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Author: Vibeke Rønneberg	…… (Author's signature)

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Supervisor: Victor van Daal

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Abstract

This thesis investigates the effects of orthographic depth of L1 on orthographic learning and reading, spelling and vocabulary knowledge in L1 and L2. Children from three countries, Denmark, Norway and Sweden were tested on reading, spelling, and vocabulary knowledge in their L1 and in their L2, English. It was expected that the Danish participants would be poorer orthographic learners, and also readers and spellers in both L1 and L2, due to their deep orthography. It was expected that the Norwegian and Swedish participants would be better orthographic learners, and that they would learn to read and spell more easily in both L1 and L2, due to their shallow orthography. The reading, spelling and vocabulary tests in L1 consisted of frequency-balanced cognates, and words of decreasing frequency in L2. A novel-word learning task was used to assess orthographic learning. The results showed that the Danish children made more spelling errors, and read slower and less accurate for both L1 and L2, than the Norwegian and Swedish children. Moreover, Danish children knew the meaning of fewer words in L1 and L2. It is concluded that shallow orthographies promote orthographic learning, and that orthographic learning mediates reading and spelling in L1 and L2.

Table of Contents

Table of Figures and tables

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1.0 Introduction

In present day society, being literate is considered self-evident. Literacy involves the mastery of reading and writing. While learning spoken language in ones mother tongue or language 1, L1, is a process that seems to happen automatically, learning the written language is a process that demands much training and explicit instruction.

Learning a second language, L2, is very different from acquiring a first language. When learning a second language at school, the setting is more formal, the methods are different and exposure to the second language is limited to a couple of hours a week. Moreover, while L1 exposure starts from birth, second language learning at school starts when you are older. Finally, when you start learning a second language at school, you already know one language, your L1.

The process of learning to read and write is more difficult for learners of certain orthographies. According to the orthographic depth hypothesis (Katz & Frost, 1992), it is easier to learn to read and write in shallow orthographies than in deep orthographies. Seeing that differences in orthographic depth influences L1 literacy, this thesis goes further, and is a study of the influence orthographic depth of L1 has not only on L1 reading and spelling, but also on orthographic learning and second language learning. The aim of this thesis is to examine the role of orthographic depth of L1 on orthographic learning, reading, spelling and vocabulary of L1, and on learning to read, spell and learning vocabulary of a deep second language.

Orthographic depth concerns the extent to which written symbols correspond directly to spoken sounds, phonemes, and the extent to which spoken sounds correspond to written symbols. Orthographies in which the letters correspond directly to phonemes are called shallow orthographies, while orthographies where the link to phonemes or the spoken word is more complex are called deep. In English, this complexity can be illustrated by the letter <a>, which can correspond to 11 different phonemes. In addition, one sound can correspond to many letters: /s/ can correspond to <s> in self, to <c> in cell, or <z> in waltz (Cook 2004: 12).

When looking at the possible effects of L1 depth on word recognition, production, and vocabulary, countries with L1s that are similar in as many as possible respects apart from orthographic depth should be examined. Therefore, Norwegian, Swedish and Danish learners

will be compared. Norwegian, Swedish and Danish languages all belong to the North Germanic group of Indo-European languages. This makes the three languages quite alike, they have several similar words, and communication between the three languages flows rather easily. Also, educational and other cultural aspects do not differ very much between these three countries. However, when it comes to orthographic depth they are on different sides of the scale (Cook 2004: 11). Norwegian and Swedish languages have a fairly regular orthography, that is, they are shallow, while Danish has a deep orthography. Seymour et al. (2003: 146) classify all three languages as having a complex syllabic structure.

In all three countries children learn English at school as a compulsory second language. Just like Norwegian, Swedish and Danish, English is a Germanic language, and like Danish it has a deep orthography. English is taught starting from Grade 1 in Norway, Grade 3 in Denmark, and in Sweden schools are free to choose, the Swedish schools included in this study started their English instruction in Grade 2 or 3.

In sum, the present research is in a position to make fair comparisons: whether the orthographic depth of L1 has an effect on orthographic learning, on reading accuracy and fluency, spelling and vocabulary in L1, and also on L2, English. Moreover, it is in position to examine whether reading, spelling and vocabulary is mediated by orthographic learning. The deep orthography, Danish, will be compared to the two shallow orthographies Norwegian and Swedish.

In particular, the following hypotheses will be tested: (1) The process of acquiring deep orthographies is different from the process of acquiring shallow ones; (2) Starting to learn L2 at an early stage is better than starting late; (3) Orthographic depth has an effect on the acquisition of both L1 and L2, that is, deep L1 orthographies are harder to acquire than shallow orthographies, and a deep L2 is harder for learners of a deep L1 than for learners of a shallow L1; and (4) The orthographic depth effects, mentioned above, are larger for poor readers of a deep L1.

1.1 Outline of the thesis

Chapter one of this thesis presents the research question, aims and hypotheses. It gives a brief overview of research already carried out in the field. The methodology is outlined and compared to methodology used in other cross-linguistic studies.

Chapter two looks into the Norwegian, Danish, and Swedish orthographies and school systems. Relevant results from PIRLS (The Progress in International Reading Study) are commented on. PIRLS is a large international study of children's reading achievements, undertaken every five years. In addition, relevant school curricula for the three countries are presented.

The methods and materials are presented in chapter three. First the participants are described. Next the design of the tests is explained in detail. Finally the procedures are described.

In chapter four the results are presented in text and in tables. Chapter four consists of two parts: first information about the participants and their teachers is presented. Next, the results from all the tests will be presented. These results are presented according to which research question they relate to.

These results will be interpreted and discussed in chapter five.

Chapter six will consist of the final conclusions and implications for further research.

1.2 Theory and research questions

The Orthographic Depth Hypothesis (ODH) proposes that differences in orthographic depth lead to differences in naming words and in lexical decision, a task in which a participant has to decide whether a string of letters is a word or not (Katz and Frost 1992: 71). Katz and Frost (1992:71) claim that a shallow orthography more easily supports word recognition that involves phonology, more specifically, phonological recoding, while a deep orthography leads the readers to recognize words by referring to morphology via the word's visual-orthographic structure, that is, that words are recognized as whole words.

By comparing Welsh bilingual children with English monolingual children on their ability to read aloud, Ellis and Hooper (2001) found evidence that different orthographies encourage different reading strategies. Mistakes made by the Welsh children reflected reliance on phonology, while the English children, reading a deeper orthography, produced mistakes that resembled the visual stimuli. Ellis et al. (2004) found support for different orthographies with also different scripts (Hiragana, 3 alphabetic scripts, and Kanji) varying in the degree to which they rely on phonology to access words. They found that learners of

transparent/shallow orthographies read new words by going from left to right. Children reading deep orthographies made more no-response errors, as they were unable to access the words by phonological decoding. Also, they made more real word substitutions, indicating that they recognise words through partial visual analysis. Chikamatsu (1996) compared users of different scripts, English and Chinese, learning Japanese. The results showed different word recognition strategies being used, depending on the children's orthographic background. The Chinese children relied more on visual information than did the English children. In addition to using different L1 scripts, alphabetic and logographic, English orthography is shallow compared to Chinese. Thus, Chikamatsu finds that L1 word recognition strategies are transferred to L2.

This thesis will investigate whether readers of Danish exhibit a different strategy when reading L1 words than Norwegians and Swedes, and whether these differences are reflected when reading L2. This research question is included in order to find out whether orthography influences reading strategy, and whether or not this strategy is transferred when learning a second language. It is hypothesized that learners of English, with a deep L1, for example Danes, rely more heavily on what is called the lexical route, and that learners with a shallow L1, for example Norwegians and Swedes, will rely more on the phonological route, and that this will be reflected in the mistakes the learners make. The first research question is:

1) Are there differences in decoding strategies between shallow Norwegian and Swedish, and deep Danish when reading L1 words, and are these decoding strategies reflected when reading L2 words?

