/ ミョ *myo* /mjo/		りょ/ リョ *ryo* /ɾjo/		

Note. 1: *ん/ン has no vowel sound; it is a syllable-final /ɴ/. This is simply its appointed place on the chart. 2. **These rows are not part of the original chart, but are usually shown on modern versions of the chart. 3. † - Character is no longer used in modern Japanese. Downloaded 21/09/2018 from from http://lingwiki.com/index.php?title=50_Sounds_Table

Irregularities in spelling are si/shi, zi/ji, ti/chi, di/dji, , tu/tsu, du/dsu.

Other irregularities look like didactics, but they have a different function and are called Dakuten (濁点) and Handakuten (半濁点). These are signs added to the upper right corner of certain *hiragana* and *katakana* characters to change their sounds.

The Dakuten looks like a double quotation mark ("), and Handakuten looks like a degree symbol (°). They change the sound as indicated in Table 1.

Dakuten (濁点)	Handakuten (半濁点)
‘k’ changes to ‘g’	--
‘s’ changes to ‘z’	--
‘t’ changes to ‘d’	--
‘h’ changes to ‘b’	‘h’ changes to ‘b’

Appendix B-2: IPA English

With only twenty-six different letters, more than 1120 combinations (graphemes) are used to represent the (atleast) 44 phonemes that make up the English language (Drift, 1988). These 44 uniquely different sounds help us distinguish one word or meaning from another. Phonemes fall into two categories: consonants and vowels (see Table 2). Various letters and letter combinations known as graphemes are used to represent the sounds.

Table 1

International Phonetic Alphabet Symbols for Consonants (n=24) and Vowels (n=20) and Examples of Use for Each

Consonants

Phoneme	IPA Symbol	Graphemes	Examples	Voiced?
1	b	b, bb	bug, bubble	Yes
2	d	d, dd, ed	dad, add, milled	Yes
3	f	f, ff, ph, gh, lf, ft	fat, cliff, phone, enough, half, often	No
4	g	g, gg, gh,gu,gue	gun, egg, ghost, guest, prologue	Yes
5	h	h, wh	hop, who	No
6	dʒ	j, ge, g, dge, di, gg	jam, wage, giraffe, edge, soldier, exaggerate	Yes
7	k	k, c, ch, cc, lk, qu ,q(u), ck, x	kit, cat, chris, accent, folk, bouquet, queen, rack, box	No
8	l	l, ll	live, well	Yes
9	m	m, mm, mb, mn, lm	man, summer, comb, column, palm	Yes
10	n	n, nn,kn, gn, pn	net, funny, know, gnat, pneumonic	Yes
11	p	p, pp	pin, dippy	No
11	p	p, pp	pin, dippy	No
12	r	r, rr, wr, rh	run, carrot, wrench, rhyme	Yes
13	s	s, ss, c, sc, ps, st, ce, se	sit, less, circle, scene, psycho, listen, pace, course	No
14	t	t, tt, th, ed	tip, matter, thomas, ripped	No
15	v	v, f, ph, ve	vine, of, stephen, five	Yes
16	w	w, wh, u, o	wit, why, quick, choir	Yes
17	z	z, zz, s, ss, x, ze, se	zed, buzz, his, scissors, xylophone, craze	Yes
18	ʒ	s, si, z	treasure, division, azure	Yes
19	tʃ	ch, tch, tu, ti, te	chip, watch, future, action, righteous	No
20	ʃ	sh, ce, s, ci, si, ch, sci, ti	sham, ocean, sure, special, pension, machine, conscience, station	No
21	θ	th	thongs	No
22	ð	th	leather	Yes
23	ŋ	ng, n, ngue	ring, pink, tongue	Yes
24	j	y, i, j	you, onion, hallelujah	Yes

Vowels

Phoneme	IPA Symbol	Graphemes	Examples
25	æ	a, ai, au	cat, plaid, laugh
26	eɪ	a, ai, eigh, aigh, ay, er, et, ei, au, a_e, ea, ey	bay, maid, weigh, straight, pay, foyer, filet, eight, gauge, mate, break, they
27	e	e, ea, u, ie, ai, a, eo, ei, ae	end, bread, bury, friend, said, many, leopard, heifer, aesthetic
28	i:	e, ee, ea, y, ey, oe, ie, i, ei, eo, ay	be, bee, meat, lady, key, phoenix, grief, ski, deceive, people, quay
29	ɪ	i, e, o, u, ui, y, ie	it, england, women, busy, guild, gym, sieve
30	aɪ	i, y, igh, ie, uy, ye, ai, is, eigh, i_e	spider, sky, night, pie, guy, stye, aisle, island, height, kite
31	ɒ	a, ho, au, aw, ough	swan, honest, maul, slaw, fought
32	oʊ	o, oa, o_e, oe, ow,	open, moat, bone, toe, sow,
33	ʊ	o, oo, u,ou	wolf, look, bush, would
34	ʌ	u, o, oo, ou	lug, monkey, blood, double
35	u:	o, oo, ew, ue, u_e, oe, ough, ui, oew, ou	who, loon, dew, blue, flute, shoe, through, fruit, manoeuvre, group
36	ɔɪ	oi, oy, uoy	join, boy, buoy
37	aʊ	ow, ou, ough	now, shout, bough
38	ə	a, er, i, ar, our, ur	about, ladder, pencil, dollar, honour, augur
39	eər	air, are, ear, ere, eir, ayer	chair, dare, pear, where, their, prayer
40	ɑ:	a	arm
41	ɜ:r	ir, er, ur, ear, or, our, yr	bird, term, burn, pearl, word, journey, myrtle
42	ɔ:	aw, a, or, oor, ore, oar, our, augh, ar, ough, au	paw, ball, fork, poor, fore, board, four, taught, war, bought, sauce
43	ɪər	ear, eer, ere, ier	ear, steer, here, tier
44	ʊər	ure, our	cure, tourist

Note. There is no definitive list of phonemes because accents, dialects and the evolution of language change the sounds we use to distinguish words. Therefore, in reality, there are more than the 44 sounds shown above.

Drift, L. (1988). In S. Embleton (Ed.), The Fourteenth LACUS Forum 1987, (pp. 373-77). Lake Bluff: Linguistic Associations of Canada and the United States.

Appendix C
Ortho-Influ Research Tools

This section is similar to an annotated bibliography, albeit for ISP tools. The list contains only some of the most frequently used tools and web sites that were useful in collecting and analysing words, providing data analysis assistance, and other functions required. This appendix is divided into the following sections according to <function>.

Word Lists and Frequencies

English

- Academic Word List sublist families
- https://www.wgtn.ac.nz/lals/resources/academicwordlist/sublist
- Web based Corpora Search   English-Corpora.org
- 1 in 10 60K words Genre based Lexis   <available here>
- Hi Friends (by author) <available here>
- Syllable Counter   https://www.wordcalc.com/
- English word references from the Farlex, free online dictionary
  https://www.thefreedictionary.com/

Japanese

- A 15,000 Japanese Word Frequency List
- Search and data tool   http://www.manythings.org/japanese/words/leeds/
- How do Jp SS learn *kanji*
  https://www.nippon.com/en/nipponblog/m00104/

IPA and *Romaji* Converters

- IPA converting website, to Phonics is available from, https://tophonetics.com/

Appendix D
MEXT Reforms

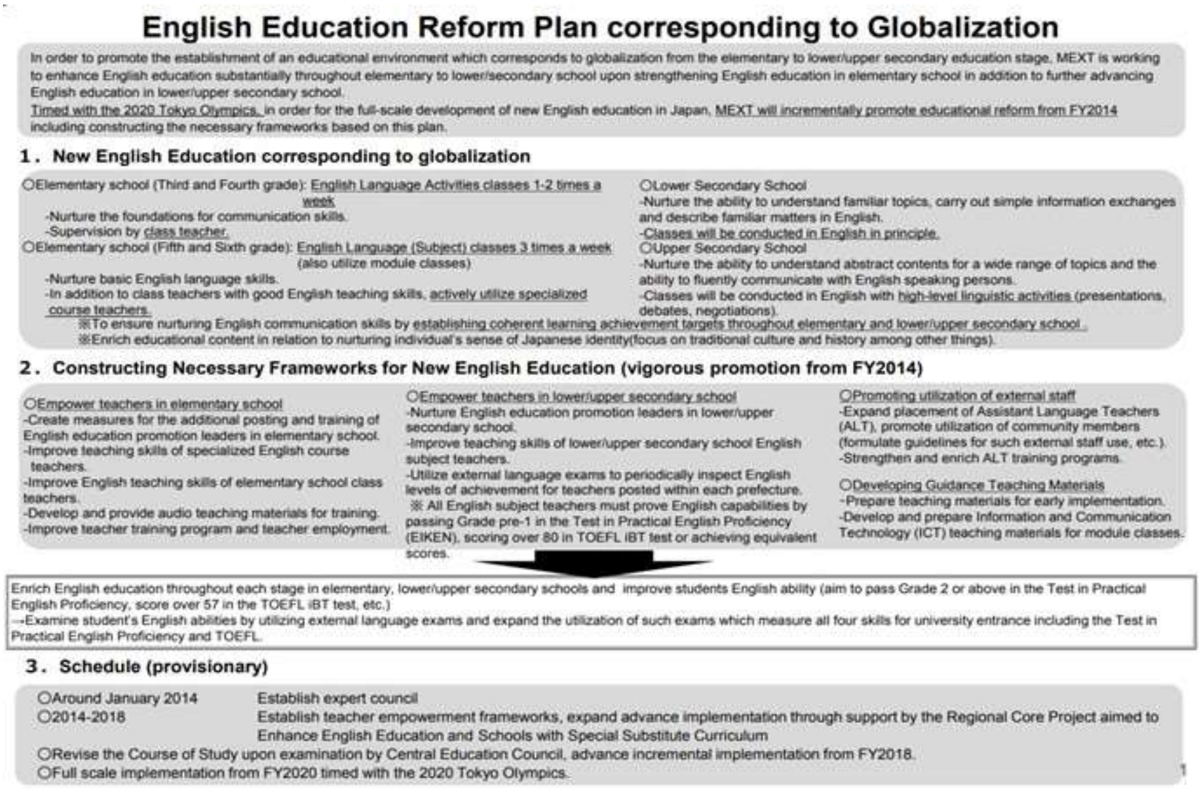
The following are snippets from MEXT reform plans. The reason for their inclusion is MEXT on occasion removes these documents and they cannot be recovered and there is no trace on Google Cache.

MEXT Reform for English - Main Influence

Below is a copy of the MEXT (2014) reform plan to implement English earlier, communication in Grade-3 and Reading and Writing in Grade-5 in English (see Figure 1) and in Japanese (see Figure 2).

Figure 1

MEXT (2014, June) English Education 2020 Reform Plan Corresponding to Globalization (in English)



English Education Reform Plan corresponding to Globalization

In order to promote the establishment of an educational environment which corresponds to globalization from the elementary to lower/upper secondary education stage, MEXT is working to enhance English education substantially throughout elementary to lower/secondary school upon strengthening English education in elementary school in addition to further advancing English education in lower/upper secondary school.
Timed with the 2020 Tokyo Olympics, in order for the full-scale development of new English education in Japan, MEXT will incrementally promote educational reform from FY2014 including constructing the necessary frameworks based on this plan.

1． New English Education corresponding to globalization

○Elementary school (Third and Fourth grade): English Language Activities classes 1-2 times a week
-Nurture the foundations for communication skills.
-Supervision by class teacher.
○Elementary school (Fifth and Sixth grade): English Language (Subject) classes 3 times a week (also utilize module classes)
-Nurture basic English language skills.
-In addition to class teachers with good English teaching skills, actively utilize specialized course teachers.

○Lower Secondary School
-Nurture the ability to understand familiar topics, carry out simple information exchanges and describe familiar matters in English.
-Classes will be conducted in English in principle.
○Upper Secondary School
-Nurture the ability to understand abstract contents for a wide range of topics and the ability to fluently communicate with English speaking persons.
-Classes will be conducted in English with high-level linguistic activities (presentations, debates, negotiations).

※To ensure nurturing English communication skills by establishing coherent learning achievement targets throughout elementary and lower/upper secondary school.
※Enrich educational content in relation to nurturing individual's sense of Japanese identity(focus on traditional culture and history among other things).

2． Constructing Necessary Frameworks for New English Education (vigorous promotion from FY2014)

○Empower teachers in elementary school
-Create measures for the additional posting and training of English education promotion leaders in elementary school.
-Improve teaching skills of specialized English course teachers.
-Improve English teaching skills of elementary school class teachers.
-Develop and provide audio teaching materials for training.
-Improve teacher training program and teacher employment.

○Empower teachers in lower/upper secondary school
-Nurture English education promotion leaders in lower/upper secondary school.
-Improve teaching skills of lower/upper secondary school English subject teachers.
-Utilize external language exams to periodically inspect English levels of achievement for teachers posted within each prefecture.
※ All English subject teachers must prove English capabilities by passing Grade pre-1 in the Test in Practical English Proficiency (EIKEN), scoring over 80 in TOEFL iBT test or achieving equivalent scores.

○Promoting utilization of external staff
-Expand placement of Assistant Language Teachers (ALT), promote utilization of community members (formulate guidelines for such external staff use, etc.).
-Strengthen and enrich ALT training programs.

○Developing Guidance Teaching Materials
-Prepare teaching materials for early implementation.
-Develop and prepare Information and Communication Technology (ICT) teaching materials for module classes.

Enrich English education throughout each stage in elementary, lower/upper secondary schools and improve students English ability (aim to pass Grade 2 or above in the Test in Practical English Proficiency, score over 57 in the TOEFL iBT test, etc.)
→Examine student's English abilities by utilizing external language exams and expand the utilization of such exams which measure all four skills for university entrance including the Test in Practical English Proficiency and TOEFL.

3． Schedule (provisionary)

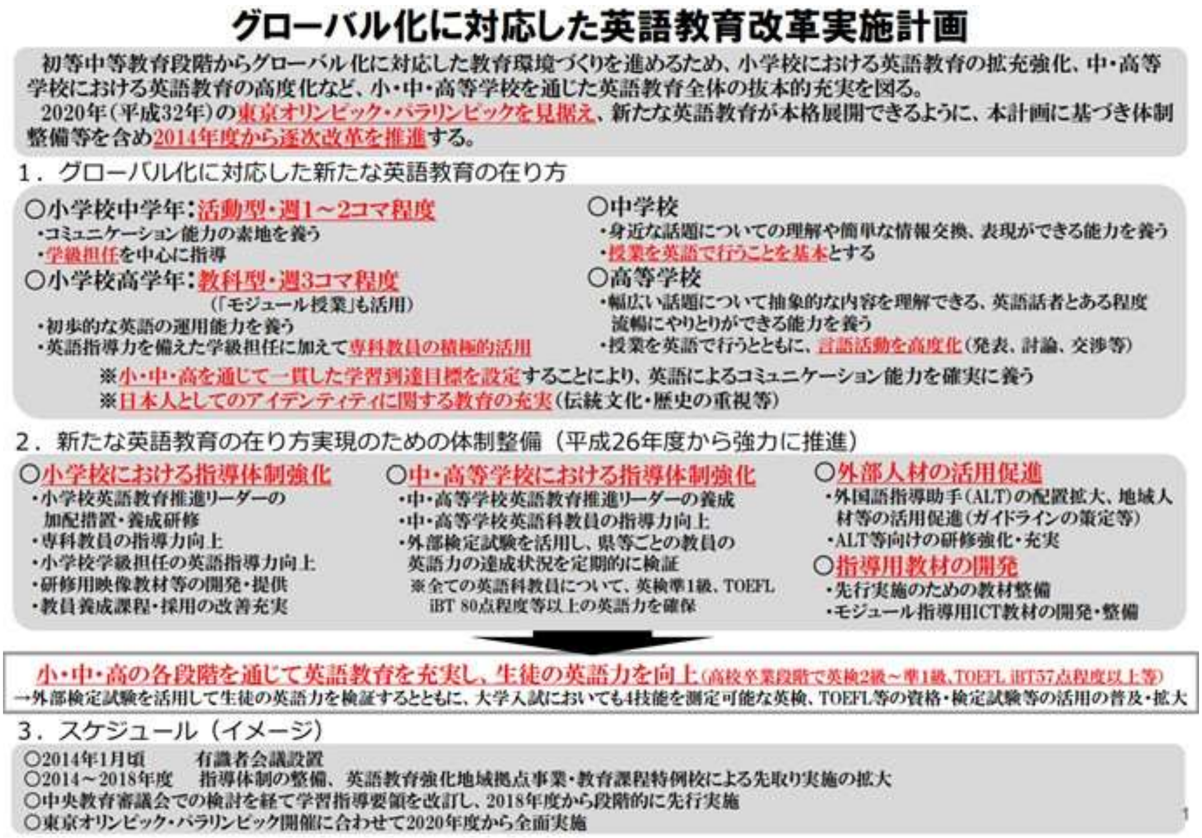
○Around January 2014 Establish expert council
○2014-2018 Establish teacher empowerment frameworks, expand advance implementation through support by the Regional Core Project aimed to Enhance English Education and Schools with Special Substitute Curriculum
○Revise the Course of Study upon examination by Central Education Council, advance incremental implementation from FY2018.
○Full scale implementation from FY2020 timed with the 2020 Tokyo Olympics.

