

HANDBOOK OF
ORTHOGRAPHY
AND LITERACY

EDITED BY
R. MALATESHA JOSHI • P. G. AARON

Handbook of Orthography and Literacy

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Edited by

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Contents

<i>Contributors</i>	ix
<i>Introduction to the Volume</i>	xiii

I: LITERACY ACQUISITION IN DIFFERENT WRITING SYSTEMS

1. Evolution of an Alphabetic Writing System: The Case of Icelandic <i>Jörgen Pind</i>	3
2. Literacy Acquisition in Norwegian <i>Bente E. Hagtvet, Turid Helland, and Solveig-Alma H. Lyster</i>	15
3. Literacy Acquisition in Danish: A Deep Orthography in Cross-Linguistic Light <i>Carsten Elbro</i>	31
4. Children's Language Development and Reading Acquisition in a Highly Transparent Orthography <i>Heikki Lyytinen, Mikko Aro, Leena Holopainen, Matti Leiwo, Paula Lyytinen, and Asko Tolvanen</i>	47
5. Sources of Information Children Use in Learning to Spell: The Case of Finnish Geminates <i>Annukka Lehtonen</i>	63
6. Orthography and Literacy in French <i>Jean-Pierre Jaffré and Michel Fayol</i>	81
7. The Acquisition of Literacy in Italian <i>Remo Job, Francesca Peressotti, and Claudio Mulatti</i>	105
8. Reading and Spelling Acquisition and Dyslexia in German <i>Karin Landerl and Verena Thaler</i>	121
9. Double Dutch: The Dutch Spelling System and Learning to Spell in Dutch <i>Anna M. T. Bosman, Saskia de Graaff, and Martine A. R. Gijssel</i>	135
10. Literacy Acquisition in Spanish <i>Javier S. Sainz</i>	151
11. Beginning Reading Acquisition in Brazilian Portuguese <i>Cláudia Cardoso-Martins</i>	171
12. Literacy Acquisition in Greek: Research Review of the Role of Phonological and Cognitive Factors <i>Costas D. Porpodas</i>	189
13. The Acquisition of Written Morphology in Greek <i>Terezinha Nunes, Athanasios Aidinis, and Peter Bryant</i>	201
14. How Language Characteristics Influence Turkish Literacy Development <i>Aydın Yücesan Durgunoğlu</i>	219

15.	Literacy Acquisition and Dyslexia in Hungarian <i>Valéria Csépe</i>	231
16.	Developmental Dyslexia: Evidence from Polish <i>Agnieszka A. Reid</i>	249
17.	Word Reading in Bulgarian Children and Adults <i>Armina Janyan and Elena Andonova</i>	275
18.	Early Phonological Skill as a Predictor of Reading Acquisition in Latvian <i>Ieva Sprugevica, Ingrida Paunina, and Torleiv Høien</i>	291
19.	If John Were Ivan, Would He Fail in Reading? <i>Elena L. Grigorenko</i>	303
20.	Reading in Arabic Orthography: Characteristics, Research Findings, and Assessment <i>Salim Abu-Rabia and Haitham Taha</i>	321
21.	Hebrew Orthography and Literacy <i>Dorit Ravid</i>	339
22.	Persian Orthography and Its Relation to Literacy <i>Bahman Baluch</i>	365
23.	Literacy Acquisition in Korean Hangul: Investigating the Perceptual and Phonological Processing of Good and Poor Readers <i>Jeesun Kim and Chris Davis</i>	377
24.	The Kagunita of Kannada—Learning to Read and Write an Indian Alphasyllabary <i>Prathibha Karanth</i>	389
25.	Literacy in Kiswahili <i>Katie J. Alcock</i>	405
26.	Reading Chinese <i>Him Cheung, Catherine McBride-Chang, and Bonnie Wing-Yin Chow</i>	421

II: LITERACY ACQUISITION FROM CROSS-LINGUISTIC PERSPECTIVES

27.	Theoretical Framework for Beginning Reading in Different Orthographies <i>Philip H. K. Seymour</i>	441
28.	Orthography, Phonology, and Reading Development: A Cross-Linguistic Perspective <i>Usha Goswami</i>	463
29.	Literacy Acquisition in Japanese–English Bilinguals <i>Nobuhiko Akamatsu</i>	481
30.	Learning to Spell in Different Languages: How Orthographic Variables Might Affect Early Literacy <i>Marketa Caravolas</i>	497
31.	Reading Acquisition in Different Orthographies: Evidence from Direct Comparisons <i>Karin Landerl</i>	513
32.	Learning to Read: The Effect of Orthography <i>Mikko Aro</i>	531
33.	Learning to Spell From Print and Learning to Spell From Speech: A Study of Spelling of Children Who Speak Tamil, a Dravidian Language <i>P. G. Aaron and R. Malatesha Joshi</i>	551

- 34.** Learning to Spell by Ear and by Eye: A Cross-Linguistic Comparison **569**
*R. Malatesha Joshi, Torleiv Høien, Xiwu Feng, Rajni Chengappa, and
 Regina Boulware-Gooden*

III: LITERACY ACQUISITION: INSTRUCTIONAL PERSPECTIVES

- 35.** Knowledge About Letters as a Foundation for Reading and Spelling **581**
Rebecca Treiman
- 36.** Morphology and Spelling: What Have Morphemes to Do With Spelling? **601**
Peter Bryant, Hélène Deacon, and Terezinha Nunes
- 37.** Metalinguistic Abilities, Phonological Recoding Skill, and the Use of Context
 in Beginning Reading Development: A Longitudinal Study **617**
William E. Tunmer and James W. Chapman
- 38.** The Case for Teaching Phonemic Awareness and Simple Phonics to
 Preschoolers **637**
Thomas Nicholson and Giok Lian Ng
- 39.** Alphabetic Instruction Helps Students Learn to Read **649**
Linnea C. Ehri
- 40.** The Effectiveness of Synthetic Phonics Teaching in Developing Reading and
 Spelling Skills in English-Speaking Boys and Girls **679**
Rhona S. Johnston and Joyce E. Watson
- 41.** Genetic?? and Environmental Influences on the Development of Reading and
 Related Cognitive Skills **693**
Richard K. Olson
- 42.** Maternal Mediation in a Young Child's Writing Activity: A Sociocultural
 Perspective **709**
Dorit Aram, Ofra Korat, and Iris Levin
- 43.** Foundations for Studying Basic Processes in Reading **735**
Richard L. Venezky

- Author Index* **759**
Subject Index **775**

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Introduction to the Volume

Until about two decades ago, the study of writing systems and its relationship to literacy acquisition has been generally modeled after studies of the English language. It was also tacitly believed, if not overtly stated, that what is true of English is also true of other writing systems. During the past 20 years or so, information technology has boomed with incredible rapidity and made the mastery of literacy skills an inevitable requirement. Reading and writing have therefore become a necessity for survival, and literacy and literacy acquisition have taken the center stage in psychological, educational, and linguistic studies. Furthermore, computerization of the world has interconnected cognitive psychologists, linguists, and educators, which has enabled them to communicate with each other with ease. A combination of these events has aroused researchers with different language backgrounds from different countries to examine the connection between their writing systems and literacy acquisition. The present volume is an assemblage of such research work undertaken in different languages by experts who are researchers in the field of literacy and who are also native speakers of the language they describe in their respective chapters. This volume contains the names of 70 such researchers and scholars, and we thank them collectively for their time and effort. A close reading of this volume will show that theirs is a superb and lasting contribution to the field of literacy studies.

Most of the information presented in these chapters was delivered at the Advanced Study Institute on Orthography and Literacy in Il Ciocco, Italy, during November of 2002. The conference was sponsored and supported by the Scientific Affairs Division of the North Atlantic Treaty Organization. We are grateful for their support.

At this point, it will be helpful to introduce some of the terms that the reader will encounter in this volume.

Writing system: Written language described in terms of linguistic units; for example, morphemic writing (Chinese), syllabic writing (Japanese Kana), alphabetic-syllabic system (Kannada and Tamil), and alphabetic writing (Italian and Spanish).

Orthography: Visual representation of language as conditioned by phonological, syntactic, morphological, and semantic features of the language. Examples of orthographies are Chinese orthography and English orthography.

Script: The graphic format in which writing is represented. Examples are Roman script and Arabic script.

The writing systems described in this volume range from Finnish, which has an almost one-to-one grapheme-phoneme correspondence to that of English, which is described often as having the most inconsistent grapheme-phoneme relationship. In other words, these writing systems vary widely in their orthographic depth. The question then arises whether the nature of orthography has an effect on the ease with which children learn to read and write. If so, it is legitimate to ask whether the research findings that come from the study of the English writing system can be applied to other orthographies as well.

Studies reported in this volume make it clear that what is true of acquisition of literacy skills in English need not be true of all orthographies. These findings provide general support to the

orthographic-depth hypotheses, which indicate that the degree of correspondence between orthography and the phonology of the written word is one of the many factors that has an influence on the rate at which literacy skills are acquired.

The chapters in this Volume are grouped into three parts. Part I deals with the acquisition of literacy in different writing systems. The research reported in Part II includes chapters that make direct comparisons of literacy acquisition in English and other orthographic systems. The chapters included in Part III are more pragmatic in nature in the sense that they explore literacy acquisition from developmental and instructional perspectives.

The relationship between orthography and literacy is addressed either directly or indirectly by almost every one of the 27 chapters contained in Part I of the volume. More important, these authors give brief sketches of the nature of the orthographic system they have studied. A total of 25 orthographies are described. This part of the volume serves as a handy reference source for knowing about the orthographies of languages such as Icelandic, Kannada, and Kishwahili.

The eight chapters included in Part II of the volume address this question by a direct comparison of the acquisition of reading skills by children who speak different languages. The overall conclusion that emerges from these studies is that orthographic depth does have an influence on literacy acquisition, primarily by slowing down the rate of acquisition of reading skills. However, eventually, most children who have to contend with deep orthographies such as English become normal readers, albeit slowly. Most, but not all. Even though deep orthography may exacerbate reading problems encountered by potentially weak readers of an orthography such as English, even some children who learn shallow orthographies remain poor readers, primarily because they are slow readers. Thus it appears that dyslexia is not an “orthography-limited” symptom, but also has an internal cognitive, biological, and genetic component.

The seven chapters in Part III deal with the pragmatic issues of literacy acquisition such as instructional strategies for promoting reading and spelling skills. This section ends with a look into the future of literacy research.

We thank Lane Akers and Paul Smolenski of Lawrence Erlbaum Associates and Susan Detwiler and Peggy Rote of TechBooks, as well as Emily Ocker-Dean and Mary Ghong, doctoral students at Texas A & M University, for their help at various stages of preparing the volume.

—R. M. Joshi

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I

Literacy Acquisition in Different Writing Systems

1

Evolution of an Alphabetic Writing System: The Case of Icelandic

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Iceland has a literary tradition reaching back for almost a millennium, with the earliest written Icelandic documents dating from the 11th century. During the 13th and 14th centuries numerous important literary works—sagas, poetry, histories—were produced. In the 12th century an alphabet was created for Icelandic in an important treatise, commonly termed the *First Grammatical Treatise*, written by an unknown author. The treatise elaborates on the letters needed for showing the phonemic distinctions of the language; it also shows a realization of the fact that numerous other considerations apply in writing than purely phonemic ones. The current Icelandic orthography has been gradually shaped over the past centuries, with the latest changes being introduced in 1973–1974. Establishing the current Icelandic system of writing has involved a struggle between two opposing viewpoints, one viewpoint arguing for the necessity of being true to the origins of words and the long tradition of writing, the other wanting to move the writing closer to pronunciation. The most recent changes introduced were, though, primarily motivated by educational concerns. The current Icelandic orthography is a compromise between these different viewpoints. The result is a writing system that is relatively transparent for the reader but rather difficult for the speller.

INTRODUCTION

In this chapter I give an outline of the history of the Icelandic writing system and briefly discuss some aspects of literacy in Iceland. Two factors make the Icelandic case somewhat unique. First, the Icelandic language is quite conservative and has remained relatively stable in its morphology and syntax, though the phonology has undergone considerable changes. Because of this conservatism, Icelanders can still read the literature of the earlier centuries. Second, of considerable interest is the fact that there exists an important document from the earliest period of Icelandic writing called the *First Grammatical Treatise* (FGT). In this work the author, who remains unknown, describes in great detail his considerations when applying the Latin alphabet

to the Icelandic vernacular. No other comparable description exists from such an early period for what must have been a quite common undertaking. Indeed, it is only in the 20th century that similar considerations have been explicitly given to the principles for reducing speech to writing. The Icelandic orthography has undergone considerable changes from medieval times, and intense debates about spelling reforms have characterized this evolutionary process. The final reforms were undertaken as late as 1974. It is clear that the current orthography reflects numerous, partly irreconcilable, views about the optimal way to write a living language with a long literary past.

THE ORIGINS OF ICELANDIC WRITING

Writing in Iceland has a history spanning almost a millennium. The country was settled about 870 C.E., mainly by Norse Vikings. The country was converted to Christianity in the year 1000 and presumably writing was introduced at that time, at least in Latin.

Writing in the vernacular in Icelandic is commonly considered to have originated in the first decades of the 12th century. *The Book of Icelanders*, written by Ari Thorgilsson the Learned in the years 1122–1133, describes how, at the session of the parliament in the summer of 1117, a resolution was passed

...that our law should be written in a book at Haflíði Másson's during the following winter according to his dictation and council, and that of Bergþórr [the Law-Speaker], and of other wise men who were selected for the task. They were to make new provisions in the law whenever they considered such to be better than the old ones. The laws were to be recited the next summer in the legislature, and all those to be kept that were not opposed by the majority (Benediktsson, 1965, p. 13).

The resulting work—Haflíði's scroll, now unfortunately lost—is generally thought to mark the beginning of writing in the Icelandic vernacular. The earliest extant manuscripts are considerably younger, most dating from after 1250 (Benediktsson, 1965). The previously mentioned *Book of Icelanders* by Ari Thorgilsson is preserved in manuscripts from the 13th and 14th centuries.

One of the earliest of Icelandic documents is the FGT, written by an unknown author, probably in the period 1125–1175 (Benediktsson, 1972; Haugen, 1972; Holtsmark, 1936). The treatise derives its name from the fact that it is the first of four grammatical works in the 14th-century manuscript *Codex Wormianus*, which is kept in the Arnarnagnæan collection in the University of Copenhagen (AM 242 fol.). This is one of the principal manuscripts of the *Edda* of Snorri Sturluson (1179–1241), a handbook of poetics and Norse mythology. Although numerous manuscripts of the *Edda* exist, this is the only extant copy of the FGT.

The unknown author of the FGT is commonly called the First Grammarian (FG), a custom that is followed here. (I also follow custom in referring to the FG in the masculine.)

The FGT is a classic work of linguistics because it describes in great detail the considerations that need to be taken into account when an already existing alphabet is applied to a new language. In the case of the FG this involved adapting the Latin alphabet for the Icelandic language. In doing this the FG describes the main features of phonemic analysis in terms strikingly similar to those used by the Prague linguistic circle and others in the 20th century (Anderson, 1985). In particular, the FG shows a deep understanding of the importance of establishing those speech sounds that have a distinctive function in the language, as these need to be depicted with their own letters.

The treatise starts out as follows (all quotations are from the translation by Haugen, 1972):

In most countries men put into books either the great events that have come to pass within their country, or whatever seems most memorable that has occurred abroad, or men put their laws into books, each people in its own language. But because languages are all unlike one another, ever since they parted and branched off from one and the same language, it is now needful to use different letters in writing them, and not the same for all.

Whatever language one has to write with the letters of another language, some letters will be lacking, because there are sounds in the language for which the other language has no letters, and some letters may be taken out. . . . And yet Englishmen write English with Latin letters, as many as can be rightly pronounced in English, but where these no longer suffice, they add other letters, as many and of such a nature as are needed, taking out those that cannot be rightly pronounced in their language.

Now according to their example, since we are of the same tongue, although there has been much change in one of them or some in both, I have written an alphabet for us Icelanders also, in order that it might become easier to write and read, as is now customary in this country as well, laws, genealogies, or sacred writings, and also that historical lore which Ari Thorgilsson has recorded in his books with such understanding and wit. I have used all the Latin letters that seemed to fit our language well and could be rightly pronounced, as well as some other letters that seemed needful to me, while those were taken out that did not suit the sounds of our language. Some of the consonants of the Latin alphabet were rejected, and some new ones added. No vowels were rejected, but a good many were added, since our language has the greatest number of vowel sounds (p. 13).

The FG then discusses in turn the vowels and consonants needed for writing in Icelandic, starting his discussion with the vowels. To the five vowels of Latin, *a*, *e*, *i*, *o*, and *u*, “I have added these four that are here written: *ø*, *ē*, *ø*, *y*.” He then explains the shapes of the vowels by referring to their pronunciation, saying of the letter *ē*, for example, that it “is written with the loop of *a* but with the full shape of *e*, since it is a blending of the two, spoken with the mouth less open than for *a*, but more open than for *e*” (p. 15) and similarly for the other vowel symbols.

In the treatise the FG introduces an imaginary opponent, in good scholastic fashion, to argue with him the merits or otherwise of his suggestions:

Now it may well happen that some one will respond in this way. “I can read the . . . language perfectly well, even though it be written with the regular Latin letters. I can make out how to pronounce it, even when some of the letters in what I read are not correctly pronounced To that I say: It is not the virtue of the letters that enables you to read and to make out the pronunciation where the letters are unclear. That is rather your virtue, and it is not to be expected that I also . . . shall be able to read well and to make out which path to take where more than one course is possible because it is written one way, but not clearly determined, and one then has to guess, as you claim you can do so well. But even though every one could make something out of it, it is practically certain that everyone will not arrive at the same result when the meaning is thereby changed, particularly in the laws (p. 15).

To further drive home the necessity of having nine vowel symbols in the orthography, the FG also sets up minimal pairs for eight of them (excepting the vowel *i*), illustrating them with made-up sentences:

Now I shall take these eight [vowel] letters and place each of them in turn between the same two consonants, and I shall show by examples how each of them . . . makes a different sense, and in this way give examples throughout this little book of the most delicate distinctions that are made between the letters: *sar*, *sør*; *ser*, *sēr*; *sor*, *sør*; *sur*, *syr*.

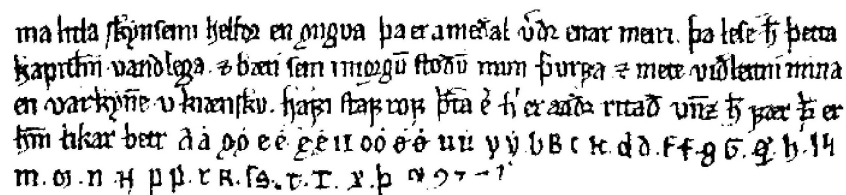
A man inflicted a *wound* (sar) on me; I inflicted many *wounds* (sǫr) on him. The priest *swore* (sor) the *fair* (sǫr) oaths only. (p. 17)

After having thus established the necessity of the nine vowel symbols in this manner, the FG also argues for the necessity of adding two more distinctions to the set of vowels, again illustrating the need for this by an analysis of minimal pairs. These are, first, the feature of nasality in which “each one of these nine letters will bring forth a new one if it is spoken in the nose (p. 17).” This the FG marks by putting a dot over the vowel letter. Add to this that “it is well known that there is another distinction in the vowels, both in those that were in the alphabet before, and in the new ones that have been added [i.e. the nasal vowels]. This is a distinction which changes the meaning, according to whether the letter is long or short (p. 17).” This distinction, the FG proposes to mark with a stroke. So this makes for an inventory of 36 vowel symbols in all! Again these distinctions are carefully documented by the use of minimal pairs of the sort shown earlier.

The analysis of the FG is highly sophisticated, as are the arguments brought forth to support it. It is clear that he has a precise understanding of the importance of distinction in the phonological system for which he uses a specific term, *grein*. His manner of establishing the necessary distinctions is of course the same as the method of substitution introduced by the structural linguists of the 20th century. A change of the vowel sound in a word will *skipta máli*, change the discourse, and thus it is also necessary to change the vowel symbol.

The FG uses a similar approach with the consonants, but details are not given of his treatment of them here (the details can be found in the excellent monographs by Benediktsson, 1972, and Haugen, 1972). The FG’s treatment of the consonants are of interest because they show well his education in classical Latin grammar (as shown most clearly by Holtsmark, 1936). In classical grammar the letter was conceived of very differently from what is now customary. In his *Ars Maior*, Donatus gives the following definition of the letter: *Littera est pars minima vocis articulatae* [the letter is the minimal part of speech]. This understanding, moving between speech and writing, survived for a long time, as shown by Abercrombie (1949). The FG adheres to the classical conception according to which each letter has three attributes, its name (*nomen*; *nafn* in the FGT), its shape (*figura*; *líkneski* or *vöxtur* in the FGT), and pronunciation (*potestas*; *jartein* or *atkvæði* in the FGT). The vowels pose no particular problem in this respect for the scholastically minded FG. However, for the consonants, things are a bit more difficult. For one thing, a vowel names itself but this is not so for the consonants, explaining the long discussion in the FGT on the correct manner of naming the consonants. Consonants need an adjacent vowel to make up their name, and their pronunciation is also often difficult to ascertain because “the sound of a consonant . . . is not easy to distinguish, for it is short and closely blended or grown together with the vowel with which it is combined (p. 21).” In modern terminology we would say that consonants are coarticulated with the adjacent vowels (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). However, in general, the FG finds that the Latin consonants do a passably good job of representing the consonants of Icelandic except that they do not distinguish between long and short consonants. He proposes to write the long ones with uppercase letters (e.g., N and R), the short ones with the ordinary lowercase consonant symbols. One symbol added to the Latin consonants is the letter þ (thorn). This letter is part of the Runic alphabet but was probably adopted from Anglo-Saxon by the FG, who uses it to denote both the voiced and voiceless dental fricatives. The voiced one later received its own letter, ð. Both these letters are part of the current Icelandic alphabet (see Fig. 1.1).