Coltheart (1978) suggests a dual route in which there are two ways to recognise words: a direct route through visual look-up, and an indirect route using phonological clues. According to Coltheart, a skilled reader always uses the visual/non-phonological route to word recognition. When reading English, Coltheart, Curtis and Haller (1993) claim that the lexical route will succeed in reading all real words, while the phonological route will only give correct output for regular words and non-words. Seen this way, following the ODH, the Danes will have an advantage when reading English. Like the Anglo-Saxons, the Danes rely very heavily on visual memory in the beginning.

A theory that accounts for how efficiently a reader develops a lexicon, that is, has immediate access to many written words is the self-teaching hypothesis first proposed by Firth (Share 2008: 7) and revised by Share (1995, 1999, 2008). The self-teaching

phenomenon is rapid orthographic learning that is dependent on successful phonological recoding (Jorm & Share, 1983). According to Share, self-teaching is relevant to the process of learning every printed word. In other words, it is item specific. The self-teaching hypothesis states that children build up word recognition by sight by their ability to convert letters into sounds as a way to pronounce new or unfamiliar words. That is, the phonological component is considered primary and the orthographic component secondary. The acquisition of visual word recognition is a result of phonological recoding. According to the self-teaching hypothesis, a child will rely on both the lexical and the phonological route at any point in time. Which route is used depends on the word that is read. To put it more simply, a beginning reader will, once he has learnt the sounds that go with the letters, by letter-by-letter recoding try to assemble a whole-word sound, and hopefully recognise that sound as a word he already knows in spoken form. The next time he encounters the same word in print, the recoding will more efficiently be processed, until the word is more or less recognised immediately. With each recoding process the word will be specified more thoroughly in his orthographic memory, making direct access possible.

The hypothesis accounts for all individuals in all orthographies. However, languages differ from each other with respect to the degree to which they enable the beginning reader to employ the self-teaching mechanism. The more irregular the letter-sound correspondences of a language are, the harder it is for a reader to apply the self-teaching mechanism. On the other hand, if an <a> always goes with the same sound, all words with an <a>, will be processed much easier. All in all, a substantial growth of the lexicon can only be achieved in a regular system. The self-teaching theory bears consequences for second language learning as well as L1 word recognition. If the phonological component is considered primary for learning all printed words in all orthographies and for all individuals, it will be primary in learning English as a second language too. Learners of shallow languages like Swedish and Norwegian will reach the stage of self-teaching earlier, and they will become better orthographic learners. Therefore, if orthographic learning is a skill that can be transferred across languages, they will be in a better position to learn words of a deeper L2.

Fewer studies have focused on spelling. Spelling is an even harder skill to master than word recognition, and possibly even more so for deep orthographies because there are more possible correspondences between phonemes and graphemes than between graphemes and phonemes. Caravolas et al. (2001: 771) found that phonological spelling skill is a critical determinant of later spelling and reading skills. Moreover, they found that the ability to spell

in English depends on two skills, namely phoneme awareness and letter-sound knowledge. These findings support Share's (1999) assumption that phonological skills are crucial for word specific orthographic representations. Share (1999) found that spelling was influenced by self-teaching. It is within this framework spelling will be looked upon here, as a skill related to reading, and as a skill related to self-teaching. If learners of a shallow orthography reaches the stage of self-teaching more easily than learners of a deep orthography, then the Norwegian and Swedish students in this study should be better spellers than the Danish students.

Ellis and Hooper (2001: 573) find it likely that differences in orthographic transparency have 'a determining effect ton rate of reading acquisition, segmental phonological awareness, reading strategy, and reading disorder'. They suggest that in orthographically transparent languages reading is acquired faster, phonemic awareness is developed quicker, and alphabetic reading is encouraged. Also, they found that due to the ambiguity of English orthography, children learn this code more slowly.

Hoxhollari, van Daal and Ellis (2004) replicated Ellis and Hooper's study from 2001, looking at children learning to read Albanian. They found further evidence that shallow orthographies like Albanian promote phonological recoding in initial reading.

Goswami et al. (1998) also found that orthographic transparency affected nonword decoding. When comparing Spanish, French and English orthographies, they found that children from Spain, having a shallow orthography, decoded nonsense words very accurately. The French and in particular the English children struggled to read these words. The children with a shallow orthographic background were better at nonword decoding.

Seymour et al. (2003: 143) investigated the development of early decoding strategies, the process of converting written signs into words and sentences, in 13 European orthographies. The 13 orthographies were classified as having simple syllable structure or complex syllable structure, and as being shallow or deep. Danish, Norwegian, Swedish and English were among the languages grouped as having complex syllable structure, however, when it came to orthographic depth, Danish and English were on the deep end while Swedish and especially Norwegian were more shallow (Seymour et al., 2003: 146). Seymour et al. found that orthographic depth and syllabic complexity are responsible for differences in accuracy and fluency in foundation level reading, grade 1 children and some grade 2 children.

That is; they found that learners of deep orthographies were less accurate and fluent than learners of shallow orthographies.

When it comes to L2, there are thus two competing hypotheses here; the Danes are better because they are accustomed to a deep orthography, and use a visual route for word recognition, which according to Coltheart gives access to all English words, or following Share's theory that the phonological component is primary for all printed words, and that learners of a shallow orthography will reach the stage of self-teaching more easily, it is hypothesized that Swedish and Norwegian learners will have an advantage in word recognition in English. Following Share, it is expected that the Norwegians and Swedes will perform better at word recognition and production (spelling) tasks, both in their L1 and in English. Also, because they are better self-teachers, Norwegians and Swedes will be better at orthographic learning tasks that directly tap orthographic processing skills. On the other hand, when it comes down to reading and spelling high-frequency words, it is hypothesized that Danish readers will perform better, both in L1 and in L2, because they rely more heavily on visual memory skills. The prediction is that the Danes will be better at the first 10 words in L1, and the first 10 in L2. However, for the Danes, there is a limit to the visual memory span and for the less frequent words it is expected that the Norwegian and Swedish participants will outperform them. Moreover, it is expected that the Danes are better than Norwegian and Swedish participants on tasks that directly tap visual, non-orthographic memory, that is, memory for nonword stimuli. The main research questions to be posed are:

> 2) Are the Norwegian and Swedish participants better orthographic learners? What cognitive skills support orthographic learning?
>
> 3) Does orthographic depth and orthographic learning affect L1 and L2 reading, spelling and vocabulary? Are the Danish learners of English more efficient, and do they make fewer mistakes in word recognition and spelling than Swedish and Norwegian learners because of their experience with a deep orthography, or is it the other way around, that is, are Norwegian and Swedish learners more efficient in acquiring English word recognition and spelling?

In order to assess what skills support orthographic learning, cognitive tests of phonological awareness, visual memory, and visual association were included.

Before addressing research question 3, whether the participants with a deep L1 background or the participants with a shallow L1 background are best when it comes to second language learning any effect from an early start of second language learning must be removed. As the Norwegian and some of the Swedish participants start learning English at an earlier age than the Danish and the rest of the Swedish participants, the two groups of Swedes must be compared to find out whether they differ in performances, next the Norwegian participants must be compared to the Swedish participants. If any significant differences are found between the groups, only the late starters must be compared to the Danes. This gives a secondary research question:

4) Does it make a difference when you start learning L2?