1

Note. Communicative International understanding will start in Grade-3. Reading and writing will start in Grade-5. From, https://www.mext.go.jp/en/news/topics/detail/__icsFiles/afieldfile/2016/10/19/1378469_001.pdf

Figure 1b

MEXT English Education 2020 Reform Plan Corresponding to Globalization (in Japanese)



Note. English version is available in Figure 1a. This is the original release of the guidelines (MEXT, 2014). From, https://www.mext.go.jp/a_menu/kokusai/gaikokugo/1343704.htm

MEXT Plans (References Only)

MEXT (2015, June, 5th). Plans on the Promotion of Improvement of Students' English Abilities. 文部科学省. https://www.mext.go.jp/en/news/topics/detail/__icsFiles/afieldfile/2016/10/19/1378469_001.pdf

MEXT, (2014). グローバル化に対応した英語教育改革実施計画 [About the "English Education Reform Implementation Plan for Globalization"]. Ministry of Education, Culture, Sports, Science and Technology-Japan. https://www.mext.go.jp/a_menu/kokusai/gaikokugo/1343704.htm

MEXT Reforms Background

MEXTa (2016, June 29th). Measures based on the Four Basic Policy Directions. https://www.mext.go.jp/en/policy/education/lawandplan/title01/detail01/sdetail01/1373805.htm

"In addition to social competencies for survival.In looking toward such training, we aim to double the educational and research bases of a global standard and dramatically increase the number of students who participate in study abroad.We shall also improve linguistic skills, including practical English skills.*Example of ability: fluent linguistic skills for international negotiation, communication skills, and independence, a spirit for taking on challenges, understanding of cultural differences while maintaining a Japanese identity, creativity Achievement indicators Concerns for personnel who create new values Averages at to the top level in international students..."

MEXTb (2016, June 29th). Hold dreams and ambitions and foster abilities necessary to challenge possibilities. https://www.mext.go.jp/en/policy/education/lawandplan/title01/detail01/sdetail01/1373822.html

"…in the future, implement practical research in pilot schools for research purposes.○ Implementation, Analysis, and Use of National Assessment of Academic Ability-Correct and enhance educational measures and teaching by implementing National Assessment of Academic Ability based on new directions, such as introducing the new Course of Study, English survey in lower secondary schools and continuous implementation of surveys with parents, etc., every year and with all students, and by using identification, analysis, and results of issues.○ Promotion of upper secondary school education reform -Review curriculums, correct learning and teaching methods, and increase the teaching ability of teachers, and ..."

MEXTc (2016, June 29th). Chapter Three: Measures to be implemented comprehensively and systematically for the next five years. https://www.mext.go.jp/en/policy/education/lawandplan/title01/detail01/sdetail01/1373812.htm

"…schools and the use of supplementary teaching materials of mathematics and science that are needed for implementing the revised Courses of Study earlier than the official full-scale implementation. About Foreign Language Activities at elementary schools, in particular, the government will deliver to schools “Eigo- note” (workbook for elementary school English classes) for fifth and sixth graders and phonetic teaching materials by April 2009, and is promoting systematically designed training for teachers and the training will be completed by the end of fiscal year 2010. In addition, the government assists with the use of outside human resources, including ALTs (*...”

MEXT (n.d.). Japan's Educational Policy Aimed at 2030. https://www.mext.go.jp/component/a_menu/other/detail/__icsFiles/afieldfile/2018/09/11/1407998_02.pdf

“Japan's Educational Policy Aimed at 2030 Current System System after academic year 2020 Multiple choice questions only introduce essay questions English test: reading and listening only Switch to assessment of four skills Three elements of academic abilities not properly assessed High school students' motivation to learn discouraged by early passing of the entrance exams Set new rules Individual admissions by Institutions Outline of reform ◆ Switch to entrance exams that evaluate the three elements of academic abilities (below) of students' with multilateral and comprehensive assessments: 1) Solid acquisition of knowledge, skills; 2) Power of critical thinking, judgment, self-expression; 3) Willingness.”

.

Appendix E

The Origins of *Kana*

Both *hiragana* and *katakana* are simplified forms of *kanji* (Chinese characters). *Hiragana* are based on entire characters written in a style of Chinese calligraphy called *sōsho* (草書) where each Chinese character is written with a few continuous brush strokes (see Table 1). *Katakana* (see Table 2) are based on parts of *kanji*. They developed from *kunten* (訓点), a way of annotating Chinese texts so that the Japanese could read them (sci.lang.japan, n.d.).

Table 1

The Parent Kanji of Hiragana

		k	s	t	n	h	M	y	r	w	nn
a	あ	か	さ	た	な	は	ま	や	ら	わ	ん
	安	加	左	太	奈	波	末	也	良	和	毛/无
I	い	き	し	ち	に	ひ	み	-	り	ゐ	
	以	幾	之	知	仁	比	美		利	為	
U	う	く	す	つ	ぬ	ふ	む	ゆ	る	-	
	宇	久	寸	州?	奴	不	武	由	留	-	
E	え	け	せ	て	ね	へ	め	-	れ	ゑ	
	衣	計	世	天	祢	部	女	-	礼	恵	
O	お	こ	そ	と	の	ほ	も	よ	ろ	を	
	於	己	會	止	乃	保	毛	与	呂	遠	

Note. From https://www.sljfaq.org/afaq/originofkana.html

Table 2

The Parent Kanji of Katakana

		k	s	T	n	h	m	y	r	w	nn
a	ア	カ	サ	タ	ナ	ハ	マ	ヤ	ラ	ワ	ン
	阿	加	散	多	奈	八	万/末	也	良	和	尓/爾
i	イ	キ	シ	チ	ニ	ヒ	ミ		リ	ヰ	
	伊	幾	之	千	二	比	三		利	井	
u	ウ	ク	ス	ツ	ヌ	フ	ム	ユ	ル		
	宇	久	須	州 ?	奴	不	牟	由	留		
e	エ	ケ	セ	テ	ネ	ヘ	メ		レ	ヱ	
	江	介	世	天	祢	部	女		流/礼	慧/恵	
o	オ	コ	ソ	ト	ノ	ホ	モ	ヨ	ロ	ヲ	
	於	己	曾	止	乃	保	毛	与	呂	乎	

Note. From https://www.sljfaq.org/afaq/originofkana.html

Appendix F

Japanese Elementary School *Romaji* and English Textbooks

Romaji Texts - Drills Mid to Post 2020

With the revision of the curriculum guidelines from 2020, English will be learned from elementary school 3 and made into subjects from elementary school 5.

Master the basic alphabets and Roman letters with cute *Sumikkogurashi* characters.

It is a writable drill.

Practice writing the uppercase and lowercase letters many times. You can review while playing in puzzles and mazes.

Romaji is centered around the Hepburn type used in passport names and station names.

I will touch on the differences between the ceremonial ceremonies learned in elementary school languages.

You can also get acquainted with simple English words and conversation.

Comes with 78 cute *Sumikkogurashi* stickers.

If you attach it to the drill after each dose, you will feel a sense of accomplishment and increase your motivation.

Of course, you can put it anywhere you like and enjoy it.

The interface between Romaji and English

A drill with a CD for elementary school students who can learn alphabets, Roman letters and phonics. A wealth of exercises will establish your listening, reading and writing skills.

◆Suitable for solidifying the basics of elementary school English!

In the alphabet, practice reading and writing uppercase and lowercase letters. You will also learn letters that pay attention to sounds and shapes, and practice saying and writing continuously from A to Z.

In *romaji*, you will learn how to write *romaji* and practice writing about 50 words in *romaji*.

At Phonics, you can practice the pronunciation and spelling of about 80 words to get the most basic rules of spelling and reading.

◆ Perfect learning from "listening and saying" to "writing"!

This book consists of the learning process of "listening and saying" → "writing". This is because I think it is an effective learning method to listen to the CD repeatedly and become accustomed to English pronunciation before going into the practice of writing. In addition, we have abundantly recorded review questions for fixing learning contents from both "listening" and "writing".

◆Comes with a CD to understand English pronunciation!

In learning elementary English, it is very important to touch the correct English pronunciation. Elementary school students become familiar with the phonetic characteristics of English and listen to English sounds.

Learning English, starting with Romaji

This is a drill with a CD for elementary school students who can learn a total of 480 important words learned in elementary school English. The ability to “listen, read, and write” is established.

◆ Carefully selected and recorded important 480 words!

Of the English words learned in elementary school English, we carefully selected 480 important words that are often used. In addition, these words are divided into genres such as "creatures" and "foods" for easy learning.

◆ Perfect learning from "listening and saying" to "writing"!

This book consists of the learning process of "listening and saying" → "writing". This is because I think it is an effective learning method to listen to the CD repeatedly and become accustomed to English pronunciation before going into the practice of writing. In addition, we have abundantly recorded review questions for fixing learning contents from both "listening" and "writing".

◆Comes with a CD to understand English pronunciation!

In learning elementary English, it is very important to touch the correct English pronunciation. Elementary school students are familiar with the phonetic characteristics of English and are of a suitable age to learn English sounds from their ears. Listen carefully to the CD and learn by imitating the native pronunciation.

Appendix G
Elementary School English Texts

Pre 2020 - Hi Friends

(Image Source: https://www.amazon.co.jp https://images-na.ssl-images-amazon.com/images/I/A1wyKWmhFUL.jpg and https://images-na.ssl-images-amazon.com/images/I/91LK392JCsL.jpg)

Transition period - Let's Try!

(Image Source: https://www.amazon.co.jp https://images-na.ssl-images-amazon.com/images/I/A1A3wBl7lmL.jpg https://images-na.ssl-images-amazon.com/images/I/A1xEtcxiaJL.jpg)

Post 2020 - We Can!

(Image Source: https://www.amazon.co.jp https://images-na.ssl-images-amazon.com/images/I/91v9D4Q0hrL.jpg https://images-na.ssl-images-amazon.com/images/I/A1Lu9eWL+vL.jpg)

Appendix H
Japanese Elementary School *Kanji* List

The following list of *kanji* are the official *kanji* to be learned in Elementary schools. The order of learning is determined by each school, or the text they are using. Therefore, the official MEXT list is in no particular order, Jukus teach by stroke order and textbooks usually apply another, contextually and functionally ordered list, as listed below.

1. Official MEXT Elementary School List https://www.mext.go.jp/a_menu/shotou/new-cs/youryou/syo/koku/001.htm
2. Juku stroke learning order https://happylilac.net/eikoh/mu1803101048.html
3. Widely accepted learning order for stories and posters, grouped in function and context order, together with *romaji* and English translations https://agreatdream.com/japanese-ministry-of-education-list-of-kanji-by-school-year-okm/

Table D-1

Official MEXT Elementary School List - 学年別漢字配当表 [Kanji divided by grade]

Grade-1: 第一学年 （80 字）

一 右 雨 円 王 音 下 火 花 貝 学 気 九 休 玉 金 空 月 犬 見 五 口 校 左 三 山 子
四 糸 字 耳 七 車 手 十 出 女 小 上 森 人 水 正 生 青 夕 石 赤 千 川 先 早 草 足
村 大 男 竹 中 虫 町 天 田 土 二 日 入 年 白 八 百 文 木 本 名 目 立 力 林 六

Grade-2: 第二学年 （160 字）

引 羽 雲 園 遠 何 科 夏 家 歌 画 回 会 海 絵 外 角 楽 活 間 丸 岩 顔 汽 記 帰 弓
牛 魚 京 強 教 近 兄 形 計 元 言 原 戸 古 午 後 語 工 公 広 交 光 考 行 高 黄 合
谷 国 黒 今 才 細 作 算 止 市 矢 姉 思 紙 寺 自 時 室 社 弱 首 秋 週 春 書 少 場
色 食 心 新 親 図 数 西 声 星 晴 切 雪 船 線 前 組 走 多 太 体 台 地 池 知 茶 昼
長 鳥 朝 直 通 弟 店 点 電 刀 冬 当 東 答 頭 同 道 読 内 南 肉 馬 売 買 麦 半 番
父 風 分 聞 米 歩 母 方 北 毎 妹 万 明 鳴 毛 門 夜 野 友 用 曜 来 里 理 話

Grade-3: 第三学年（200 字）

悪安暗医委意育員院飲運泳駅央横屋温化荷界開階寒感漢館岸
起期客究急級宮球去橋業曲局銀区苦具君係軽血決研県庫湖向
幸港号根祭皿仕死使始指歯詩次事持式実写者主守取酒受州拾
終習集住重宿所暑助昭消商章勝乗植申身神真深進世整昔全相
送想息速族他打対待代第題炭短談着注柱丁帳調追定庭笛鉄転
都度投豆島湯登等動童農波配倍箱畑発反坂板皮悲美鼻筆氷表
秒病品負部服福物平返勉放味命面問役薬由油有遊予羊洋葉陽
様落流旅両緑礼列練路和

Grade-4: 第四学年（200 字）

愛案以衣位囲胃印英栄塩億加果貨課芽改械害街各覚完官管関
観願希季紀喜旗器機議求泣救給挙漁共協鏡競極訓軍郡径型景
芸欠結建健験固功好候航康告差菜最材昨札刷殺察参産散残士
氏史司試児治辞失借種周祝順初松笑唱焼象照賞臣信成省清静
席積折節説浅戦選然争倉巣束側続卒孫帯隊達単置仲貯兆腸低
底停的典伝徒努灯堂働特得毒熱念敗梅博飯飛費必票標不夫付
府副粉兵別辺変便包法望牧末満未脈民無約勇要養浴利陸良料
量輪類令冷例歴連老労録

Grade-5: 第五学年 （185 字）

圧移因永営衛易益液演応往桜恩可仮価河過賀快解格確額刊幹
慣眼基寄規技義逆久旧居許境均禁句群経潔件券険検限現減故
個護効厚耕鉱構興講混査再災妻採際在財罪雑酸賛支志枝師資
飼示似識質舎謝授修述術準序招承証条状常情織職制性政勢精
製税責績接設舌絶銭祖素総造像増則測属率損退貸態団断築張
提程適敵統銅導徳独任燃能破犯判版比肥非備俵評貧布婦富武
復複仏編弁保墓報豊防貿暴務夢迷綿輸余預容略留領

Grade-6: 第六学年 （181 字）

異 遺 域 宇 映 延 沿 我 灰 拡 革 閣 割 株 干 巻 看 簡 危 机 揮 貴 疑 吸 供 胸 郷
勤 筋 系 敬 警 劇 激 穴 絹 権 憲 源 厳 己 呼 誤 后 孝 皇 紅 降 鋼 刻 穀 骨 困 砂
座 済 裁 策 冊 蚕 至 私 姿 視 詞 誌 磁 射 捨 尺 若 樹 収 宗 就 衆 従 縦 縮 熟 純
処 署 諸 除 将 傷 障 城 蒸 針 仁 垂 推 寸 盛 聖 誠 宣 専 泉 洗 染 善 奏 窓 創 装
層 操 蔵 臓 存 尊 宅 担 探 誕 段 暖 値 宙 忠 著 庁 頂 潮 賃 痛 展 討 党 糖 届 難
乳 認 納 脳 派 拝 背 肺 俳 班 晩 否 批 秘 腹 奮 並 陛 閉 片 補 暮 宝 訪 亡 忘 棒
枚 幕 密 盟 模 訳 郵 優 幼 欲 翌 乱 卵 覧 裏 律 臨 朗 論

Appendix I

Gairaigo and Wasei-Eigo Listed in Country of Origin

This section contains a list of many of the more frequently known Romanised scripted words that have been sourced from countries outside of Japan. Some of the words are direct phonetic transcriptions of foreign languages, within the compounds of the Japanese phonetic system based on *kana*. Some words are constructions, made to sound English. These constructed or pseudo-English foreign loan words are called wasei-eigo. In general, words "loaned" from languages outside Japanese are called *gairaigo*.

The following list is from the Sanseidō New Modern Dictionary (Ichikawa, 1998), as it was displayed in Wikipedia.