The manner in which the FG proceeds suggests that he is proposing a more or less phonetically correct system of spelling for Icelandic. Unfortunately, the manuscript of the FGT dates from the 14th century and bears the mark of the orthography then current (except that



ma lita skiptum helva en gunga þa er meðal vdr enar man. þa lita þi þetta
 kapitlin vandlega. z bæti san inögū stöðv mun þurpa z meæ viðlætti muna
 en varðtne v knætku. hær stæp ror þia è h' er aða ritad vnz h þær þ er
 km tikar bett dā pō eē gē u oō ø ø uu y v b c k d d. f f g g. h. i. l. u
 m. o. n. h. p. p. r. s. t. t. x. p. q. r. s. t. u. v. w. x. y. z.

FIG. 1.1. The end of the FGT in the *Codex Wormianus* illustrating the alphabet for Icelandic as proposed in the Treatise.

in illustrating the use of minimal pairs the scribe is obviously at great pains to remain true to the original; which may, of course, not be the treatise as left by the FG). However, modern commentators (Benediktsson, 1972; Haugen, 1972; Holtsmark, 1936) have expressed doubt as to whether the system of writing proposed by the FG was to be used consistently in the spelling of every word, in effect constituting a phonetic transcription, or whether it was primarily to be employed in those cases in which there was a danger of misunderstanding arising because of homophony. The following remarks from the treatise definitely suggest that the FG is well aware that establishing an alphabet for a language does by no means solve all problems as regards the manner in which individual words should be written:

If I were to write another discourse, which there might be good reason for and plenty of material, if only I had the wits to do it, concerning the letters that make up the nature of each word or the way in which all the letters should be combined,—then that would be an entirely different work and much larger, and so I cannot take up that subject in this one (p. 21).

These remarks suggest that the FG saw the need for a “spelling dictionary” or some similar treatise to illustrate the proper and correct writing of the language.

The alphabet established by the FG forms the core of the present Icelandic alphabet, though changes in the phonology of the language have been considerable, especially as regards the vowel system (Benediktsson, 1959). Nasalization of vowels seems to have disappeared around the time the treatise was written. In the 16th century the quantity system underwent a drastic change so that quantity is no longer free to vary but depends on context. Thus a vowel is short if followed by one or no consonants (with some exceptions); otherwise it is long (Pind, 1986, 1999). The accent mark, which used to denote length, now symbolizes differences in quality (i [i] vs. í [iː]), diphthongs (ó [ou] or á [au]), or even a combination of semivowel and vowel (é [je]). Current Icelandic speech has eight vowels and five diphthongs. Some vowels that were distinguished in the writing of the FG are no longer distinguished in pronunciation (e.g., e and ę; ȳ and ø; i and y).

WRITING BEFORE THE AGE OF PRINTING

The orthography of the medieval Icelandic manuscripts was not standardized, despite the efforts of the FG. According to an authority on early Icelandic writing, the FGT influenced the writings of “most scribes” in the 13th century and, to some extent, also those in the 14th century (Karlsson, 1989). The move to standardize the orthography gained momentum with the advent of printing (the first printed book, the New Testament in an Icelandic translation, dates from 1540) but did not reach its final form until the first decades of the 20th century with some changes being introduced actually as late as 1974.

With the advent of printing, reading materials became much more widely available and the need for a unified spelling became more apparent. Numerous attempts were made to provide a rational and consistent system of spelling. The need for this became widely felt toward the end of the 18th century with the advent of magazines and newspapers and especially at the beginning of the 20th century, when universal schooling was mandated by law. Shortly afterwards, in 1918, the first government regulations for spelling were published; this was supplanted by another regulation in 1929 and a third one in 1973–1974. The last changes led to intense and heated debates even in the Icelandic Parliament.

An early writer on Icelandic orthography and spelling was Jón Ólafsson (1705–1779), secretary to Árni Magnússon (1663–1730), the great collector of Icelandic manuscripts. At the beginning of his essay on spelling Ólafsson notes that spelling can be based on three principles: “1. The method of our predecessors, as found in their ancient books; 2. On the origins of word, and 3. Daily pronunciations as well as the custom of learned men” (Helgason, 1929, p. 81).

This quote nicely illustrates the opposing viewpoints on which spelling can be based, in particular whether to base spelling on the daily pronunciation or on ancient custom, reflecting the “origins of words.” Over the next centuries scholars and writers, and, in the 20th century, politicians too, engaged in fierce debates over the proper way to spell Icelandic, arguing either for a spelling based on pronunciation or one based on adherence to traditional principles. It should not come as a surprise that the latter viewpoint has usually carried great weight, considering how old the Icelandic tradition of writing in fact is. Interestingly, in the last round of spelling reforms, instituted in 1973–1974, yet another viewpoint was given considerable weight, namely educational considerations.

I do not describe in detail the history of Icelandic spelling (a good overview can be found in Jónsson, 1959) but just mention the major steps in this evolutionary history. This history clearly shows that current Icelandic spelling involves a compromise among different principles.

The first major step towards a unified spelling for Icelandic was taken by the famous Danish linguist Rasmus Kristian Rask (1787–1832) who published an Icelandic reading primer in 1830, “for the children of gentlemen,” as it says in the title (R. Rask, 1830). Rask had early become interested in Icelandic and wrote a scholarly treatise on the origins of the Old Icelandic language (R. Rask, 1818), which is one of the founding documents of comparative grammar in the 19th century. Earlier he had written an Icelandic grammar, and later he prepared the first major Icelandic dictionary for publication. Rask was one of the founders of the Icelandic literary society, founded in Copenhagen in 1816, which has played an important part in intellectual affairs in Iceland since. Rask also argued forcefully for spelling reforms in his native Danish (K. Rask, 2002).

Rask’s reading primer had two aims. The first was to establish the use of Latin letterforms for the customary Gothic letterforms that up to that time had mostly been used for printing. The other was to establish a consistent system of spelling. These were ambitious goals for a reading primer, as indeed Rask acknowledges! As far as spelling is concerned, Rask argued for a conservative approach, wanting to base spelling on the model of earlier writing. Thus he kept the i/y distinction, wrote *è* for the earlier long e (now spelled *é* but pronounced [je]), wanted to keep the letter z for those cases in which *ðs*, *ds*, or *ts* were pronounced as [s]. He established the rule, since adhered to consistently in Icelandic spelling, of writing -nn at the end of disyllabic adjectives in their masculine form and -n in their feminine form; thus *iðin kona* [industrious woman] and *iðinn maður* [industrious man]. This distinction is not heard in the pronunciation but makes the spelling consistent with other cases in which the distinction is heard in the pronunciation, for example, *mikil kona* [great woman], *mikill maður* [great man].

In general, Rask wanted his spelling to be faithful to older stages of Icelandic writing and to give morphological considerations their due. However, he did not do this consistently. Thus he did not adopt the custom of distinguishing between *æ* and *œ* (both now pronounced [ai])

to show the different origins of the two vowels, but he stated that it is necessary to keep this distinction in published editions of earlier Icelandic literature.

In 1835 the first volume of the Icelandic literary magazine *Fjölur* by a group of young radical intellectuals was published. One of the principals of the journal was Konráð Gíslason (1808–1891), later to become professor of Old Icelandic at the University of Copenhagen. In the second volume of the magazine Gíslason wrote a long essay on Icelandic spelling and argued forcefully for a phonetically based spelling. This was a radical break with earlier traditions. It involved the abolition, for example, of *y* from the alphabet as well as numerous other changes. One of Gíslason's arguments against the earlier system of spelling was that the advocates of etymologically based spelling were not consistent in their approach, sometimes being faithful to this approach (e.g., in the spelling of *i/y*, in other cases not, e.g., *æ/œ*).

In 1850 Halldór Kr. Friðriksson (1819–1902), who was a teacher of the Icelandic language at the Reykjavík grammar school for almost 50 years, published a book on spelling, an exhaustive treatise, in which he carefully argued for an etymologically based spelling. This may be seen as a direct response to the attempted spelling reforms of Gíslason. Friðriksson's spelling became known as the "school spelling" as it was taught at the Reykjavík grammar school for a long period. It was much more archaic than the spelling of Rask because it introduced items such as the *æ/œ* distinction that otherwise had not been in common use in Icelandic spelling.

Another attempt to move spelling closer to pronunciation was proposed by Björn M. Ólsen (1850–1919), who succeeded Friðriksson as teacher of Icelandic at the Reykjavík grammar school. Ólsen was an outstanding linguist and later became the first rector of the University of Iceland when it was founded in 1911. Ólsen based his arguments on the needs for spelling reforms primarily on educational considerations. He (Ólsen, 1889) cataloged the spelling errors found in essays written by students entering or graduating from the Reykjavík grammar school. Ólsen analyzed 200 essays by pupils entering and the same number of essays from those graduating from the school. In the former set of essays Ólsen counted 1,008 errors in all (based on Friðriksson's rules for spelling) but 300 errors in the essays of the graduating students (and this in spite of the fact that these were considerably longer). The major categories of errors involved *i/y*, *s/z*, and *-nn/-n*. Table 1.1 shows the proportion of errors as regards these categories.

From these data Ólsen drew the conclusion that the letters *y* and *z* should be abolished from the Icelandic alphabet because they posed unnecessary difficulties for the speller and did not serve a useful orthographic purpose.

Icelandic spelling was finally standardized by government decree in 1918 in response to the introduction of mandated schooling. This spelling did in fact abolish *z* from the spelling, but it was reintroduced in another regulation in 1929. It was finally abolished in the final reform

TABLE 1.1
Three Classes of Spelling Errors (Expressed as a Percentage of All Errors)

Type of Error	Entering Class (%)	Graduating Class (%)
<i>i/y</i>	20.2	27.7
<i>s/z</i>	7.6	22
<i>-nn/-n</i>	9.1	8.7

Note: From essays written by entering and graduating students at the Reykjavík grammar school near the end of the 19th century (Ólsen, 1889).

undertaken in 1973–1974. This reform met with fierce opposition, and the Icelandic Parliament passed a resolution to the effect that these reforms should be rescinded. However, the reforms had the support of all the teachers' unions in the country as well as that of the professor of modern Icelandic grammar at the university, and thus the Ministry of Education refused to comply with the wishes of the parliament.

LITERACY IN ICELAND

The extensive vernacular literature of the medieval period points to widespread literacy, or at least literacy that was not confined to the clergy, as many of the major manuscripts were made at the order of wealthy farmers. However, literacy figures are hard to come by so nothing definite can be said on this score. It is certainly an exaggeration to claim, as scholars of a romantic persuasion in earlier times did, that the whole population was literate. Evidence can be had from a much later time, from figures of literacy gathered in the 18th century, admittedly a difficult period in the history of the country. As illustrated in Fig. 1.2, from the data from the south of Iceland, literacy is growing in the period up to the middle of the century (ability to read became a prerequisite for confirmation in 1746). Interestingly, from the same data, an early indication of the effect of “print exposure” on literacy can be seen in Fig. 1.3. This figure shows that illiteracy is 100% in household with no books, falling to 0% in households owning 20 or more books!

After universal—or near universal—literacy became the norm at the beginning of the 20th century, the view became widely accepted that learning to read in Icelandic was not a difficult task, though learning to spell might be quite difficult. This view was reflected in the remark

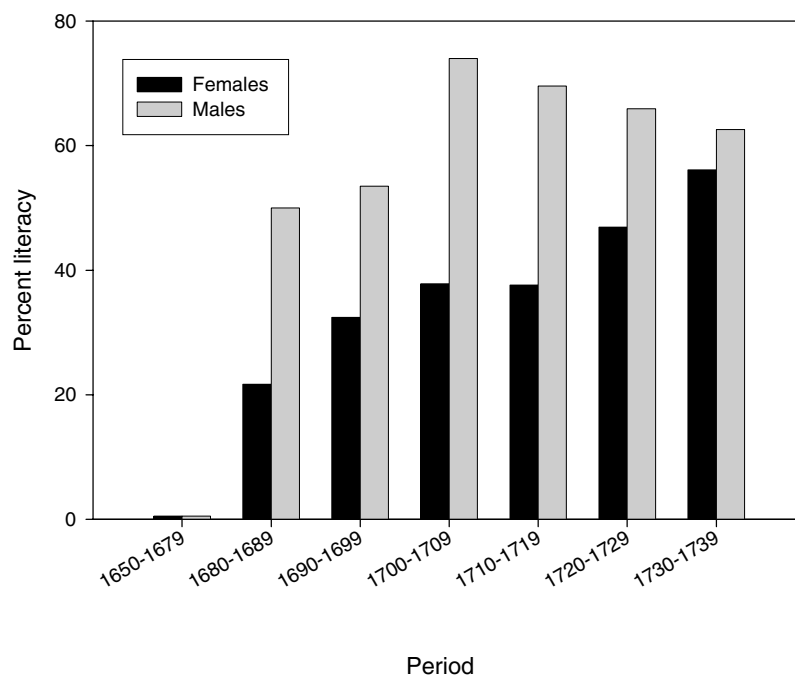


FIG. 1.2. The growth of literacy in Iceland according to church registers from the south of Iceland (Guttormsson, 1989).

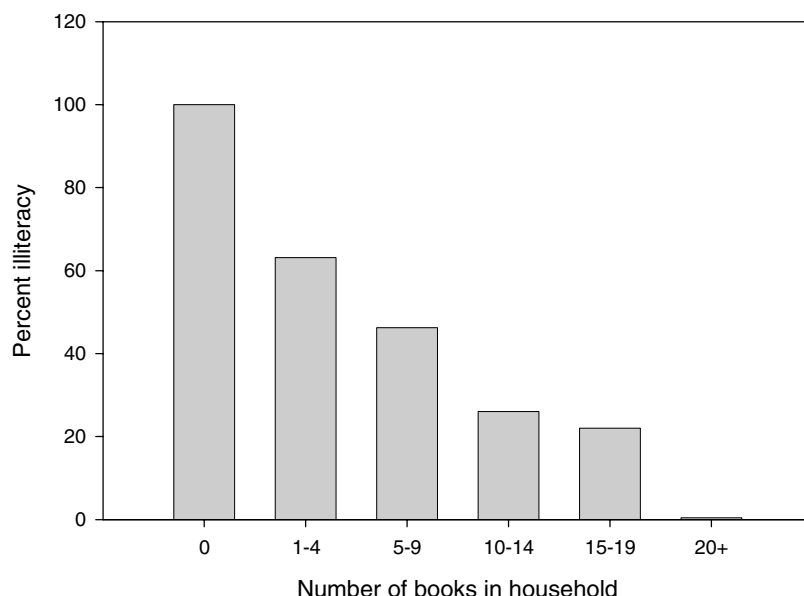


FIG. 1.3. Illiteracy in households according to church registers from the south of Iceland and the number of books in the households (Guttormsson, 1989).

made by Wayne O’Neil, currently professor of linguistics at MIT, at a conference in 1971, later published in the landmark book *Language by Ear and by Eye* (Kavanagh & Mattingly, 1972):

In Iceland a child starts school at 7 if he has already learned to read at home; otherwise, he must wait a year (p. 329).

O’Neil had been a Fulbright scholar in Iceland and so could be expected to be knowledgeable about this. However, presumably the statement reflects more the common belief among Icelanders up until just a few years ago that learning to read is easy. In earlier times children were indeed taught to read at home, especially in the countryside, but this was definitely the exception by 1970. In any case it is clear that until quite recently reading has not been considered problematic in Iceland. Interestingly, difficulties in spelling have long been recognized, as already mentioned, and have led to heated debates over issues of spelling reform. However, currently there is much interest in reading problems and dyslexia, which has become a widely recognized problem. It is, however, difficult to estimate the occurrence of reading problems because almost no standardized diagnostic instruments are available.

Reading instruction has changed over the past century, moving from the letter/word method to a predominantly phonic approach in the first grades. A failed attempt was made to introduce a “whole-word” method by an Icelandic educator who had studied at the Teachers College at Columbia University in the earlier part of the 20th century. The phonics approach was solidified by Ísak Jónsson (1898–1963), who was probably the most influential primary school educator of the 20th century.

A phonics approach would seem well suited to the Icelandic orthography as the mapping from print to sound is, in most cases, quite regular. Icelandic children in general do not have great trouble in learning to decode print. This can be seen from a study conducted by Ingibjörg Sigurjónsdóttir as part of her master’s degree in psychology at the University of Iceland in 2001. The study involved 134 children in grades 1–4 in three schools. Ingibjörg measured,

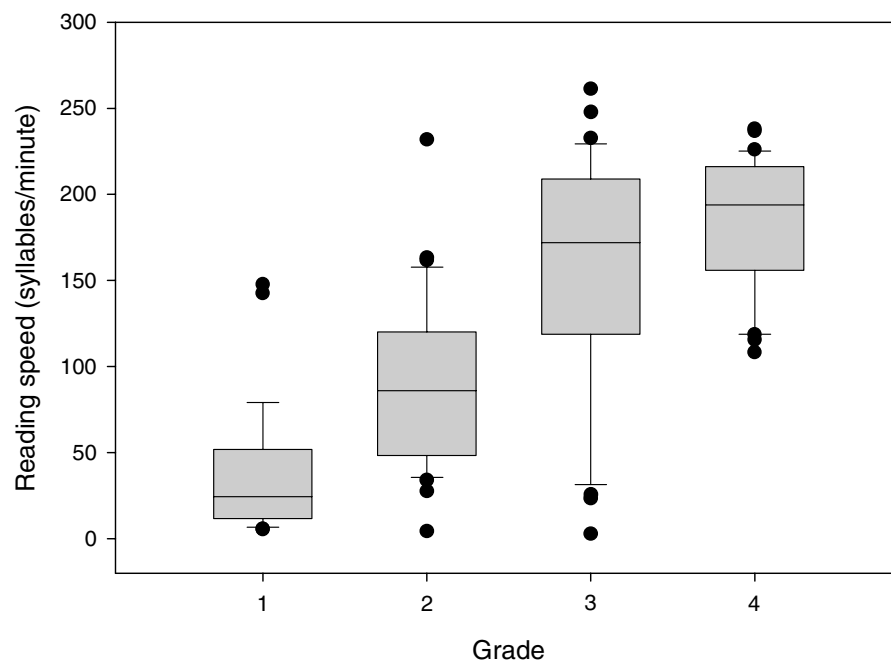


FIG. 1.4. The growth in reading speed in a sample of 134 children from the first four grades in the Icelandic primary schools. Reading rate is here measured as the number of syllables read per minute. Based on unpublished data from Ingibjörg Sigurjónsdóttir (2001).

among other things, their reading speed. Her results are shown in Fig. 1.4, which show steady progress in reading connected text aloud in the first three grades, leveling off in the fourth grade.

Further evidence on reading acquisition can be obtained from the IEA study of reading conducted in 1990–1991 (Elley, 1992). In this study Icelandic 9-year-old children were ranked 8 out of 27 countries studied and 14-year-olds were ranked 5–7 out of 31 countries.

CONCLUSIONS

In this chapter the main events in the evolution of the current Icelandic orthography have been traced. The literary tradition in Iceland extends back for almost a millennium. The adoption of the Latin alphabet for the writing of the Icelandic language was described in great detail in the so-called *First Grammatical Treatise* from the middle of the 12th century. The alphabet adopted by the First Grammarian still forms the core of the current Icelandic alphabet. Intense debates over spelling have taken place over the past two centuries, with the last spelling reforms being undertaken in 1973–1974. The current Icelandic spelling is a compromise between opposing viewpoints arguing either for an orthography that is close to the pronunciation or one that remains faithful to the long tradition of writing in the country. Educational considerations have played an important part in the last round of changes. Interestingly, even “aesthetic” viewpoints have played a part in shaping the orthography and explain the great reluctance shown by the majority of Icelanders toward abolishing the i/y distinction. This has generally been believed to alter the “look” of the writing too much to be acceptable. Abolishing the distinction between æ and œ met with general approval because, in that case, the look of the

writing was unchanged. Indeed, making this distinction is a tricky matter needing considerable linguistic insight because little support is to be had from the visual shape of the words. This is very different for the linguistically comparable i/y distinction. In those cases the look of the words is believed to provide a salient cue for the correct spelling.

The current Icelandic orthography is pretty regular in the mapping from print to sound, making it relatively easy for most children to learn to decode. The mapping from sound to print is much more difficult to master, as shown by the amount of time needed to make pupils proficient spellers (Sigurðsson & Þórðarson, 1987).

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2

Literacy Acquisition in Norwegian

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Norwegian belongs to the North German group of the Indo-European languages. It has developed from Old Norse with a rich morphology into a modern language with less morphological complexity. Morphemic reading, however, is still needed. Norwegian orthography is described as semi-transparent. Studies of Norwegian children show that even subjects with dyslexia break the alphabetic code rather easily. However, automaticity of decoding skills appears to be generally slow to develop in Norwegian children. This developmental picture is supported by large-scale international comparative studies in which a fair proportion of older Norwegian children (ages 14–15 years) read laboriously, and with limited comprehension. This chapter discusses the role of orthography from a developmental perspective. It argues that largely because of the fairly systematic sound–letter correspondence of Norwegian orthography, learning the sound–letter relationships associated with early reading is easy even for children at risk of developing reading problems. However, even subtle variations in phonological qualities such as word length and minor irregularities in degree of phoneme–grapheme correspondence appear to have a negative impact on reading speed and fluency and, in many cases, reading comprehension as well. How these issues interact with the individual child’s linguistic and cognitive skills and with the teaching methods used in school is not clear and should be the focus of future research.