A fifth research question is added in order to assess whether the poor readers of the deep orthography are impaired more than the poor readers of the two shallow orthographies. Wimmer (1993) argues that reading difficulties manifest themselves differently in shallow and deep orthographies. In deep orthographies reading difficulties have an impact on fluency and accuracy, while in shallow orthographies reading difficulties have an impact on fluency and hardly any on accuracy. Vellutino et al. (2004) also state that in more transparent orthographies word identification problems only impair fluency in word identification. Thus, it is expected that the poorest readers of Danish are impaired more when it comes to reading accuracy and spelling than the poorest readers of Norwegian and Swedish. Moreover, it is expected that the good readers of the deep orthography are equally good as the good readers of the two shallow orthographies. The good and the poor readers are defined on basis of fluency or reading speed of L1. The last research question is:

5) Are the poorest readers of deep and shallow orthographies differentially affected?

1.3 Research method.

The study has a cross-sectional design; children of three age-bands are tested. The reason for the cross-sectional design is to assess whether there is some evidence for a differential growth across orthographies.

In addition to making sure the schools were representative for each country, the children within each class had to be controlled for background factors like languages spoken

at home, experience with other languages and so on. Therefore a questionnaire for the students and one for their parents was handed out. The answers were used to assess that the 3 subsamples are comparable with respect to language use.

When comparing written word recognition and spelling of L2, it is needed to assess L1 performances to find out if there already is a difference across countries. Such a difference could explain differences in L2 performances, or confound with orthographic depth effects. The test materials must be unbiased in order for cross-linguistic research to be fair. When comparing deep English to shallow Austrian German, Wimmer and Goswami (1994) assumed that numerals are equally frequent in different orthographies, and thus constructed nonwords of numerals assuming these nonwords would be unbiased. In order to balance the stimuli, Thorstad (1991) balances the meaning of the words by using translation equivalents. Landerl, Wimmer and Frith (1997) used words of the same origin when comparing German to English. That way they could compare their participants' performances on words that were very similar, PFLUG- PLOUGH. Seymour, Aro and Erskine (2003) used high-frequency materials for all the languages they tested assuming these would be equally familiar across languages. When comparing deep English to shallow Welsh, Ellis and Hooper (2001) used a frequency-balanced word-reading test in order to ensure the opportunity to learn the words was the same across languages. Ellis et al. (2004) also used a frequency-balanced test to make their cross-linguistic research fair.

By comparing the Scandinavian languages, this study does use cognates. That is, although different orthographies are compared, the stimuli are basically the same. By using cognates ,the stimuli are controlled for meaning and CV structure, and any morphological differences, that would otherwise jeopardize a fair comparison. Moreover, the words were frequency-balanced. This ensured that all participants had the same opportunity to learn the words. Cognates were found in all frequency bands, even in the highest-frequency bands that contains very few words, due to $\log_{10}$ transformation. The matching process also controlled for word length by using blocks of one-, two-, three-, and four- syllable words.

Research (Ellis, N.C., Hooper. M. (2001), Ellis, N.C., Natsume, M., Stavropoulou, K., Hoxhollari, L., Van Daal, V., Polyzoe, N., Tsipa, M., Petalas, M. (2004)) on the effect of orthographic depth on learning to read, has shown that the percentage of errors made in each category of errors vary according to orthographic depth when reading L1 words. Errors in the no response category, or do not know, are more common with readers of opaque

orthographies. Whole word substitutions are also more common with readers of opaque orthographies, while nonword responses are most common to readers of shallow orthographies. Overall, the Danes were expected to make most mistakes due to their deep orthography, and because they have not reached the same level of self-teaching as Norwegians and Danes. Moreover, reaction times were expected to be shorter for Norwegians and Swedes than for the Danes. These differences were expected to decrease for the older children.

The reading and spelling test in L2 were fair, because the stimuli were the same for all participants. The words covered a range of 50 frequency bands. The Norwegian participants had more experience with English than the Swedes and Danes; otherwise there is no reason to believe the L2 words would favor any of the countries. For L2 reading and spelling, Norwegians and Swedes were expected to outperform the Danes, because of them being better self-teachers. In L2, however, the differences were expected to increase as none of the youngest participants had much experience with written English. It was assumed, however, that the Danes would be assisted by their visual memory skills when reading the most frequent words. A word chain test was used to assess silent reading. The word chain test in L1 mainly consisted of cognates. For some words it was impossible to find a cognate, then a frequency-matched word was used instead. The L2 word chain test was the same for all countries. The Norwegian and Swedish participants were expected to outperform the Danes in the L1 word chain test. With the L2 test, only smaller differences were expected with the youngest children, while the oldest Norwegians and Swedes were expected to perform better than the oldest Danes.

The reading and spelling of isolated words does not tell whether the child is able to understand the word he/she reads or spells. In order to get information about the children's vocabulary, a vocabulary test was given to all participants. In addition to selecting schools that were representative for each country, L1 vocabulary was used as a control variable. As L1 vocabulary is influenced both by school and home background, it was used to correct for possible background differences in the sample. The L1 vocabulary test was fair because all the words in the test were cognates, and frequencies were checked for all three orthographies. By using a frequency-matched test, the participants have equal opportunity to learn the words. The stimuli in the L2 vocabulary test were the same across countries. Still, it was expected that Norwegian and Swedish children would have a greater vocabulary due to the self-teaching process. The Norwegians were expected to have the largest L2 vocabulary.

The cognitive tests were also unbiased. To assess phonological awareness, Welsh words were used. This way the stimuli were the same for all participants. Moreover, none of the participants had any experience with Welsh, so these words functioned as non-words. It was predicted that Norwegian and Swedish children would have a better phonological awareness than Danish children.

The visual memory test was the same for all participants, and thus unbiased. The Danes were expected to do better on this task as they were thought to rely more on pure visual memory when reading, and thus having practiced this skill more. The visual association task was an experimental task concerning the ability to remember order of symbols. This task was included in order to have a test that had to do with word-specific knowledge, that is the order of items of a string, but not a word-like string. Therefore strings of symbols, consisting only of vowels, were compared with strings of numbers and symbols. The nine vowels from each country were included, and the test was thus unbiased.

There was one task that had to do with orthographic learning. The task was a novel word-learning task. For the brand orthographic learning task, words were used that were equally unfamiliar for all participants. Orthographic learning is one of the skills believed to supported by phonological reading, therefore he Norwegian and Swedish participants were expected to perform best at the orthographic learning task. When making mistakes, the participants with a deep orthographic background, the Danes, were expected to chose alternatives that were visually similar to the target word, or to chose the alternative that had nothing to do with the target word. The participants with a shallow orthographic background were expected to choose alternatives that were phonologically similar to the target word when making mistakes.

2.0 Languages and education

In this chapter the language backgrounds of the three Scandinavian orthographies will be presented. Next, early literacy acquisition, school curricula and second language education in the countries will be discussed.

2.1 The Scandinavian languages

Hagtvet, Helland and Lyster (2005) describe the differences between Norwegian, Swedish and Danish as merely dialectical. Together with Icelandic these three languages form the North Germanic group of Germanic languages. The countries are closely linked politically and historically as well. Norway was in union first with Denmark, and later with Sweden. All three languages use the Roman alphabet, extended with Æ, Ø and Å in Norway and Denmark, and with Ä, Ö and Å in Sweden.

Written Norwegian has two standard, official orthographies today. *Nynorsk* is based on dialects from the western part of the country, while *bokmål* developed from Danish and was based on the southern and eastern dialects. It is users having the urban Norwegian, *bokmål,* as their L1 that will be compared with the Danes and Swedes, and *bokmål* is what is meant when referring to written Norwegian. Written Norwegian resembles Danish very much, but their spoken forms are more different. Norwegians often find it easier to read Danish than Swedish, but when it comes to the spoken word it is the other way around.