Japanese	**Hepburn *romaji***	Original	Meaning	Origin
キリスト/ 基督	kirisuto	Cristo	Christ	*Portuguese / Spanish
すべた or スベタ	subeta	*espada* ("spade")	unattractive woman	*Portuguese / Spanish
タバコ, たばこ or 煙草	tabako	tabaco	tobacco, cigarette	*Portuguese / Spanish
イギリス	igirisu	*inglês or inglés	English, England or the UK	*Portuguese & Spanish
ラッコ	rakko	rakko	a sea otter	Ainu
アルコール	arukōru	alcohol, álcool	alcohol, alcoholic beverage	Arabic
アロエ	aroe	aloë	aloe	Dutch
ビール	bīru	bier	beer	Dutch
チンキ	chinki	tinktuur	tincture	Dutch
エキス	ekisu	ex(tract)	extract	Dutch
ゴム	gomu	gom	rubber, eraser, rubber band	Dutch
ホース	hōsu	hoos	a hose	Dutch
カン or 缶	kan	kan	can (beverage can or tin can)	Dutch
カラン	karan	kraan	faucet	Dutch
カリウム or カリ or 加里	kariumu or kari	kalium	potassium	Dutch
カルキ	karuki	kalk	lime (mineral)	Dutch
コーヒー or 珈琲	kōhī	koffie	coffee	Dutch
コック	kokku	kok	a cook	Dutch

オルゴール	orugōru	orgel	music box or a calliope instrument that operates off of a music roll	Dutch
ピンセット	pinsetto	pincet	tweezers	Dutch
ポンプ	ponpu	pomp	pump	Dutch
ランドセル	randoseru	ransel	Hard backpack, worn by elementary school children	Dutch
シュプール	Shupūru	spoor	trail from/for skis	Dutch
スコップ	sukoppu	schop	trowel, spade, shovel	Dutch
スポイト	supoito	spuit	syringe, dropper	Dutch
ガラス or 硝子	garasu	*glas* or glass	glass (material)	Dutch/En
ドイツ	doitsu	Duits(land), Deutsch(land)	Germany	Dutch/De
アフレコ	afu-reko	af(ter) + recor(ding)	post recording, dubbing	English
アフターサービス	afutā sābisu	after service	customer service, user support, after-care, service	English
アイドル	aidoru	idol	(teen) idol, pop star	English
アイスキャンディー	aisu-kyandī	ice + candy	popsicle, ice lolly	English
アメフト	amefuto	Ame(rican) foot(ball)	American football	English
アメリカンドッグ	amerikan doggu	American dog	corn dog	English
アニメ	anime)	anima(tion), anime	animation, animated cartoons or films	English
アニソン	anison	ani(me) + son(g)	an anime song, often the theme	English
アンサー	ansā	answer	reply to a question or solution	English
アンチ	anchi	anti-	hater, anti-fan	English
アポ	apo	appo(intment)	appointment	English
～アップ	-appu	up(grade)	to upgrade or improve (something).	English
アールブイ	ārubui	RV	truck, van, SUV, recreational vehicle	English
アウトコース	autokōsu	out-course	outside	English
バーゲン	bāgen	bargain	a sale at a store	English
バイキング	baikingu	viking	smorgasbord, buffet. (.. the first buffet in Japan "Imperial Viking"	English
バイク	baiku	bike	a motorcycle, but not a bicycle	English
ブックカバー	bukku kabā	book cover	dust jacket	English
バックミラー	bakku mirā	back mirror	rear-view mirror	English
バックナンバー	bakku nanbā	back number	back issue	English
バックネット	bakku netto	back net	a backstop (in baseball)	English
バンパー	banpā	bumper	Fender (AmE) or bumper bar (UK)	English

バリアフリー	baria furī	barrier-free	accessible facilities for handicapped persons	English
バター	batā	butter	butter, sometimes used on food packaging for margarine	English
バッティング	battingu	batting or butting	Swing the bat in baseball; or, compete in business likeanimals "butting heads"	English
ベビーカー	bebī kā	baby car	stroller (US), pushchair or pram (UK)	English
ベッドタウン	beddo taun	bed town	bedroom suburbs, bedroom community, dormitory suburb, commuter town	English
ビジネスホテル	bijinesu hoteru	business hotel	budget hotel	English
ビル	biru	buil(ding)	building (especially modern steel-and-concrete buildings)	English
ボールペン	bōru pen	ball(point) pen	a ballpoint pen	English
ブラセラ or ブルセラ	burasera or burusera	bloo(mer) sailor	panty fetishism, esp. teenage girls wearing school outfits ("sailor suits") and bloomers.	English
ブルセラショップ	buru-sera-shoppu	bloo(mer) + sailor (suit) +	a shop selling schoolgirls' used underwear and other fetish items	English
ブレザー	burezā	blazer	*blazer*, or a Japanese school uniform that includes that garment. It usually has buttons	English
ブルマ	buruma	bloomers	short pants worn for exercise by girls, usually in PE class in high school	English
キャビンアテンダント	kyabin atendanto (abbr. CA)	cabin attendant	A flight attendant	English
チャージ	chāji	charge	to top up, to add value, used for e-payment	English
チェンジレバー	chenji-rebā	change + lever	gearshift, gear lever, gear stick	English
チェリーボーイ	cherī bōi	cherry boy	a male virgin	English
チアガール, チアマン, チアリーダー	chia gāru, chia man, cheerleader	cheer girl, cheer man, cheerleader	(female), (male) cheerleader	English
チアリーディング	chiarīdingu	cheerleading	cheerleading	English
チケット	chiketto	ticket	ticket	English
コラボ	korabo	collab(orations)	collaboration; crossover	English
コンピューター or コンピュータ	konpyūtā or konpyūta	computer	computer	English
ダブル(noun), ダブる(intransitive verb)	daburu	double	(noun and adjective) double; double-breasted (jacket), or turn-ups (cuffs) on trousers;	English
ダンプカー	danpu kā	dump car	dump truck (US), dumper (UK)	English
ダストボックス	dasuto bokkusu	dust box	rubbish bin (UK), garbage can (US)	English
ダッチワイフ	datchi-waifu	Dutch + wife	sex doll	English
ダウンロードオンリーメンバー	daunrōdo onrī menbā	download-only member	a computing leech	English
～ティック or ～チック	-tikku or -chikku	"-tic", as in (roman)tic,	*-esque*, attached to a noun. For example, a product with cute character illustrations may	English
デッドボール	deddo bōru	dead ball	hit by a pitch	English
デコレーションケーキ	dekorēshon kēki	decoration cake	a fancy cake	English
デパート	depāto	depart(ment store)	department store	English
デリバリーヘルス	deribarī herusu	delivery health	a form of prostitution, essentially a call girl or escort service	English

デスク	desuku	desk	an editor for a certain section of a publication. (Derived from *desk*'s meaning as a division	English
ドアカット	doakatto	door + cut	selective door operation	English
ドクター ストップ	dokutā sutoppu	doctor stop	when the doctor tells a patient to stop doing something	English
ドンマイ	donmai	don('t) mi(nd)	"don't worry about it", "don't pay (that) any mind", "it's/I'm OK", "no problem". Used	English
ドライバー	doraibā	driver	a screwdriver; motor vehicle driver	English
ドライブイン	doraibuin	drive in	rest area, motor lodge, drive-in	English
ドリフト	dorifuto	drift	drifting (when a car is in a controlled skid)	English
エアコン	eakon	air con(ditioning) /	air conditioning or air conditioner	English
AV	ēbui or ēvui	wasei-eigo AV	adult video; audiovisual (audio-video)	English
エンスト	ensuto	en(gine) sto(p)	stall (as in an automobile engine)	English
NG	enu-jī	n(ot) + g(ood)	Acronym for not good or no good	English
エログ	erogu	ero(tic) + (b)log	erotic blog, adult-oriented blog	English
エログロ	eroguro	ero(tic) gro(tesque)	an artistic movement featuring "erotic grotesque nonsense"	English
エール	ēru	yell	(1) to cheer on a player in a sports competition; (2) to express support for a	English
LLC	eruerushī	acronym for "long-life	antifreeze coolants	English
エスカレーター	esukarētā	escalator	escalator	English
エッチ	etchi	H (likely from the first letter of	dirty, naughty; sex. (The etymology of *etchi* is still debated.)	English
ファイナル	fainaru	final	last	English
ファイト	faito	fight	often used to mean "Do your best!" or "I'll do my best."	English
ファミコン	famikon, Famicom	fami(ly) com(puter)	the Nintendo Entertainment System. Also a catch-all term by the older generation for any	English
ファンタジック	fantajikku	fantasy + -ic	fantastic	English
ファッションヘルス	fasshon herusu	fashion health	a form of brothel	English
フェッチ	fetchi	fetch	(computer jargon) To fetch an instruction from main memory when a microprocessor	English
～フェチ	fechi	feti(sh)	fetish (a sexual fetish or just a distinctive preference)	English
フィリピンパブ	firipin-pabu	Philippines + pub	a bar with Filipino staff	English
フォアボール	foabōru	four ball	walk, base on, ball four	English
フライ	furai	fly	fly ball (baseball term)	English
フライ	furai	fry	deep frying	English
フライングゲット	furaingu getto	flying get	to purchase an item before its official release date	English
フライドポテト	furaido poteto	fried potato	french fries (US), chips (UK)	English
フライング(スタート)	furaingu (sutāto)	flying (start)	premature start, breakaway	English

フリーダイアル or フリーダイヤル フ	furī daiaru or furī daiyaru, furī	free dial, free call	toll-free call	English
フリーサイズ	furī saizu	free size	one-size-fits-all	English
フロント	furonto	front (desk)	the reception desk, e.g., at a hotel or a sentō	English
フロントガラス	furonto garasu	front glass	windshield (US), windscreen (UK)	English
ガードマン	gādo man	guard man	a (private) security guard, a person who directs traffic around work sites	English
ガソリンスタンド	gasorin sutando	gasoline stand	gas station (US), petrol station (UK)	English
ガッツポーズ	gattsu pōzu	guts pose	fist pump, victory pose	English
ゲームセンター or ゲーセン	gēmu sentā or gēsen	game centre	video arcade	English
ギブ(アップ)	gibu(appu)	give (up)	to give up	English
ゴールデンアワー or ゴールデンタイ	gōruden awā or gōruden taimu	golden hour or golden time	prime time in Japanese television	English
ゴールデンウィーク or ゴールデンウ	gōruden wīku or gōruden uīku	golden week	A week of holidays in Japan, Golden Week.	English
グラビア	gurabia	gravure	glamour photography	English
グラス	gurasu	glass	drinking glass	English
グロ	guro	gro(tesque)	grotesque	English
ギャラリー	gyararī	gallery	an art gallery, audience, or a pool of celebrities on a program.	English
ギャル	gyaru	gal	a young woman who belongs to the gyaru subculture	English
ハイカラ	haikara	high colla(r)	(1920s slang) a person who was devoted to Western fashions, trends and values. E.g.,	English
ハイネック	hainekku	high neck	A turtleneck style shirt or sweater	English
ハイオク	haioku	high octane	high-octane gasoline	English
ハイタッチ	haitatchi	high touch	High five	English
ハッカー	hakkā	hacker	refers specifically to a computer black hat	English
ハンバーグ	hanbāgu	hamburg(er steak)	Salisbury steak (culinary term)	English
ハンドル	handoru	handle	steering wheel or bicycle handlebars	English
ハンドルキーパー	handoru kīpā	handle keeper	designated driver	English
ハンドルネーム	handoru nēmu	handle name	handle, screen name	English
ハンカチ	hankachi	han(d)kerchie(f)	handkerchief	English
ハンスト	hansuto	hun(ger) st(rike)	hunger strike	English
ハッピーエンド	happī endo	happy end	a happy ending	English
ハウス (ビニールハウス)	hausu (binīru hausu)	house (vinyl house)	greenhouse or glasshouse	English
ヘアピンカーブ	heapin kābu	hairpin curve	hairpin turn	English
ヘルスメーター	herusu mētā	health meter	bathroom scales, scales	English

ヒップ	hippu	Hips	buttocks, butt	English
ホッチキス	hotchikisu	Hotchkiss	stapler (a genericised trademark of the E. H. Hotchkiss company, also used in Korea)	English
ホテヘルス	hote-herusu	hote(l) + health	erotic massage provided in a hotel room	English
ホテトル	hote-toru	hote(l) + Tur(kish bath)	sexual services provided in a hotel room	English
ホットケーキ	hotto kēki	hotcake	a pancake, hotcake	English
ホーム	hōmu	(plat)form	a railway platform	English
ホワイトデー	howaito dē	White + Day	White Day, a month after Valentine's Day	English
イメージ	imēji	image	an image, often used to indicate an artist's rendering or a graphic intended to provide a	English
イメージクラブ	imēji-kurabu	image + club	a type of brothel in which the staff dress in costumes (schoolgirl, nurse, etc.)	English
インスタ	insuta	Instagram	Instagram	English
インフレ	infure	infla(tion)	inflation	English
イン・キー	in kī	in key	locking one's car keys inside of one's car	English
イラスト	irasuto	illust(ration)	an illustration	English
イヤー・オブ・ザ・コーチ	iyā obu za kōchi	year of the coach	coach of the year (a title given to coaches by *Asahi Shimbun* and the High School Baseball	English
ジャンパー	janpā	jumper	jacket, jumper (ski jumping athlete)	English
ジェンダーフリー	jendā furī	gender free	gender equality, gender blind	English
ジェットコースター	jetto kōsutā	jet coaster	roller coaster	English
ジーパン	jīpan	jea(ns) + pan(ts)	jeans	English
ジープ	jīpu	jeep	a small, sturdy motor vehicle with four-wheel drive, especially one used by the military	English
ジュース	jūsu	juice	soda or energy drinks, regardless of whether they contain any juice	English
カーセックス	kā-sekkusu	car + sex	public sex (in a car)	English
カメラマン	kameraman	cameraman	photographer or cameraman	English
カモン or カモーン	kamon or kamōn	come on	An invitation to join an activity or event.	English
カンニング	kanningu	cunning	cheating	English
カシューナッツ	Kashū nattsu	cashew nut	cashew	English
キーホルダー	kī horudā	key holder	key ring or key chain	English
キーボード	kībōdo	keyboard	a keyboard	English
キスマーク	kisu māku	kiss mark	hickey	English
キッチンペーパー	kitchin pēpā	kitchen paper	paper towel	English
コインランドリー	koin randorī	coin laundry	laundromat (US), launderette (UK)	English
コインロッカー	koin rokkā	coin locker	coin-operated locker	English

コマーシャルメッセージ or CM	komāsharu messeji	commercial message	television advertisement	English
コミカライズ	komikaraizu	comic[al] + *-ize*	to make a comic strip (*manga*) version of an originally non-comic strip title, such as a	English
コンビニ	konbini	conveni(ence store)	convenience store	English
コンセント	konsento	concent(ric plug)	power outlet	English
コロッケー	korokke	croquette	croquette, a small fried roll	English
コスプレ	kosupure	cos(tume) play	cosplay (dressing up in costumes, especially from manga, anime and video games)	English
クラブ or 倶楽部	kurabu	club	a club or society	English
クラクション	kurakushon	Klaxon	horn (on an automobile)	English
クレーム	kurēmu	claim	a complaint	English
クレーンゲーム	kurēn-gēmu	crane + game	claw crane (an alternate term used in Japan is "UFO catcher", derived from the Sega game	English
クリスタル	kurisutaru	crystal	shiny or clear	English
キャバクラ	kyabakura	cabaret club	hostess club	English
キャベツ	kyabetsu	cabbage	cabbage	English
キャンペーン	kyanpēn	campaign	a sales campaign or sweepstakes	English
キャッチボール	kyatchi bōru	catch ball	the game of catch	English
キャッチホン	kyatchi hon	catch phone	call waiting	English
キャッチコピー	kyatchi kopī	catch copy	tagline	English
キャップ	kyappu	cap	cap	English
マグカップ	magu kappu	mug cup	mug	English
マイナスドライバー	mainasu doraibā	minus driver	(flathead) screwdriver	English
マイ～	mai~	my	Someone's own. E.g., *mai būmu*: personal taste; *mai kā*: one's own car; *mai waifu* : one's	English
マジックインキ	majikku inki	Magic Ink	permanent marker (a genericised trademark of Uchida Yoko Co.)	English
マジックテープ	majikku tēpu	magic tape	velcro	English
マニア	mania	mania	enthusiasm, enthusiast	English
マンション	manshon	mansion	modern concrete apartment / condominium block	English
マントル	man-toru	man(sion) + Tur(kish bath)	sexual services provided in a private apartment	English
マスコミ	masukomi	mass communication	mass media, the media, the press	English
マザコン	mazakon	mother com(plex)[2]	Oedipus complex, a strong attachment to one's mother (often used derogatorily); "girly	English
メーカー	mēkā	maker	manufacturer	English
メール	mēru	mail	e-mail	English
メールマガジン	mēru magajin	mail magazine	e-mail newsletter, ezine	English