PHONOLOGICAL, MORPHOLOGICAL AND ORTHOGRAPHIC NATURE OF NORWEGIAN ORTHOGRAPHY

From Old Norse to Contemporary Norwegian

The Norwegian script, together with the Icelandic, Danish, and Swedish, form the North Germanic group of the Germanic branch of the Indo-European languages. Scripts in Old Norse date back to the period of the Vikings, about the 10th century C.E. Modern Swedish, Danish, and Norwegian languages are closely related to each other with minor variations in phonology, morphology, syntax, and semantics of the spoken languages, in addition to orthography of the written languages. These differences can be described as merely dialectal. Oral, even more

so than written, communication flows relatively easily among the three languages. Danish orthography, however, is less transparent than Swedish and Norwegian orthographies. Icelandic, on the other hand, is close to the Old Norse language and cannot be immediately understood by Norwegians today.

Politically, Norway was in union first with Denmark, and then with Sweden. The languages of these two countries dominated Norwegian written language. Modern written Norwegian did not start to develop until 200 years ago. In the 19th century, two eminent dialect researchers, Knud Knudsen (1812–1895) and Ivar Aasen (1813–1896), developed their own Norwegian grammars and orthographic dictionaries. The result of their works is that today we have two standard, official orthographies: urban Norwegian (*bokmål*), which originally developed from Danish and was based on the southern and eastern dialects centred around Oslo, and rural Norwegian (*nynorsk*), which is based on dialects of the western parts of the country. Norwegian has furthermore many different dialects, which are appreciated and used officially.

With a total of about 4.7 million inhabitants and users of the Norwegian language, this diversity may look trivial from the outside. However, for years the presence of these two orthographies has caused discussion and controversy among the Norwegian population.¹ The orthographies are regularly being reformed, not only in accordance with dialectal changes, but also in accordance with the ongoing debate of the two official orthographies.²

Norwegian has developed from the synthetic Old Norse into a modern Norwegian with a less complicated morphology, especially when it comes to cases. A few remnants of the cases in Old Norse are seen in inflections of the pronouns and also in nouns in some dialects. Nouns, adjectives, and pronouns are inflected in singular and plural in congruence with the three grammatical genders of the language. Verbs are conjugated according to tense. Syntactically, Norwegian is quite similar to English, except for the use of “to do” in interrogative and negative sentences. Rather, interrogation is marked by inversion (verb–subject) and a tonal rise at the end of the sentence. Inversion is always seen in any sentence starting with an adverbial phrase.

The Structure of the Language: The Alphabet and the Word Classes

Roughly speaking, the Norwegian language comprises 40 phonemes³ and 29 letters. The alphabet consists of 20 consonant phonemes: b [b], (c), d[d], f[f], g[g], h[h], j[j], k[k], l[l], m[m], n[n], p[p], (q), r[r], s[s], t[t], v[v], (w), (x), and (z). The parentheses indicate that the letters are not used in any word of Norwegian origin, but are seen in imported words. Four different graphemes make three different consonant phonemes: kj/tj[ç], skj[j], and ng[n], and the eastern dialects have the retroflexes rt[t], rd[d], rn[r], and rs[s]. A tendency to fail to distinguish between [ʃ] and [ç], fading out the [ç], is seen in young people’s oral language. The Norwegian alphabet has nine vowels, which can be either short or long: a[a]/[ɑ]/[ɑ:]/[ɑ:], e[e]/[æ]/[e:], i [i]/[i:], o[o]/[u:], u[u]/[u:], y[y]/[y:], æ[æ:], ø[ø]/[ø:], and å[ɔ]/[o:]. Further, there are four diphthongs: ei[æi], au[æu], øy[œ], and ai[ai] (Endresen, 1996; Moen, 1993). A recent newspaper survey reported that Norwegian parents no longer want to name their children with traditional names containing the letters ‘æ’, ‘ø’, or ‘å’, probably because the difficulty in making a personal computer readily accept these letters.

¹ Both orthographies are taught in junior and senior high school, but one of the orthographies is chosen as the main orthography for each class or school.

² Up until the 1960s the two orthographies were assimilated, leading to three fractions: one rural *nynorsk*, one urban *bokmål*, and one for a joint venture (*sammorsk*). Today the third, joint alternative is not debated, and the two orthographies, *nynorsk* and *bokmål* exist side by side. In this chapter only the urban *bokmål* is referred to, as it is most frequently used in mass media and in Norwegian literature. About 80% of the population use this orthography.

³ Notated per the International Phonetic Alphabet.

The number of spellings for the 40 Norwegian phonemes is relatively high and somewhat more complex compared with the more-or-less one-to-one correspondence between for example, the Finnish phonemes and graphemes. Nevertheless, the difference between the number of phonemes and graphemes in the Norwegian script is fairly small compared with those in for example French, in which approximately 30 phonemes are represented by more than 130 graphemes. As to English, Dewey (1971) reported 561 different ways of spelling 41 English phonemes (English is often reported as having approximately 44 phonemes), showing that the English script is all by itself at the very “deep” end on a continuum from highly regular and transparent to highly irregular and deep orthography. Despite the fair simplicity and regularity of sound–letter correspondences in Norwegian, orthographic challenges are quite numerous, caused by consonant clusters.

Many Norwegian words have consonant clusters, and some combinations such as *oftest* [most often], *nifst* [scary], or *kringkasting* [broadcasting] may be especially difficult. Typically, the first syllable is stressed in Norwegian multi-syllabic words: *skole* [ˈskʊ:lɛ] (school); *merkelig* [ˈmærkɛli] (strange). There are also two tonemes, often called toneme 1 and toneme 2, differentiating the meaning of some words with identical spelling or words that would otherwise have had the same pronunciation: (1ˈlœvɐ) [the leaf, the foliage] and (2ˈlœvɐ) [lion] (see Kristoffersen, 2000; Moen, 2000; Simonsen, Endresen, & Hovdhaugen, 1996, for further studies on Norwegian phonology).

Basic units of the written Norwegian language are words, which grammatically are categorised into 10 word classes: nouns, articles, pronouns, verbs, adjectives, adverbs, prepositions, conjunctions, numerals, and interjections. Norwegian nouns have three grammatical genders: masculine (*m*), feminine (*f*), and neuter (*n*). The nouns are marked by a preceding indefinite article: *en* (*m*), *ei* (*f*), and *et* (*n*) in the singular. The plural has no indefinite article, but is marked by endings according to grammatical gender. Table 2.1 shows how regular nouns are inflected in *bokmål*.

A few nouns have irregular inflections, usually shown by changes in the stem vowel (brother: *en bror*–*brøren*–*brødre*–*brødrene*). The adjectives usually modify and precede a noun and are inflected in agreement with the noun. The definite form of the adjective demands a definite article. The inflections for *m* and *f* are identical: *en fin gutt*–*den fin/e gutten*–*fin/e gutter*–*de fin/e guttene*; for *n*: *et fin/t hus*–*det fin/e huset*–*fin/e hus*–*de fin/e husene*. Adjectives are indicated either by the inflectional endings (*-ere* in the comparative and *-est* in the superlative), or by the modifiers ‘more’ and ‘most’.

TABLE 2.1
Nouns: Inflectional Classes in Norwegian *Bokmål*

Gender	Singular, Indefinite	Singular, Definite	Plural, Indefinite	Plural, Definite
<i>M</i>	En gutt (a boy)	gutt/en (the boy)	gutt/er (boys)	gutt/ene (the boys)
<i>F</i>	Ei jente (a girl)	jent/a (the girl)	jent/er (girls)	jent/ene (the girls)
<i>N</i>	Et hus (the house)	hus/et (the house)	hus (houses)	hus/a/ene (the houses)

Note. *M*: masculine; *F*: feminine; *N*: neuter.

TABLE 2.2
Verb Conjugation in Norwegian *Bokmål*

<i>Conjugation</i>	<i>Infinitive</i>	<i>Present</i>	<i>Past</i>	<i>Past Participle</i>
Regular [to dance]	<i>å dans/e</i>	<i>dans/er</i>	<i>dans/et</i>	<i>har dans/et</i>
Irregular [to ask]	<i>å be</i>	<i>be/r</i>	<i>ba</i>	<i>har be/dt</i>

Norwegian verbs are conjugated by tense, and there are both regular and irregular conjugations, as shown in Table 2.2. The subject marks grammatical person, with no effect on the verb. The modal auxiliaries are used in approximately the same way as in English. There are no grammatical progressive aspects in Norwegian. The rest of the 10 word classes are not conjugated, with an exception of the adverbs, which are indicated in the same way as adjectives.

Structure and Challenges of the Norwegian Script

Although Norwegian script is described as fairly transparent, it is not transparent to the same degree as Italian, Spanish, or Finnish (Elley, 1992). The reasons why some words are not written the way they are spoken are etymological, but to a far lesser degree than in English orthography. For instance, the first two letters of Norwegian interrogatives *hvem* [who], *hva* [what], and *hvor* [where], are pronounced as one phoneme, much like the English words ‘who’ and ‘when’. Presumably all Norwegians have a memory of their first-grade step into literacy: the walls of the classroom covered by red and blue letters, the vowels and the consonants. In a comparatively shallow orthography, synthesising these letters into words would be easy. However, authors of Norwegian ABC textbooks will testify that pronouncing these words is not that easy for beginning readers. The pronouns ‘*jeg*’ [i], *meg* [me], *deg* (you, accusative of *du* [you]), *seg* [herself/himself, reflexive pronoun] are all pronounced with ‘-ei’ after the onset. The conjunction *og* [and] is pronounced as if it should be spelled ‘å’ which is the infinitive marker in Norwegian. Two other rather tricky phonemes are [v] and [j] when they occupy the initial position in a word. As a rule, these phonemes are written as ‘v’ and ‘j’, respectively, but quite frequently they have another letter added to them. High-frequency exception words have to be learned from an early stage on.

Somewhat humorously, but with some truth to it, the double consonant is called the most expensive letter combination in the Norwegian language, as it has caused many extra training lessons at school. The problematic double consonant is not a matter of the consonant phoneme, but of the preceding vowel sound—whether it is short or long. In some languages, the long vowel sound is marked by a double vowel. In Norwegian, a long vowel sound is followed by a single consonant whereas a short vowel sound is followed by a double consonant. Some words have retained the spelling from Old Norse as manifested by ‘mute letters’ at the end of the words, as in *land* (/lan/, meaning land) and *sild* (/sil/, meaning herring), contrary to the expectation that there should not be a letter or that there should be a double consonant.

Vowels can also cause problems, as there is not always a phoneme-to-grapheme correspondence. This concerns above all the letter ‘o’, which is sometimes pronounced [u], as in *bort* (/but/, meaning away), and sometimes [ɔ], as in *godt* (/gɔt/, meaning good). Similarly, the letter ‘e’ is often pronounced [æ], as in *her* (/hær/, meaning here).

A couple of other features of the Norwegian orthography need to be mentioned. Many function words, as well as some short words, have a rule-breaking spelling of their own. Because these words are not semantically dense, little attention may be paid to them as they are read. The reason why many individuals with reading and writing disabilities often misspell these words may be that the combination of irregular spelling and low semantic loading makes them harder to memorise compared with content words.

Compound words are widely used in Norwegian, adding a creative element to the language in the sense that a compound word can be made up on the spot, if needed. The two (or more) words that are combined are then written as one word, as in *tog/stasjon/s/betjenten*, meaning the train station operator. An 's', a reminiscence of a genitive from Old Norse, is sometimes (but not always) seen in compound words and may be a challenge to young writers. Many compounds are high-frequency words, such as *matematikkundervisning* [teaching of mathematics], *klatrestativ* [climbing frame], and *brannslukningsapparat* [fire extinguisher]. These long words cause problems for beginning and slow readers. Another typical way of creating new words in Norwegian is by the compilation of affixes. Much-used prefixes are 'u-', 'unn-', 'inn-', 'an-', 'be-', and 'for-', and frequent suffixes are '-ning', '-ing', and '-else'. Prefixes and suffixes can be seen in the same word, for example, *inn + flyt + else* [influence] and *an + be + fal + ing* [recommendation]. Affixes in nouns do not influence the spelling of the word roots, but may change the pronunciation and thereby reduce the transparency of the written language.

Finally, the Norwegian language has many words with a rather complex phonological structure, especially for word onsets. Word onsets such as 'str-', 'skr-', 'fr-', 'tr-', and 'br-' are very common, as well as words with more than one consonant cluster. Examples are *struts* [ostrich], *skrumpe* [shrink], and *straks* [soon]. The complex phonological structure in combination with compound words may then easily produce words such as *strakstiltak* [immediate measure] consisting of the words *straks*, *til*, and *tak*, and with two consonant clusters in the first word.

In summary, a semantically simple text will have quite a few words with exceptional spelling, showing that there are many pitfalls even in a rather shallow orthography such as Norwegian. Both grammatical meta-knowledge and linguistic meta-knowledge are required for reading and writing Norwegian. Rules, exceptions to the rules, and exceptions to the exceptions pose problems to children who are learning to read and spell, particularly to those with weaknesses in language processing ability.

THE ROLE OF ORTHOGRAPHY IN LITERACY ACQUISITION AND PROBLEMS OF READING AND SPELLING IN NORWAY

The Influence of Orthography on Reading Development and Reading Disability

The research literature is not at all clear about the extent to which the orthographies of the script influence the ease with which children learn to read and spell. There appears to be general agreement, however, that significant individual differences in literacy development could be accounted for by the properties of the language (Caravolas, 1993; Goulandris, 2003; Hagtvet & Lyster, 2003; Landerl, 2003; Leong & Joshi, 1997; Wimmer & Goswami, 1994). The influence of factors such as phoneme-grapheme correspondence, the distinctiveness or stress pattern of the phonological system, and the characteristics of the morphological system on reading and spelling development, however, is still not well understood (Goulandris, 2003). How these issues interact with the linguistic-cognitive skills of the individual and with the teaching methods used in school is even more unclear. A hypothesis with much theoretical appeal assumes that the closer the number of graphemes is to the number of phonemes, the

easier the orthography is to handle for the users of the language. Conversely, when there is a considerable difference between the number of phonemes and the number of corresponding graphemes (the latter always being greater), the link between the spoken language and the written language becomes complex, and it is difficult to access the written language through a phonemic approach alone (see for example Jaffré, 1997).

However, phonemes and graphemes are not the only two factors involved when an alphabetic script is deciphered. Other features such as sound- and word length, prosody, and phonemic distinctiveness and how these are represented orthographically also play a role in reading and writing.

When words and text are read, phonological processes are integrated with semantic processes. We presume that efficient use of the phonological code in automated and speeded reading therefore is semantically and morphologically driven. Such “extra phonological influences” are presumably more critical in later rather than in early literacy development, when automatization and speed become important (Snowling, 1987). Evidence supporting this hypothesis has been found in connectionist models of training reading (e.g., Seidenberg & McClelland, 1989). These models typically assume a phonological pathway that maps orthography to phonology and a semantic pathway that links orthography, phonology, and semantics. In the beginning of the training process (i.e., the early stages of learning to read), the connectionist model depends primarily on the connections between orthography and phonology. Later in the training process, the model comes to depend less on the phonology–orthography pathway and more on the semantic pathway. This is particularly true of exception words, which are more economically processed by means of the semantic rather than the phonological pathway.

Evidence of the importance of semantics in the acquisition of reading skills is also found in prediction studies that have demonstrated an association between comprehension of words and sentences by children at ages 2–4 years, and overall reading performance by children at ages 8–9 years (Gallagher, Frith, & Snowling, 2000; Hagtvet, Horn, & Lyster, 2003; Scarborough, 1989, 1990, 1991). Studies that have shown a relationship between poor reading and low scores on semantic and syntactic variables also emphasize the importance of semantics (Helland, 2002; Korkman & Häkkinen-Rihu, 1994; Snowling & Nation, 1997; Vellutino, 1979). Training studies show that morphological awareness training has a positive effect on reading outcome (Henry, 1993), especially when children have developed a certain awareness of the phonological features of the language (Lyster, 2002).

Lyster (1998, 2002) compared the long-term effect of phonological awareness training on Norwegian pre-schoolers with that of morphological awareness training. Phonological awareness training had an early effect on reading development of children who entered the study with poorly developed phonological awareness skill (Lyster, 2002). The strongest longitudinal effects, however, were found for pre-school morphological awareness training when these children reached Grade 6 (Lyster, 2003). Morphological awareness training may have developed an orthographic knowledge that helped the children to speed up the process by which orthographic structure is linked to meaning.

In addition, morphological decomposition may have been a particularly useful strategy in identifying the numerous long compound words and other morphological structures in the Norwegian script.

The Case of Norway: Evidence and Perspectives

As mentioned in the preceding section, the orthographic systems of the world vary considerably in their transparency. On a scale of 1 to 5, in which Finnish is categorised as highly regular (score 5) and English as highly irregular (score 1), Norwegian, along with German, Dutch, Swedish, Icelandic, and Greek orthographies, gets a score of 3 (Elley, 1992). By comparison,

Danish and French get a score of 2 and Spanish and Hungarian 4. In other words, Norwegian has a fairly regular orthography, implying that, in most cases, the reader can learn the written language through a phonemic approach, even though there are a number of exceptions. These may quite often be accessed morphemically, for example, *trygt* (/trykt/, neutral for safe) is spelled with a 'g' because the root morpheme is 'trygg-' (added to the root morpheme is the suffix '-t', signifying the neutral gender). Treiman and Cassar (1997) present research suggesting that although sound is important in children's spelling, so is morphological information.

Preliminary results from an ongoing study of 140 Norwegian children of dyslexic parents showed that approximately 50% of these children, who were followed from pre-school to the age of 9 years, struggled in learning to read and spell (Hagtvet and Lyster, 2003). Qualitative analyses of the reading pattern performance of this group of children when they were 8 years old suggested that they generally read words and non-words slowly, but still accurately.⁴ They thus appeared to break the alphabetic code easily, presumably because of the fair degree of sound-letter regularity in combination with a teaching method that most typically emphasized sound-letter relationships.

When faced with phonologically or orthographically complex words, these children read with greater difficulty and reduced speed, but still quite accurately. This is in agreement with studies of German-speaking children who, in contrast to English-speaking poor readers, have been documented as reading non-words accurately but slowly (Wimmer & Goswami, 1994). Few studies have investigated literacy development with reference to Norwegian samples for the purpose of assessing the impact of orthography on literacy development. However, information about its impact may be deduced from studies of literacy development. Hagtvet and Lyster (2003) analysed the spellings of Norwegian beginning readers on the assumption that their spellings would reveal their notions of speech sounds and how they relate to the orthographic system. They compared the spellings of 21 poor and 23 good readers. The children were about 8 years old, and the two groups were selected on the basis of reading speed and accuracy. To address the "phonological deficit issue" the investigators undertook a qualitative analysis of the spelling errors (words and non-words) of the good and poor readers, respectively.

The spellings of these children were scored in the following four categories, reflecting degrees of correspondence to standard spelling, but with a focus on phonemic structure: Category A, correct phonemic spelling; Category B, phonemic spelling with a reduced, but correct phonemic representation involving omissions; Category C, phonemically inaccurate spellings involving substitution, reversal, and addition of phonemes; Category D, unclassifiable spellings.⁵

The main finding was that both good and poor readers appeared to apply the phonological strategy in the sense that in most cases they preserved the phonemic structure in their spellings, but the good readers were better in spelling irregular words. The poor readers spelled short non-words and regularly spelled words almost as well as the good readers did. The words that caused problems for the poor readers were most typically irregularly spelled words (*seg* /sæi/ [himself/herself]; *med* /me:/ [with]) and words with complex orthography, that is, words with

⁴ The children were average to above average in intelligence, and they scored below the 22nd percentile compared with a typical group of Norwegian children unselected for IQ, thus satisfying typical criteria for dyslexia.

⁵ Most of the non-standard spellings of *words* for both good and poor readers preserved the phonemic structure (Category A), whereas the other spellings for both groups were fairly evenly distributed on the other categories. The "error pattern" of *non-words* was somewhat different. The dominant type of error for *good readers* continued to be Category A, preserving the phonemic structure of the words (48% of the spellings), whereas the other errors were evenly distributed on Categories B (23%) and C (20%) (partial and inaccurate preservation of phonemic structure, respectively). Only 4% of the non-standard spellings were unclassifiable. On the other hand, the dominant type of error for the *poor readers* when spelling non-words was unclassifiable (42%) (Category D), whereas 24% preserved the phonemic structure (Category A), 20% preserved it partially (Category B), and 10% preserved an inaccurate phonemic structure (Category C) (Hagtvet & Lyster, 2003).

multiple-letter graphemes representing one phoneme: *lenger* [longer/anymore]; *bort* [away]. Words and non-words with a complex or less distinct phonological structure, such as *bnof* [non-word], and *damer* [ladies], also caused problems. Poor and good readers, in other words, showed different spelling patterns only when they spelled words with a challenging orthography or phonology. To some extent their spelling performance was moreover influenced by the degree of familiarity of a word. *Jeg* (/jæi/, meaning 'I') was, for example, much easier than *seg* (/sæi/, meaning 'herself/himself'), even though the degree of irregularity is the same. Thus reading experience appeared to have an impact on how well an irregular word was spelled. The correlation between word reading and spelling was found to be .77, suggesting that most good readers were good spellers and that most poor readers were also poor spellers.