Norwegian language consists of 40 phonemes and 29 letters (Hagtvet, Helland, Lyster 2005:16). Although there are a number of spellings for the 40 Norwegian phonemes, the difference between the number of phonemes and graphemes are fairly regular compared to Danish, or even more so to English. The fact that Norwegian has a relatively regular orthography, indicates that a reader can access most of the written language using a phonemic approach (Hagtvet, Helland, Lyster 2005:21). Still there are some exceptions that need to be accessed morphemically.

A national norm for Danish orthography was established around 1200 (Elbro 2005:33). The orthography was conservative already from the beginning. The scribes that instituted the national spelling norm chose an old-fashioned style as the basis for spelling. Taken together with the fact that spoken Danish has changed more than most Germanic

languages since the 1200s (Elbro 2005:33), and that written norm seldom keeps up with the spoken changes, makes Danish a deep orthography. Also, Danish has accepted more foreign loan words than Norwegian and Swedish, thus importing orthographic complexities. Just like English, Danish orthography represents some morphology.

Spoken Danish contains 12 vowel phonemes that are qualitatively different from each other (Elbro 2005:34), which means there are too few vowels in the alphabet to represent them. In addition, one letter may represent more than one phoneme, and fixed letter combinations can represent single phonemes.

In Sweden, the translation of the Bible in 1541 played an important role in the development of a standardized written Swedish. However, Swedish orthography was not established until the spelling reform of 1906. Today, Swedish language has 29 letters. Although it represents the more shallow side of the orthographic depth scale here, it has not always got a one to one mapping of graphemes to phonemes. A grapheme usually has one or two possible pronunciations (Danielson, 2003). Spelling is more difficult than reading as there are many ways a phoneme can be represented in spelling.

2.2 Literacy Acquisition in Norwegian, Danish, and Swedish

This section contains information about early literacy, school curricula, and second language education in the three countries.

2.2.1 Early literacy

In order to assess early literacy skills, PIRLS 2006 asked parents how well their children could perform the following activities; recognize most of the alphabet, read some words, write some words, and read sentences. (Mullis et.al, 2007:159). Parents could chose between the responses very well, moderately well, not very well, and not at all. Thirty four percent of both Danish and Swedish parents reported that their fourth grader could read very well. In Norway 23 percent of the parents reported that their child could perform the early literacy skills very well when they entered school. Forty three percent of the Danish parents, 36 percent of the Swedish parents, and 28 percent of the Norwegian parents reported that their child could perform the early literacy skills moderately well when they entered school.

Twenty percent of the Danish parents, 24 percent of the Swedish parents, and 29 percent of the Norwegian parents reported that their child could not perform the early literacy skills very well when they entered school. Four percent of the Danish parents, 6 percent of the Swedish parents and 20 percent of the Norwegian parents reported that their child could not at all perform the early literacy skills. The results from Pisa 2006 indicate that Danish and Swedish children in general are more literate when entering school than Norwegian children. This result must be considered in relation to at what age children start school. In 2006 (Mullis et.al, 2007:163), 44 percent of all fourth graders in Denmark started school when they were six years old, whereas 48 percent started when they were seven years old. In Norway, 20 percent of the fourth graders reported that they started school when they were five years or younger, 79 percent reported that they were six years old when they began primary school. In Sweden 21 percent of the fourth graders reported that they were six years old when they began school, 78 percent reported that they were seven years old. As Danish and Swedish children in general are one year older than the Norwegian children when they begin school, they have one more year to practice the early literacy skills before entering school. In the present study, using vocabulary of L1 as a covariate controlled for these possible differences.

2.2.2 School curricula

All three countries that were compared in this project have a national curriculum. In Denmark a new curricula, *Fællesmål 2009*, was introduced in 2009, which means that when the Danish participants in this study started school, the old curricula, *Fællesmål* set the norm. The Norwegian *Kunnskapsløftet* was introduced in August 2006. This means that the 5th and the 6th graders in this survey started school when the old *L97* was defining the curricula. The Swedish curricula, *Skolvärket*, was introduced in 1994.

Fællesmål 2009 (2009: 37) clearly states that word recognition demands that the pupil understands the alphabetic principle; that letters represent spoken sounds. Moreover, it is emphasized that when teaching initial reading, practices that stimulate phonological consciousness should be prioritized. However, it is added that because of the irregular character of the Danish language, other decoding strategies must be used as well. Word pictures, that is whole word reading is mentioned as a method for high frequency words. According to Elbro (2005: 32) initial reading in Danish is taught by a variety of methods; whole- word look –and-say, use of contextual cues, phonetics, and easy book reading.

In *L97* (p.118), reading instruction for 2nd graders is described, it says that; the pupils should start using sentences connected text when the connection between letter and sound is automatic. In *Kunnskapsløftet* from 2006 it says that the children should be able to show understanding of the connection between spoken sounds and letters, and that they should be able to link letter sounds into words.

According to *Skolvärket,* Swedish children should, by the end of the third school year, at least be able to read known texts and texts about familiar subjects, be able to retell familiar stories both orally and written, be able to write both stories and texts containing facts. Moreover, they should be able to spell high frequency words. After the 5th grade, Swedish children should at least know the most common spelling rules.

Summing up: both Danish and Norwegian national curricula emphasize the alphabetic principle. In addition to this the Danes have added that knowing other decoding strategies is important due to their deep orthography. The Swedish curriculum does not mention any decoding strategies. Perhaps the alphabetic principle is learned more intuitively in Swedish due to the shallow character of the orthography?

When PIRLS 2006 asked in which grade by which certain skills or strategies is emphasized for at least 50 percent of the students, all three Scandinavian countries reported that knowing the letters of the alphabet is emphasized in grade 1 (Mullis et.al, 2007:176). Knowing letter-sound relationships too was emphasized in grade 1 for all countries. Moreover, Danish, Norwegian and Swedish schools reading of words in the first grade. This means that the Danish, and Norwegian children in the present study were expected to know the letters of the alphabet, know letter-sound relations, and be able to read words when they were one year younger than the Swedish children. However, as 70 percent of Swedish parents reported in PIRLS 2006 that their child could perform the early literacy skills; recognize most of the alphabet, read some words, write some words, and read sentences, very well or moderately well when they entered school it seems most children from all three countries master these skills when they are around six years old.

2.2.3 Second language teaching in Denmark, Norway and Sweden

The goal for the first two years of English education for Norwegian children is described in *Kunnskapsløftet*. Skills relevant to the tests in this thesis will be referred. After the 2nd grade,

the children should be able to find words and expressions that are common to L1 and L2, give examples of English words, be able to use some frequent English words and phrases connected to the child's close surroundings, recognize some words, expressions and simple sentences in spoken and written text, and experiment with spelling English words. This means that after the two first years of English Norwegian children have little experience with written language, especially producing written text. After the 4th grade, Norwegian children should be able to understand and use frequent English words and expressions related to everyday living, spar time, and interests, both orally and written. Also, they should be able to use normal grammatical structures, particles and simple sentence and spelling patterns.

Children following the Danish Fælles Mål 2009 start their English education in the 3rd grade. After the 4th grade the children should be able to (Fælles Mål 2009 Engelsk, faghefte 2: 7) understand spoken English related to subjects like family, everyday living, school, spare time, vacation and holiday. Moreover, they should be able to understand short, simple written texts about *familiar* subjects. They should also be able to write simple words, expressions and sentences about familiar subjects. The children should be able to understand a basic vocabulary, spell basic words and expressions. In addition, the education should give the children courage to write in English.