メタボ	metabo	metabo(lic)	Fat around the middle, big-bellied	English
ミクスチャーロック	mikusuchā-rokku	mixture + rock	rock music with rap, hip-hop, and reggae influences; also, as a catch-all term to	English
ミニアルバム	mini-arubamu	mini + album	extended play	English
ミルク	miruku	milk	milk, non-dairy creamer	English
ミシン	mishin	machine	sewing machine	English
モバイル	mobairu	mobile	mobile communications, mobile communications capability, or mobile	English
モバメ	mobame	mobile + mail	mobile phone-based mailing list subscription, usually used by entertainers to share their	English
モボ	mobo	mo(dern) bo(y)	(1920s slang) young men adopting western styles and behaviours	English
モガ	moga	mo(dern) gi(rl)	(1920s slang) young women adopting western styles and behaviours, flapper	English
モーニングコール	mōningu kōru	morning call	wake-up call	English
モーニングコート or モーニング	mōningu kōto or mōningu	morning coat	morning coat	English
モーニングサービス or モーニング	mōningu sābisu	morning service	breakfast special, complimentary toast, hard-boiled egg et al. that is served at cafes when a	English
モーテル	mōteru	motel	recently called as "love hotel". Does not have meaning of English "motel" used by tourists	English
ムーディ	mūdi	moody	nice	English
ナイター	naitā	night + -er	a night game	English
ナンバーディスプレイ	nanbā disupurei	number display	caller ID	English
ナンバープレート	nanbā purēto	number plate	number plate (UK), license plate (US)	English
ニート or NEET	nīto	Not in Employment,	underemployed young adults, akin to *freeter*	English
ノークレームノーリターン	nō kurēmu nō ritān	no claim, no return	sold "as is"	English
ノート	nōto	note	a notebook	English
ノートパソコン	nōto-pasokon	note + perso(nal) + com(puter)	laptop	English
ニューハーフ	nyūhāfu	new-half	A transgender individual that has undergone a sex change operation.	English
オーバー	ōbā	over	overreaction to a situation or the end of a dating relationship	English
OB, OG	ōbī, ōjī	old boy, old girl	alumnus, alumna, former student; furthermore used for former sport team	English
オーダーメード	ōdā-mēdo	order + made	bespoke (tailoring)	English
オーディエンス	ōdiensu	audience	group of people who participate in a show	English
オーエル	ōeru	O.L. (office lady)	female office worker, usually in a clerical or support job	English
オフ	ofu	off	a sale at a store; e.g., a "big summer off" (=big summer sale)	English
オフヴォーカル	ofu-vōkaru	off + vocal	backing track, instrumental	English
オイルショック	oiru-shokku	oil + shock	oil crisis	English
オージー	ōjī	orgy	an orgy	English

オンリーワン	onrīwan	only one	(adjective) one-of-a-kind or unique; e.g., オンリーワン技術 (-gijutsu, "unique	English
オープンカー	ōpun kā	open car	convertible (automobile)	English
オーライ	ōrai	a(ll) righ(t)	all right, OK	English
オートバイ	ōtobai	auto-bi(cycle)	motorcycle, motorbike	English
パイン	pain	pine(apple)	pineapple	English
パーマ	pāma	perma(nent wave)	perm	English
パネリスト	panerisuto	panelist	panelist	English
パンク	panku	punc(ture)	flat tire	English
パンスト	pansuto	pan(ty) + sto(cking)	pantyhose	English
パソコン	pasokon	perso(nal) com(puter)	PC	English
パーソナルコンピューター	pāsonaru konpyūtā	personal computer	personal computer	English
ペアルック	pea rukku	pair look	matching outfits (usually between a couple)	English
ペーパーカンパニー	pēpā kanpanī	paper company	dummy company, shell company	English
ペーパードライバー	pēpā doraibā	paper driver	a person who has a driver's license but does not usually drive (i.e. a driver only on paper)	English
ペーパーテスト	pēpā tesuto	paper test	written examination/test	English
ピンサロン	pin-saron	pink + salon	sex parlor	English
ピンチ	pinchi	pinch	potentially disastrous situation (from "in a pinch")	English
ポケベル	pokeberu	pocke(t) bell	beeper, pager	English
ポケモン	Pokémon	pocke(t) mon(ster)	Pokémon	English
ポスト	posuto	post	a mailbox (US), a postbox (UK)	English
ポテチ	pote-chi	potato + chips	potato chips	English
プラスドライバー	purasu doraibā	plus driver	Phillips screwdriver	English
プレイガイド	purei gaido	play + guide	(theater) ticket agency	English
プリクラ	purikura	Print Club (trademark)	photo booth #purikura	English
プロ	puro	professional	describes a business professional or professional sports	English
プロレス	puroresu	pro(fessional) wrest(ling)	professional wrestling	English
プッシュホン	pusshu hon	push phone	push-button telephone. A genericised trademark first registered by the Nippon	English
ラブドール	rabu-dōru	love + doll	a sex doll made of silicone	English
ラブホテル	rabu hoteru	love hotel	love hotel (hotel used as a private place for couples to have sex)	English
ライバル	raibaru	rival	A fellow competitor or an enemy	English
ライブアクション	raibu akushon	live-action	animated or comic form stories made into TV shows/movies involving real actors. It's the	English

ライブハウス	raibu hausu	live house	club with live music, rock bar	English
ライフライン	raifurain	lifeline	infrastructure	English
ラムネ	ramune	lemona(de)	Ramune (a lemon-lime soft drink; hard, powdery candy like Rockets or Smarties)	English
ランジェリーパブ	ranjerī-pabu	lingerie + pub	a public house in which the waitresses work in their underwear	English
ランニングホームラン	ranningu hōmu ran	running home run	an inside-the-park home run (baseball)	English
ランニングシャツ	ranningu shatsu	running shirt	a sleeveless T-shirt	English
レースクイーン	rēsu kuīn	race queen	umbrella girls	English
リベンジ	ribenji	revenge	return match, rematch, chance for redemption after a failed attempt	English
リーチ	rīchi	reach	One step away from winning. Usually used in bingo.	English
リードオンリーメンバー	rīdo onrī menbā	read-only member	an internet lurker, thought to be a pun on "read-only memory"	English
リフォーム	rifōmu	reform	remodel, renovation (as in a building)	English
リモコン	rimokon	remo(te) con(trol)	remote control	English
リンクフリー	rinku furī	link free	free to link	English
リニューアル	rinyūaru	renewal	remodeling	English
リサイクルショップ	risaikuru shoppu	recycle shop	secondhand shop (selling used or unwanted furniture, household appliances, housewares,	English
リセマラ	rise-mara	reset marathon	uninstalling and reinstalling a game in order to re-roll certain starting items or statistics	English
リストラ	risutora	restru(cturing)	(noun) restructuring, but with emphasis on lowering headcounts as in downsizing,	English
ロードショー	rōdo shō	roadshow	premiere, especially of a film	English
ロケーションハンティング ロケハン	rokēshon hantingu,	location hunting	location scout	English
ロマンスグレー	romansu gurē	romance grey	silver-gray hair	English
ロマンスカー	romansu kā	*Romancecar*	deluxe train (named after a series of limited express operated by the Odakyu Electric	English
ロープウェー	rōpuwē	ropeway	ropeway	English
ロリコン	rorikon	Loli(ta) (title of a novel by	sexual attraction to fictional and real underage girls, or ephebophilia. (reborrowed	English
ロスタイム	rosu taimu	loss time	added time, additional time	English
サービス	sābisu	service	service, often used to describe something as being free of charge	English
サイドブレーキ	saido burēki	side brake	hand brake, parking brake, emergency brake	English
サイダー	saidā	cider	a kind of soda unrelated to actual cider	English
サイン	sain	sign	signature, autograph	English
サインペン	sainpen	sign pen	marker, Trade name of Pentel's	English
サンドイッチ or サンド	sandoitchi, sando	sand(wich)	sandwich	English
サンドバッグ	sandobaggu	sandbag	punching bag	English

サラリーマン	sararīman	salaried man	salaryman: a salaried office/white collar worker	English
セックス	sekkusu	sex	sexual intercourse	English
セフレ	sefure	se(x) + frie(nd)	casual sexual partner	English
セクハラ	sekuhara	sex(ual) hara(ssment)	sexual harassment	English
セメダイン	semedain, Cemedine	ceme(nt) dyne	glue, adhesive. A genericised trademark of Cemedine Co., Ltd.	English
センス	sensu	sense	understanding of subtleties	English
セレブ	serebu	celeb(rity)	a rich person, whether or not they are famous	English
シャープペンシル or シャーペン	shāpu penshiru or shāpen	Shar(p) pencil	mechanical pencil (referring to Sharp, a manufacturer)	English
シャッターチャンス	shattā-chansu	shutter + chance	the perfect opportunity to take a photograph	English
シーエム	shīemu	C.M. ("commercial	television commercial	English
シール	shīru	seal	sticker, decal	English
シルバーシート	shirubā shīto	silver seat	priority seating on public transportation. ("Silver" refers to the hair of elderly	English
ソフト	sofuto	soft(ware)	video game console or computer software; also used to describe tasks or work (such as	English
ソフトクリーム	sofuto kurīmu or softcream	soft (ice) cream	soft serve (ice cream)	English
ソーラーシステム	sōrā shisutemu	solar system	a solar battery	English
スイートルーム	suīto rūmu	suite room	a suite in a hotel	English
スケボー	sukebō	ska(te)bo(ard)	skateboard	English
スケルトン	sukeruton	skeleton	translucent	English
スキー	sukī	ski	(noun) skiing	English
スキンシップ	sukinshippu	skin + -ship	skinship (bonding through physical contact)	English
スマート	sumāto	smart	slim, stylish, well-dressed, cool, handsome	English
スマホ	sumaho	sma(rt) + (p)ho(ne)	smartphone	English
スムーズ	sumūzu	smooth (transaction)	When a plan or transaction happens without incident	English
スーパー	sūpā	super(market)	supermarket	English
スパッツ, スパッツタイツ	supattsu, supattsu taitsu	spats, spats tights	tights (US), leggings	English
スペル	superu	spell	(noun) spelling	English
スピン	supin	spin	a ribbon or tassel on a book	English
スリーサイズ	surī saizu	three size	three primary female body measurements (bust, waist, hips)	English
スタイル	sutairu	style	body shape; style	English
ストライキ or スト	sutoraiki or suto	strike or st(rike)	labor strike	English
ストレートティー	sutorēto tī	straight tea	black tea without milk or lemon	English

ストーブ	sutōbu	stove	space heater	English
スーツアクター	sūtsu akutā	suits actor	suit actor, an actor who performs wearing a cartoon-character costume	English
タイムオーバー	taimu ōbā	time over	when a time limit has been reached	English
タイムリー	taimurī	timely (hit)	a clutch hit (in baseball), on time	English
タオルケット	taoru ketto	towelket (towel + (blan)ket)	a type of blanket made of a material similar to a beach or bath towel	English
テンキー	tenkī	ten key	numeric keypad	English
テンション	tenshon	tension	a state of excitement	English
テレビ	terebi	televi(sion)	television	English
テレビゲーム	terebi gēmu	televi(sion) game	video game	English
テレフォン	terefon	telephone	telephone, phone	English
テレカ	tereka	tele(phone) ca(rd)	prepaid card for using public telephones	English
ティーンエージャー	tīn'ējā	teenager	teenager, teen	English
トイレ(ット)	toire(tto)	toile(t)	toilet, bathroom, washroom, restroom	English
トンカツ	*tonkatsu*	ton (豚, pork) + katsu (from the	pork cutlet	English
トップページ	toppu-pēji	top + page	home page, start page	English
トラブル (noun), トラブる (verb)	toraburu	trouble	(noun) (legal) trouble, a dispute or altercation; (verb) to encounter or experience	English
トラックメーカー	torakkumēkā	track maker	music producer	English
トランプ	toranpu	trump(s)	playing cards	English
トレーナー	torēnā	trainer	sweatshirt	English
トレーニングパンツ	torēningu pantsu	training pants	pants for toddlers or babies; diaper	English
ツイッター	tsuittā	twitter	twitter apps	English
ウィンカー or ウインカー	winkā or uinkā	winker	turn signal, a.k.a. blinker or indicator on an automobile	English
ウーパールーパー	ūpārūpā or WuperRuper	(s)uper	an axolotl	English
ヴァージンロード	vājin rōdo	virgin road	the aisle (in a Western-style or Christian wedding ceremony, as followed by the bridal	English
ワイドショー	waido shō	wide show	talk show	English
ワイシャツ or Y シャツ	wai shatsu	*Y* (< "white") shirt	dress shirt (of any color)	English
ワンパターン	wan patān	one pattern	of (artificial or boring) uniformity or conformity, lacking of (spontaneous)	English
ワンピース	wan pīsu	one piece	(a single-piece) dress	English
ワープロ	wāpuro	wor(d) pro(cessor)	word processor	English
ウォシュレット	woshuretto	washlet (wash+(toi)let)	a toilet with a built-in bidet (a genericised trademark of Toto)	English
ヨット	yotto	yacht	a sailboat or yacht	English

ヤンエグ	yan egu	youn(g) ex(ecutive)	young executive	English
ユニットバス	yunitto basu	unit bath	modular bath, prefabricated bath	English
U ターンラッシュ	yūtān rasshu	U-turn rush	the rush of traffic and people, and attendant traffic jams and crowding of transportation	English
パンツ	pantsu	pants	underpants (US; simply called "pants" in the UK)	English (UK)
アパート	apāto	apart(ment)	apartment (US), flat (UK), though apāto are usually in small two-story wood-structure	English (US)
エレベーター	erebētā	elevator	elevator (US), lift (UK)	English (US)
タレント	tarento	talent, *talento*	TV personality/celebrity	English / Spanish
ドラマ	dorama	drama	TV drama, soap opera	English / Spanish / Latin
ロンパリ	ronpari	Lon(don) + *Paris*	slang for strabismus (crosseyed, wandering eye), alluding to one eye looking toward	English + French
フリーター	furītā	free *Arbeiter* ("worker")	underemployed young adults, people who opt to work (a series of) part-time jobs rather than	English + German
ムーンサルト	mūnsaruto	moon + *Salto*	an artistic gymnastics maneuver. Also used to describe a professional wrestling maneuver.	English + German
プラスアルファ	purasu arufa	plus alpha (ἄλφα) (a	in addition, a little bit more, with something else	English + Greek
デパ地下	depa chika	*de(partment) store) + 地下*	a shopping area, often focused on food and located adjacent to train stations, found in	English + Japanese
ググる	guguru	goog(le) + -ru (Japanese verb	to google	English + Japanese
ハモる	hamoru	harmo(ny) + -ru (Japanese verb	to harmonise (when singing)	English + Japanese
ハンチング帽	hanchingu-bō	hunting + 帽 (bō, hat, cap)	deerstalker cap, hunting cap	English + Japanese
モラトリアム人間	moratoriamu ningen	moratorium + 人間 (ningen	a person who, having completed education and other preparations, delays the transition	English + Japanese
カルピス	karupisu	cal(cium) + सरपिस (sar)pis	Calpis (a milky soft drink)	English + Sanskrit
ポエマー	poemā	*poema* (poem) + -er	a poet	English + Spanish
バスジャック	basu jakku	bus (hi)jack	a bus hijacking (possibly based on the English term "carjack")	English?
アイス, アイスクリーム	aisu, aisu kurīmu	ice/Eis, ice cream	ice; ice cream	English/German
アベック	abekku	*avec* (meaning 'with')	romantic couple	French
アンケート	ankēto	enquête	questionnaire, survey	French
アンニュイ	annyui	ennui	ennui, boredom	French
バカンス	bakansu	vacances	holiday, vacation	French
バリカン	barikan	Bariquand et Marre	hand-operated or electric hair trimmer	French
デッサン	dessan	dessin	line drawing, sketch	French
エステ	esute	esthé(tique)	beauty salon, esthetic clinic	French
コンクール	konkūru	concours	a contest, a competition	French
コント	konto	conte	a short comedy	French
マロン	maron	marron	chestnut, metaphor for brown eyes	French