Helland (2002) studied a group of 33 older Norwegian dyslexic adolescents who were 11 to 16 years old and had IQs in the average range. With the phase model of Frith used as a frame of reference, a subgroup of 23 of the 33 participants was defined as being in "the alphabetic phase" of their literacy development. Of these 23 participants, 8 had problems in comprehension and mathematics. The other subgroup of 10 participants had reached an 'unstable orthographic phase'.⁶ Both groups scored below average on accuracy and speed measures when they read short regular words. Furthermore, the groups read short, regular words with equal accuracy, but the 10 participants in the unstable orthographic phase read them faster. As to reading speed of longer and irregular words, there was no group difference, but the "orthographic readers" read these words more accurately. This group also showed more advanced spelling.

Taken together, these studies offer a number of theoretically important suggestions regarding the role of orthography in literacy acquisition and reading disability. First, breaking the alphabetic code appears fairly simple even in a semi-transparent orthography such as the Norwegian. However, automatised reading is not. These findings differ from the studies of English-speaking readers, which report that poor readers have problems in manipulating the phonological structure of language even at a basic alphabetic level (Lennox & Siegel, 1994).

Second, the speed of reading is affected by variables such as word length, phonological complexity, and orthographic complexity suggesting that fluent reading presupposes rapid integration of phonological and orthographic processes. Morphological information inherent in the orthographic system is a constituent part of this integration process connecting phonology and semantics.

Third, there appears to be a developmental interdependence between accuracy and speed of reading in which 'accuracy precedes speed'.⁷

We now explore the impact of orthography on reading performance by examining how Norwegian children and youths in general score in international comparative reading studies.

INCIDENCE OF READING PROBLEMS

The Challenges of Defining Literacy and Literacy Problems

With a well-developed school system, compulsory schooling from the age of 6 years on (before 1997 from the age of 7 years), and a healthy economic condition, one would expect the incidence of reading problems in Norway to be low. Relatively speaking, this is indeed the case, but the incidence of reading problems varies with the criteria used for defining reading problems.

⁶ There was no correlation between age/years of schooling and reading/spelling scores.

⁷ This relation between accuracy and speed of reading is further empirically documented in a Danish study including 576 Danish participants 8–12 years old showing that fluency in reading was achieved at the point where 80–90% of the words of a test could be read with accuracy (Nielsen et al., 1992).

Reading skills have been defined in various ways depending on time, tradition, purpose, and so forth. Today, it is generally agreed that reading is a complex process encompassing decoding abilities and comprehension abilities. In addition to reading skills, writing skills are also used to define problems with written language. To encompass the many aspects of reading and writing, the term 'literacy skills' is often preferred.

Literacy in the Adult Population

The most recent study of reading skills and reading deficiencies in the adult population is the International Adult Literacy Survey (IALS) (2000), comprising 22 nations, in which Norway participated in the third round of data collection in 1998. The IALS is a large-scale collaboration among governments, national statistical agencies, research institutions, and the Organization for Economic Co-operation and Development (OECD).

In the IALS study 'literacy' is defined functionally as understanding and employing printed information in daily activities, at home, at work and in the community (The Final OECD Report of the International Adult Literacy Survey, 2000). Literacy is operationally defined in terms of three domains of skills: prose literacy, document literacy, and quantitative literacy. Nationally representative samples of the adult population from 16 to 65 years old participated in the study. Norway received the following rankings which were based on mean scores: Prose literacy (3), document literacy (2), and quantitative literacy (4). However, as much as 30% of the population still functioned below Level 3, that is, the level defined as critical in terms of 'functional literacy'.⁸ Furthermore, Norway was among the six countries in which less than 15% of the population functioned at Literacy Level 1, indicating a severe literacy deficit in everyday life and at work. Even in Sweden, which was the nation ranked at the top on all measures, about 8% of the population functioned at Literacy Level 1. The equivalent figure for Norway was 9%.⁹

Taken together, the IALS results show that Norway has a relatively high literacy level, but that about 10% of the adult population read at a critically low level and another 20% at a marginal level.

Age was negatively correlated with literacy skills, with older cohorts tending to score lower than younger cohorts.¹⁰ Other variables predicting adult literacy skills were home background (in particular the level of education of parents) and active use of literacy skills at work. Most studies of literacy skills of adults and older schoolchildren have not looked at orthography as an explanatory variable for differences in literacy skills.

⁸ Five levels of literacy were identified corresponding to measured ranges of scores achieved on various tests. Level 1 'indicates persons with very poor skills, where the individual may, for example, be unable to determine the correct amount of medicine to give a child from information given on the package'. At Level 2 'respondents can deal only with simple material which is clearly laid out, and in which the tasks involved are not too complex'. Level 3 is considered a critical minimum skill level for coping with the demands of modern life and work, and Levels 4 and 5 refers to command of higher-order information processing skills (The OECD Report, 2000).

⁹ The fact that the IALS describes reading problems in terms of a continuum suggests that an incidence figure for reading problem is indeed a very relative entity. In Denmark for example, which is a country with social, political, and cultural values similar to those of Norway, different comparative studies of adult literacy have come up with widely differing figures for reading problems: 45% (IALS) and 12% (Elbro, Møller, & Nielsen, 1995). There are probably good reasons for this difference in incidence figures—reasons related to differences in screening instruments and criteria used to define literacy. Elbro and collaborators (1995) also defined literacy functionally and focused on texts from daily life (newspaper articles, documents, forms at the post office, etc.). The tests are, however, quite different from those used by IALS and somewhat stricter criteria have been applied when deciding the cutoff between 'problems' and 'normality' (whereas the IALS included a rather large group of individuals, including so-called 'marginal reading problems').

¹⁰ In the study by Elbro et al. (1995), 'incidence of reading problems' varied strongly across ages: 4% (age 18–29), 9% (age 30–44), 25% (age 45–59), 27% (age 60–67).

TABLE 2.3
Mean Student Ability Scores (With Standard Deviations) for All Domains, Arranged in Order
of Overall Achievement

<i>Country</i>	<i>Rank</i>	<i>Grade/Age</i>	<i>Overall</i>	<i>Narrative</i>	<i>Expository</i>	<i>Documents</i>
Finland	1	3 / 9.7	569 (70)	568 (83)	569 (81)	569 (88)
United States	2	4 / 10.0	547 (74)	553 (96)	538 (80)	550 (81)
Sweden	3	3 / 9.8	539 (94)	536 (100)	543 (112)	539 (106)
Norway	8	3 / 9.8	524 (91)	525 (102)	528 (103)	519 (101)
Denmark	26	2 / 9.8	475 (111)	463 (119)	467 (127)	496 (125)

Note. International mean score = 500.

Incidence of Reading Problems in Children

Over the past 15 years, Norway has taken part in a number of large-scale international comparative reading literacy studies of children 9 to 15 years of age. In general, the results place Norway above the international average, but well below what one might expect on the basis of her high composite development index (CDI).¹¹

The IEA Reading Literacy Study of 1990–1991 The international association for the evaluation of education achievement (IEA) was based on representative national samples of 9- and 14-year-old pupils from 32 countries ($N = 1,500$ –3,000 per country). This study was planned and organized by The International Association for the Evaluation of Educational Achievement with the aim of assessing “the average levels of reading literacy of representative samples of all students in the grades where most 9- and 14-year-olds were to be found” (Elley, 1992). Three domains of reading were used for this survey: narrative prose, expository prose, and documents. Starting school at the age of 7 years the Norwegian children were assessed at the end of Grade 3 (mean age 9.8 years) and at the end of Grade 8 (mean age 14.8).¹²

For several reasons, Finland, Sweden, Denmark and the United States provide interesting units for comparison. All nations except Denmark were ranked at the top for 9-year-old children, and they render great importance to education. As previously mentioned, the orthographic systems of the languages of these countries vary in degree of transparency. The mean student ability scores (and standard deviations) for all domains, ranked in the order of overall achievement, are presented in Table 2.3 for the 9-year-olds and in Table 2.4 for the 14-year-olds.

Table 2.3 shows that the Norwegian pupils at 9 years of age scored above the international mean in all the literacy domains, but somewhat below the rank the Composite Development Index (CDI) status would predict (Elley, 1992). Furthermore, results across genres were quite stable, but with a rather large standard variation relative to the top-ranking country, Finland, indicating that a fair number of children read below the national mean. The lowest 5% of the participants furthermore read extremely poorly relatively speaking. This is a most unexpected finding, given that socioeconomically Norway is one of the most homogeneous countries in the survey.

¹¹ (Composite Development Index is a composite based on a set of selected national indicators GNP per capita, public expenditure per student on education, life expectancy, low birth weight, newspapers per 100 populations, % adult literacy).

¹² School entrance age was in 1997 reduced to six in Norway, but not in Sweden and Finland. This has of course no impact on the IEA-results, which were obtained before the reform.

TABLE 2.4
Mean Student Ability Scores (With Standard Deviations) for All Domains, Arranged
in Order of Overall Achievement

<i>Country</i>	<i>Rank</i>	<i>Grade/Age</i>	<i>Overall</i>	<i>Narrative</i>	<i>Expository</i>	<i>Documents</i>
Finland	1	8/14.7	560 (65)	559 (84)	541 (71)	580 (82)
Sweden	3	8/14.8	546 (80)	556 (93)	533 (91)	550 (90)
United States	9	9/15.0	535 (85)	539 (98)	539 (107)	528 (84)
Denmark	13	8/14.8	525 (77)	517 (83)	524 (94)	532 (88)
Norway	17	8/14.8	516 (71)	515 (76)	520 (86)	512 (82)

Note. International mean score = 500.

In terms of the potential impact of orthography on the results a rather complex picture is revealed where Finland with the most transparent orthography scores the highest followed by Sweden and Norway with semi-transparent orthographies. Of the Nordic countries Denmark with the deepest orthography ranks the lowest. However, the USA with the deepest orthography of all the countries in the table ranks second. This indicates that while orthography appears to play a part during early reading development as suggested by the relative ranks of the Nordic countries, the causal pattern is complex, which is also argued by the authors of the study.

Table 2.4 illustrates equivalent results for the 14-year-olds and shows that Norway has had the largest negative change in ranking, both overall and for the different literacy domains of all these top-ranking countries. There may be numerous substantive explanations to this negative change in Norwegian scores (for example inefficient teaching methods or subtle impacts from orthography) as well as methodological explanations and characteristics of tests (e.g., lower sensitivity of tests at 14 years old than at 97 years old). Sampling bias may also be a possible explanation. We will get back to the causal pattern below.

The Programme for International Student Assessment (PISA) (2001) is another large-scale comparative reading study in which Norway has participated. One of the main purposes of the project was to compare a large body of aspects associated with reading: retrieval of specific information, interpretation of written texts, and reflection and evaluation of information given in written texts. The focus, in other words, was on 'reading to learn' rather than on 'learning to read'. In this survey, 15-year-olds from 31 countries participated.

The results showed that Norwegian 15-year-olds—while still scoring marginally above average relative to the other OECD countries—ranked 13th in overall competence in reading comprehension, again after Finland and Sweden, but ahead of the United States, and also ahead of Denmark, which were ranked 15th and 16th, respectively. Compared with the IEA study, this study may be seen as an improvement in reading competence. However, the variation in reading skills was higher among the Norwegian pupils than was the case for the participants from the other Nordic countries. Also, gender differences in favour of girls had increased in all countries, but only Finland and New Zealand had larger gender differences than Norway. Further, as many as 16% of the pupils read at Level 1, in which students are capable of completing only the least complex reading tasks. In short, Norwegian schools appear to foster or 'get' a high proportion of poor readers.

In addition to reading skills, attitudes towards reading were evaluated. It turned out that Norwegian pupils manifested the least positive attitudes after Belgium and the United States, but girls were more positive than boys.

The most recent large-scale comparative study in which Norway participated is The Progress in Reading Literacy Study of 2003. (PIRLS, 2003), which examined the reading comprehension level of 9-year-olds. The study confirmed the previous findings, but also added a dramatic twist. Of the 17 OECD countries that participated in this study, Norway was ranked almost the lowest. These findings have caused political turmoil because this cohort of Norwegian fourth graders included children who had had one more year of schooling than children in the previous international literacy studies. (Children started school at the age of 6 years after the 1997 Reform, when school entry age was lowered by one year).

To obtain a comparative measure of low-scoring readers in each country, PIRLS identified the 25th percentile as a lower benchmark. Only 80% of the Norwegian sample had scores above this benchmark, whereas as many as 86% of the Swedish and 98% of the Dutch sample had such high scores. This is a challenging finding, as the Dutch, Swedish, and Norwegian orthographies have a similar level of transparency. The PIRLS study showed that, among the Norwegian poor readers, 63% were boys and 37% were girls, although a clear gender difference was not observed among good readers (46% boys and 54% girls).

In summary, these international studies are different in scopes and measures and also indefinite as to the impact of orthography on literacy development. Yet some results of relevance to the issues at stake in this chapter stand out with fair consistence: The incidence of poor Norwegian adolescent and adult readers is higher than one would expect on the basis of Norway's high CDI score and egalitarian school system, as are inter-individual variations and gender differences. Furthermore, judging from the IEA-results, the scores of Norwegian pupils appear to deteriorate with age (from age 9 to age 14) relative to those of pupils from other comparable nations. In the IEA-study of "reading literacy" Norway had the largest negative change in ranking from age 9 to age 14. Also, the lowest 5% of the participants at age 9 read extremely poorly. Taken together these findings suggest that relative to other countries with a comparable CDI-status, a fair amount of Norwegian children appear to face larger reading comprehension problems the older they become. Other international comparative studies corroborate this finding. In the PISA-study (2001) focusing "reading to learn" as many as 16% of the Norwegian 15-year-olds read at the lowest level of literacy, and in the IALS-study, as many as 30% of the adults read below the level defined as critical in terms of "functional literacy".

According to the authors of the international studies the variables that contributed to the observed variations in literacy skills appeared to be multiple with CDI scores and the quality of the environmental input judged the most influential ones. Orthography was granted only a minor impact, if considered at all. It is true enough that Finland, the best reading nation in the world, had the most consistent grapheme-phoneme system they argued. Yet other nations with deeper orthographies did almost as well while nations with shallow orthographies did more poorly. Rather, the high quality of teacher training, an emphasis on teaching reading strategy from an early age, and a widespread interest in reading and schooling in the Finnish culture was highlighted as more probable explanations (e.g., Elley, 1992).

While not disregarding the importance of quality teaching and well developed school systems, we would like to underscore that the international comparative studies converge with studies of reading disabled children on the two developmental key issues highlighted in the preceding passage (beginning reading appears on the whole simpler for Norwegian pupils than is continued reading, and continued reading (involving fluency and advanced comprehension) appears surprisingly difficult for a fair number of Norwegian adolescents and adults). We will argue that the semi-transparent Norwegian orthography may play a part in explaining these findings. However, with little systematic focus on the possible impact from orthography on literacy development in the international studies (and also in other studies including Norwegian samples), its explanatory potential and more precise impact as to the case of Norway has to be hypothesized mainly by implication.

SUMMARY AND CONCLUSIONS

Two strands of Norwegian studies have been investigated for the purpose of exploring the role of orthography on the development of literacy skills in Norwegian children. One strand referred to developmental studies of children with reading disabilities. The other regarded large scale international comparative studies of typical development of “reading literacy”. The converging evidence states that breaking the alphabetic code in a “semi-transparent” Norwegian script (and with a reading instruction which is generally phonics oriented) is fairly easy. This regarded typically developing children as well as children with problems in learning to read and spell. We tend to see this in connection with a fairly shallow (semi-transparent) orthographic system where connections between the phonemic structure of spoken language and the orthographic structure of the script are regular enough for even the slow learner to understand and master the alphabetic code at a basic level within a reasonable amount of time. This causes almost all Norwegian children to be fairly accurate readers and spellers, in particular when reading and spelling short and orthographically simple words.

The converging evidence furthermore relates to “continued reading”. Both typically developing Norwegian adolescents and adults and those who struggle with reading and spelling appear to be “set back” relative to relevant comparison groups when reading demanding texts. Also, relative to other countries with a comparable CDI-status, a large amount of Norwegian children appear to read at the lowest level of literacy, and in the IALS-study, as many as 30% of the adults read below the level defined as critical in terms of “functional literacy”. Good text comprehension presupposes among other things automated and fluent decoding skills in addition to good understanding of the semantic content of words. We hypothesize that for reading disabled children even a semi-transparent orthography with moderate irregularities in phoneme-grapheme correspondence may slow down the automation of sound and letters causing reading comprehension to suffer. We see this in connection with characteristics of fluent reading where rapid integration of phonological and semantic processes is crucial and heavily dependent on variables such as word length, sound length, phonological complexity and orthographic complexity. The meaning making processes in fluent reading is therefore presumably strongly influenced by morphological information inherent in the orthographic system and also by more subtle irregularities between sound- and letter patterns. In sum therefore, even in a semi-transparent orthography like the Norwegian the orthographic system may be a barrier to fluent reading and reading comprehension via its impact on rapid and automated integration of phonology and semantics, and in particular in poor readers.

How does the observation that the Norwegian reading disabled children had problems in integrating phonology and semantics (reading speed and fluency), but not in breaking the alphabetic code, fit in with the hypothesis that a phonological weakness is crucial in most serious reading problems? In our view, the Norwegian results do not necessarily challenge the ‘phonological deficit hypothesis’. Rather, they challenge the way we have perceived its manifestations and the issue of specificity of phonological difficulties, that is, whether reading disability is primarily associated with a specific phonological dysfunction, or whether it reflects a more general language problem. Many researchers, for example Ehri (1992), claim that phonological recoding underlies the storage of sight words in memory, that is, phonological recoding supports children’s development of orthographic knowledge and their ability to use an orthographic strategy. If phonology is important in “orthographic reading” (and spelling), phonological weaknesses may at least partly explain why it was so difficult for the Norwegian poor readers to accelerate their speed of reading. Regarding specificity, it is interesting to note that in Helland’s study of impaired reading in 11- to 16-year-olds 15 out of 23 subjects in the “alphabetic phase-group” (i.e., the children with the most serious problems including problems with accuracy) had a history of delayed language development; this was the case for

only 2 of the 10 subjects in the “orthographic phase-group”. This suggests that the phonological deficit in very poor readers may be associated with a more general language problem than is the case with marginally poor readers and. This again raises the question of the universality of the manifestations of dyslexia across languages. Carefully planned comparative studies are needed to establish in more detail the complex interactive set of variables influencing literacy development in different orthographies, and in particular in relation to poor reading skills.

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3

Literacy Acquisition in Danish: A Deep Orthography in Cross-Linguistic Light

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Danish and English are similar in many ways. Both are Germanic languages with deep orthographies. Both in Denmark and in the United States, reading and writing are usually taught through a variety of approaches such as phonics, whole word, and whole language. Because Danish orthography also shares some basic similarities with English, Danish children would be expected to acquire reading and writing skills in ways that are similar to those of English-speaking children. This is so in spite of the fact that Danish children do not receive formal instruction in reading until the age of 7 years. The available evidence summarized in this chapter suggests that initial reading and spelling development in Danish is indeed similar to that in English.

WHY STUDY READING IN DANISH?

Reading acquisition has been studied far more extensively in English than in any other language. This means that the standard models of reading acquisition have been developed and validated in terms of English. Little is known about how these models generalize to other alphabetic orthographies—not to mention syllabic and morphemic orthographies. Some comparisons have been made, though, between English and other, more regular, orthographies.

However, almost all of these comparisons rest on somewhat soft grounds because orthography is far from the only difference between languages. When English and French are compared, for instance, a deep orthography with many deviations from a simple one-to-one phoneme–grapheme writing system (English) is compared with a system with a much more predictable pronunciation of written words (French) (e.g., Goswami, Gombert, & Barrera, 1998). Furthermore, the two languages have rather different syllabic structures. There are also differences between the ways reading is taught in the two languages. Consequently, observed differences in reading acquisition in English and French may be difficult to interpret because they may stem from differences in orthography, language, teaching methods, and so forth. Similarly, comparisons of reading acquisition in English and German (e.g., Landerl, Wimmer, & Frith, 1997)

are probably influenced not only by differences in the orthographies—German orthography is much more shallow than English orthography—but also by differences in teaching methods. German children are initially taught to read exclusively through the synthetic phonics method, whereas initial reading instruction in English uses a mixture of methods.

These differences make Danish interesting from an international perspective, because Danish is similar to English in at least three respects: Danish, like English, is a Germanic language; Danish also has a somewhat deep orthography; and initial reading in Danish is traditionally taught by means of a variety of instructional methods, such as whole-word look-and-say, contextual cues use, some phonics, and easy book reading. We can therefore expect reading acquisition in Danish to parallel that in English.

Needless to say, there are also differences between the Danish and English orthographies. For example, unlike English, Danish has only a few vowel digraphs, mainly in French loan words that have preserved their French spelling. Danish also has three extra vowel letters (*æ*, *ø*, and *å*). Nevertheless, these differences appear to be minor when the entire language structure is taken into consideration. The basic similarities between English and Danish therefore permit us to study the effects of orthographic structure on literacy acquisition. So far, however, only a few cross-linguistic studies have been carried out, and they are presented in this chapter.

The studies in this chapter have mostly been conducted within the framework of a reading acquisition model that assumes that literacy development follows the principle of economy: That is, the most productive and reliable grapheme–phoneme associations are learned first and complex associations are learned later. This means that standard pronunciations of the single letters are learned first because, in addition to the one-to-one association, their number is also determined by how many letters are there in the alphabet. More complex grapheme–phoneme associations are acquired progressively with these simple associations used as the base, and this progressive development occurs in *overlapping waves*. This means that the knowledge of other principles of orthography is collected from early on, but each principle is made use of in spelling over a period of time.