In Sweden schools are free to chose when they want to start English training. The children in the present study started their English education in the 2nd or 3rd grade. In the Kursplan for English, goals that the children should have achieved after the 5th grade are described. The child should be able to; understand spoken English related to everyday living and other familiar subjects, be able to orally give information about themselves and others. Moreover, they should be able to express themselves in a simple written form and be able to perform simple oral and written tasks in groups or alone.

Thus, after the fourth grade the goals set for Norwegian and Danish children, when comparing *Kunnskapsløftet* to *Fælles Mål 2009,* do not seem all that different even if the Norwegian children have had two more years of English training. Still, it needs to be taken into account that the Norwegian children are one year younger when they leave the fourth grade than what the Danes are. Goals set for the Swedes are less specific, and only describes what the children should be able to do after the 5th grade. Still, when comparing these goals to the Norwegian and Danish goals set for the 4th graders, it seems the three countries are comparable.

3.0 Materials and method

At three different sites students of age bands 1, age 9-10, 2, age 10-11 and 3, age 11-12 (year 3, 4 and 5 in Norway, and year 4, 5 and 6 in Denmark and Sweden), were examined on reading and spelling in L1 and L2, L1 and L2 vocabulary, and underlying skills like visual memory, orthographic processing, and phonetic awareness. This chapter will be structured into the following sections: participants, measures and procedure.

3.1 Participants

3.1.1 The Norwegian participants

The Norwegian participants were recruited from two different schools in Stavanger, Madlavoll and Vaulen. Because Madlavoll only had one class available during the test period, two schools were chosen. Both schools are primary schools with three parallel classes for each age group. Twenty-two 4th Graders took part, 22 5th Graders and 18 6th Graders. Originally 4 more children had accepted to take part in the study, but they were absent during the test week. 7 Norwegian children did not wish to take part in the study. According to the teachers, these were children performing at all levels, so that there was no systematic drop-out.

The Norwegian 4th Graders all came from Madlavoll school, they were organized in groups of fourteen, but when they were taught English, and most other subjects, these three groups were organized in two classes of 18 and 20 children. Children from all three groups were given numbers and asked to take part in the project. Their English teacher did not have any formal education in English, but was an experienced teacher. It is common that English teachers in the four lowest grades do not have any formal training in the language. According to the teachers this school scored slightly above the national average at national tests for 2009.

The Norwegian fifth graders were all recruited from one class. The fifth grade class scored below average on the national tests in Norwegian, but slightly above in English.

3.1.2 The Swedish participants

In Sweden, the fourth and fifth Graders were recruited from two different schools, Stjärnebo in Åtvidaberg and Långbrott in Kisa. Both schools were about 45 km south of Linköping. Two 4th grade classes were tested at each school, one 5th grade class from Stjärnebo and two from Längbrott. The Swedish third Grade participants came from Oxelbergsskolan and Folkparksskolan in Norrköping. A total of 21 3rd Graders, 29 4th Graders, and 17 5th Graders made up the Swedish sample.

Långbrottsskolan children from 1st to 5th Grade. 45 kilometres south of Linköping.

3.1.3 The Danish participants

The Danish participants were recruited Tinglev, a school in the outskirts of Sönderborg, in the South of Jutland, about 45 kilometers from the German border. The school had pupils from grade 0-9, and there were more than 400 pupils at the school. 18 3rd Graders, 18 4th Graders, and 12 5th Graders took part in the project. The third graders were recruited from two different third grades as there were only 15 children in the third grade class that was first contacted. The group of sixth graders was described as a class with a lot of special needs children. It turned out that getting the handouts back from the parents in this group was harder than in the two other groups. The special needs children chose not to take part in the project, which means that the children who took part were, as a group, average performers.

Some of the children at this school came from low-income homes, but according to the teachers the school normally scored above average at national tests.

All in all, the sample was considered representative at each site, and across sites.

3.2. Materials

3.2.1 Questionnaires

Questionnaires were made to assess whether the 3 subsamples are comparable with respect to language use. Before filling out the questionnaires parents had to sign an acceptance form.

Questionnaires for the students contained questions regarding; what languages they use outside school, how often they read in different languages (L1, English and other languages), how often they watch television or DVD in different languages (L1, English and other languages), how often they play computer-games in different languages (L1, English and other languages), finally they are asked to list other places or activities where they hear, read or speak English. The parents were asked to estimate a percentage of; how often different languages were used by the adults in the household when addressing the child, how often the child is exposed to different languages outside school, and what languages the child regularly uses when talking to persons outside school. Next the parents were asked to report whether their child had ever lived in another country, where they were exposed to other languages than their L1 (Swedish, Norwegian, and Danish). The parents were asked to report on their own and other caretakers' language skills, in which languages they spoke and understood fluently, good, ok and bad. Finally there is a question concerning the number of books, and the number of children's books in the household. See Appendix I for acceptance form, and appendix II for questionnaires.

All English teachers were asked to fill in a one-page questionnaire. The questions concerned years of experience, and what kind of formal education they had been through. Moreover, they were asked to range how often they used different activities when teaching English. The Different activities were listed in the questionnaire were: oral activities, reading aloud, silent reading, listening to English speaking persons on CD, DVD or TV, watching English movies, using English web pages, writing in English, practice grammar, and practice translation. For each activity the teachers could chose between: very often, often, now and then, rarely and never. See Appendix III for teacher questionnaire.

3.2.2 L1 Reading and spelling

An adaption of the method used by Ellis and Hooper (2001) and refined by Ellis et al (2004) was used to select 40 words for the L1 reading and spelling tests. Ellis' method of constructing language-fair tests entails that each word has an equivalent word in the other languages that has the same written frequency, so that all factors that have to do with the opportunity to learn are controlled for, and that all other factors are free to vary, as they are typical for the language. However, to increase control, words were selected not only from

corresponding frequency bands, but also only cognates, that is, words that have the same word form and same meaning across the three Scandinavian languages.

The Oslo corpus, (http://www.tekstlab.uio.no/norsk/bokmaal/) containing 9.6 million words from newspapers, was used as a basis. The 10000 most frequent Norwegian words from this word count were divided into 50 decreasing log10- frequency strata. Within each stratum the first cognate, with a frequency per million close to the frequency per million for the same word in Danish was chosen. In order to find the Danish frequencies Korpus 2000 was used (http://korpus.dsl.dk/korpus2000/indgang_til_korpusdk.php). As there were problems with the web version of the Swedish word count (http://g3.spraakdata.gu.se/saob/), it was not possible to check the frequencies in the Swedish count. However, there is no reason to believe that the Swedish frequencies differ that much.