マゾ	mazo (abbr. "M")	masochiste	masochist	French
オードブル	ōdoburu	hors-d'œuvre	hors-d'œuvre	French
ペンション	penshon	pension	a resort hotel / chalet / cottage	French
ピエロ	piero	pierrot	a clown	French
ピーマン	pīman	piment	sweet bell pepper	French
ポシェット	poshetto	pochette	a small bag	French
プロフィール	purofīru	profil	a profile	French
レジュメ	rejume	résumé	a resume, an outline	French
レストラン	resutoran	restaurant	restaurant	French
ロマン	roman	roman	novel, something that rouses one's dreams / longings	French
ルー	rū	roux	roux, most commonly used in describing the sauce of the popular dish, curry rice	French
ルポ	rupo	repo(rtage)	reportage	French
サド	sado (abbr. "S")	sadiste	sadist	French
ズボン	zubon	*jupon* (meaning "petticoat")	trousers (UK), pants (US)	French
ゼロ	zero	zéro	zero	French / Italian / Latin
サボる	saboru	*sabo(tage)* + *-ru* (Japanese verb	to slack off, to shirk one's duties	French + Japanese
キャンピングカー	kyanpingu kā	camping-car	a recreational vehicle. (A pseudo-anglicism used in France)	French-made English
シュークリーム	shūkurīmu	chou (à la) crème	a cream puff	French, English
アイゼン	aizen	*(Steig)eisen* (meaning	crampons	German
アルバイト or バイト	arubaito or baito	*Arbeit* (meaning 'work')	part-time job	German
ボンベ	bonbe	Bombe	a steel canister for storing pressurised gas, such as a propane tank	German
エネルギッシュ	enerugisshu	energisch	energetic	German
ファンファーレ	fanfāre	Fanfare	a musical fanfare	German
ガーゼ	gāze	Gaze	gauze	German
ゲレンデ	gerende	*Gelände* (meaning 'site;	ski slope	German
ギプス or ギブス	gipusu or gibusu	Gips	cast (*gipusu* also means a plaster cast, while *gibusu* refers to a plastic brace)	German
ヒステリー	hisuterī	Hysterie	loss of (self-)control	German
ホルモン	horumon	Hormon	hormone; also offal when served for yakiniku or hotpot	German
カルテ	karute	Karte	(a patient's) medical record	German
コラーゲン	korāgen	Kollagen	collagen	German
クランケ	kuranke	Kranker	patient	German

メルヘン	meruhen	Märchen	fairy tale	German
ノイローゼ	noirōze	Neurose	neurosis	German
オナニー	onanī	Onanie	masturbation (see Onan)	German
オペ	ope	*OP* (abbr. from ***op****eration*)	surgical operation, minor surgery	German
ピッケル	pikkeru	*(Eis)pickel* (meaning 'ice	ice axe	German
レントゲン	rentogen	*Röntgen*	X-ray, X-ray medical imaging	German
リュックサック	ryukkusakku	Rucksack	backpack, rucksack	German
テーマ	tēma	Thema	theme	German
ヨードチンキ	yōdo chinki	Jodtinktur	tincture of iodine	German
ザイル	zairu	*Seil* (meaning 'rope')	rope (used in a climbing context, in preference to the general term 'rōpu')	German
ゼミナール or ゼミ	zemināru or zemi	Seminar or Semi(nar)	seminar	German
ヨード	yōdo	Jod, Yodo	iodine	German / Spanish
カタルシス	katarushisu	katharsis (κάθαρσις)	catharsis, purification, purgation	Greek
イエス	iesu	Jesus	Jesus	Greek (reconstructed)
エロ	ero	ero(s)	erotic	Greek / English / Spanish
アロワナ	arowana	*arwana* or arowana	a freshwater bony fish of the family Osteoglossidae.	Indonesian
パパ	papa	papà or papá	dad	Italian or Spanish
チューハイ or 酎ハイ	*chūhai*	酎 (shō/chū) + high(ball)	a kind of alcoholic drink from Japan	Japanese + English
*電子レンジ*or レンジ	denshi renji or renji	電子 (denshi, electronic) +	a microwave oven	Japanese + English
カラオケ	Karaoke	空 (kara, empty) + orche(stra)	karaoke	Japanese + English
満タン	mantan	満 (man, full) + tan(k)	full tank (as in the fuel tank of an automobile)	Japanese + English
ペニス	penisu	penis	the penis	Latin
ナトリウム	natoriumu	Natrium	sodium (Na)	Latin via German
マンジャカニ	manjakani	*manjakani* (Aleppo oak)	a species of oak, bearing galls that used for traditional medicine in Asia	Malay
チャンプルー	chanpurū	campur	stir fry dish from Okinawa	Malay or Indonesian
ガタパーチャ	gata pācha	*getah perca* or gutta percha	a hard tough thermoplastic substance which is the coagulated latex of certain Malaysian	Malay via English
ジンギスカン	jingisukan	Genghis Khan	jingisukan (Mongolian-style barbecue with cut lamb and vegetables)	Mongolian
トマト	tomato	tomato	tomato	Nahuatl
ビロード	birōdo	veludo	velvet	Portuguese
ボタン	botan	botão	button	Portuguese
ブランコ	buranko	balanço	a swing	Portuguese

カステラ	kasutera	*(pão de) Castela* (bread from	castella, a kind of sponge cake at festivals and a street food in Japan	Portuguese
コップ	koppu	copo	a glass or tumbler	Portuguese
てんぷら or 天ぷら	tenpura	tempero & têmpora	tempura. Conflation of Portuguese *tempero* ("seasoning") and *têmpora* ("ember days", a	Portuguese
カッパ or 合羽	kappa	capa (de chuva), capa (de lluvia)	(rain) coat	Portuguese / Spanish
カルタ	karuta	carta	karuta (Japanese playing cards)	Portuguese / Spanish
ミイラ or 木乃伊	mīra	*mirra* (myrrh: an oil used in	a mummy	Portuguese / Spanish
パン	pan	pão, pan	bread	Portuguese / Spanish
ビー玉	bīdama	*vi(dro)* (glass) + 玉 (dama, ball)	marbles	Portuguese + Japanese
サラダ	sarada	*salada* or salad	salad	Portuguese or English
イクラ	ikura	икра (*ikra*, meaning 'caviar')	salmon roe	Russian
カチューシャ	kachūsha	Katyusha, a character in the	Alice band: horseshoe-shaped hairband made of metal or plastic (often covered with cloth).	Russian
コンビナート	konbināto	комбинат (*kombinat*,	combine (enterprise)	Russian
ノルマ	noruma	норма (*norma*, meaning	quota, minimum requirement (tasks)	Russian
ペチカ	pechika	печка (*pechka*, meaning 'little	Russian stove	Russian
トーチカ	tōchika	точка (*tochka*, meaning 'point')	bunker	Russian
マンダラ or 曼陀羅	mandara	मण्डल (*mándala*)	mandala	Sanskrit via Chinese
セツナ or 刹那	setsuna	क्षण (*kṣaṇa*)	moment	Sanskrit via Chinese
ゼン or 禅	zen	ध्यान (*dhyāna*)	a meditation	Sanskrit via Chinese
ママ	mama	mamá	mom	Spanish / Portuguese
シャボン玉	shabondama	*xabon* ("soap" in Old Spanish) +	soap bubble	Spanish + Japanese

Appendix J

"Hi Friends" MEXT Guidelines and Lexical Frequency

Notice on the development of "Hi，friends！" New Materials for introducing Foreign Language Activities in Elementary Schools. (MEXT, 2012, January 12)

From, http://www.mext.go.jp/en/news/topics/detail/1372708.htm

From FY2011, the Course of Study for Elementary Schools has been generally implemented by elementary schools nationwide, which introduces foreign language activities once a week to students in the 5th and 6th grades.

The teaching materials "（EIGO NOTO English Notebook）" were developed by MEXT in order to be used for these classes. MEXT has distributed these materials to elementary schools which have requested their use during FY2009 ~ FY2011.

In order to further enhance the content of these English classes, MEXT has developed a new set of teaching materials "Hi, friends！" to be used starting from April 2012.

MEXT will send these materials out to schools nationwide by the end of FY2011.

1. Background on the development of "Hi, friends！"

From 2011, the Course of Study for Elementary Schools, which has been generally implemented, introduces foreign language activities once a week to students in the 5th and 6th grades. At present, the study of foreign languages in elementary school is not regarded as an official subject, hence, no generic textbook exists. In order to provide an equal opportunity for education, to secure a smooth transition from elementary to junior high school, as well as to secure quality standards for foreign language activity classes, MEXT developed the generic teaching materials "EIGO NOTO (English Notebook)" in accordance with the Course of Study for Elementary Schools, and has distributed these materials to schools which have requested their use, during FY2009 ~ FY2011.

In order to further enhance this new curriculum, however, upon consideration of the problems posed by teachers using the "EIGO NOTO (English Notebook)", MEXT has developed a new set of teaching materials, "Hi, friends！", to be used by elementary schools starting from April 2012.

2. Subject grade levels

5th and 6th grade elementary students

3. Contents

Title: “Hi, friends ! ” （Includes “Hi, friends! Part 1” and “Hi, friends! Part 2”）

Form and method of distribution: study materials for students, one booklet per student.

Teaching materials for educators: booklets highlighting the aim of each lesson, phrases to be used, specific points to consider to be distributed to 5th and 6th grade homeroom teachers.

Digital study materials: to be distributed to each

Yearly lesson program, lesson plan, worksheets: To be posted on the MEXT website, and or included in the digital study materials

4. Method and Period of distribution

Study materials for students, teaching materials for educators, digital study materials, will be directly distributed to each school by the end of March 2012. Yearly lesson program, lesson plan, worksheets, will be posted on the MEXT website accordingly between January and March 2012.

MEXT: Corpus of Language: Hi Friends related materials landing page

https://www.mext.go.jp/a_menu/kokusai/gaikokugo/1314837.htm

MEXT Foreign language activities and foreign language training guidebook I
https://www.mext.go.jp/a_menu/kokusai/gaikokugo/__icsFiles/afieldfile/2017/07/07/1387503_1.pdf

MEXT Foreign language activities and foreign language training guidebook II
https://www.mext.go.jp/a_menu/kokusai/gaikokugo/__icsFiles/afieldfile/2017/07/07/1387503_2.pdf

Table-1

Hi Friends-1: Lesson 1-4 Vocabulary From MEXT Foreign Language Activities and Foreign Language Training Guidebook I (p. 33)			
Hi Friends-1	Example	New Vocab and Phrases	Existing Lexis
Lesson-1	Hello. Hi. I'm (Hinata). Goodbye. See you.	hello, hi, friends, I, am, goodbye, see, you	
Lesson-2	How are you? I'm (happy).	how, are，気持ちを表す語（fine, happy, good, sleepy, hungry, tired, sad, great）	Hello. Hi. I'm (Hinata). Goodbye. See you.
Lesson-3	How many (apples)? Ten (apples). Yes. That's right. No. Sorry	many，数（1—20），marble, ball, pencil, eraser, ruler, crayon, apple, strawberry, tomato, circle, triangle, cross, stroke, yes, no, sorry, that, is, right	how, Hello. Hi. I'm (Hinata). Goodbye. See you.
Lesson-3	I like (blue). Do you like (blue)? Yes, I do. / No, I don't. I don't like (blue).	like, do, don't, 色（red, blue, green, yellow, pink, black, white, orange, purple, brown），スポーツ（soccer, tennis, baseball, basketball, dodgeball, swimming），飲食物（ice cream, pudding, milk, orange juice），野菜（onion, green pepper, cucumber, carrot），who, touch, rainbow	Hello. Hi. I'm (Hinata). Goodbye. See you.

The words from columns 1 through 3 are used in the lexis count. The reason 'Lesson' and the number are used is because the writing is visible in the first page of each Lesson, and the teacher explicitly says /レッスン/ (i.e. 'resson' in *romaji*)

The lexis would then be formed using a spreadsheet to count the occurrences related to the lesson number. The resultant lexical data is recorded in Table-2

Table-2

Hi Friends-1: Lesson 1-4 Vocabulary From MEXT Foreign Language Activities and Foreign Language Training Guidebook I (p. 33)

CNT	Lemma	Lsn	Syllabus Position							
8	you	L4	L1	L1	L2	L2	L2	L3	L4	L4
6	How	L3	L2	L2	L2	L3	L3	L3		
6	I	L4	L1	L4	L4	L4	L4	L4		
5	blue	L4	L4	L4	L4	L4	L4			
5	Goodbye	L4	L1	L1	L2	L3	L4			
5	Hello	L4	L1	L1	L2	L3	L4			
5	Hi	L4	L1	L1	L2	L3	L4			
5	I’m	L4	L1	L2	L2	L3	L4			
5	like	L4	L4	L4	L4	L4	L4			
5	See	L4	L1	L1	L2	L3	L4			
4	Hinata	L4	L1	L2	L3	L4				
3	are	L2	L2	L2	L2					
3	do	L4	L4	L4	L4					
3	don’t	L4	L4	L4	L4					
3	many	L3	L3	L3	L3					
3	No	L4	L3	L3	L4					
3	Yes	L4	L3	L3	L4					
2	apples	L3	L3	L3						
2	green	L4	L4	L4						
2	happy	L2	L2	L2						
2	orange	L4	L4	L4						
2	right	L3	L3	L3						
2	sorry	L3	L3	L3						
1	2	L2								
1	3	L3								
1	4	L4								
1	am	L1								

1	ball	L3								
1	baseball	L4								
1	basketball	L4								
1	black	L4								
1	brown	L4								
1	carrot	L4								
1	circle	L3								
1	crayon	L3								
1	cream	L4								
1	cross	L3								
1	cucumber	L4								
1	dodgeball	L4								
1	eraser	L3								
1	fine	L2								
1	friends	L1								
1	good	L2	L1	L2						
1	happy	L2								
1	hungry	L2								
1	ice	L4								
1	is	L3								
1	juice	L4								
1	marble	L3								
1	milk	L4								
1	onion	L4								
1	orange	L4								
1	pencil	L3								
1	pepper	L4								
1	pink	L4								
1	pudding	L4								
1	purple	L4								
1	rainbow	L4								

1	red	L4								
1	ruler	L3								
1	sad	L2								
1	sleepy	L2								
1	soccer	L4								
1	strawberry	L3								
1	stroke	L3								
1	swimming	L4								
1	Ten	L3								
1	tennis	L4								
1	that	L3								
1	That’s	L3								
1	tired	L2								
1	tomato	L3								
1	touch	L4								
1	triangle	L3								
1	white	L4								
1	who	L4								
1	yellow	L4								

Note. This list of frequencies neglects the oral exposure and usage in the classroom. For example, ‘am’ could be used multiple times in any lesson during the input, presentation, practice phases of learning in the sentence “I am <happy, name>.”

Appendix K
Material (Primes)

Appendix-4 relates to the material discussed in Chapter Four. The following sections are related to only the materials used for testing. The links to the “live” presentations are provided in the notes of each illustration.

The response device comprised four tests. On the first page was the picture primes, the second page comprised the space to write the reply to audio primes and orthographic primes. The last page was the ODT and ORT response page (see Figure 4.1).

The rationale behind this order was both cognitive and neurological. Also, this order prevented students having any preconception as to what the response could be, prior to the test. Thereby preserving the at rest state of each student's mind (without orthographic or semantic priming) and reducing the possibility to pre-empt answers or ‘cheat’ the result.

Appendix K-1 - RAN Primes

The following pallet (see Figure 4.2.1) is a complete set of the slates (N = 35, plus 5 title slates) used as primes in the RAN test, grouped in language genre.

1. *Kanji*, 8-Slides
2. Colors, 8-Slides
3. Geometry Items (Shapes and Numerals), 8-Slides
4. Age specific picture primes, 8-Slides
5. Alphabet combination (Audio Slides)

Figure 1

RAN Primes grouped in genre of Kanji, Color, Geometric Items, Age Specific Pictures

Note. This illustration is a pallet of the RAN slates (N = 35, plus 5 title slates) used in the 2020 study into the influence of learning *romaji* before English. To obtain copies of this presentation please contact the author (in the title page). View the presentation here: https://docs.google.com/presentation/d/1rdc-tiF51iVNEQeh8wSWBO5kt4a3-i267hRpVenLnPU/edit?usp=sharing

Appendix K-2 TACHiD Primes

The following pallet (see Figure 4.2.2) is a complete set of the slates (N=14 , plus one title slate) used as primes in the TACHiD test.

1. *Kanji*, 8-Slides
2. Colors, 8-Slides
3. Geometry Items (Shapes and Numerals), 8-Slides
4. Age specific picture primes, 8-Slides

Figure 2

TACHiD in Modulated Complexity, That Is Random Length, Syllable Count, Orthographic Density and Complexity, and Word Familiarity

Note. This illustration is a pallet of the TACHiD test slates (N = 14, plus one title slate) used in the 2020 study into the influence of learning *romaji* before English. To obtain copies of this presentation please contact the author (in the title page). View here: https://docs.google.com/presentation/d/1rdc-tiF51iVNEQeh8wSWBO5kt4a3-i267hRpVenLnPU/edit?usp=sharing

Appendix E-3 ORT Primes

The following pallet (see Figure 4.2.3) is a complete set of the slates (N=18 , plus one title slate) used as primes in the Orthographic Recognition Test (ORT) test.