This general model gives rise to several expectations. First, if standard pronunciations of the single letters are learned first, then any deviation from a simple grapheme–phoneme correspondence may cause difficulties for beginning readers. Even common digraphs—in which two letters regularly represent one phoneme—can be expected to cause difficulties. Second, spelling patterns in which single letters have more than one pronunciation are expected to pose difficulties for novice readers. In a language such as English with many such patterns, the acquisition of literacy skills is likely to be a protracted affair. Third, morphemic spelling patterns are expected to be a major challenge because they are based on morphology, information that is categorically different from phonology. Fourth and finally, word-specific orthographic forms that do not conform to either phonologic or morphologic conventions are expected to be the ones that will be acquired last.

INITIAL READING DEVELOPMENT IS SLOW IN DANISH

A large-scale IEA (which stands for the International Association for the Evaluation of Educational Achievement) study of reading literacy conducted in 1992 reported that Danish 9-year-old children ranked 24th among children from 27 countries (Elley, 1992). The Danish students were on average the slowest readers among children from all participating European countries. This was found in both word decoding and in reading of narrative and expository texts. Since then, because of increased awareness about literacy education, the reading accuracy of Danish

9-year-olds has improved from below the international average to somewhat above it; but reading speed still remains relatively low (Allerup, Mejding, & Zeuner, 2001).

In Denmark, formal schooling starts when the child reaches 7 years of age. Before this, very little informal reading instruction takes place at home. Therefore, Danish children are at a position of disadvantage when compared with children of the same age in other countries where formal schooling starts when children are 6 years, or even 5 years, of age, as in Britain.

A small-scale study of initial reading development in 13 European orthographies including Danish and English (Seymour, Aro, & Erskine, 2003) indicated that Danish and English children are far behind other children by the end of the first school year. One would expect English-speaking children, because they started school much earlier, to have done better, but that did not happen. Even though Danish children knew as many letters as children from other countries and could name more than 90% of the letters by the end of the first school year, they were able to read monosyllabic nonwords with an accuracy rate of only about 60%. The corresponding figure was around 90% or higher for children who spoke other European languages. Only the English-speaking (Scottish) children read worse (40% correct) than Danish children.

By the age of 14 years, Danish youths, however, read relatively better. In the 1992 IEA study Danish youth came in at the 13th place out of 31 participating countries. This result was corroborated in the 2000 OECD PISA study (Andersen et al., 2001) in which the performance of Danish 15-year-olds came very close to the average of youths from 33 participating countries.

Together, these studies suggest that the initial phase of reading development is slow in Danish. There may be many reasons for this. The particular difficulties of the Danish orthography may be one of them; this probably is exacerbated by the relatively late school start in Denmark.

DANISH DEPTHS

Danish orthography was already old when a national norm was first established around the year 1200. From the very beginning, Danish orthography reflected several obsolete pronunciations. For example, even though Danish words like *lov* [law] had been pronounced with a final /w/ sound for generations, scribes working during the 13th century spelled such words with a final *-gh* (*logh*) in conformity with the archaic pronunciation. Similarly, the *th* sound (as in *myth*) had long since been replaced with /ð/ (as in *with*) in the final position, yet Danish scribes continued to insert *-th* in words that did not have that sound anymore. The developmental changes in the pronunciation of spoken Danish were so numerous during the early middle ages that, by about 1300, a majority of words contained segments that made the grapheme–phoneme correspondence of these words opaque (Skautrup, 1944, 257–258).

The scribes who instituted the first national spelling norm were, without doubt, learned men, who came from various parts of the country and who spoke different Danish dialects (or regional variants). Hence one possible reason for the initial orthographic conservatism may be that the scribes may have wished to select spellings that were not based on any one spoken Danish dialect as norm. Instead, the scribes appear to have chosen old-fashioned, possibly high-status, Danish as the basis for spelling.

Whatever the reason for the initial conservatism of Danish spelling may be, things have become worse since the 1200s. Written language is by nature more conservative than spoken language. Spelling reforms usually lag far behind changes in pronunciation, and spoken Danish has changed more than most Germanic languages since the 1200s. For instance, spoken Swedish has stayed much closer than Danish to its East Nordic root, which is one major reason why Swedish orthography is much more shallow than Danish orthography.

In addition, Danish has been more accepting than most languages of foreign loan words. This means that Danish has imported many orthographic complexities along with imported words. In comparison, Norwegian spelling of loan words conforms much more closely to Norwegian spelling conventions. For example, Danish *psykologi* [psychology] has a silent *p* whereas Norwegian *sykologi* does not; in the Danish word *nation* (from the Latin), the middle /ʃ/ sound is spelled with a *t* whereas the Norwegian spelling is *nasjon*, with a standard digraph *sj*; Danish *tusch* [Indian ink, from the German] uses a German spelling of the /ʃ/ sound whereas Norwegian *tusj* uses the standard *sj*; and Danish *niveau* (from the French) has the French *eau* for the /o/ sound whereas Norwegian spelling is more simple, *nivo*.

The changes in spoken language and the influx of foreign words and their spellings from other languages are two main reasons why Danish orthography deviates from a simple phoneme–grapheme structure. In addition, some orthographies, like those of English and Danish, also represent morphology to some extent. Examples of the influence of morphology on spelling are *bomb–bombardment*, *damn–damnation*, and *boys* versus *boy’s*. Deep orthographies, such as those of English and Danish, differ from shallow ones because they reflect such morphological information even when it conflicts with simple grapheme–phoneme correspondences.

From a present-day perspective, however, the consequences of the three sources of orthographic irregularity are difficult to identify and isolate with precision. It may be pedagogically more productive to disregard the historical perspective and take a look at orthographies as they appear from a contemporary perspective. Four orthographic principles may be distinguished. For the sake of simplicity, they are presented in their order of acquisition in the next section. The first is the basic phonemic principle that is common to all alphabetic orthographies.

TAKING THE PLUNGE

The Alphabetic Principle 1: Standard Letter Sounds

Single, abstract letters (graphemes) represent single, abstract segments of speech (phonemes). This is the basic principle of all alphabetic orthographies—including deep ones such as those of English and Danish. This is the principle that Danish children acquire first, as we shall see.

Danish children are taught the letter names directly during the first months of Grade 1. In some cases, the introduction to the letters takes a full semester. Sometimes, but not always, letter sounds are taught along with letter names.

However, the basic alphabetic principle faces a challenge in Danish and in all other Germanic languages. There are not enough letters in the Latin alphabet to match all the phonemes. The Latin alphabet had enough letters to represent spoken Latin, but the Germanic languages that borrowed it have more sounds. The problem is particularly pressing for the Danish vowels. It can be argued that there are 12 Danish vowel phonemes that qualitatively differ from each other (Elbro, 2001). Therefore, even disregarding vowels that differ only in length, there are too few letters in the alphabet to represent all the Danish vowel phonemes. Attempts to deal with this problem have resorted to three solutions, all of which make the orthography deviate from a simple phonemic script.

First, one letter may represent more than one phoneme; for example, written *s* may represent /s/ in *press*, /z/ in *present*, /ʃ/ in *pressure*, and /ʒ/ in *pleasure*. Each Danish vowel letter regularly represents two or more different short-vowel phonemes and at least one long-vowel phoneme.

Second, special letters may be added to the Latin alphabet. Danish, like Norwegian, has three additional vowel letters, *æ* (originally *ae*), *ø* (originally *oe*), and *å* (originally *aa*).

Third, fixed letter combinations (e.g., *ng* in *ring*, and *sh* in *shoe*) can be used for representing single phonemes (/ŋ/ and /ʃ/). Such fixed letter combinations, or *complex graphemes* or *digraphs*, are very common in English; and they exist in all Germanic orthographies. The *ng* (as in *ring*) digraph is a very widespread example. Another complex grapheme in Danish is *sj* that represents /ʃ/.

Digraphs and trigraphs are complex graphemes

Digraphs such as *ng*, *sj*, and *sh* are fixed letter patterns that generally represent only one phoneme. Digraphs are interesting in the study of reading development because they have highly regular pronunciations on the one hand, but, on the other hand, they deviate from the basic alphabetic principle that each letter corresponds to a sound. Therefore, if children initially associate single letters with single (standard) sounds, complex graphemes should pose a problem for them. It should be harder for them to read words like *shin* with complex graphemes compared with words like *spin* and *pen*, even though *spin* has more sounds than *shin*.

To my knowledge, there has been only one study that investigated the acquisition of complex graphemes in Danish. That is the study reported below. The study also examined complex grapheme acquisition in English and German. The materials used were nonwords with complex consonant graphemes (e.g., *shig*), matched nonwords with consonant clusters instead of complex graphemes (e.g., *spig*), and matched nonwords with the same number of sounds but fewer letters (e.g., *deg*). These “words” are listed in the appendix. Details of the participants are shown in Table 3.1.

The results indicated that words with complex graphemes were significantly harder to read than both types of control words with and without consonant clusters (Table 3.2). The tendencies, with Grade 3 as an example, can be clearly seen in Fig. 3.1. The effect was confirmed for English and Danish in a repeated-measures analysis of variance with three word types $\times$ two languages $\times$ two grade levels and planned contrasts between the words with digraphs and the other two word types: $F(1, 109) = 85.1$, $p < .001$, and $F(1, 109) = 137.9$, $p < .001$, respectively. Grade level had a significant main effect: $F(1, 109) = 6.6$, $p < .05$. Language did not significantly interact with other factors.

A second analysis of variance looked at all three languages and Grades 3 and 4 (between subjects), but only two word types (within subjects). This analysis indicated a strong main effect of word type, $F(1, 146) = 125.8$, $p < .001$; a main effect of grade level, $F(1, 146) = 4.7$, $p < .05$; and an effect of language, $F(2, 146) = 12.6$, $p < .001$. A post hoc test (Scheffé,

TABLE 3.1
The Participants

<i>Language</i>	<i>Grade Level</i>	<i>N</i>	<i>Mean Age</i> <i>Mean Age</i>	<i>SD</i>
English	3	30	7,4	0,4
(Scottish)	4	30	8,6	0,4
German	1	13	7,5	0,6
(Austrian)	2	20	8,3	0,4
	3	20	9,1	0,4
	4	19	10,4	0,4
Danish	3	19	9,11	0,4
(proper)	4	34	10,8	0,6

TABLE 3.2
Mean Reading Accuracy of Nonwords With Complex Consonant Graphemes, Consonant Clusters, and Simple Consonant Graphemes in Three Languages

Language	Grade Level	Consonant Graphemes		
		Digraphs	Clusters	Simple
English	3	53.7 (26.6)	73.3 (27.9)	74.3 (24.0)
	4	62.2 (20.3)	80.0 (22.5)	82.7 (18.4)
Danish	3	57.9 (23.3)	70.2 (24.9)	77.8 (24.6)
	4	70.6 (21.9)	84.3 (20.7)	87.9 (15.1)
German	1	67.3 (27.7)	—	92.3 (12.0)
	2	73.8 (19.0)	—	92.5 (18.3)
	3	80.0 (17.4)	—	93.8 (13.8)
	4	81.6 (14.0)	—	92.1 (16.8)

Note. Standard deviations are given in parentheses.

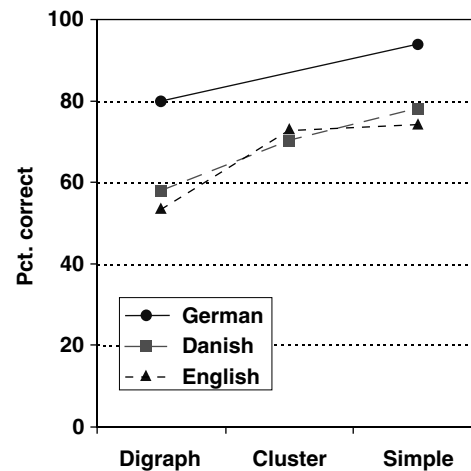


FIG. 3.1. Reading accuracy in grade 3 in three languages with words containing digraphs (e.g., *shig*) compared with consonant clusters (e.g., *spig*) and simple consonants (e.g., *deg*).

$p < .05$) indicated that the language effect was caused by significantly higher scores in German than in both Danish and English. None of the interaction effects was significant.

The results of this study support three general hypotheses. First, it is obvious that German children who learn to read a relatively shallow orthography by means of a synthetic phonics approach develop basic decoding skills more rapidly than do English and Danish children.

Second, the results support the hypothesis that deviations from the basic alphabetic principle—that each grapheme represents one phoneme—are acquired more slowly. These letter patterns challenge beginning readers in all alphabetic orthographies regardless of the depth of the orthography. Not only English and Danish children were affected by complex graphemes; readers of the more regular German orthography were also affected. It should also be noted that the complex graphemes had a disruptive effect on children's reading even though the complex graphemes have predictable pronunciations in both Danish and German.

Third, the results are in accordance with the general idea that reading development starts with the acquisition of the basic alphabetic principle, that is, learning the phonemes associated with each letter of the alphabet.

The Alphabetic Principle 2: Letter Patterns

As spoken Danish has continued to develop, orthographic conservatism has resulted in many inconsistencies between spelling and sound. Many of these orthographic complexities are nonetheless rather predictable because the changes in pronunciation have occurred in similar sound contexts across many words. The general development means that regularities may still exist between *strings* of letters and the corresponding *strings* of sounds—even though the *individual* grapheme–phoneme relationships have become opaque. For example, consider how the standard sound of written *o* and *ou* is modified by context in English (collected from Carney, 1994):

- o- → /ɒ/ (*hot, mob*)
- ou- → /aʊ/ (*doubt, about*)
- ough → /ʊ/ (*though, dough*)
- ought → /ɔ:/ (*ought, thought*)

Note that the letter pattern *-ought* has a completely predictable pronunciation as a whole (this rime is pronounced the same way in all words) although the individual letters of the pattern have mostly nonstandard pronunciations. Another example is the so-called magic *e-* rule in English. A final *e-* changes the vowel in words like *cape* and *bite* from the short standard sounds /æ/ as in *cap* and /ɪ/ as in *bit* into tense (long) variants, /eɪ/ and /aɪ/. In other words, *a* and *i* receive *conditional* pronunciations in words with final *e*'s.

Similar situations exist in most alphabetic orthographies, even though they many not have as many in English. The regularities of letter patterns exist *above* the single-letter–sound level, but *below* the morphemic and lexical levels. Implicit knowledge of letter patterns is likely to be an important part of the internalized orthographic code (or the *cipher*). An overview of the most common letter patterns in Danish may be seen in Elbro (2001, p. 78–79). A detailed account of Danish letter-to-sound correspondences is provided in Becker-Christensen (1988).

The acquisition of regular letter patterns (such as *-ought* and *-ake*) was studied with the same groups of schoolchildren who took part in the preceding study of digraphs. The study focused on patterns in which the vowel letter receives a conditional pronunciation, because such patterns are very common in Danish. The expectation was that words with conditional vowel pronunciations would be more difficult to learn than words with standard pronunciations—indicating that conditional pronunciations are learned *later* than standard pronunciations. The materials were nonwords with vowel letters with a conditional pronunciation (e.g., *pake*) and matched nonwords in which the same vowel letters had standard pronunciations (e.g., *pask*). The English part of the study was also conducted with real words. The materials are listed in the appendix.

The results showed significant effects of letter patterns with conditional letter sounds in both languages and at each grade level (Elbro et al., 2000; Juul & Elbro, 2001) (see Fig. 3.2). A repeated-measures ANOVA with two word types × two languages × two grade levels showed a significant main effects of word type, $F(1, 109) = 81.7, p < .001$; grade level, $F(1, 109) = 8.7, p < .01$; and language, $F(1, 109) = 8.1, p < .01$; and a significant interaction effect of word type and language, $F(1, 109) = 8.4, p < .01$. The analysis thus suggests that nonwords such as *pake* were significantly harder to read than nonwords with standard sounds such as *pask* for both third and fourth graders. The same was found with English real words, even

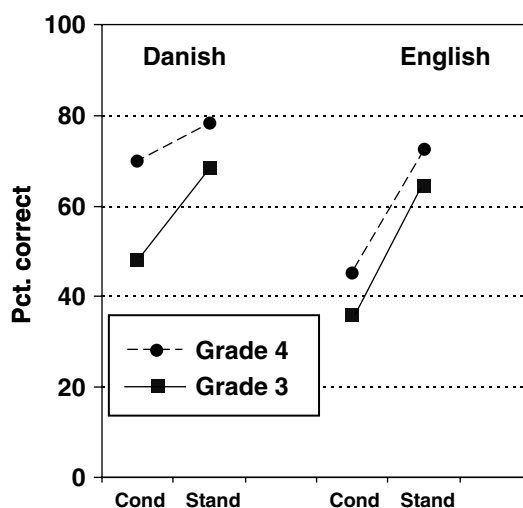


FIG. 3.2. Reading accuracy with words with conditional versus standard vowel letter sounds. Means are shown for grades 3 and 4 in Danish and English.

though the effect was significantly smaller in Danish. This difference in orthographic effect suggests that Danish children are about to master the conditional vowel grapheme–phoneme rules by Grade 4 whereas the English-speaking children have a longer way to go.

The fact that words with conditional pronunciations are relatively difficult indicates that orthographies with such conditional pronunciations are more difficult to learn than other, more regular orthographies. The parallel results for Danish and English suggest that letter patterns with conditional vowel letter pronunciations are a general problem, regardless of the language.

Vowel Length

The orthographic representation of vowel length is no problem in Latin because vowel length is not distinctive. It is, however, a potential problem in Germanic languages and in many other languages (including Finnish and Greenlandic) in which vowel length (or tenseness) is distinctive. Many languages use more than one way to represent vowel length. A simple doubling (gemination) of a letter that represents a long sound (as opposed to a short one) would seem the most straightforward way. This is the principle used by both Greenlandic and Finnish, which have very regular orthographies. Nevertheless, the acquisition of the representation of phoneme length appears to be a problem in both languages (e.g., Jacobsen, 1994). The difficulty may be similar to the one with digraphs—two letters representing one sound.

The most common way of representing short, stressed vowels in Danish is by *consonant doubling* (in polysyllabic words). It works as in English to distinguish between, for example, *bitter* with a short (lax) vowel and *biter* with a long (tense) vowel. The convention is, of course, used very frequently. Not surprisingly, it is also acquired from an early point in both reading and writing Danish (Elbro et al., 2000; Juul, 2004).

One major problem in Danish orthography is that the convention for representing vowel length is not used consistently with unstressed vowels. Although it is relatively safe to assume that double consonants are preceded by a short vowel in Danish, a single consonant is less reliably associated with a long vowel. Therefore, for unstressed vowels, word-specific knowledge is needed, and this is acquired rather slowly (Juul, 2004).

Rime Analogy Is Not a Flotation Device

The orthographic rime comprises the vowel letter and the consonants that follow it. The status of the rime in the development of decoding is controversial (e.g., Bowey, Vaughan, & Hansen, 1998). On the one hand, it is clear that many regular orthographic patterns coincide with the rimes; and it is generally the case that consonants after the vowel exert greater influence on the pronunciation of the vowel than consonants before the vowel. On the other hand, there is such a large number of different rimes that it would seem a rather uneconomic strategy to try to internalize their individual pronunciations.

A more economic strategy would be to internalize the *minimal* letter patterns that predict a conditional pronunciation. For example, in Danish it would be economic to remember the conditional pronunciation of *-u* as /ʊ/ when it is followed by an *-m* (as opposed to the standard pronunciation /u/ as in *bus* [bus]). This minimal rule would cover several rimes at once, for example, *-umf*, *-ums*, and *-umt*, in addition to the simple *-um*. Therefore, each of these rimes and their pronunciations would *not* have to be stored separately.

The presence of a digraph in the rime should *not* pose any particular problem to the reader if the rime is recognized as a whole. In such cases, the frequency of the rime as a whole would be an important predictor of how easily the word is read. On the other hand, if rimes are not recognized as wholes, their internal structure is likely to play a role. In that case, the frequency of digraphs in the rimes will be an important predictor of how easily the word is read. These two hypotheses were assessed by means of the data from the study of the impact of digraphs. A plot of the relation between digraph frequency and reading accuracy is shown in Fig. 3.3(a), and rime frequency is plotted against reading accuracy in Fig. 3.3(b). The Danish reading data are averages across Grades 3 and 4.

It is clear that the frequency of the digraphs [Fig. 3.3(a)] provided a much better fit to the reading scores than did the frequency of the rimes [Fig. 3.3(b)]. Unfortunately, the English words were not ranked differently according to digraph and rime frequencies, so a comparison

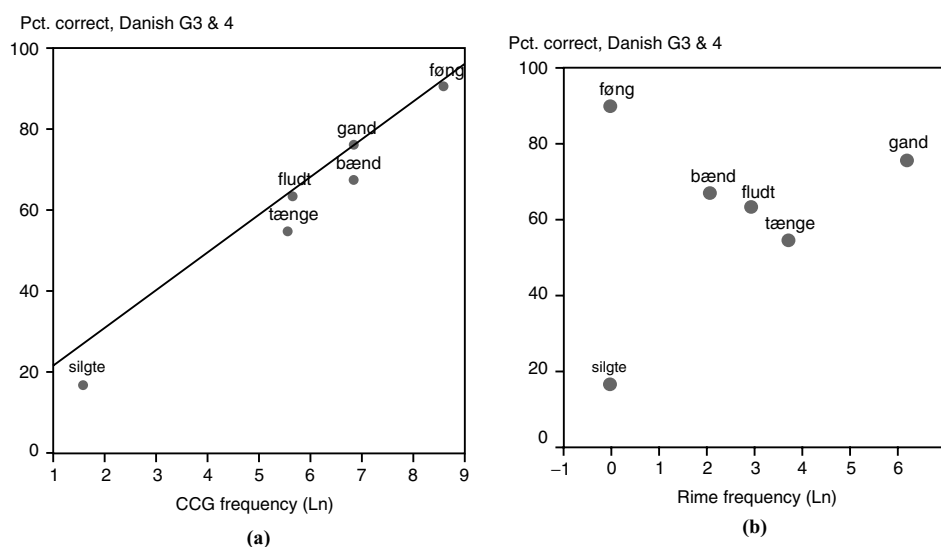


FIG. 3.3. (a) Reading accuracy in Danish plotted against the frequency of the complex consonant graphemes (CCGs.) in the words; (b) the same reading performance but now plotted against the frequencies of the rimes that contained the CCGs.