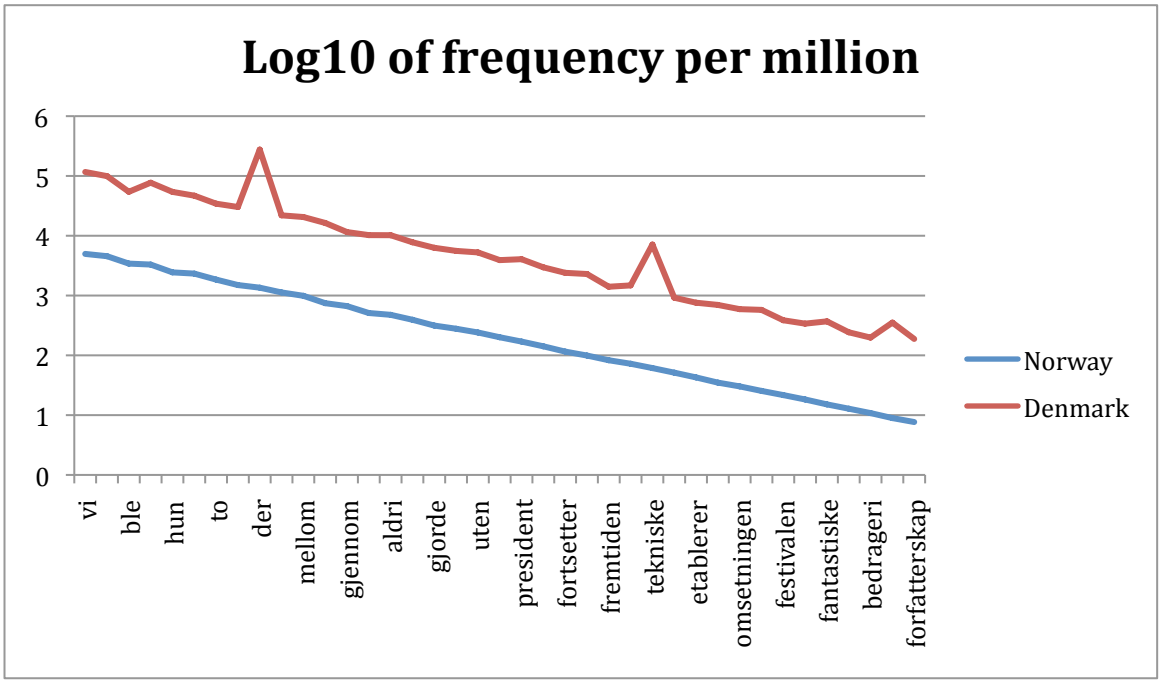

Figure 1.The decreasing log10 frequencies for the words included in the reading and spelling test.

The cognates chosen from strata 11-20 were all monosyllabic. Words chosen from strata 21-30 were cognates with two syllables, from strata 31-40 three syllables, and finally the cognates from strata 41-50 four syllables. This way the chosen words would not only have a decreasing frequency, but also increase with respect to number of syllables, thus the least frequent words would also be relatively longer than the most frequent. As both the Norwegian and the Danish corpus were taken from newspapers, it was assumed that if a cognate were

equally frequent in Norwegian and Danish newspapers, it would be so in Swedish too. By using cognates that has almost the same frequency in Norwegian and Danish the reading and spelling tests were ensured to be fair for all languages. Only words from strata 11-50 were used in the test. Words in strata 5-10 were used as warm ups.

For the English reading and spelling test words from Van Daal, Spencer, Cashman, Hoxhallari, The Welsh Dyslexia Project 2003, University of Wales at Bangor were used. The first 45 words from the test of 50 words of decreasing frequency with 2 $\log_{10}$ steps were used. The words were selected from the CELEX database (Baayen, Piepenbrock & Van Rijn, 1995). In L1 there were two parallel tests with cognates reading and spelling. The spelling test was always conducted before the reading test. The reading score may have been inflated, but all in the same way.

For the spelling test, words were scored correct, or incorrect. No further analysis of mistakes was done. Each correct spelling was given one point. In the reading test too, each correct response was one point. Here, however the mistakes were categorizes into real word substitutions, ending mistake, nonword mistake, do not know (if the participant gave no response, or said "I do not know"), and other. Other was used if the researcher pressed too hard on a key so that a word was skipped. The reading test was programmed in SuperLab 4.0.7 (Abboud, Schmitz & Zeitlin: 2008). See Appendix IV for the contents of reading and spelling tests in each of the four languages.

3.2.3 The Meara test/ Vocabulary test

The English vocabulary size test was downloaded from http://www.lognostics.co.uk/tools/index.htm. The Lex vocabulary tests are based on research carried out by Professor Paul Meara's group at the University of Wales, Swansea. The X_Lex test was used to test the vocabulary breadth. Words are selected from five different frequency bands, which allow the program to calculate how many words are known in each frequency band. Words from the five different frequency bands are presented together with non-words. By including the nonwords it is possible to calculate how many of the real words the participants claim to know, but do not really know. When the test is finished each participant comes out with two scores, one raw score- the amount of words the participant claimed to

know, and one corrected score- the raw score corrected for all the non words the participant claimed to know. The Lex test was reprogrammed in Super Lab 4.0.7 (Abboud, Schmitz & Zeitlin: 2008).

The L1 vocabulary tests were made using the same principles as the Lex test. Two cognates from each of the 40 least frequent frequency bands from the 50 frequency bands of the 10.000 most frequent Norwegian words were chosen. Other words than the ones used in the reading and spelling tests were chosen. Danish and Swedish frequencies were controlled to avoid large differences in frequencies. Scandinavian nonwords were created by using cognates from every second frequency band, and then one letter was changed. 20 non words were created. Cognates were chosen so that the words would be equally similar to real words for all three languages.

All the children were presented with the same words, but in different random order. They were presented with a total of 80 real words and 20 non-words. The scores were calculated by summing the number of words correctly identified, and subtracting the false alarms (non-words they identified as words) times 4. When looking at the results obtained in the vocabulary tests in L1 and L2, Meara's method of ending up with two scores, one raw score, and one corrected score indicating how many words a person knows was not used. The purpose of the vocabulary test in this project was to compare individuals, not to know how many words each individual knows within each frequency band. Therefore, a D-prime was calculated for each participant. A d-prime is a measure of the difference between the z-transformed hit rate and the z-transformed false alarm rate. See Appendix V for the contents of the vocabulary tests in each of the four languages.

3.2.4 Phonological awareness

The nonword repetition task consisted of 16 Welsh words. There were four monosyllabic words, four words with two syllables and, four words with three syllables, and four words with four syllables. The students were asked to repeat the Welsh word as accurately as possible.

The examiner scored the words correct or error to be scored later. Two researchers scored the words from the first ten Audacity files. The reminder was scored by one scorer using the scoring rules previously agreed on. The number of correctly pronounced phonemes was counted when later going through the Audacity files, and scoring the data.

3.2.5 Visual memory

The test was made by coloring random squares in a table consisting of 25 squares, 5*5. The visual test consisted of a total of 20 images. Four with one black square, five with two black squares, five with three black squares and five with four black squares. The colored squares did not make a particular pattern, but were chosen at random. The test was taken out of the Sips computer-based test battery, Wass et al. (2008).

When scoring, one point was given for each correctly identified square.

3.2.6 Orthographic learning

The orthographic learning task was taken from "Learning Spellings: The Development of an Orthographic Learning test" a master thesis written in Dutch by Carole Thate at the Free University of Amsterdam in 1998. Minor adjustments were made so that the test suited Scandinavian learners. The test consists of 73 Power Point slides showing 25 different items, and a slogan/ sentence promoting a special brand of this kind of item; Løp raskt med LOTAN sko (Run fast with LOTAN shoes). The slogans were presented in the children's L1. The brand names were originally Dutch non-words but where needed they were changed to make up a Scandinavian non-word. The brand names were sorted according to how many letters they consisted of. Their length varied from four to seven letters; however most of the words had five or six letters. Two of the words consisting of four letters were shown once, two twice, two three times and one four times. Three of the words consisting of five letters were shown once, three twice, three times and three four times. Three of the words consisting of six letters were shown once, two twice, two three times, and three words were shown four times. There was only one word consisting of seven letters, and this word was shown twice. This means that the participants were presented with a total of 73 slides. All slides were shown for five seconds. The randomization function in excel was used to make sure the slides would

appear in a random order. The same random order was used for all classes. By presenting some slides more times then others it was possible to find out how many presentations was needed before the children learned a word. This test is equivalent to Share's theory about self-teaching happening unconsciously. Share (1999) included novel words for names of places and persons and animals in a short story to assess self-teaching.
The answers were scored as correct, phonological mistake, orthographic mistake or other mistake. Some of the students however, found it hard to guess if they did not know the answer, therefore some of them did not circle an alternative for all brand names. See Appendix VI for an example of the test.