Figure 3

ORT Primes in Graduated According to Age Specific Word Frequency and Complexity, and Syllable/Mora Complexity

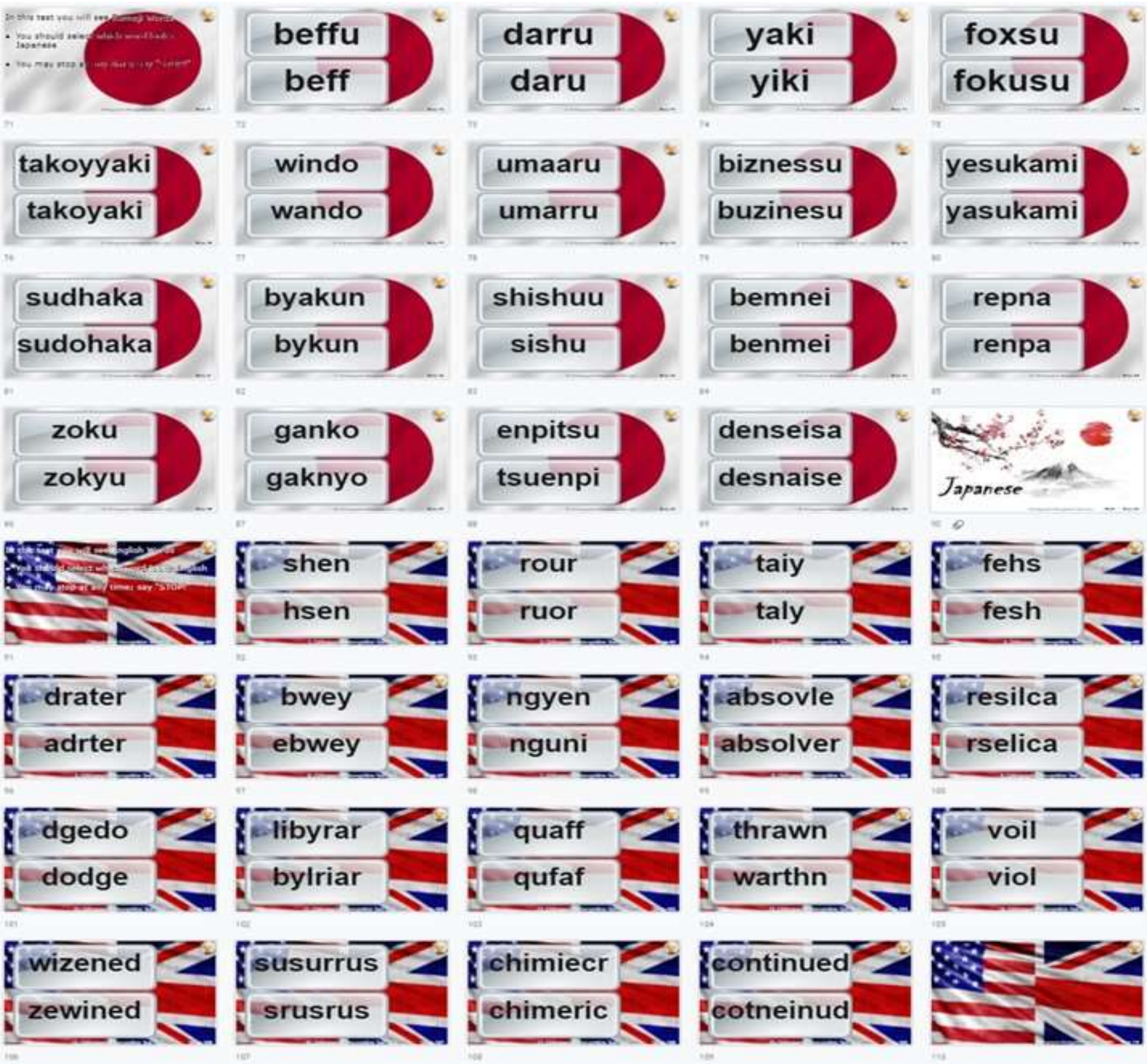
Note. This illustration is a pallet of the TACHiD test slates (N = 14, plus one title slate) used in the 2020 study into the influence of learning *romaji* before English. To obtain copies of this presentation please contact the author (in the title page). View here: https://docs.google.com/presentation/d/1rdc-tiF51iVNEQeh8wSWBO5kt4a3-i267hRpVenLnPU/edit?usp=sharing

Appendix E-4 ODT Japanese and English Primes

The following pallet (see Figure 4.2.4) is a complete set of the slates (N=36 , plus four slates) used as primes in the Orthographic Decision Test (ODT) test.

Figure 4

ODT Primes Graduated According to Age Specific Word Frequency and Orthographic Complexity



Note. This illustration is a pallet of the ODT test slates (n = 18 for Jp and En plus four title slates) used in the 2020 study into the influence of learning *romaji* before English. To obtain copies of this presentation please contact the author (in the title page). View here: https://docs.google.com/presentation/d/1rdc-tiF51iVNEQeh8wSWBO5kt4a3-i267hRpVenLnPU/edit?usp=sharing

Appendix L

Ethics

Ethics Application Approval

USQ

Daniel Dusza <q9221895@umail.usq.edu.au>

[RIMS] USQ HRE Application - H19REA261 - Expedited review outcome - Approved

human.Ethics@usq.edu.au <human.Ethics@usq.edu.au> Thu, Dec 12, 2019 at 12:36 PM
To: Q9221895@umail.usq.edu.au
Cc: Shirley.O'Neill@usq.edu.au

Dear Daniel

I am pleased to confirm your Human Research Ethics (HRE) application has now been reviewed by the University's Expedited Review process. As your research proposal has been deemed to meet the requirements of the National Statement on Ethical Conduct in Human Research (2007),
ethical approval is granted as follows:

USQ HREC ID: H19REA261
Project title: A study of orthographic influence of Romaji on Japanese beginning EFL writing and spelling in Japan
Approval date: 12/12/2019
Expiry date: 12/12/2022
USQ HREC status: Approved

The standard conditions of this approval are:

a) responsibly conduct the project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments made to the proposal;.

(b) advise the University (email:ResearchIntegrity@usq.edu.au) immediately of any complaint pertaining to the conduct of the research or any other issues in relation to the project which may warrant review of the ethical approval of the project;

(c) promptly report any adverse events or unexpected outcomes to the University (email: ResearchIntegrity@usq.edu.au) and take prompt action to deal with any unexpected risks;

(d) make submission for any amendments to the project and obtain approval prior to implementing such changes;

(e) provide a progress 'milestone report' when requested and at least for every year of approval.

(f) provide a final 'milestone report' when the project is complete;

(g) promptly advise the University if the project has been discontinued, using a final 'milestone report'.

The additional conditionals of approval for this project are:

(a) Nil.

Please note that failure to comply with the conditions of this approval or requirements of the Australian Code for the Responsible Conduct of Research, 2018, and the National Statement on Ethical Conduct in Human Research, 2007 may result in withdrawal of approval for the project.
Congratulations on your ethical approval! Wishing you all the best for success!

If you have any questions or concerns, please don't hesitate to make contact with an Ethics Officer.

Kind regards

Human Research Ethics

University of Southern Queensland
Toowoomba – Queensland – 4350 – Australia
Phone: (07) 4631 2690
Email: human.ethics@usq.edu.au

Participant Information and Consent (Parent/Guardian)

University of Southern Queensland

Participant Information for USQ Research Project Questionnaire

Project Details

Title of Project:	**A study of orthographic influence of Romaji on Japanese beginning EFL writing and spelling in Japan**
Human Research Ethics Approval Number:	**19004667**

Research Team Contact Details

Principal Investigator Details

Mr. Daniel Dusza
Japanese / English Contact
Email: Daniel.Dusza@usq.edu.au
Telephone: (8180) 3392 7900
Mobile: (8180) 3392 7900

Supervisor Details

Professor Shirley O'Neill
Official University Contact
Email: Shirley.ONeill@usq.edu.au
Telephone: (617) 3470 4513
Mobile: (614) 0926 4883

Description

This project is part of a Doctoral study.
The purpose of this project is to check how well you can understand romaji and English alphabets.
I hope you will do your best, and enjoy the English games that will be part of this test.

Participation

Your child will play five games. Each game takes only about 5-minutes. The total time will not be more than 30 minutes. We will start the first game soon after you read this instruction sheet and your consent is given by signing the attached consent form or submitting the online consent.

Here are some examples of some typical questions.

Test-1 (Easy)

What is this in Japanese? (Answer: ARI) Can you write it in romaji? (Answer: ari)
What is this in Japanese? (Answer: ARI) Can you write it in romaji? (Answer: ari)

Test-4 (Tricky)
Which word could be Japanese 1. Boru or 2. Boor (Answer: **1. Boru**)
Which word could be English 1. Bolr or 2. Bolor (Answer: **2. Bolor**)

Test-5 (Challenge)
Please read this Japanese word. (Kuruma)
Now say the word without 'ru'. (Kuma) Can you write Kuma? (Answer: kuma)
Please read this English word. (banana)
Now say the word without 'ba'. (nana), and write the word. (Answer: nana)

Decision to Decline or Withdraw

You may decide to stop the test and withdraw your child and consent at any time. You may decide to stop the test at any time. You may also ask for me not to keep your results. If you do, they will be withdrawn and confidentially destroyed. You may withdraw data collected about yourself later by contacting me. The contact details at the top of this form.

Your decision to allow your child to take part, or not to take part, will remain confidential and therefore will not influence your child's school grades or future educational prospects in any way.

Expected Benefits

I expected this test will directly benefit you because of the experience your child will receive by doing the test and being a part of education research. The greatest benefit is you will know that your effort will help make learning English in Japanese schools even better. You will also be given a small gift at the end of the session as a reward for your effort.

Risks

There are no anticipated risks beyond what your child would normally experience during any regular English lesson or playing language games at school or online.

Privacy and Confidentiality

The names of individual persons are not required in any of the responses. You will be asked your age and name to identify who you are, but these responses will not be recorded in any way. All comments and responses will be treated confidentially unless required by law.

Any data collected as a part of this project will be stored securely as per University of Southern Queensland's Research Data Management policy.

Assent to Participate

Clicking on the 'Submit' button at the conclusion of the test is also considered as an indication of your consent to participate in this project. You should sign the written assent form to confirm your agreement to join this project; this paper will be collected before you start the test.

Questions or Further Information about the Project

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

Concerns or Complaints Regarding the Conduct of the Project

If you have any concerns or complaints about the ethical conduct of the project, you may contact the University of Southern Queensland Manager of Research Integrity and Ethics on +61 7 4631 1839 or email researchintegrity@usq.edu.au. The Manager of Research Integrity and Ethics is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for taking the time to help with this research project.
Please keep this sheet for your information.

Page **2** of **2**

University of Southern Queensland

Parental/ Guardian Consent Form for USQ Research Project Questionnaire

Project Details

Title of Project:	**A study of orthographic influence of Romaji on Japanese beginning EFL writing and spelling in Japan**
Human Research Ethics Approval Number:	**19004667**

Research Team Contact Details

Principal Investigator Details

Mr. Daniel Dusza
Japanese / English Contact
Email: Daniel.Dusza@usq.edu.au
Telephone: (8180) 3392 7900
Mobile: (8180) 3392 7900

Supervisor Details

Professor Shirley O'Neill
Official University Contact
Email: Shirley.ONeill@usq.edu.au
Telephone: (617) 3470 4513
Mobile: (614) 0926 4883

Statement of Consent

I have read and understood the information document regarding my child's potential participation in this research project ☐Yes / ☐No

As parent or legal guardian, I give permission to the research team to approach my child

....(name of child) and ask if he/she wishes to participate in

your research project.

Name	
Signature	
Date	

Please return this sheet to a Research Team member.

Page **1** of **1**

Participant Information and Assent (Child Under 18 Years of Age)

University of Southern Queensland

Under 18 years Participant Information for USQ Research Project Questionnaire

Project Details

Title of Project:	**A study of orthographic influence of Romaji on Japanese beginning EFL writing and spelling in Japan**
Human Research Ethics Approval Number:	**19004667**

Research Team Contact Details

Principal Investigator Details
Mr. Daniel Dusza
Japanese / English Contact
Email: Daniel.Dusza@usq.edu.au
Telephone: (8180) 3392 7900
Mobile: (8180) 3392 7900

Supervisor Details
Professor Shirley O'Neill
Official University Contact
Email: Shirley.ONeill@usq.edu.au
Telephone: (617) 3470 4513
Mobile: (614) 0926 4883

Description

This project is part of a Doctoral study.
The purpose of this project is to check how well you can understand romaji and English alphabets.
I hope you will do your best, and enjoy the English games that will be part of this test.

Participation

If you want to participate, you will play five games. Each game only takes about 5-minutes. The total time will not be more than 30 minutes. We will start the first game soon after we read this instruction.

Here are some examples of some typical questions.
Test-1 (Easy)

What is this in Japanese? (Answer: ARI) Can you write it in romaji? (Answer: *ari*)
What is this in Japanese? (Answer: ARI) Can you write it in romaji? (Answer: *ari*)

Test-4 (Tricky)
Which word could be Japanese 1. Boru or 2. Boor (Answer: **1. Boru**)
Which word could be English 1. Bolr or 2. Bolor (Answer: **2. Bolor**)

Test-5 (Challenge)
Please read this Japanese word. (Kuruma)
Now say the word without 'ru'. (Kuma) Can you write Kuma? (Answer: *kuma*)
Please read this English word. (banana)
Now say the word without 'ba'. (nana), and write the word. (Answer: *nana*)

Page **1** of **2**

Decision to Decline or Withdraw

You may decide to stop the test or withdraw at any time, it's OK. You may also ask for me not to keep your results. If you do, they will be withdrawn and confidentially destroyed. You may withdraw data collected about yourself later by contacting me. The contact details at the top of this form.

Your decision to take part, or not to take part will always remain a secret (confidential) and therefore will not influence your school grades in any way.

Expected Benefits

I expected this test will directly benefit you because of the English practice you get, and the experience of being in this research. The greatest benefit is you will know that your effort will help make learning English in Japanese schools even better. You will also be given a small gift at the end of the session as a reward for your effort.

Risks

There are no anticipated risks beyond what your child would normally experience during a normal English lesson or playing language games at school or online.

Privacy and Confidentiality

Your name will not be stored in any of the responses. You will be asked your age and name to identify who you are, but these responses will not be recorded in any way. All comments and responses will be treated confidentially unless required by law.

Any data collected as a part of this project will be stored securely as per University of Southern Queensland's Research Data Management policy.

Assent to Participate

Clicking on the 'Submit' button at the conclusion of the test is also considered as an indication of your consent to participate in this project. You should sign the written assent form to confirm your agreement to join this project; this paper will be collected before you start the test.

Questions or Further Information about the Project

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

Concerns or Complaints Regarding the Conduct of the Project

If you have any concerns or complaints about the ethical conduct of the project, you may contact the University of Southern Queensland Manager of Research Integrity and Ethics on +61 7 4631 1839 or email researchintegrity@usq.edu.au. The Manager of Research Integrity and Ethics is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for taking the time to help with this research project.
Please keep this sheet for your information.

Page **2** of **2**

University of Southern Queensland

Under 18 years Assent Form for USQ Research Project Questionnaire

Project Details

Title of Project:	**A study of orthographic influence of Romaji on Japanese beginning EFL writing and spelling in Japan**
Human Research Ethics Approval Number:	**19004667**

Research Team Contact Details

Principal Investigator Details
Mr. Daniel Dusza
Japanese / English Contact
Email: Daniel.Dusza@usq.edu.au
Telephone: (8180) 3392 7900
Mobile: (8180) 3392 7900

Supervisor Details
Professor Shirley O'Neill
Official University Contact
Email: Shirley.ONeill@usq.edu.au
Telephone: (617) 3470 4513
Mobile: (61) 409264883

Statement of Consent

By signing below, you are indicating that you:

- Have read and understood the information document regarding this project. ☐Yes / ☐No
- Have had any questions answered to your satisfaction. ☐Yes / ☐No
- Understand that if you have any additional questions you can contact the research team. ☐Yes / ☐No
- Understand that any data collected may be used in future research activities, including all future research activities OR only those related to this field]. ☐Yes / ☐No
- Agree to participate in the project. ☐Yes / ☐No

Name	
Signature	
Date	

Please return this sheet to a Research Team member prior to undertaking the questionnaire.