TABLE 3.3
Danish Study of Effects of Rime (VCC) vs. Small Unit (VC) Frequency

VC	Rime	
	+ Frequent	– Frequent
+ Frequent	–ink ...	–ins ...
– Frequent	–uft ...	–ums ...

is not possible. However, the Danish results suggest that digraphs are dealt with as problem units rather than as an integral part of the whole rime.

A study by Shkoza (2000) confirmed this result. She studied the effects of planned contrasts between words with high- versus low-frequency rimes and high- versus low-frequency vowel–consonant combinations. (See Table 3.3 for an overview of the contrasts with examples of rimes). In this comparison, all the test words had conditional vowel pronunciations; but there were also some filler words with standard vowel pronunciations. The participants were Danish school children from grades 2 to 4.

The results were very clear in that only the frequency of the relevant spelling pattern (the vowel–consonant combination) influenced reading accuracy. The rime frequency of which the pattern was a part did not.

Again, these results are in line with the general idea that children adopt a principle of economy as they internalize the conventions of the orthography. Small orthographic units are more productive, and hence more economical, than large units.

Nonetheless, whole rimes may be useful entities in reading instruction. The corresponding rhymes are easily accessible and well known from poetry and language games. Therefore the regular spelling of some rimes may be useful for demonstrations of regularities above the single-letter level. It is unlikely, however, that *rhyme analogy* in general is a major strategy in reading development in Danish—even though Danish orthography has many irregularities.

BOYS WILL BE BOY'S

The Morphemic Principle in Spelling

Sometimes spelling reflects the morphological structure of the word rather than just the phonemic structure. The smallest meaningful unit, a morpheme, may sometimes be spelled in only one way in spite of variations in pronunciation, as is the case with the *-ed* past-tense ending that is pronounced /d/, *beamed*; /t/, *dropped*; or /ɪd/, *rested*; depending on the end of the verb root. In the case of the *-ed* ending, the morphemic principle overrules the phonemic principle and causes the orthography to increase in depth.

Learning to use the morphemic principle appears to be a long-lasting problem for Danish schoolchildren. The problems in Danish are similar to problems in English. Danish also has a number of homophones that are spelled differently. For example, verbs with roots that end in *-r* (e.g., *bor* [the root of *drill*]) have identically sounding infinitives and present-tense forms that are spelled differently, *at bore* [to drill] and *borer* [drills], respectively. The derived noun, *en borer* [a driller], is also a homophone. Other examples are the homophones *-ene* (plural

definite noun) versus *-ende* (present participle of verb) and *-ed* (end of some noun roots) versus *-et* (past participle of verbs). These word endings can be spelled correctly only by reference to the morphological structure.

In a cross-sectional study of 142 Danish students from Grades 4, 6, 8, and 10, Juul and Elbro (2004) found that the silent *r* and similar morphologically determined letters were applied correctly in only about 50% of the items, even by children in Grade 8; by Grade 10, their accuracy was about 90%. When errors occurred, it was almost always because students provided a standard spelling of the sound pattern they heard. Hence the results of the study indicated that morphological spelling knowledge is indeed acquired over a long period of time.

SEEING READ IN READY

The Morphemic Principle in Reading

The role of morphological decomposition in decoding is a controversial issue. However, once the reader has learned to recognize the root word such as *read*, this orthographic knowledge would be helpful in reading words that contain that root (e.g., *reads*, *reading*, *reader*, *unreadable*, *readability*, etc.).

A major problem with prelexical morphological decomposition is that it cannot distinguish between real morphemes and pseudomorphemes. Before a word is recognized, it is impossible to know whether or not a particular letter string is in fact the morpheme it looks like. For example, *read* might be a root in *ready* but it is not, and *car* might be a root in *carrot* but it is not. As pointed out by Taft (1981) and others, high-frequency prefixes may facilitate decoding based on morpheme analysis; but the evidence is not very strong.

However, morphological analysis may be used as a compensatory strategy by dyslexic readers. In one study, Elbro found that dyslexic adolescents rely more on morphological word structure than do younger typical readers with a similar level of word decoding ability (see Elbro and Arnbak, 1996). In comparison, there was a significantly smaller effect of morphology on a group of younger typical readers matched for reading level (Elbro, 1990).

WORD-SPECIFIC SPELLING–SOUND RELATIONS

When spelling patterns and the morphemic principle are taken into account, deep orthographies are not as unpredictable as they might seem at first. Nevertheless, Danish has very many words in which one or more letters have unique pronunciations. This is the case for some highly frequent words that have preserved their odd spelling precisely because they are so common, for example Danish *de* [they] pronounced with an /i/ rather than standard /e/ or /e/, or any of the conditional pronunciations. Other examples are Danish *af* [of, from] with a silent *f*, *kobber* [copper] with /w/ for written *b*, and *otte* [eight] with a nonstandard, long vowel /ɔ:/ for written *o*. In addition, there are numerous words of foreign origin that have preserved their non-Danish spellings. Examples are relatively new loan words from French and English such as *mayonnaise*, *gear*, and *juice* (the unique spellings are emphasized).

In addition to these words with unique spelling-to-sound relationships, there are many inconsistent spelling patterns in Danish (as in English). For example, the *-uk* pattern is pronounced /ɔk/ in some words (e.g., *luk* [close]) and /uk/ in other words (e.g., *kluk* [cluck]). As a consequence, the reader needs lexical orthographic knowledge.

The general framework for understanding reading development put forward in this chapter would predict that such word-specific spellings are acquired late in reading development. Unfortunately, there are very few studies of reading in Danish that have tested this prediction. There is good evidence from English, however, that word-specific orthographic knowledge

is indeed acquired relatively late (when word frequency is controlled). Zinna, Liberman, and Shankweiler (1986, exp. 1) studied children's reading of three types of words: words with standard letter sounds (e.g., *green, paint*), words with consistent spelling patterns (e.g., *beach, mount*), and words with inconsistent spelling patterns (e.g., *steak, touch*). It was very clear that children in Grades 3 and 5 made many more errors in the words with inconsistent spelling patterns than in the words with consistent patterns, whereas the words with standard letters sounds were the easiest. Not surprisingly, these differences were especially large for low-frequency words. The results suggest that word-specific letter pronunciations are indeed learned later than words with consistent letter-sound patterns.

One Danish study has compared acquisition of spelling patterns and word-specific spelling (Juul, 2003). In this study, 140 children in Grades 4 and 6 were asked to spell words with consistent standard spellings (e.g., /i/ spelled *i*), words with consistent conditional spelling (e.g., /e/ spelled *i* before /s/), and words with inconsistent spellings (e.g., /ε/ spelled *æ* before /s/). Both vowels and consonants were studied as the critical segments of the words. The results supported the hypothesis about the developmental sequence: Proficient spellers were at or near ceiling with both standard spellings and consistent conditional spellings, but less adept with the word-specific spellings. Poor spellers were good at standard spellings, but lagged behind in both consistent conditional spellings and word-specific spellings. Together, the results are in line with the general idea that the acquisition of orthographic knowledge starts with standard letter-sound relationships and progresses toward less common and less productive orthographic patterns.

CONCLUSIONS

Danish is a Germanic language with a comparatively deep orthography. Reading and writing are usually taught by a mixed approach in Danish schools. Hence Danish has some basic similarities with English, and Danish children would be expected to acquire reading and writing abilities in ways that are somewhat similar to those of English-speaking children—even though Danish children do not receive formal instruction in reading until the age of 7 years. The available evidence summarized in this chapter suggests that initial reading and spelling development in Danish is, indeed, similar to that of English.

Almost all comparisons between reading in English and in other languages have focused on differences that are hypothesized to be consequences of the deeper English orthography. Comparisons with Danish are particularly interesting because they make it possible to see whether the orthographic complexities that are generally presumed to be a challenge to English readers are also problems to readers in other languages. Some complexities such as digraphs exist even in shallow orthographies such as German. There is now some evidence that digraphs do seem to be a challenge across orthographies—even when there are few of them and even if the orthography is shallow. This finding has far-reaching implications. One implication is that such possibly universal complexities may reflect universal phases (or trends) in reading development: Some aspects of orthographies (the complexities) are learned *after* the standard grapheme-phoneme correspondences are learned. Another implication is that cross-orthographic complexities provide a metric for comparisons of the relative difficulty of orthographies; in principle, it is possible to measure the complexities of orthographies.

The complexities of the Danish orthography are obviously not mastered all at once. The results from recent studies of reading and spelling acquisition in Danish conform to a general framework for the development of reading and writing: Short letter patterns are learned more quickly than patterns comprising many letters, and consistent (reliable) patterns are learned more quickly than inconsistent ones.

At least four different developmental waves can be distinguished during literacy development in Danish (and English) (cf. Siegler, 1986):

Wave 1. Learning of Single-Letter–Single-Sound Correspondences. The dominant strategy during the initial phase of learning to read and write is to associate one sound with one letter and one letter with one sound. The preferred sound is often the one present in the letter name. This strategy results in problems with digraphs and all other forms that deviate from simple letter–sound relationships.

Wave 2. Learning of Letter–Sound Patterns With Conditional Pronunciations. Conditional pronunciations (e.g., *mat, mate; rat; rate*) are learned at first in the smallest possible units (e.g., vowel–consonant combinations) rather than as part of bigger units (e.g., rimes).

Wave 3. Learning of Spelling Based on Morphemic Orthographic Knowledge. These patterns are acquired relatively late. Even the spellings of some frequently occurring morphemes continue to be a challenge when they are distinguished in spelling, but not in pronunciation, such as the genitive apostrophe in English or the present tense *–r* in Danish. However, some morphographic units with invariant spelling of morphemes, such as the *–ed* verb ending, are learned earlier.

Wave 4. Learning of Word-Specific Orthographic Patterns. This is a lifelong process. Needless to say, some high-frequency words are learned as whole patterns (“sight words”) from the very beginning of reading development. Although the orthographic representations of individual morphemes (or words) may be recognized following only a few presentations, there are so many of them that their acquisition is never really complete.

APPENDIX

Materials in the Study of Digraphs

<i>Language</i>	<i>Digraph</i>	<i>Consonant Cluster</i>	<i>Simple Consonant</i>
Danish	sjål	spål	jål
	føng	føsp	føm
	gand	gasp	gan
	hvam	svam	vam
	hjælle	pjælle	jælle
	tænge	tækle	tæse
	silgte	silste	silte
	bænd	bælk	bæn
	fludt	flusk	flut
English	shig	spig	peb
	dack	besk	cag
	ladge	dand	pon
	knop	skop	mun
	wemb	famp	bip
	ling	twid	tud
	shid	spid	deg
	dotch	twonk	pon
	wrin	trin	rit
German	schore		sore
	bung		bun
	dech		def
	kosch		kos

Materials in the Study of Conditional Vowel Letter Sounds

<i>Language</i>	<i>Conditional</i>	<i>Standard</i>
English	pake	pask
	bline	blin
	clind	clend
	nold	nond
	peather	deacher
	wab	wak
	squas	squag
	whap	whang
	rall	bramp
	hode	hont
	dyth	yath
Danish	kotter	søtter
	fumme	jalle
	ginse	hamse
	gosse	goser*
	vunke	biffe
	tummer	siffen
	tejser	fæbes*
	mølse	dæske
	gimme	mæsle

*Two Danish nonwords with long vowels gave rise to many errors. They were subsequently left out of the data analyses.

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4

Children's Language Development and Reading Acquisition in a Highly Transparent Orthography

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In this chapter we discuss the relation between early language skills and reading acquisition in the context of the Finnish language. Roughly one third of Finnish children acquire reading skills before school entry; apparently in part because of the transparent nature of the Finnish orthography and also in part because of the availability of written material in the home and children's attendance at day-care centers. The results from the Jyväskylä Longitudinal Study of Dyslexia (JLD, Lyytinen et al., 2004) which we summarize in this article reveal that, although the process of acquiring fluent reading in Finnish can be relatively effortless, a number of children still face problems in mastering reading skill. Approximately 6% of children do not achieve accurate reading skill when 90% accuracy in reading pseudowords is used as the criterion. The reasons for such reading difficulties in Finnish children are attributed at least in part to speech processing problems which compromise language development and acquisition of reading and challenge achievements in spelling accuracy and reading fluency. Every reader of Finnish is affected by the agglutinative nature of the language which results in longer than average word length. Finally, the role of phoneme awareness in reading Finnish in comparison to less regular orthographies is examined.

FINNISH ORTHOGRAPHY FACILITATES THE ACQUISITION OF BASIC DECODING SKILLS IN MOST CHILDREN

In this section we describe the features of Finnish orthography that may have an effect on the development of early literacy skills. For a more detailed description, see Lyytinen, Aro, and Holopainen (2004).

Grapheme–Phoneme Correspondences in Finnish. In the Finnish orthography, the grapheme-phoneme (G-P) correspondences are regular and symmetrical. There are 21 Finnish phonemes: 8 vowel phonemes¹ (/i/, /y/, /u/, /e/, /o/, /ö/, /ä/, and /a/) and 13 consonant

¹ The graphemes *y*, *ö*, and *ä* mark front vowels /y/, /œ/, and /æ/, respectively.

phonemes (/p/, /t/, /k/, /m/, /n/, /l/, /r/, /s/, /h/, /j/, /v/ and more marginal /d/ and /ŋ/). Three additional “foreign” consonant sounds (/b/, /g/, /f/) are used in recent loan words. The phoneme /ŋ/ is marked with the letter *n* when short in front of /k/ (in combination *nk*) and as a bigraph *ng* when long. Other phonemes are marked with a corresponding single-letter grapheme. Thus the number of letters with a corresponding phoneme is 23. As already mentioned, all of these G-P correspondences are regular in both directions.

Phonemic quantity is a distinctive feature in Finnish word production. All phonemes (with the exception of /d/, /h/, /j/ and /v/) can have two phonological lengths, long and short. Thus words like *tuli* (tuli) [fire], *tulli* (tul:i) [customs], and *tuuli* (tu:li) [wind] have different meanings. The long quantity is marked by the doubling of the corresponding letter. With regard to articulation, the stop consonants /p/, /t/, and /k/ are lengthened by a longer voiceless occlusion before the explosion of the sound.

Syllables in Finnish. There are 10 types of syllables: CV, CVC, CVV, CVVC, VC, V, VV, CVCC, VVC, and VCC. The number of distinct syllables in Finnish is estimated to be slightly over 3,000. Open syllables are more frequent than closed syllables. A syllable (or a word) never begins with a consonant cluster, with the exception of some loan words such as *traktori* (*tractor*). Consonant clusters can appear at the end of the syllables but not at the end of the word. The longest syllables consist of four phonemes.

In spoken Finnish, the main stress is placed on the first syllable, and the secondary stress on the third, fifth, etc., that is, on every second syllable of words (with some exceptions), and the final syllable is always unstressed. Because of this regular stress pattern, the syllable is a perceptually salient unit in the segmentation of spoken language. The basic rule for syllabification in reading is that there is a syllable boundary before every CV- combination (e.g., par.ta, kat.to, kelk.ka). Syllabification of written words closely matches the phonological syllable segments of spoken words. However, in the case of stop consonants, the syllabification does not perfectly correspond to phonological syllable segments of spoken language.

Explicit segmentation of syllables forms a central component of early reading and spelling instruction, and syllables are explicitly delineated in the reading materials of beginning readers. Because words can be quite long, working memory capacity is easily exceeded at the level of the phonemes. The standard instruction methods guide children in the use of the syllable as a substage of assembly, thus reducing the memory demands during recoding.

Words in Finnish. Almost all Finnish words are multisyllabic. There are only approximately 50 monosyllabic words, and most of these are conjunctions and interjections. Because of highly productive compounding, a rich derivational system, and agglutinative and fusional morphology, the words tend to be relatively long. The mean length of a written word is 7.86 letters and correspondingly contains about the same number of phonemes (Pääkkönen, 1990). The agglutinative and fusional morphological system results in words that contain multiple segments of semantic information, as can be seen in the following examples:

taloissani [in my houses]

stem	plural	case	possessive
talo	+i	+ssa	+ni

or *näytettyämme* [after we have shown]

stem	derivative	past participle	case	possessive
näy	+te	+tty	+ä	+mme

Any noun can have over 2,000 orthographic forms with different combinations of case (15), plural marker, possessives (6), and a variety of clitics. This number is even higher for verbs.

When one takes into account derivation and compounding, the same stem can exist in a large number of orthographic contexts. Because the morphology is also fusional, the stem may have several different allomorphs depending on the inflection (e.g., *käsi* [hand], *käde*+*n*, hand+genitive, *kät*+*tä*, hand+partitive). On the other hand, the same stem can be used in several words, for example, *kirja* [book], *kirjoittaa* [write], *kirjain* [letter], *kirjailija* [author], and *kirjasto* [library]. These allomorphic variations and derivational affixes force readers toward careful phonemic analysis of words, but the variation also adds to the predictability in reading: The stem forms limit the range of the following suffixes, the phonemic variation of the suffixes depends on the stem, and transparent derivations form semantic networks that can benefit semantic analysis. Affixes, on the other hand, frequently occur in the language (across words) and also reinforce their acquisition in writing. Because small morphemic chunks are semantically distinct, children learn to recognize them even though their critical parts may be only one phoneme/letter in size. This may be helpful in the acquisition of spelling skills.

Finnish orthography differs in many ways from that of English. The features of the orthography that may have an effect on reading development and the nature of reading problems in general are described in more detail toward the end of this chapter. Finnish is an extremely regular and purely phonemic orthography. It stands in stark contrast to English which is one of the most irregular orthographies and relies on morphological information at the expense of phonemic information. In Finnish, the G-P correspondences are regular and symmetrical at the level of single letters (23 phonemes that map onto single letters and one phoneme that is represented by a digraph). The syllables are simple, and consonant clusters are relatively rare, whereas diphthongs and vowel combinations are relatively frequent. Because of the agglutinative nature of morphology, Finnish words are relatively long and can have different orthographic forms depending on the derivational or inflectional suffixes. An exciting feature of Finnish is the variation of phonetic duration which can vary substantially but the proportion of which within a word is in a key position for semantic distinctiveness (for details, see Lehtonen, 1970; Richardson 1998, Richardson, Leppänen, Leiwo, & Lyytinen, 2003). It is a feature of interest to reading research, as we subsequently demonstrate (for a closer review, see Lyytinen, Leppänen, Richardson, & Guttorm, 2003).

The acquisition of phonological recoding skill seems to be a major difficulty for beginning readers in irregular orthographies such as English (Seymour, Aro, & Erskine, 2003). Nonetheless, a number of Finnish children also struggle with the acquisition of literacy skills, albeit of such a transparent, alphabetic orthography. This means that even when the acquisition of phonological recoding skill is facilitated by the orthography, there are obviously other obstacles that hinder mastery of accurate reading and spelling and also fluent reading. This could mean that the language-related background of developmental reading problems is wider than is being postulated in theories that emphasize the exclusive role of phonology. On the other hand, the subsets of phonological skills of relevance to early reading skills may be more dependent on the language and orthography than has been generally thought thus far. From this perspective, knowledge from different orthographies adds to our knowledge of reading development and, it is hoped, helps toward our understanding of the true universal nature of developmental dyslexia.

ASSESSING THE LANGUAGE BASIS OF FAMILIAL RISK FOR EARLY READING FAILURE

In the Jyväskylä Longitudinal Study of Dyslexia (JLD), we began the follow-up study of children who were at familial risk for dyslexia ($N = 107$) and their controls ($N = 93$) from

birth and follow them into school age. We assessed the contribution of quantity-related aspects such as difficulty in discriminating phonemic quantity in speech processing during infancy. Three types of experimental approaches were used: (a) recording brain event-related potentials (ERPs) to sounds and speech stimuli, (b) assessing categorical perception of variations of speech sound by use of behavioral head-turning techniques, and (c) assessing the ability of children to imitate minimal pairs such as *mato* (mato) [worm] and *matto* (mat:o) [rug].

In addition to concentrating on this special quantity feature, we also conducted more global and intensive assessments of early language development in the JLD. We followed language production and comprehension by using structured parental reports of vocalization and vocabulary growth during the first years. We assessed vocalization by identifying the ages at which infants reached important, established milestones (P. Lyytinen, Poikkeus, Leiwo, Ahonen, & Lyytinen, 1996). Assessment of vocabulary growth was conducted in terms of both production and comprehension of spoken items. This type of assessment was based on the use of the MacArthur Communicative Development Inventories (CDI; Fenson et al., 1994; P. Lyytinen, Poikkeus, Laakso, Eklund, & Lyytinen, 2001) and the Reynell Developmental Language Scales (RDLSs; Reynell & Huntley, 1987). The CDI covered the ages from 1 to 2.5 years; the RDLS was administered when the children were 18 and 30 months old. This test validated the parental reports (based on the CDI) of their children's receptive and expressive language (P. Lyytinen, Poikkeus, & Laakso, 1997). In addition, the development of symbolic play was followed when the children were between the ages of 14 and 18 months (P. Lyytinen, Laakso, Poikkeus, & Rita, 1999).