3.2.7 Visual association

Pictures of nine animals were used in the test. Pictures of individual animals were presented together with a letter string, a number string or a string of symbols. As there are only nine numbers to chose from (excluding zero), only vowels were used (A,E,I,O,U,Y,Æ,Ø,Å for the Norwegians and Danes, A,E,I,O,U,Y,Ä,Ö,Å for the Swedes), and nine different symbols, = ! * % + / - & and ?. Using only vowels also made the words unpronounceable, so that it was possible to see whether pronouncability makes a difference. Three words consisting of five vowels were constructed. In the answer sheet four different words made from the same five vowels were written, in one of the words the letters had the same order as the original word. The same thing was done for numbers and symbols. The vowels, symbols and numbers chosen for the target strings were chosen using the randomization function in excel, the same function was used to make up the three alternatives for each target string.

Correctly identified alternatives were scored 1, errors were scored 0.

3.2.8 Silent reading

In order to assess silent reading a word chain test was used. For the Norwegian word split test, the standardized Norwegian version of the Wordchains test (Høien & Tønnesen, 1997) was used. It consists of 75 strings of letters, all made of four relatively common words. The Norwegian words were translated into Swedish and Danish. Some words had to be altered in the Norwegian test in order to find suitable Swedish and Danish words. The English

Wordchains test (Miller-Guron, 1999) was used. The test consists of 60 strings of letters made of three or four words.

One point was given for each word string correctly split up.

3.3.0 Procedures

The students were first informed about the project by their teachers, next they received an information letter and the questionnaires. In the letter the participants were informed that these tests would also be used for older children, and that therefore some of the tests might be hard for them.

The classroom tests were administered first. This way the children got to know the examiner before being tested individually, they also got used to being in a test situation in a safe and familiar setting. A teacher was present during all classroom tests in Norway and Denmark, whereas 2 experimenters ran both the classroom and the individual session. All children were instructed to sit one by one during the classroom tests, and they only had a pen/pencil and the test booklet on their desks. For the computer-based tests, a smaller room or a not-used classroom was used. The entire computer-session was recorded, in order to be able to reconstruct the responses in case of a failure with the voice-keys that were used and to enable the scoring of the responses by a native speaker of the Scandinavian. For the classroom tests the children got two booklets. The tasks in booklet one were L1 spelling, L2 spelling, L1 word chains, and L2 word chains. Booklet two contained the orthographic learning task, the visual memory task, and the memory of order task. There was time for a short break after finishing booklet one. The computer tasks were administered in the following order; L1 word reading, L2 word reading, non-word repetition, L1 vocabulary, L2 vocabulary.

3.3.1 Questionnaires

The children and their parents were asked to fill in questionnaires approximately two weeks before the test started.

3.3.2 Reading and Spelling

A native speaker of the different L1s prerecorded instructions, and all the words. First the target word was read, next a sentence in which the target word was used in a natural setting, and finally the target word was reread. The children were instructed to write the word on the empty line in the sentence next to the word's number. The same procedure was followed when the participants were asked to spell English words, this time the words were read by a native speaker of English. Five warm-up words were given, before the participants started spelling 40 L1 words. The same was done for L2. The participants were instructed to have a go at words they were not absolutely sure of how to write. To make sure all the participants had enough time to write all the words, the examiner did not move on to a new word before all the children had raised their hands to signal that they were done.

The reading test was conducted individually in a room at the school. A Mac-Book was used, and all computer-based tests were programmed in SuperLab 4.2. Accuracy and latency times for each word were measured. The children used a voice key/ microphone, and the voice key was used to detect the onset of a child's pronunciation of a word. The experimenter pressed a key to register whether the response was correct or not. The session was recorded; using Audacity, so that all errors could be classified later, also if something had gone wrong with the voice key reaction times could be measured in the Audacity file. As a warm up for the real experiment, five high frequency words were presented. This way the children were familiar with the procedure when presented with the test words. The children were instructed in their native language to read aloud each word as quickly as possible after it had appeared on the screen. All words were preceded by a beep cue. If a child made five mistakes in a row, the test was stopped. The L2 test followed the same procedures as the L1 reading test.

3.3.2 Vocabulary

The vocabulary test was given individually to the participants. On a data screen the participants were first presented with 100 L1 words and next with 100 L2 words. Words of varying frequency were presented randomly. The children were instructed to press a green key if they knew the meaning of the word, and to press a red key when presented with words they did not know the meaning of. There was no time limit, so the children had plenty of time to read the words. However, the participants were encouraged to respond as quickly as they could.

3.3.3 Phonological awareness

The Welsh words were presented to the children in SuperLab, and read by a native speaker of Welsh. All sixteen words were presented twice. After two presentations the children were asked to repeat the word once. The children were instructed to pronounce the word as accurately as possible. All responses were recorded on Audacity.

3.3.4 Visual Memory

The visual memory test was conducted in a classroom setting. The visual images were shown as a PowerPoint presentation on a big screen. The children had tables similar to the one that was shown on the screen on their answer sheets; only their tables did not have any colored squares. All tasks were shown for four seconds. Then the children would write an X in the square(s) they meant were the colored ones on the screen. The children were instructed to look at the screen for as long as the black squares were there. As soon as the square disappeared, the children were instructed to indicate in their booklets where the colored squares had been. Before moving on to a new slide, the examiner counted to three to make sure all the children were looking at the screen. The experimenter would press a key to present the next task.

3.3.5 Orthographic Learning

In their booklet the children were presented with the slogan, and four alternative brand names. One alternative was the correct one, one was phonologically similar to the target word, one was orthographically similar, and the final alternative had nothing in common with the target word. After watching the 73 Power Point slides, the students were instructed to open their booklets and circle the alternative they thought was the correct one. In their booklet, the children were presented with the slogan, and four alternative brand names. One alternative was the correct one, one was phonologically similar to the target word, one was orthographically similar, and the final alternative had nothing in common with the target word. The students were asked to guess if they did not remember the correct alternative. They were told to work quickly, and that they had approximately three minutes to finish. The students were allowed to use more time if they needed.

3.3.6 Visual association

The children were instructed to remember the animals' strange names. The animals were used to make the test more interesting for the children, and in order for the children to have something to associate the letter-, number- and symbol strings with.

The letter, number, and memory test was conducted in the classroom. The pictures of the animals and the names were presented in a Power Point presentation. The order of the slides was random, but all slides were presented three times. Each picture was shown for 4 seconds. After seeing all nine animals three times the children were asked to circle the correct alternative in their booklet. They were encouraged to answer quickly.

3.3.7 Silent reading

For the silent reading test, the children were instructed to split as many words as possible. They were asked to find four words within each string of words. To make sure all children knew what to do three test strings were presented first. The children were instructed to put a line between the letters where there should have been space. The examiner used the blackboard to show the children what to do, and split the first string of letters into words. The children were asked to solve the second one, themselves. Finally, the third string was written on the blackboard. This time, the examiner made one mistake on purpose so that the children would know what to do if they made a mistake. After making sure everyone knew what to do, the participants were given five minutes to split up as many strings as possible.

For the L2 word split test, three new test strings were presented on the blackboard. The children were instructed to do what they had done on the L1 test, only this time the test was slightly harder because some strings consisted of three words, and some of four. The L2 test only lasted for 3 minutes.

3.4 Statistical analyses

Data from the student and parent questionnaires were analyzed using χ^2 for ordinal and nominal data. χ^2 computes expected value of occurrences minus actual value of occurrences.