Page 1 of 1

Appendix M

Response Device for Each Test

Appendix M-1 RAN Test Student Response Form

英語とローマ字のクイズ・チャレンジ
(2020-0207 前 5 年 3 組)

	漢字/ ひらがな	色	数字/ 形
1	________________	________________	________________
2	________________	________________	________________
3	________________	________________	________________
4	________________	________________	________________
5	________________	________________	________________
6	________________	________________	________________
7	________________	________________	________________

Appendix M-2 RAN Audio Prime Student Response Form

英語とローマ字のクイズ・チャレンジ
(2020-0207 前 5 年 3 組)

Image source: https://www.mirror.co.uk/news/uk-news/grom-a-phone-record-463176

日本語リスニング (見る／聞く)		英語アルファベット (2 文字　聞く)
1	____________	______ ______
2	____________	______ ______
3	____________	______ ______
4	____________	______ ______
5	____________	______ ______
6	____________	______ ______
7	____________	______ ______

Appendix M-3 TACHiD Test Student Response Device

英語とローマ字のクイズ・チャレンジ

(2020-0207 前 5 年 3 組)

	レベル 1	レベル 2	レベル 3
1			
2			
3			
4			
5			
6			
7			

Appendix M-4 ODT and ORT Student Response Device

英語とローマ字のクイズ・チャレンジ
(2020-0207 前 5 年 3 組)

選びなさい 日本語/英語			日本語に似てる言葉を選びなさい (丸をつけてください)		英語に似てる言葉を選びなさい (丸をつけてください)	
1	日	英	beffu	beff	shen	hsen
2	日	英	darru	daru	rour	ruor
3	日	英	yaki	yiki	taiy	taly
4	日	英	foxsu	fokusu	fehs	fesh
5	日	英	takoyyaki	takoyaki	drater	adrter
6	日	英	windo	wando	bwey	ebwey
7	日	英	umaaru	umarru	ngyen	nguni
8	日	英	biznessu	buzinesu	absovle	absolver
9	日	英	yesukami	yasukami	resilca	rselica
10	日	英	sudhaka	sudohaka	dgedo	dodge
11	日	英	byakun	bykun	libyrar	bylriar
12	日	英	shishuu	sishu	quaff	ffaqu
13	日	英	bemnei	benmei	thrawn	warthn
14	日	英	repna	renpa	voil	viol
15	日	英	zoku	zokyu	wizened	zewined
16	日	英	ganko	gaknyo	susurrus	srusrus
17	日	英	enpitsu	tsuenpi	chimiecr	chimeric
18	日	英	denseisa	desnaise	continue	cotniune

Appendix N

Student Written Response Data

Due to the sheer volume of data, the original data had to be stored online.

Appendix H-1 Student Raw Data

This data includes photos of the original transcripts written by the students accessible through the links and QR Codes provided below.

Fuji view Elementary School - Student Responses

Test-1 Test-2,3,4

Ortho Influ FUMI 20200204-t1.pdf Ortho Influ FUMI 20200204-t2,3,4.pdf

Minami Aakutos Elementary School - Student Responses

Test-1 Test-2,3,4

Ortho Influ MAE 20200207-t1.pdf Ortho Influ FUMI 20200207-t2,3,4.pdf

Appendix H-2 Student Coded Data

Data from response devices were transcribed using a mathematical code, to allow for automated categorisation using spreadsheet analysis programs. This coded data for each set of tests is accessible through QR Codes listed below.

Test-1 RAN

Ortho Influ FU-MA (20200204-07) T1-Read

Test-2 RAN

Ortho Influ FU-MA (20200204-07) T2-Pic/Lis

Test-3 TachiD (300 ms)

Ortho Influ FU-MA (20200204-07) T3-TachiD (300 ms)

Test-4 ODT/ORT

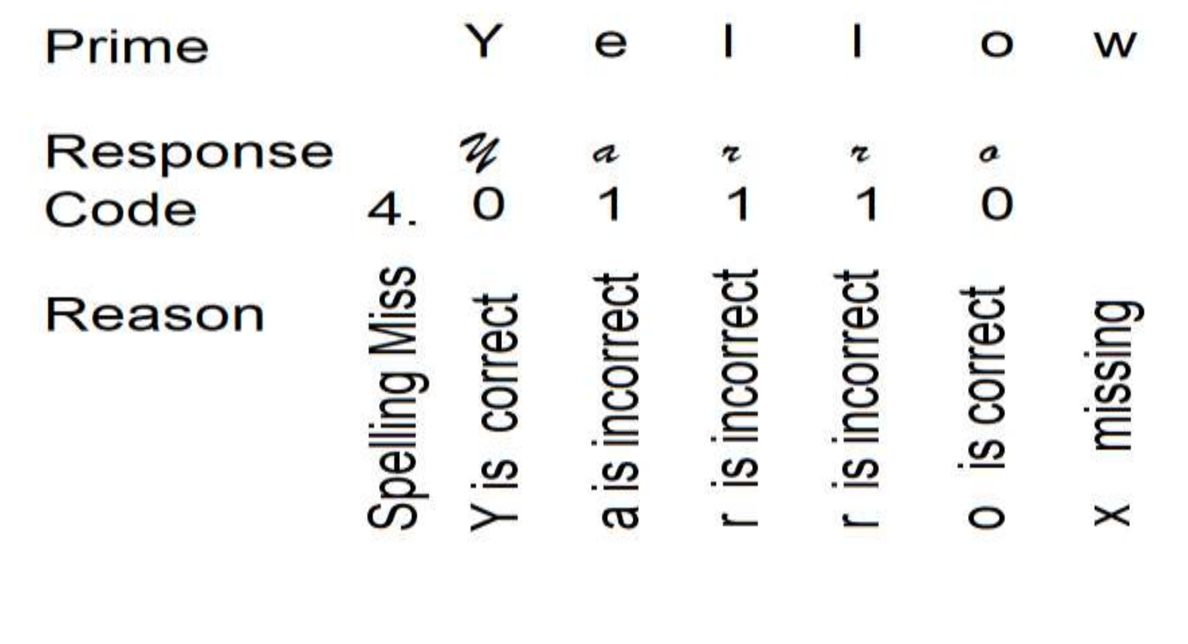
Ortho Influ FU-MA (20200204-07) T4-ODT/ORT

Coding of Student Data

A coding protocol was adopted to facilitate logical manipulation and automated data analysis. The coding protocols are illustrated (see Figure 5.2.1 and Figure 5.2.2) explained below.

Figure 5.2.1

Coding Protocol for Data Entry From Student Raw Data. The Example Prime YELLOW, the Subsequent Response, and the Derivation of the Code Are Indicate



The coding was performed using the following criteria.

Scoring: 0 = No answer, that is, noting was written

1 = Wrote something

2 = Incomprehensible

3 = Wrong answer or spelled wrong

4 = Spell miss, and decimal places indicate the position and type of mistake

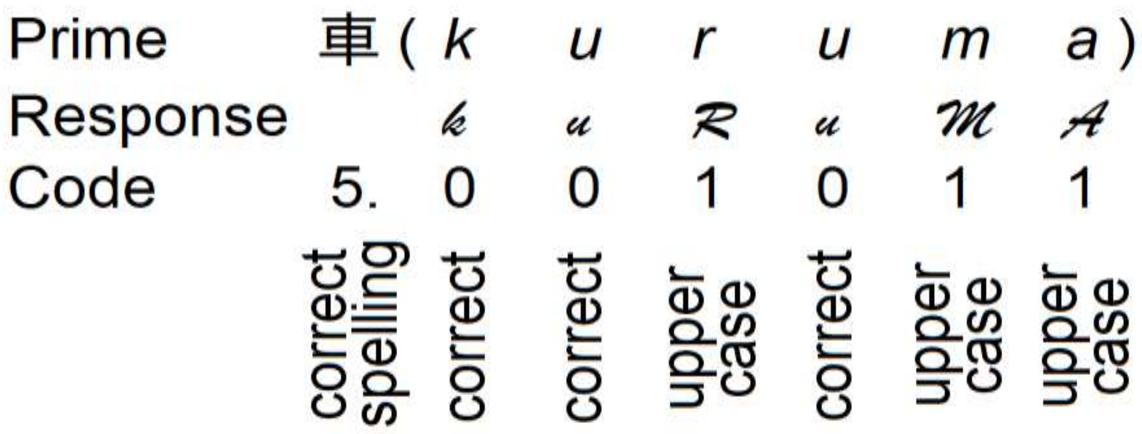
(see Figure 5.2.1. The prime = Yellow. Response = Yarro. The resulting code = 4.01110x, because “Y” is Ok = 0; “e” wrong letter =1; “ll/rr” confusion = 1 a piece; “O” is OK; “w” is missing so “x”.)

5 = Spelling good, but there are Upper/Lower Case Problems (Digits indicate the position of the miss).

(See Figure 5.2.2. The prime kuruma elicited the response kuRuMA. The resulting code = 5.001011, because “ku” is correct = 0; “r” was uppercase “R” so one problem = 1; “u” is ok so, “0”; and so on.)

Figure 5.2.2

Coding Protocol for Data Entry From Student Raw Data. The Example Prime 車 (kuruma) and Subsequent Response (kuRuMA), and the Derivation of the Code are Indicated.



Appendix O
Romaji Surveys

The following unpublished works were compiled by research assistant, Marina Goto (2020). They were compiled to investigate the assumptions and theories presented in the current thesis. This compilation comprises surveys, transcriptions or comments recorded in the field, and notes taken during the analysis of results.

Please cite this work as in the following APA7 citation.

Goto, M. (2020). *Romaji* Surveys: Investigating the practice, testing and use of *romaji* in Japanese schools prior to the introduction of English writing in the fifth grade [Unpublished manuscript]. In D. G. Dusza, *Measuring the orthographic ingluence of romaji on English in Japanese schools prior to 2020* [Unpublished doctoral thesis]. Univesity of Southern Queensland, Toowoomba, Australia.

When & How English/Romaji Is Learned in Primary School in Japan
by Marina Goto

Educational system of Japan

Japanese children begin their primary education at the age of six. They have the opportunity to attend kindergarten or preschool, but this is not compulsory. Kindergartens usually have activities that give word exposure and letter recognition in Japanese (mostly *hiragana*), but the program depends on each kindergarten. Most first graders in Japan enter school with L1 letter or written word awareness.

The Japanese educational system consists of:

- 6-year course of elementary school (6-12 years old)
- 3-year course of junior high school (13-15 years old)
- 3-year course of high school (16-18 years old)
- 4-year (or 2 year) course of university (18-22 years old).

English education - history

Introduction of English education goes back to the Meiji Restoration. As soon as the modern school system was laid down, a foreign language (English) was introduced in some elementary schools. In 1947, the Fundamental Law of Education (or Basic Act on Education) was laid and English became a compulsory subject in junior high school; however, English was removed from elementary schools (伊村元道 『日本の英語教育 200 年』大修館書店, 2003). In 1998, MEXT announced that foreign conversation will be introduced as a part of "comprehensive learning" (国際理解教育「総合的な学習の時間」) from 3rd grade in elementary schools, starting in 2002. Foreign conversation did not necessarily have to be English; it could be any program like going to the paddy field or interacting with foreign people with different languages.

In 2008, MEXT announced that English will be introduced into elementary schools once a week (35 lessons a year) in 5th and 6th grade starting in 2011.

It was decided that (文部科学省 (2008)「小学校学習指導要領解説 外国語活動編」):

- English is not a subject, therefore, English is not to be graded
- Focus on listening and speaking
- Written representations of English, that is, alphabet should be minimum (but exposure to alphabet capital and small letter to support understanding of English sound is allowable) (文部科学省 『小学校学習指導要領解説　外国語活動編』東洋館出版社, 2008, p.19.)
- Aim to foster an attitude to communicate
- Students should become familiar with English sounds and expressions
- Aim to develop communicative competence.

Although it was decided that English will be introduced once a week, 35 lessons a year, each school implemented lessons differently, and most schools were not able to provide enough time for English lessons or consistent English programs.

Current English education

English Education Reform Plan

In 2013, MEXT announced English Education Reform Plan corresponding to Globalization and then in 2014, Five Proposals and Specific Measures for Developing Proficiency in English for International Communication, whose goal is to provide consistent English education from elementary, junior high, and senior high school. Advance incremental implementation started from 2018 and full scale implementation was scheduled from 2020, timed with the 2020 Tokyo Olympics (however, because of Covid-19, full-scale implementation could not be realised).

According to the English Education Reform Plan, MEXT aimed to do the following:

3rd and 4th grade

- Start English education
- English Language Activities classes
- 1-2 times a week (35-70 lessons a year)
- Goal: nurture the foundations for communication skills

5th and 6th grader

- English Language (Subject) classes (105 lessons a year)
- 3 times a week (also utilise module classes)
- Goal: nurture basic English language skills, including reading and writing, which was the first time ever in elementary school

This proposal tries to give a solution to the long-term writing problem and negative attitudes toward English in junior high schools students. Until 2013, many researchers and educators had been criticizing the MEXT's policy on written letters and words in elementary schools. Although curriculum standards do not officially rule out the introduction of letters in elementary schools, it is suggested that writing letters should be carefully introduced not to confuse the students and not to distract their attention to sounds. Many teachers were discouraged from teaching written words.

Criticism for not introducing alphabet letters in elementary schools

The Japanese orthography is extremely transparent, but the English orthography lacks transparency, which becomes a problem for Japanese learners in terms of spelling, reading, and writing. Educators who were in support for early introduction of letters argued:

- Elementary school teachers had to wait until their students became fifth graders to teach letters. However, most students have natural curiosity for written letters earlier than 5th grade and get tired of simple ABC songs or games. Discouraging letter teaching limits students curiosity and potential to learn.
- Students did not learn letters in elementary schools, so first year junior high school students could not read English words without relying on phonetic symbols like *kana* or *romaji* known as furigana (=the name for the phonetic characters often placed above *kanji* to tell the reader the pronunciation).
- Once learners become underachievers, it is very difficult for them to change their situation or negative attitude about their language learning. According to Yamada, Matsuura and Yanase (1988) about one tenth of students become underachievers by the end of the first year of school.
- In addition, students learn *romaji* in the 3rd grade, so they analyse the English word based on *romaji*. By the time they are 5th or 6th graders, they make a habit of reading English based on the Japanese system.

MEXT (2015) Survey of Attitudes Towards English

The survey conducted in 2014 小学校外国語活動実施状況調査 investigated the attitudes of elementary 5th and 6th grades and junior high 7th and 8th students toward English education. It revealed that 70.9% of elementary students have positive attitudes toward English, whereas 61.6% of junior high grade 7 and 50.3% of grade 8 students have positive attitudes toward English.

As for the question, “What do you find helpful in elementary school English classes?”, junior high grade 7th students answered:

- “reading the alphabet (88.8%)
- “writing the alphabet” (83.9%)
- “having simple conversation in English” (82.8%)
- “practicing English pronunciation” (75.8%).

The top four things that junior high school students wanted to practice in elementary school were:

- “writing English words (83.7%)
- “writing English sentences (80.9%)”
- “reading English words (80.1%)
- “reading English sentences” (79.8%).

Some researchers use this survey to defend their support for teaching letters and written words in elementary schools.

English practice in schools

English in junior high schools has a long tradition of grammar-translation methods and explicit Focus on FormS instruction, where the teacher is an authoritative figure. Based on the structural syllabus, teachers usually explain the grammatical points of the lesson using textbooks, and then have students do drills, pattern practices, or repeating the sentences after CDs.

Other activities include:

- Controlled games, often with closed outcome
- role play, skit
- presentations and speeches - some schools limit this to volunteers, but other schools use powerpoint presentations
- group/pair activities -have been increasing

The English ability gap among students has been widening, and it has been a big problem for teachers to adjust the English activities to suit the students’ proficient level. Generally, the teacher tries to make lessons easy to help lower-level learners, so students who go to cram schools and/or English conversation schools are often unsatisfied with the English lessons at school, and as a result they do not participate in lessons.

The recent trend is the more communicative approach with a use of technology, but how much schools incorporate them in their lessons depends on the teachers. In reality, many schools still continue the traditional approach or include tasks and freer communication activities at the end of PPP sequence (Task-supported language teaching).

Some of the problems are:

- Many teachers are too busy

- Teachers do not have experience with communicative approach themselves
- Teachers are not trained and thus do not know how to teach effectively
- Teachers have a negative attitude towards English or their ability to teach English
- Teachers are not familiar with the use of technology

Romaji education - General

Romaji instruction is mandatory in Japanese class (国語の時間) in elementary school, starting in 3rd grade. In 2008, it was decided that children learn *romaji* in the 3rd and 4th grade. According to educational guidelines, the goal of *romaji* learning is to read and write simple, everyday words in *romaji*. It only requires learners to read and write words, not sentences. In fact, elementary schools **only teach nouns which do not contain special sounds**. Schools do not teach verbs or adjectives, which are more complex than nouns.

Currently, *romaji* instruction is only given about **4 hours a year**, including the time to memorise the alphabet letters.

The national achievement test (全国学力テスト) tests students' understanding of *romaji*. It shows that syllabic nasal (撥音「ン」), geminate/a double consonant (促音), and contracted sounds (拗音) have lower accuracy rate.

Misconceptions about *Romaji*

Misconceptions about *romaji* among teachers, students, and their parents include:

- What *romaji* is - Confusion with English. Some children think that *romaji* is the representation of English.
- Why study *romaji* - Many people misunderstand the reasons for studying *romaji* is to foster English learning. They also think that *romaji* fosters *romaji* entry typing and vice versa. *Romaji* and *romaji* entry typing are completely different things. Survey by MEXT (2014) shows that *romaji* knowledge and skill of *romaji* typing entry are not related. For example, elementary school students can only type 5.9 letters of a *kanji*-and-*kana*-mixed sentence in 1 minute.