The parental reports of the ages at which their child's developmental milestones of vocalization and later language production and comprehension were reached revealed no significant group differences before the age of 2 years. At 2 years of age, a child's maximum sentence length was the first measure that showed a difference (P. Lyytinen et al., 2001) between the groups. In addition, early symbolic play assessed when the toddler was 14 months old revealed significant correlations to subsequent language development (P. Lyytinen, Eklund, & Lyytinen, 2003; P. Lyytinen et al., 2001).

Our findings showed that assessments carried out during infancy may give indications concerning future reading readiness. ERPs to speech sound obtained immediately after birth differentiated children with and without risk for dyslexia (Guttorm, Leppänen, Richardson, & Lyytinen, 2001) and revealed cues about critical brain processing features associated with later language development and reading. These ERP-indices predicted reliably later global language composite scores (Guttorm et al., 2005). The predictive ERPs were based on contrasts between responses to syllable sounds that differed in temporal features such as voice onset times (ba, da, ga). Responses to /ga/ especially differentiated the groups and predicted later language development. The results were linked to duration whereby the formant transitions (specifically of F2) of the synthetic consonant sounds were longest (45 ms) in /ga/. It has to be emphasized that, in Finnish, the voiced /b, d, g/ and the voiceless stops /p, t, k/ are not in phonological opposition, and hence the differences are subphonological.

The next analysis was specifically associated with duration-specific processing because the critical stimuli differed from each other in vowel duration (/ka/–/ka:/). Here, as in our later ERP-studies, an oddball paradigm was used to assess brain responses to an infrequent deviant syllable presented among repeated syllables. The difference (deviancy from repeated sounds) of interest was the increase or decrease of duration. Preliminary analyses of the data reveal that, already at birth, babies' differential responses to duration discriminate the groups. However, only results from the next age of assessment—6 months of age—have thus far been analyzed in detail to document differences related to processing vowel duration between children who were and were not at risk (Leppänen, Pihko, Eklund, & Lyytinen, 1999).

Also at the age of 6 months, babies' processing of stop consonant duration (based on a longer silence associated with the long consonant sound and reflected in the brain responses) was assessed by use of the pseudowords /ata/ and /atta/ as repeated and deviant stimuli. The results clearly differentiated the groups (Leppänen et al., 2002). The lengthening of the duration of /t/ affected the ERP-response in both hemispheres of all children. However the amplitudes were reliably higher in the left hemisphere of the children in the control group. The ERPs of the at-risk children tended to respond to the deviant sound mainly in the right hemisphere. Preliminary analyses also reveal that ERP responses to /ata-atta/ stimuli have a significant correlation with later language development in the at-risk groups.

From different experiments, the ERPs of the at-risk children tend to agree on one issue: The differential brain processing of speech stimuli between groups seems to be dominantly related to hemisphere-specific differences (for a review of the early ERP-results from the JLD, see Lyytinen et al., 2003). When compared with the left hemisphere, the right hemisphere of children who were at risk for reading failure was more active than in children who were not at risk.

The JLD children were studied in their categorization of duration on a short to long /ata-atta/ continuum with a head-turning paradigm. The infants were 6 months of age. It transpired that at-risk children had clear difficulties in perceiving durational cues indicating the change from short to long sound, just like the adults with dyslexia (see Richardson, Leppänen, Leiwo, & Lyytinen, 2003). What makes both ERP and these behavioral results especially interesting is the association of the ERPs of interest (especially the hemispheric difference) with the behavioral results from behavioral categorical perception studies at the same age. Richardson et al. (2003) showed that children require 30 ms or more of a longer silence (the cue making consonant sounds such as /t/ to be perceived as long) for perceiving the /t/ phoneme as crossing the categorical border between short and long. The association between ERPs in the oddball situation to the lengthening of the same sound and its categorical perception is especially clear among at-risk children.

The imitation experiments of the 18-month-old JLD-children (Richardson, 1998) showed that the children were able to imitate the temporal aspects of quantity distinction in a similar manner. It seems, however, that both the dyslexic adults and the at-risk children had more difficulties in the production of the durational cues of length in word-final vowel phonemes in the studied CVCV and CVCCV structures.

LANGUAGE DEVELOPMENT AND EARLY ACQUISITION OF READING

Several early language related skills correlate to reading at the early school age (see Table 4.1.). A reliable association is seen between early receptive speech and reading. However, the most strong correlations are between letter naming and reading reaching at best a level of .5 to distributionally very well-behaved text reading measures at the end of the first grade, four years after the predictor was assessed. The table shows that also expressive speech—maximum sentence length at 2.5 years of age and inflectional skills assessed using a Berko type task tapping language skills in a little bit wider sense—have highly significant correlations.

The most thoroughly analyzed production data related to early phonological development of the JLD children come from the examination of word-production skills, especially of how accurately the children produce words in spontaneous naming behavior within a play context. Turunen (2003) analyzed words produced by the children of the JLD at the age of 2.5 years. She failed to find any significant differences between the at-risk group and the control group in their production of correct word structures in the naming of familiar objects, or in the total number

TABLE 4.1
Correlations for Early Language Measures, Reading and Spelling During the First Grade.

<i>Early Language Measures</i>	<i>Reading Measures at School</i>			
	<i>At the End of First Semester</i>		<i>At the End of Second Semester</i>	
	<i>Word Recognition</i>	<i>Spelling Pseudowords</i>	<i>Reading (a Story)</i>	<i>Spelling Pseudowords</i>
<i>1.5 years</i>				
Symbolic play at 14 months	.14*	.22**	.12	.09
Vocabulary production	.15*	.24**	.08	.16*
<i>2.5 years</i>				
Maximum sentence length	.27**	.28**	.29***	.19*
Reynell receptive	.30***	.29***	.24**	.23**
<i>3.5 years</i>				
Inflectional morphology	.28***	.33***	.22**	.27***
Letter naming	.38***	.27***	.48***	.17*

Note. Ns from 145 (JLD children assessed at the end of the second semester) to 196 (first semester).

* $p < .05$, ** $p < .005$, *** $p < .001$.

of named items. The examination covered the production of four- and three-syllable word structures, heavy unstressed syllables, homorganic and heterorganic consonant sequences and diphthongs, and the phonemes /r/ and /s/. It may be that possible group differences between at-risk and control children can be observed only in linguistically more demanding tasks such as pseudoword repetition, or in more detailed phonetic analyses.²

There were statistically significant differences between the groups in relation to reading before they entered the school (Turunen, 2003; see Table 4.2). Approximately one third of Finnish children can read before entering school, one third have no obvious reading skills although they may know a lot of letters, and one third have some preliminary blending ability (e.g., in their readiness to spell their own first name). At the age of 2.5 years, children's speech production accuracy differed reliably among these three groups of the JLD, who were identified just before the start of formal reading instruction and labeled as non-readers, middle group, and early readers. Early readers clearly produced more target items than did middle and poor readers. The groups also differed significantly in the production of word level phonological structures such as four- and three-syllable words and heavy unstressed syllables.

No differences were found in the production of difficult heterorganic consonant clusters, with the exception of diphthongs, and phonemes /s/ and /r/. These word-level measures also significantly predicted spontaneous reading acquisition. It must be noted, however, that the correlations become markedly smaller soon after children have been exposed to reading instruction.

P. Lyytinen et al. (2001) showed that a substantially higher number of members identified as late talkers at 2 years of age among the familial risk group compared with similarly defined late talkers of the control group failed to reach the age norm in language during the next

² It must be noted, however, that apparently no more than half of the children in the group will really be affected and face reading failure. This means that the assessment should be quite reliable and the differences quite robust in order to reach statistical significance.

TABLE 4.2

Phonological Production at Age 2.5 Years of Poor, Middle, and Early Readers at the Age of 7 Years. The Attempts to Name (Namings) and the Number of Accurate Productions of the Labeled Feature are Listed.

Naming Categories	Skill Level of Reading			F-Value
	Poor	Middle	Early	
Number of namings (max = 38)	25.0	26.5	29.9	4.84*
Namings of four-syllable targets (max = 8)	4.1	3.9	5.5	8.95***
Correct four-syllable forms	3.2	3.3	4.8	6.70**
Namings of heterorganic targets (max = 6)	4.1	4.5	4.6	ns.
Correct sequences	2.1	2.9	2.5	ns.
Namings of heavy unstressed syllable targets (max = 12)	6.6	7.4	8.4	5.42**
Correct heavy syllable	4.3	5.6	6.5	5.21**

Note. Modified from Turunen, 2003.

* $p < .05$, ** $p < .01$, *** $p < .001$.

few years of life. This means that apparently those at real risk for dyslexia are much more likely to belong to the group who will face reading failure at school. This is why a closer look of this subgroup may be warranted. In Turunen's study, children diagnosed as late talkers at 2 years of age were less advanced in their production at all phonological levels (word, syllable, phoneme, and phoneme sequence) in comparison with the other members of the JLD at-risk or control groups, but no differences were found between similarly defined late talkers selected from the at-risk and control groups. A good example of the difference between late talkers and non-late talkers independent of the main groups is the naming and production of words *pyörä* /pyøræ/ [bike] and *pöytä* /pøytæ/ [table] with front vowels in all positions of the words. The at-risk children and the control children managed to produce the front vowels well and had almost no problems with "frontness" whereas seven children diagnosed as late developers at the ages of both 2 and 5 years could not articulate the vowels of the two words and produced forms that do not obey the front-vowel harmony rule of Finnish words (Leiwo, Turunen, & Koivisto, 2002).

At 3.5 years of age, the JLD children participated in a computer-based assessment of *phonological skills* (Puolakanaho, Poikkeus, Ahonen, Tolvanen, & Lyytinen, 2003, 2004). Computer animations were used to make tasks commonly used to assess phonological skills at later ages interesting and reliable for the assessment of younger children between the ages of 3.5 and 5.5 years. Phonological awareness at different levels of units (word, syllable, and phoneme) and preliminary blending skill (continuation of phonological units) were assessed. The results revealed that a substantial proportion of children as young as 3.5 years of age were aware of the syllabic units—apparently because of the syllable-based stress pattern of spoken Finnish. The mean correct score was 7.4 out of 12. The accuracy scores reflecting phonemic level awareness were naturally lower (approximately 12% correct). Because about 10% of the JLD children knew most Finnish letters at this age and more than 20% identified a few most common letters, phonemic awareness may be associated with letter knowledge. Children tend to say the letter name when they have to identify the first sound in words. Knowing the letter names helps to produce phonemic awareness because vowel names are identical to the

TABLE 4.3
Correlations Between Reading and Nonreading Measures at the End of the First Grade.

<i>Nonreading Measures</i>	<i>Reading Measures</i>					
	<i>Text Reading Accuracy</i>	<i>Pseudoword Reading Accuracy</i>	<i>Text Reading Speed</i>	<i>Pseudoword Reading Speed</i>	<i>Spelling Accuracy</i>	<i>Single-Word Reading Speed and Accuracy</i>
Phonological skills before school	.42**	.29	.55**	.11	.41**	.40**
RAS	.32*	.42**	.51***	.33*	.39**	.42**
RAN	.42**	.31*	.37*	.19	.26**	.26
Categorical perception	.47**	.33*	.40**	.11	.51***	.33*

Note. The measure representing phonological segmentation was deduced before the children started school to reduce the influence of reading skill thereupon; other nonreading measures were carried out simultaneously with reading and spelling assessments at the end of the second semester of the first grade.

* $p < .05$, ** $p < .001$, *** $p < .001$

long-duration phonemic sounds (represented in writing by the repeat of the vowel; e.g., the name for a is /a:/).

The groups differed reliably in all but the synthesis of phonological units in which the difference marginally failed to reach significance at 3.5 years of age. The phonological measures—and especially the repetition of pseudoword-type tasks—correlated significantly with different early reading measures until the end of the first grade.

JLD children with and without familial risk for dyslexia differ very clearly in language measures such as Boston naming (Kaplan, Goodglass, & Weintraub, 1983), and an inflectional morphology test (P. Lyytinen et al., 2001; Lyytinen & Lyytinen, 2004) at the age of 3.5 years, and the differences increase as functions of age (H. Lyytinen et al., 2001). It is interesting to note that the groups did not differ consistently on any performance-related IQ measure taken at any age. Consistently, none of the observed language-related differences between groups was affected, even when the effect of the nonverbal IQ was controlled for (H. Lyytinen et al., 2001). The main differential source of variance between children with and without risk for dyslexia in language assessments reflects specifically their perception, discrimination, identification, and/or manipulation of speech sound of various unit sizes and is found in more global assessments of expressive or receptive language skills. It must be added that both categorical perception of speech units associated with duration and more pure auditory tasks—such as discrimination of modulated sounds (a task provided by John Stein and his colleagues)—correlate highly with emergent reading measures; but so do more global language measures such as rapid naming (RAN) and the rapid alternating stimulus test (RAS; see Table 4.3 for examples from the JLD data).

DEVELOPMENTAL PATHS OF READING-RELATED LANGUAGE SKILLS

The JLD's language assessments comprised follow-ups of receptive and expressive language, vocabulary growth, naming accuracy and speed, phonological, morphological, and

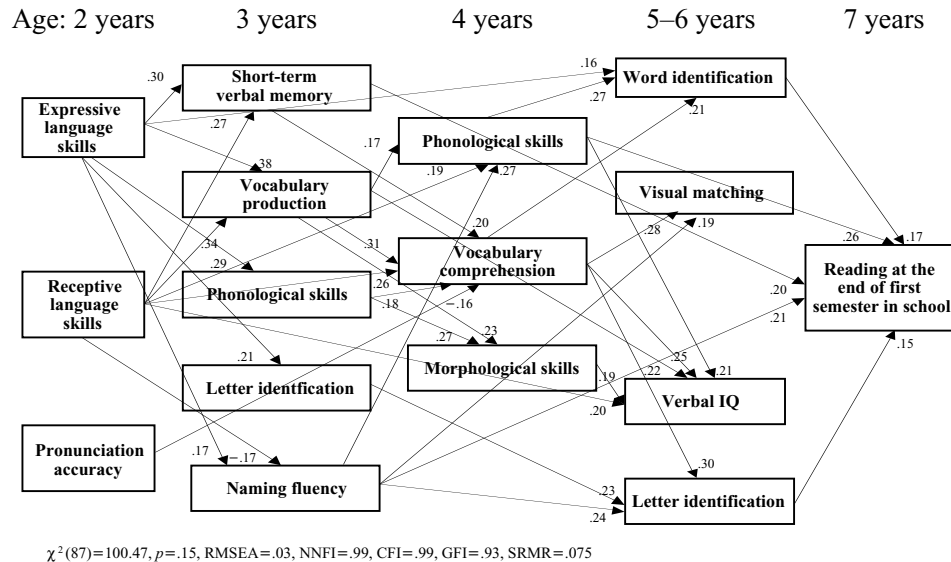


FIG. 4.1. Predictive paths of language skills to reading at the end of the first semester in school. To ensure readability of the figure, the connections within each age level have not been drawn.

Assessment of expressive and receptive language skills is based on the RDLs (Reynell & Huntley, 1987) and the pronunciation accuracy is based on the number of correct names of pictures articulated correctly (Turunen, 2003). Memory was assessed with the digit span task modified by Gathercole and Adams (1994). Vocabulary production is based on the Boston naming test (Kaplan et al., 1983), naming fluency on the RAN (Denckla & Rudel, 1976; short version), and assessment of letter identification finger-pointing of letters whose names are pronounced to the child. Phonological assessments were conducted with computer-animated tests (see Puolakanaho et al., 2003). Vocabulary knowledge was based on the Peabody picture vocabulary test (Dunn & Dunn, 1981). Morphological skills were assessed with a Berko-type test (Lyytinen & Lyytinen, 2004), and a word-identification test that required the child to identify an orally presented word from a list of nine written words. In the visual matching task, the child had to recognize a shown form from four alternatives (the visual material contained non-letter forms, numbers, letters, and letter sets), verbal IQ was based on the Wechsler Preschool and Primary Scale of Intelligence—Revised (Wechsler, 1989). The criterion reading measure is a composite score of nationally normed timed mechanical reading tests based on the number of (a) words correctly identified and (b) number of errors detected in a list of written words.

orthographic skills at each age level. The differences between groups with and without familial risk tend to increase in language measures as functions of age and also occur after controlling for nonverbal IQ (H. Lyytinen et al., 2001). However, parental education and both environmental and biological factors tend to make a significant additional contribution in regression models that predict early reading. Depending on which kind of early reading measure is used, the total contributions of these language measures explain close to 80% of variance among the children who have completed the first semester of school. The highest percentages are reached if multiple phonological skills assessed just before the beginning of school are included in the model. The main reason is that almost all typical phonological measures (excluding nonword repetition) are so close to reading of Finnish that their correlation is at the level of the reliability ($>.7$) of the variables. Preliminary path analyses (see Figure 4.1) reveal expected connections from a very early age to the reading status reached at the end of the first semester of school, when the distribution of a composite score of mechanical reading skill has reached quite a normal form.

We computed the path analyses illustrated in Figure 4.1 by proceeding from the reading status and finding the highest predictive routes to identify the contribution of skills at earlier ages. Each age stage variable was added to the model, step by step, from a later to earlier age. The model was built favoring the path between successive age stages and estimated by using the maximum likelihood method. The nonsignificant predictors were eliminated one by one, and modification indices were used to identify paths crossing stages, thus favoring indirect connections. In the end, all non-significant covariances between measures from the same age were also eliminated. Before analysis, the distributions of the predictors were corrected (using *Preliis 2.0*) and, after this, missing values were imputed using an EM algorithm. The final data comprises 170 JLD subjects whose scores were available at the time (early spring 2003) of the execution of this analysis. In Figure 4.1, the within-age stage connections have not been drawn. All significant predictors directly connected to reading skills have been marked in the figure using standardized coefficients.

Early receptive and expressive language makes the widest and strongest relative contribution to the successful path to reading. Early expressive language skills are also directly connected to both early letter knowledge and word identification. The development of letter-identification skills forms its own path to reading. Phonological skills form a path that has multiple connections to vocabulary and in its early stage is connected to naming fluency. With the exception of the role of the early “general” language skills, the nonspecific language measures (such as verbal IQ or vocabulary) have no direct connection to reading according to this model, which explains about 40% of the variance of reading at the end of the first semester of school.

PHONEMIC AWARENESS, EARLY LETTER KNOWLEDGE, AND READING SKILLS

The most interesting phase of pre-reading development covers the time from when children first become aware of letters and phonemes to the start of formal reading instruction. This happens in the very literacy-oriented Nordic countries relatively early, although formal reading instruction begins at the age of 7 years. The value of literacy is documented by the fact that the ability to read *Catechismus* has historically been required before couples obtain permission to marry (Lundberg & Nilsson, 1986).

The acquisition of basic phonological recoding skills is a relatively rapid process for beginning readers in Finnish. Although no formal reading instruction takes place before school, children are typically introduced informally to letters and words during the kindergarten year preceding school entry. In a follow-up study, Holopainen, Ahonen, Tolvanen, and Lyytinen (2000) report that half of the children knew all Finnish letters when they entered school. At school entry, one fourth of the children reached 90% decoding accuracy of syllables and pseudowords. During the first semester of the first grade, the children are taught most of the letter sounds and they practice phonological assembly with familiar letters from the very beginning of reading instruction. The single letters map onto phonemes in a regular manner, as described at the beginning of this chapter. Thus, after the basic letter sounds are learned, phonemic blending skill is required for mastering basic recoding.

Aro et al. (1999) monitored the development of phonological skills and reading in a group of children whose school entry had been postponed and who were participating in a special kindergarten group. The development of the children was followed from the year preceding school entry until the end of the first semester of the first grade. The results indicated that there was considerable inter-individual variation in the emergence of phonological skills. For some children, the development was gradual whereas others showed sudden progress. Rhyme detection and phoneme identification skills seemed to be present to some degree 1 year before

the children entered school. All children showed emergence of phoneme-identification and syllable-deletion skills before the acquisition of phonological recoding, although children were unable to reliably solve phoneme synthesis and phoneme deletion tasks before mastering phonological recoding. These phonemic awareness tasks require high levels of analytical skills and conscious representations of the phonological segments. The results support the notion that these phonemic skills develop as a product of reading instruction or reading acquisition. This conclusion is further supported by the fact that five out of six children gave only letter-name responses in the phoneme-identification task, both before and after learning to read. Similar findings regarding the use of letter-name responses are reported by Holopainen et al. (2000).

In their study, Holopainen, Ahonen, and Lyytinen (2001) reported that preschool phonological awareness skills differentiated those children who showed very fast reading acquisition after school entry. These same skills failed to identify children whose reading acquisition was delayed; but a preschool letter-knowledge task differentiated the children with delayed reading from children who acquired reading skill normally. This finding casts doubt on the predictive value of phonemic awareness tasks in Finnish. A number of children also performed quite poorly on phonological awareness tasks at the beginning of school despite their becoming good readers shortly after school entry. Holopainen et al. also reported that the earliest readers in their study were close to perfect in their letter knowledge a year before school entry.

Interestingly, Mann and Wimmer (2002), in their recent study, compared phonemic awareness and reading skills in groups of Austrian and American children in kindergarten, grade 1, and grade 2. The American children outperformed the Austrian children at kindergarten age in phonemic identity judgment tasks, as well as in letter knowledge and reading ability. However, by the end of first grade, the Austrian children performed at the same level as the American children on phoneme awareness tasks. The Austrian children also had perfect knowledge of letters; they also read pseudowords more accurately than did the American children. These differences do not support the notion that phonemic awareness is the result of phonological reorganization triggered by the development of spoken language skills. Instead, the authors interpret the differential development of Austrian and American children as supporting the literacy hypothesis on phoneme awareness. The inducement of phoneme awareness requires more than just experiences supporting primary language development. It seems to develop typically as a result of learning to read.