Why does *Romaji* cause problems?

- There are different types of *romaji*, that is, *Kunreishiki* and *Hebonshiki*. Children learn mostly *Kunreishiki* at school, but *Hebonshiki* is also introduced but only briefly. What children see outside of school is mostly words written in *Hebonshiki*, so they are more familiar with *Hebonshiki*.
- The differences between *Kunreishiki* and *Hebonshiki* are not taught at school. Many teachers do not tell the students the name of *romaji*, *Kunreishiki* or *Hebonshiki*. This is why many Japanese people do not know which *romaji* they learned in elementary school nor do they remember whether they learned *Hebonshiki* in school.
- Teachers do not/cannot explain the exception of *romaji* (often seen in *Hebonshiki*), which students encounter outside school. This is because the exceptions of *romaji* spelling do not follow the *romaji* rule decided by the government. Students are only told that there are different ways to write *romaji*.
- *Hebonshiki* has a rule that *Kunreishiki* does not have. There is no detailed explanation in elementary school textbooks. Teachers do not teach them, and students are not tested.
- Elementary schools teach *romaji* entry typing. Although *romaji* and *romaji* entry typing is completely different, many people believe that they are the same and use *romaji* entry spelling when writing *romaji*. For example, otusan (お父さん), okaasan (お母さん), kuusou（空想）, and mikaduki（三日月）are only accepted in typing.
- When students learn *romaji* typing entry fist, it is difficult for them to learn *romaji* afterwords
- *Romaji* do not have rule on writing 特殊音 or special sounds such as foreign words or Onomatopoeia. Therefore, schools do not teach these special sounds like zyettoki（ジェット機）and hwerî（フェリー）.

Some educators blame the inefficiency and inadequateness of English education for *romaji* transfer on English learning. They argue that *romaji* transfer is natural, so *romaji* instruction should not be blamed. Children are not taught how to read or pronounce English words in an English way, so they emphasise teaching pronunciation.

Rules of *Romaji* Learned in Elementary School

Kunreishiki	*Hebonshiki*
Syllabic nasal sounds（ン） are expressed as “n”. If a vowel or “y” comes after a syllabic nasal sound, use きる印/mark (‘) to divide them. Ex: onsen（温泉）, sinbun（新聞）hon'ya（本屋）	Syllabic nasal sounds（ン） are expressed as “n”. However, a syllabic nasal sounds before “b” “m” “p” should be written as “m”. If a vowel or “y” comes after a syllabic nasal sound, use つなぎ/mark (-) to divide them. Ex: onsen（温泉） shimbun（新聞） hon-ya（本屋）
If there is a geminate/a double consonant （促音「ツ」）, double the next consonant letter. Ex: kitte（切手） zassi（雑誌） itti（一致）	If there is a geminate/a double consonant （促音「ツ」）, double the next consonant letter. However, a geminate sound before “ch” should be written as “t”. Ex: kitte（切手） zasshi（雑誌） itchi （一致）
As for a long vowel or prolonged sound (ー), use 山形/mark (^) on the prolonged vowel sound. Ex: utyû（宇宙） kibô（希望） takusî （タクシー） Tôkyô（東京） Yamada Tarô（山田太郎）	As for a long vowel or prolonged sound (ー), use 山形 or mark (^) on the prolonged vowel sound. Or use マクロン/mark (¯). Ex: uchū（宇宙） kibō（希望） takushī （タクシー） Tōkyō（東京） Yamada Tarō（山田太郎）

***Romaji* - notes**

- Japanese consists of three types of script: *Hiragana*, *katakana*, and *kanji*. *Hiragana* and *katakana* are syllabaries (each symbol is a syllabic unit) while *kanji* are ideographic symbols. Japanese children have to memorise the two syllabaries, with each set made of the basic 46 syllabic units and 61 extensions, before mastering over 2,000.
- The **orthographic depth hypothesis** (Katz & Frost, 1992): easier to learn to read words written in a transparent script than an opaque' script.
- Transparent script: a type of orthography in which phoneme-grapheme mappings are highly consistent (E.g., *kana*). Compared with *kanji* and English, "the regularity of the symbol-sound mappings makes *hiragana* an exceptionally transparent orthography" (Ellis et al., 2004, p. 443).
- Opaque script: a type of orthography that lacks systematic sound-symbol correspondence. Ex: English
- A transparent script like *kana* syllabaries are processed differently than *kanji* characters by NS of Japanese (Kawakami, Hatta, & Kogure, 2001; Sumiyoshi et al., 2004).
- The orthographic distance between L1 and L2 creates a cognitive overload in deciphering L2 lexical items or processing L2 reading materials (Akamatsu, 1999; Fender, 2003; Laufer, 1997; Koda, 1997).
- The similarity in L1 and L2 spelling patterns facilitates word recognition (Muljani, Koda, & Moates, 1998)

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Appendix I-2 Romani Leaning in School

The following is an excerpt of a study by Marina Goto, research assistant to this thesis, in the winter of 2019. The survey included open ended questions. The initial assumption was that most students were not given adequate practice of *romaji*. These assumptions were based on personal observations, and the observations of other foreign and native Japanese teachers. This survey of teachers and parents asked five questions. The responses support the original assumption that students received little to no formal instruction on how to write letters or their connections to phonemes.

Questions <Link>

1. ローマ字は３年生で習うと思うのですが、授業で発音や筆順等の指導などはありましたか？

Did you have any guidance on how to write *romaji* in third grade, e.g., stroke order, or where stems and tails should start and stop?

2. ローマ字のドリルは、主に家庭用でしたか？それとも、授業でもドリルを使ってローマ字を練習する時間がありましたか？

Was the *romaji* drill mainly practiced at home, or did you have time to practice *romaji* in class?

3. 先生はローマ字の間違えをはっきりと直しますか？

Did the teacher clearly correct the mistakes in Roman characters, so that students can make corrections or recognise mistakes.

4. ローマ字のテストはありましたか？

Was there a test for *Romaji*?

5. 昔と比べて、小学校でのローマ字の取り扱いは変わったと思いますか？

Do you think that the handling of *romaji* in elementary school has changed compared to the past?

Answers

1. 神奈川、10 年前、Na さん
    1. あった。
    2. ドリルは使用していないと思う。
    3. 筆順などは直されてないが、それ以外のミスは直された。
    4. 年生のとき、A〜Z・a〜z を順番に書くテストがあった。
    5. No response.
2. Kanagawa, 10 years ago, Mr. N
    1. There was.
    2. I don't think I use drills.
    3. The stroke order has not been corrected, but other mistakes have been corrected.
    4. When I was in 6th grade, there was a test that wrote A to Z and a to z in order.
    5. No response.
3. 2.2.2 千葉県、船橋市、現在、H さん(English teacher）
    1. 6 月からローマ字を習う。ドリルを使い、音・筆順・アルファベットの大文字小文字を学ぶ。英語ではなく国語としてローマ字を学ぶが、授業は「総合の授業」として 20 分をローマ字に使っている。
    2. ドリルは学校で保管していて、授業中にだけ使う。ドリルを宿題に出されたことはない。ドリル学習が終わったら、毎日書く連絡帳にローマ字を使い連絡を書いて練習する。←こちらはかなりハードルが高い

ようで、クラスの全員がきっちり書けているとは思わないが、毎日ローマ字練習ができているので定着に繋がっているように思う。全てをローマ字となると難易度が高いので、先生もチェックが大変だと思うので、クラスによってはやらない先生もいる。

3. ドリルは担任が赤ペンで直す。間違えたものは 書き直しをさせている。
4. テストはしていないが、毎日「帰りの会」の前に、先生が 3 語問題を出し、連絡帳に日本語→ローマ字の練習をしている。
5. 扱いは変わったと思う。数十年前はさらっとやったくらいで、練習を重ねたりはしなかった。なので、中学の最初の中間テストで必死だったように思う。今は、パソコンでローマ字を使わせて、文字入力をさせて練習をしている。個人的には、小学校では訓令式を学び、中学校ではヘボン式を使うので、統一して小学生もヘボン式を中心に学べば、後々混乱が生じないのではないか。

   例えば、a) 小学校の「し→si」と中学校の「し→shi」、b) n のルール、c) 小学校は「てんぷら→tenpura」中学校は「てんぷら→tempura」等。

4. Funabashi City, Chiba, currently Mr. H (English teacher)

1. Learn Roman letters from June. Learn the sound, stroke order, and capitalization of the alphabet using a drill. I study *romaji* as a national language, not English, but the lesson uses 20 minutes for *romaji* as a “general class”.
2. The drill is kept at school and used only during class. I have never given a drill for homework. After drilling is finished, practice using the *romaji* in the contact book you write every day. ← This seems to be a very high hurdle, and I don't think that everyone in the class can write it properly, but I think I can practice *romaji* every day, so it seems to be well established. There are teachers who do not depend on the class because it is difficult to check everything because it is difficult to do everything in Roman letters.
3. The teacher will fix the drill with a red pen. I have rewritten the mistakes.

4. Not tested, but every day before the “Return Meeting”, the teacher gives [sic] a three-word question and practiced Japanese → *romaji* in the contact book.
5. I think the handling has changed. I did it a few decades ago, and I didn't practice. So I think it was desperate for the first intermediate test in junior high school. Now I'm practicing by using a *romaji* on a computer and letting me input characters. Personally, I learn the ceremonies at the elementary school and use the *Hebonshiki* at the junior high school, so **if the elementary school students learn by focusing on the *Hebonshiki* type, there will be no confusion later.**

   For example, a) elementary school “shi → si” and junior high school “shi → shi”, b) n rules, c) elementary school “tempura → tenpura” and junior high school “tempura → tempura”.

5. 神奈川、川崎市、4 年前、Ka さん

1. あった。
2. ドリルはなかったけど、プリントはもらった。
3. 直していた。
4. なかった気がする。
5. 昔は標識とかスポーツ選手の名前表記とか覚えれば十分なレベルだった。今はキーボードを使った学習をしている。ローマ字入力でタイピングの学習までしている。

6. Kanagawa, Kawasaki City, 4 years ago, Mr. K.

1. I did.
2. I didn't have a drill, but I got a print.
3. It was fixed.
4. I feel like I didn't.
5. No response.
6. In the past, it was enough to remember signs and names of athletes. Now I'm learning with the keyboard. I have been learning typing by typing *romaji*.

7. 千葉県、勝浦市、現在、Ku さん

1. 特に発音や筆順等の指導はなく、宿題でローマ字を書くプリントが出された。

2. テキストブックはなく、授業でもプリントを配られて練習するのみ。
3. 特に直さない。
4. テストはなし。
5. No response.

8. Chiba Prefecture, Katsuura City, now Mr. K

1. There was no special instruction on pronunciation or stroke order, and a print of writing Roman letters for homework was given.
2. There are no textbooks, just print out and practice in class.
3. Do not fix.
4. No test.
5. No response.

9. 千葉県、勝浦市、3 年前、M さん

1. 大文字、小文字などの書き方の指導はあるが、発音に関しては、発音というより読み方という感じの指導だった。
2. 国語の授業の中なのでドリルというものはなかった。夏休み中のドリルにローマ字のページが多少入っている程度で、宿題も何回かしかローマ字はやっていない。
3. はい。
4. テストがあったかどうかあまり覚えていないが、小テスト程度のプリントだったと思う。
5. No response.

10. Ms. M, Katsuura City, Chiba Prefecture, 3 years ago

1. Although there is guidance on how to write uppercase and lowercase letters, in terms of pronunciation, it was teaching more like reading than pronunciation.
2. There was no drill because it was in a Japanese language class. There are only a few pages of Roman letters on the drill during the summer vacation, and the homework has been done only a few times.
3. Yes.
4. I don't remember much if there was a test, but I think it was a quiz print.

5. No response.

11. 千葉県、勝浦市、3 年前、Ni さん

1. 3 年生の時は、A〜Z の発音と筆順を習った。
2. 学校の授業だけで、家でやるドリルはない。
3.
4. テストもなかった。
5. No response.

12. Chiba Prefecture, Katsuura City, 3 years ago, Mr. N

1. When I was in 3rd grade, I learned pronunciation and stroke order of A to Z.
2. There are no drills at home, only at school.
3. No response.
4. There was no test.
5. No response.

13. 千葉県、勝浦市、3 年前、Ki さん

1. 日本語の五十音を基準に学び、筆順は習わない。
2. 自分の名前をローマ字で聞いたり、先生が書いた黒板に書いたローマ字を書き写しただけだった。
3. No response.
4. なし。
5. No response.

14. Katsuura City, Chiba Prefecture, 3 years ago, Mr. K

1. I learn based on the Japanese syllabary, and I don't learn the stroke order.
2. I just listened to my name in *romaji*, or just copied the *romaji* written on the blackboard that the teacher wrote.
3. No response.
4. None.
5. No response.

15. 千葉県、蘇我市、50 年前、S さん（English teacher）

1. 文字の名前(エー、ビー、シーetc)だけ習ったが、音は習わなかった。筆順はわからない。
2. ドリルは使ってない
3. No response.
4. あったと思う。
5. 思う。以前は、キーボード入力のためローマ字学習にもっと力をいれていましたが、今はインターネット検索が携帯電話のひらがな入力で済むので、ローマ字は自分の名前が書ければいいくらいで、ローマ字学習を省く、あるいは少しだけ指導するという学校が多いと聞いている。中１最初の前期中間テストも、「次をヘボン式ローマ字に直しなさい。１、東京、２、千葉、３、新聞」などという問題が必出だったが、この数年は見ていない。

16. Chiba Prefecture, Soga City, 50 years ago, Mr. S (English teacher)

1. I learned only the letter names (A, B, C, etc.), but I didn't learn the sound. I don't know the stroke order.
2. I don't use a drill.
3. No response.
4. I think it was.
5. I think. Previously, I had put more effort into learning *romaji* for keyboard input, but now Internet searches can be done only with *hiragana* input on a mobile phone, so *romaji* only has to write my name, omitting *romaji* learning, I have heard that many schools teach a little. In the first half of the first half-term test, the problem of “Please change to the Hebrew *romaji*. 1. Tokyo, 2, Chiba, 3. Newspaper” was necessary, but I have not seen it in the last few years.

17. 千葉県、千葉市、4 年前、Ke さん（English teacher）

1. 国語の時間を使って少し習った程度。とにかく時間に余裕がないので指導は少ない。
2. ローマ字は基本的に日本語の音を現した文字ですので、発音指導はないと思う。ラ行もローマ字では、l(エル) ではなく r で習うので、英語

導入のときに生徒は混乱する。筆順も習うはずだが、漢字ほど重要視されていないと思う。実際、筆順テストはなかったと思う。

3. See below.
4. 授業内の小テストでは、赤で添削してくれていたと思う。
5. 中学１年生の最初の中間テストで、ヘボン式ローマ字の出題は今年もあった。小学生のうちは、ぼんやりと理解しただけで終わる。
小学生のうちはローマ字が書けなくてもそのままにされるが、中学に入るといきなり成績に順位が付く。

18. Chiba Prefecture, Chiba City, 4 years ago, Mr. K (English teacher)

1. I learned a little using Japanese language time. Anyway, **there is little guidance because there is no time**.
2. *Romaji* is basically a character that expresses Japanese sounds, so I don't think there is guidance on pronunciation. La line is also Romanised, and it is learned with r instead of l, so students are confused when introducing English. You should learn the stroke order, but I don't think it is as important as *kanji*. In fact, I think there was no stroke order test.
3. See below.
4. I think that the quiz in the class was corrected in red.
5. In the first intermediate test of the first grade of junior high school, there was a question of Hebron-style Roman letters this year. For elementary school students, it just ends up being understood vaguely. Among elementary school students, even if they cannot write *romaji*, they are left as they are, but when they enter junior high school, their grades are suddenly ranked.

Research Notes

<Source: Transcript 02092020 Comparing Fujimi and Minami Ashigara>

We need to compare the *Romaji* and English results between Fujimi and Minami Ashigara because Fujimi kids were [a] stratified sample, because it was the parents that were interested in this research, and probably had their kids go to juku. Can we find the evidence in the spelling? I think we can. Also, because they [the Fuji Group] have English knowledge, we should have an [sic] evidence of word imageability in

English and in *romaji*, and that will show up in the taki [i.e, the TACHiD] test, real words.

There are a lot of pseudo words in that test, but some words are real. And it will also show up in the fluency of writing like “*ni*" and "*no*" and "*hon*" and maybe "*basu*" because they know they’ve seen those words before. And for that reason, we will choose 5 students from each group. MA group, we can get a lot of students but as many students as I can, analyze their writing speed just for manageability and that is what we use the video for. the other stuff will be for how many words are right. we can compare the groups because Fujimi group maybe they are actually post 2020 which means that they learned *romaji* and English at the same time.

End of Thesis