PREDICTING LATER STAGES OF READING

As yet, the JLD project cannot provide predictions of mature reading because only a few of the children have reached later grades. This is why we report here predictive correlations obtained from another Finnish study (Holopainen et al., 2001; Holopainen, Ahonen, & Lyytinen, submitted). In these studies, a reading-related development of a random sample of Finnish children was followed from preschool age to fourth grade. They reveal that the language skills that children acquire before school entry can be used to predict both success and failure of long-term reading instruction. This conclusion was reached by assessment of verbal and nonverbal skills of a random sample of 89 children who were assessed at the age of 6 years, one year before the start of formal synthetic phonics reading instruction. After two years of schooling, participants were divided into four reading groups depending on the duration of instruction required to reach 90% decoding accuracy in the reading of pseudowords. These reading groups were the precocious decoders (PDs), who read at school entry, early decoders (EDs), who reached the criterion within the first 4 months in grade 1, and ordinary decoders (ODs), who reached this

criterion within 9 months. The last group, late decoders (LDs), failed to reach the criterion within the first 2 years of instruction.

The most interesting difference emerged between the ODs and the LDs. These groups were significantly different in (and the membership predictable from) pseudoword repetition accuracy and naming speed assessed before entry into school. Naming speed was also associated with slow reading speed at the end of the second grade. As described at the end of this chapter, Finnish words are long and generally consist of a large number of syllables because of multiple inflections. Consequently, slow reading seems to be a characteristic of Finnish adults with dyslexia (Leinonen et al., 2001).

The pseudoword repetition task requires several phonological processes: accurate phonological representation of the input, good phonological working memory to keep an unfamiliar representation in mind, and the ability to keep the phonological representations distinct for accurate co-articulation of the output. Pseudoword repetition covers these critical skills so well that no other phonological measure can add significantly to the discrimination between ODs and LDs. Interestingly, the phonological awareness task seems to play a significant role in discriminating only PDs and EDs from ordinary and late decoders. Phonological awareness, however, did not differentiate between the OD and the LD groups. This challenges the value of phonological awareness measures used in studies of deep orthographies such as English as predictors of later reading problems. In short, children who may achieve a relatively low phonological awareness score but who are exposed to reading instruction in a highly transparent language, in this case, Finnish, can become very accurate readers in about 6 months. The obvious reason is that reading instruction itself develops awareness of the 24 phonemes that children should master to acquire reading skill. These results indicate that assessments and interventions for children with potential problems in reading acquisition should be expanded to include a wider battery of functions (especially pseudoword repetition) to identify individuals who are in need of additional support.

The role of naming dysfluency in reading may indicate that automatization is affected by difficulties in retrieving accurate phonemic representations of words. On the other hand, the contribution of naming speed to reading significantly increased the prediction made by the phonological measures showing the independence of these two predictors. This begs the question as to whether failure to automatize can be solely a result of phonological weakness. The speed factor could alternatively affect the establishment of fluent identification of larger graphemic chunks.

The extent to which phonological awareness acquired before reading instruction contributes to reading achievement at later stages of reading is an interesting question. Phonological awareness (as determined by single-phoneme identification, phoneme deletion, syllable deletion, and phoneme-blending tasks) assessed before children's entry into school did not predict their later reading, but phonological awareness measured at the end of the first grade predicted both reading accuracy and reading fluency in the fourth grade. Because the orthographic representations available to readers can substantially help in the solving of phonological tasks, it was of interest to ascertain the correlation of phonological awareness and later reading when reading accuracy in the year before school entry and in the first grade was partialled out from their association. As expected, the effect of the phonological awareness measure taken before school entry was no longer a significant predictor of fourth-grade reading accuracy. Earlier reading accuracy was the best predictor. This was also the case in the prediction of reading fluency in the fourth grade: first-grade fluency, together with pseudoword repetition measures, was the strongest predictor in jointly explaining over 50% of the variance.

Performance in pseudoword repetition identified those children who were unable to achieve accurate reading skills during the first 3 years of synthetic phonics instruction. Difficulty

with both the segmentation of words into phonemes and with the mental organization of the articulatory output may explain difficulties in both pseudoword repetition and reading acquisition. This finding shows that some basic phonological feature also affects readers of a highly regular orthography. Children learn to identify phonemes but may continue to make errors in complex word-level features such as phonemic length which is based on the relative duration of consecutive sound segments rather than on absolute duration. Studies of very young children who were at risk for dyslexia suggested that phonological representations entail word-level problems in using sub-phonemic duration cues. Inaccuracies in the categorical perception of speech based on the variation of the duration of consecutive sounds can widely affect the development of phonological segmentation and manipulation skills. Although semantic support at the word level helps children to avoid errors in the reading of familiar words, even the spelling of familiar words seems to be affected. This is shown in the analysis of spelling errors committed by children who are not good readers and adults in the JLD study (Lyytinen, Leinonen, Nikula, Aro, & Leiwo, 1995).

IMPLICATIONS OF THE FINNISH ORTHOGRAPHY FOR THE BEGINNING READER

From the perspective of phonological recoding, the simple Finnish G-P correspondence system has distinct advantages. As noted at the beginning of the chapter, the number of phonemes is relatively small and G-P conversion rules are perfectly regular. Because there are only single letter graphemes (with one exception), the written word also makes the abstract phonemic structure explicit for the reader. Consequently phonological assembly is a fairly simple serial process of putting the letter sounds together. As long as beginning readers are able to perform phonemic synthesis after mastering the basic letter-sound correspondences, they have the tools for recoding any given word or pseudoword. This stands in marked contrast to the requirements of an irregular orthography such as English, in which readers first have to be able to perform orthographic segmentation of multi-letter graphemes (*thief*→/th/ /ie/ /f/) and in which the knowledge of basic letter sounds is insufficient in terms of being able to use the G-P correspondences. In English, readers also have to take context into consideration and irregular words completely elude phonemic assembly. Compared with irregular orthographies, it seems plausible to conclude that the regularity of the Finnish orthography makes it relatively easy to master and thus to systematically apply phonological recoding in the early stage of reading development.

This effect of orthographic depth on the acquisition of early reading skills has been shown in a cross-linguistic comparison by Seymour et al. (2003). This conclusion is also supported by international comparison studies (Elley, 1994) and the recent PISA study³ (OECD, 2001, OECD, 2002). These PISA studies reveal that, internationally, Finnish children are at the top in terms of their ultimate reading achievement, comprehension, and use and interpretation of written texts. Even Finnish dyslexic children are usually able to master phonological recoding and attain relatively good accuracy in their reading skills. Their problems seem to manifest in poor fluency.

The English-based models of reading acquisition typically describe separate processes of phonological recoding and direct word recognition. Because of the synthetic and agglutinative

³ The Programme for International Student Assessment (PISA) is an international assessment of the skills and knowledge of 15-year olds, a project of the Organisation for Economic Co-operation and Development (OECD) and participating member countries.

nature of Finnish, the use of a direct strategy for word recognition in beginning reading would be inefficient. In sentences, the nouns and verbs are inflected; hence the ability to recognize the uninflected root does not suffice. In the case of fusional structures, even the stem has different allomorphs in different inflections, and also the suffixes may have several allomorphs. Thus, the number of possible word forms for any given item is excessive. For a beginning reader, this means that phonological recoding is the only efficient route toward word recognition. In practice, reading instruction methods in Finland are almost uniformly based on phonics approaches.

From the point of view of early literacy skills, Finnish orthography has two specific hurdles. These relate to the marking of the phonemic quantity and to the length of the words. To correctly code phonemic quantity in reading, and especially to correctly mark it in writing, children require sensitivity to the phonological and sub-phonological cues of length and syllable-segmentation. However, in the coding of double-stop consonant letters that demarcate long-quantity, phonological syllable segmentation does not necessarily help in the identification of quantity. It is also worthy of note that, at the morphographic level, there are a few irregularities in marking the phonemic quantity: After some lexical morphemes before clitics, in some compound words (e.g., *sadetakki* /sadet:ak:i/ [raincoat]), and at some word boundaries in sentences, the initial consonant of the suffix or the word that follows geminates in spoken standard Finnish. However, in these cases, the long quantity is not marked in the orthography. Another problem for beginning readers relates to the length of the words. The memory demands of recoding are high because a large number of phonemes require to be assembled before pronunciation is accessed. For slow, beginning recoders, this often means that the assembly process can become disrupted. Consequently, children are usually instructed to use the syllable as a subroutine in phonological assembly. In general, syllables play a central role in reading and spelling instruction and problems in syllable segmentation or syllabification are also typically reflected in reading and spelling skills. Furthermore, it has to be emphasized that the preceding lexical context often predicts the selection of the morpheme and the stem from the selection of its allomorph.

THE ROLE OF PHONEMIC AWARENESS MAY HAVE BEEN EXAGGERATED IN EXPLAINING SUCCESS OR FAILURE IN READING

The phoneme is a very abstract speech unit to a child who has not been exposed to letters. It seems likely that, in the Finnish context, being exposed to letters creates a sufficient basis for the achievement of phonemic awareness. This is documented by the fact that a large majority of Finnish children have full mastery of all Finnish letter-names before school entry. Those who fail to name letters tend to have difficulties in following the synthetic phonic instruction—instruction which very successfully helps a similarly large majority of Finnish children to accurately decode any short word/nonword within 3–4 months of instruction. Children who, at this stage, have difficulties in the simple G-P association learning process also fail to show accurate speech perception in the most complex challenge of Finnish phonology—the interpretation and classification of duration into short and long which persists as the most usual indicator of reading difficulties in adulthood. A similarly common problem is dysfluency of reading which is affected by the agglutinative nature of Finnish, that is, long words in many contexts can only be read with accuracy through phoneme-by-phoneme decoding.

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5

Sources of Information Children Use in Learning to Spell: The Case of Finnish Gemimates

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Two experiments were designed to investigate the ways in which children use orthographic, phonological, and morphological information in spelling double consonants (gemimates) in Finnish. In the first experiment, children had to choose out of two pseudo-word spellings the one that looked more like a real word on the basis of orthographic or phonological information. In the second experiment, children spelled real words containing target consonant clusters in either word stems or inflections. The results showed that even children just starting school were able to use orthographic information to their advantage in spelling, whereas phonological aspects of spelling rules were acquired only later on. During the first school year also the use of morphological information began to emerge. Thus children seem to use multiple kinds of information in spelling from very early on.

INTRODUCTION

Traditionally the study of literacy development has been dominated by research concentrating on English orthography. However, languages differ in their structure and the characteristics of their orthography, and English with its deep morphophonological orthography and relatively simple morphological structure is by no means the norm. This is increasingly acknowledged in the field, as the past decade has seen a remarkable increase in the number of studies investigating literacy acquisition in languages other than English, including studies concerning bilingualism and cross-linguistic comparisons in a variety of languages. Because languages differ from each other in multiple ways, they provide different kinds of opportunities for investigating the factors affecting literacy development. Finnish is an interesting language for this kind of research for several reasons. It has an almost perfectly transparent orthography, phoneme length in addition to phoneme quality distinguishes between meanings, and the morphological structure of the language is very complex.

Characteristics of Finnish

Orthography

The most remarkable characteristic of Finnish orthography is that it is very transparent, because the relationships between graphemes and phonemes are regular and consistent. This is true for both spelling-to-sound and sound-to-spelling relationships, so that each letter denotes only one sound and each sound can be spelled with only one letter. This makes Finnish symmetrically transparent, unlike, for example, French and German, which are more transparent in their spelling-to-sound relationships than in their sound-to-spelling relationships and thus easier to read than to spell. The only exception to the one-to-one phoneme–grapheme mappings in Finnish is the nasal consonant phoneme /ŋ/, which is represented by the digraph *ng*. Finnish uses the Roman alphabet to represent its 13 consonants and 8 vowels. It is worth noting that Finnish has fewer phonemes than, for example, English, as there are only 21 phonemes compared with the 44 that are used in English. Therefore not all the letters of the Roman alphabet are used in Finnish, for example, *c* and *w* are never used to represent Finnish phonemes. Consequently Finnish gives young readers and spellers two kinds of advantages in acquiring the alphabetic principle. First, the number of different sounds that need to be distinguished and represented is smaller than in languages that are richer in phonemes. Second, the way in which phonemes are mapped onto letters is much more straightforward than in most other orthographies. A further constraining factor is the small number of legal syllable structures allowed in Finnish. Finnish allows only 14 basic syllable types, and therefore syllables provide quite stringent phonotactic constraints for Finnish words and possibly give guidelines for beginning and more advanced spellers.

Phoneme Length in Finnish

Although many languages, such as English, code only for phoneme quality, in Finnish it is also necessary to pay attention to phoneme quantity, that is, the duration of phonemes in terms of time. There is a difference between short phonemes, which are spelled with a single letter, and long phonemes, which are spelled with two identical letters. The distinction in Finnish is like the difference in duration in pronouncing the letter *a* in the English words *bat* and *bad* (Treiman, 1993), rather than the qualitative difference in pronouncing the same letter in the words *hat* and *hate*. The difference between *bat* and *bad* does not distinguish between meaning in English, but does so in Finnish. Both consonants and vowels can appear as long in Finnish. Long consonants are referred to as geminates. Examples of how the length of phonemes distinguishes between meanings are provided in Table 5.1.

TABLE 5.1
Examples of How Length Affects Meaning in Finnish

<i>Finnish</i>	<i>English</i>
<i>Taka</i>	Back
<i>Takka</i>	A fireplace
<i>Taakka</i>	A burden
<i>Takaa</i>	From behind
<i>Takkaa</i>	Of a fireplace
<i>Taakkaa</i>	Of a burden

Whereas determining phoneme quality is relatively straightforward in Finnish, defining the length of a phoneme is more complicated, as length is not an absolute concept. Rather, it depends on the total duration of the word in question and also on the other phonemes in the word (Lehtonen, 1970). However, there is no evidence as of yet that normally developing Finnish school-age children have problems distinguishing between short and long phonemes in speech, whereas they often make errors in representing long phonemes with two letters in the early phases of literacy acquisition. Problems in representation of length also provide one potential marker of reading and spelling problems in Finnish, both for children and adults (Lyytinen, Leinonen, Nikula, Aro, & Leiwo, 1995). This might be partly because the spelling of long phonemes deviates from the “one-sound, one-letter” rule that otherwise holds well in the Finnish orthography because of its transparent nature. Therefore we can say that representing phoneme length is an inconsistent aspect of this otherwise very regular orthography.

Morphology

Finnish is a very complex language with respect to morphological structure. Possession, plurals, prepositions, and some particles are all expressed by inflections added to the ends of words, so Finnish is a good example of an agglutinative language (see Table 5.2). In practice, this means that words are long and can take on a vast number of different forms. Each noun can have over 2,000 different forms and each verb as many as 10,000. The morphology is particularly complex as words often have several different stems, which are used depending on the type of inflection that is attached to the end of the word in different occasions. Table 5.3 shows an example of this.

This kind of morphological structure sets certain requirements for how it can be processed. Niemi and Laine (1995) point out that there simply is not enough time to go through all the possible forms of words if they were all represented as separate entries in the lexicon. Indeed, several studies looking at reading in Italian (Caramazza, Laudana, & Romani, 1988), which is another highly inflected and agglutinative language, and Finnish (Niemi, Laine, & Tuominen, 1994) suggest that word stems and inflections are represented separately in the lexicon of Italian and Finnish readers. This work is still at a preliminary stage, however, and we do not know how the representations develop or how they may affect spelling or be affected by spelling.

Most of the aforementioned research in Finnish has investigated case inflections. Finnish has 14 different case inflections, and they are used instead of word order to express the role of a word in a sentence. They are very frequent in the language and children acquire them relatively early. Thus, if morphological information were to influence children’s literacy acquisition, case inflections would probably be involved, and this is why the focus in this study was the possible role of case inflections in spelling.

TABLE 5.2
Examples of Finnish Morphology

<i>Finnish</i>	<i>Translation</i>
Taloissammekin	In our houses as well
TALO + <i>I</i> + SSA + <u>MME</u> + <u>KIN</u>	House + <i>s</i> + in + <u>our</u> + <u>as well</u>

TABLE 5.3
Some Finnish Case Inflections Showing How the Stem
of the Word (in Boldface) Changes

<i>Finnish</i>	<i>English</i>
Vesi	Water
Veden	Of water
Vettä	Some water
Vetenä	As water
Vedeksi	Into water
Vedessä	In water
Vedestä	From water
Veteen	To water
Vedellä	With water

The Types of Information That Children Use in Spelling

The development of children's spelling skills is generally considered an increasingly sophisticated process of understanding how the sounds of words can be represented by letters or letter groups. The specifics of this developmental progression have been outlined in several spelling models, for example, those of Frith (1985) and Ehri (1992). The different models agree on many of the main characteristics of spelling development. Initially, children do not attempt to represent the sounds in words, but their "spellings" are letters and numbers jumbled together with no clear correspondence to the words that they are supposed to represent. Children's first attempts at representing the sound structure of words are incomplete, as they represent some of the correct sounds, but not all of them. Both letter-name knowledge and children's phonological knowledge affect the outcome of these early spelling attempts. The next step is considered to be the "phonetic" stage of spelling, in which children's spellings represent the complete sound structure of the words. However, they still fail to consider many of the conventional constraints of the orthography of the language (orthographic rules), such as legal letter position and the types of letters that can appear adjacent to each other. Children also overlook many morphologically regular spelling sequences. The ability to use orthographic and morphological information in spelling is considered to be a more sophisticated approach on the way to proficiency than the children in the semiphonetic or phonetic stage are capable of. A question that the spelling models disagree on and that has not been resolved yet is whether children use qualitatively different spelling strategies at different times. If this were the case, we would expect to find that children use different kinds of information in spelling at different points in time. In contrast, if we were to learn that children can use different types of knowledge to their advantage in spelling from early on, this would be evidence against the strict stage model approach.

One way to investigate how children's ability to use different kinds of knowledge affects their developing spelling skills is to look at how a specific aspect of spelling develops over time. The study by Cassar and Treiman (1997) of children's knowledge of the use of letter doublets offers a good example of this approach. They used an orthographic constraints test, in which children were shown non-word pairs and asked to choose the member of the pair that looked more like a real word. Cassar and Treiman (1997) compared legal and illegal doublets in final (legal) and initial (illegal) positions of the word. They also ran an experiment in which

the non-words were read out loud, so that it was possible to test children's knowledge of the phonological rule associated with letter doublets, that is, that a consonant letter doublet usually follows a short vowel (Carney, 1994). The results showed that first graders chose non-words with final doublets and legal doublets more often than they chose non-words with initial or illegal doublets. Kindergartners were similarly sensitive to the legal position of doublets, whereas they were still at chance when having to choose between legal and illegal doublets. This suggests that already very young children know something about the orthographic rules that govern letter doublet use. However, it was not until sixth grade and above that children had begun to master the phonological rule of doublet spelling.

These results illustrate two important issues. First, even kindergartners can make certain judgements on the basis of orthography, although their spelling is still on the semiphonetic or phonetic level. Although these children have not been learning to spell for very long yet, they have been exposed to print in their environment and have had the opportunity to pick up information about the conventions of their orthography implicitly. Second, we can see that information of the function of spelling sequences is acquired gradually, depending on the nature of the information involved. Although kindergartners already seemed to know about the allowed position of doublets, it takes an additional year for them to work out that not all letters are allowed to double. More sophisticated aspects of spelling, like the phonological relationship between the medial doublet and the preceding vowel, are not mastered until considerably later.

Pacton, Perruchet, Fayol, and Cleeremans (2001) investigated French children's performance in the orthographic constraints test. They controlled the frequency of letter doublets by using consonants that differ in their frequency of doubling. This is possible because there are consonants (e.g., c, d, v) that are frequent as single letters, but double rarely, whereas other consonants (e.g., l, m, s) are frequent as both single and double letters. Pacton et al. (2001) also investigated children's learning of the rule about the doublet position by using doublets of letters that are never doubled. Thus children's responses should not have been biased by the number of times that they had seen these doublets in either initial or final position. The results showed that, even when the frequency of the single consonants making up the doublets was controlled, children preferred more frequent doublets and thus showed sensitivity to the frequency of doublets per se already in their first school year. This sensitivity increased from grade 2 to grade 3. Moreover, children were more likely to choose medial doublets (legal in French) than initial or final doublets (illegal in French) even when all the doublets were made up of consonants that cannot be doubled in French and children could not have responded on the basis of how often they had seen the doublets. These results corroborate those of Cassar and Treiman (1997) and suggest that children in the semiphonetic and phonetic stages of spelling development already possess some orthographic knowledge that they can bring into their spelling.

Before we draw any firm conclusions about children's concept of doublets in spelling, it is important to note that doublets have different functions in different orthographies. In English, doublets usually follow a short vowel, and in principle this should also help children to know that doublets are not allowed in the initial position of a word. In French doublets do not have a phonological function at all, so their role is exclusively orthographic. Yet another type of function appears in Finnish, in which doublets represent the length of phonemes. Italian doublets have a similar function, but the phoneme-grapheme relationships in Italian are somewhat more irregular than those of Finnish. These cross-linguistic differences offer an interesting opportunity to investigate the interaction between orthography and phonology. French children have only orthographic information to guide them in the use of doublets, which allows us to look at the development of orthographic information alone. English children have to learn quite a complex rule about doublets, involving both phonology and orthography, and indeed they begin to follow it only at the age of 12 years and above. However, already beginning