Manova with stepdown procedures were used to analyse continues data. A step down procedure entails that the mean for the different groups are adjusted stepwise. That is, the effect of the second variable on the dependent variable list is corrected by the first. The effect of the third variable is corrected by the first and the second, and so on. Thus, effects of all previous dependent variable on the ones that come later are taken away. This means that the order of entering variables is important. Ideally the covariate that has greatest influence on the dependent variable is entered first. For all Manovas, the D-prime of L1 vocabulary was used as the first variable, because L1 vocabulary is believed to be influenced by both home background and school, and it can therefore be used as a corrective variable for any background differences. Orthographic learning was added as a second co-variable for reading and spelling in order to see whether orthographic learning mediates reading and spelling.

4.0 Results

This chapter presents the results from the student questionnaires, the parent questionnaires, the teacher questionnaires, and from all reading, spelling and cognitive-tests. First information about the sample will be presented, this section contains two subsections: the language background of the participants, and teachers and teaching of L2 across the countries. Next, the results concerning the five research questions will be examined.

4.1 The Sample

Results from the student- and parent questionnaires are presented in this section. For the Norwegian and Danish participants the questionnaires were attached to the consent forms, and therefore all the participants from these countries filled in the questionnaires. The Swedish participants filled out the consent forms where they agreed to take part in the study. Forty-eight Danish, 60 Norwegian, and 54 Swedish participants returned the student questionnaire. Forty-eight Danish, 60 Norwegian, and 44 Swedish participants returned the parent questionnaires.

On the basis of background information from the questionnaires, two Norwegian children were excluded from the sample; one of them had just returned to Norway from a school in England, the other had only lived in Norway for two years, and had initial reading and writing experience in a semi-deep orthography - French. In addition, the teachers were asked whether there were children with special diagnosis, such as dyslexia. Two children fell into this group. These children were allowed to do the tests, but were later excluded from the sample. Finally, one Swedish child was excluded because his parents reported to use Kirundi 99% of the time when talking to the child, and there was uncertainty about his age and the number of years he had been to school.

The final sample consisted of 48 Danish, 58 Norwegian and 66 Swedish participants.

4.1.1 The Language background of the participants

The results from the questionnaires were analyzed with two-factor analysis of variance model for continuous variables and χ^2 tests for categorical data. The independent variables or factors were age-band and country (orthography). Significant differences will be reported and

it will be discussed whether or not these findings jeopardize comparability of the national samples.

Use of L1 outside school

The children were asked to report how much they use Danish, Norwegian and Swedish, respectively, they could choose between always (scored 4), often (3), now and then (2) and seldom (1). When running Chi-square the results showed that χ^2 (2) =10.88, p = .004. Significant difference between countries was found because 4 of the 58 Norwegian, and 10 of the 54 Swedish children did not always use L1 outside school. In these cases one of the parents spoke another mother tongue. All children had, however, been exposed to Norwegian or Swedish from birth. There was no significant difference between the age-bands.

Use of L2 outside school

When reporting on how much the participants use English outside school, the children could choose between always (scored 4), often (3), now and then (2) and seldom (1). 45 Danish, 57 Norwegian and 48 Swedish children reported to use L2 outside school. Out of these 24 Danish, 22 Norwegian and 14 Swedes reported to use it seldom. Fifteen Danish, 26 Norwegian and 29 Swedish children reported to use it now and then. Five Danish, 9 Norwegian, and 5 Swedish children reported to use English often. Finally one Dane reported to use English always, however this child also reported to use L1 always. There was no significant difference on how often the children used L2, English, outside school (χ^2 (6) = 10.16, p = .118). There was no significant difference between the age-bands either.

Use of other mother tongue than Danish, Norwegian or Swedish

One Dane reported to use another mother tongue than Danish. She reported to use Icelandic. Farsi, Lao and French were mentioned as other mother tongue languages used by three Norwegian children. French, Arabic, Thai, Kirundi, and Kurdish were listed as other mother tongues used by eight of the children from the Swedish sample. The children were asked to report on how often they used this other mother tongue, they could choose from the alternatives always (scored 4), often (3), now and then (2) and seldom (1). The Danish child reported to use this other mother tongue always outside school. One Norwegian child reported

to use this other mother tongue seldom, another now and then and the last one always. Five of the Swedish children reported to use this other mother tongue seldom, 2 reported to use it often, and 1 reported to use it always outside school. The reason for the statistical difference in use of L1, between Denmark and Norway and Sweden, is explained by the samples from the two latter countries having more immigrants.

Use of other languages outside school

Seven Danes reported that they used other languages, apart from their L1, English and other mother tongue outside school. One child reported to use this other language now and then, the others reported to use it seldom. The language they reported to use was German. The Danish school was only 35 km from the German border, and a substantial German-speaking population lives in the area. Also some of the children went to Germany on a regular basis.

No Norwegians reported to use other languages than their L1, English or other mother tongue languages. One Swede listed Norwegian, and 1 listed German as languages they used, apart from their L1, English and other mother tongue languages. The Swedes reported to use this other language seldom.

In conclusion, the three samples were made comparable by removing the emigrant children who did not speak Norwegian and Swedish from birth.

Book reading in L1, Danish, Norwegian and Swedish, respectively

The children were asked to report on how often they read books and magazines in L1, Danish, Norwegian and Swedish, respectively, they could choose between very often (scored 4), often (3), now and then (2) and seldom (1), and never (0). No significant difference between countries was found on how often the children read books in L1 (χ^2 (6) =8.14, p = .228). There was no significant difference between the age bands.

Book reading in L2

When reporting on how often they read books and magazines in L2, English, the participants could choose between very often (scored 4), often (3), now and then (2) and seldom (1), and never (0). Chi-square showed that there were no differences between the countries (χ^2 (6) = 8.28, p= .218).

TV and DVD in L1

When reporting on how much they watch TV and DVD the children could choose between always (scored 4), often (3), now and then (2) and seldom (1). Differences were found on how often the children watch TV and DVD in L1 χ^2 (6) = 12.70 = .048. The Danish participants reported to watch more TV and DVD in their L1.

TV and DVD in L2

Again, the categories, used to report how often the children watch TV and DVD in English, were always (scored 4), often (3), now and then (2) and seldom (1). For all countries, the older children reported to watch more TV and DVD in their L2. Differences were found on how often the children watch TV and DVD in L2 χ^2 (8) = 18.51, p= .018). Swedish children reported to watch most TV and DVD in English.

Computer games in L1

The children could choose between the alternatives always (scored 4), often (3), now and then (2) and seldom (1) when they reported on how often they play computer games in their L1. No differences were found on how often the children played computer games in L1 (χ^2 (8) = 5.78, p= .672).

Computer games in L2

The children could choose between the alternatives always (scored 4), often (3), now and then (2) and seldom (1) when they reported on how often they play computer games in their L2. No differences were found on how often the children played computer games in L2 (χ^2 (8) = 13.259, p = .103.

Parent talks to child in L1

Parents were asked to report in percentages how often they use Danish, Norwegian and Swedish, respectively when they talk to their children. From the questionnaire it was gathered that both the Danish, Norwegian and Swedish parents mainly use L1, Danish, Norwegian and Swedish, when they talk to their children. The mean was that 97.85 % of all parent to child conversation for the Danish sample is in Danish. For the Norwegians the mean was 94.34%. The Swedish mean was 91.64. The difference is not significant ($F (2, 149) = 1.839$, $p = .163$). No significant difference is found between age-bands. These results are in line with what was reported in PIRLS 2006, when parents were asked how often the students speak the test language at home. Results showed that 81 % of the Danes always spoke Danish at home, 80 % of the Norwegians always spoke Norwegian and 75 % of the Swedes always spoke Swedish (Mullis et al. 2007: 135).

Parent talks to child in L2

When it came to the question of how much English was used when parents talked to their children, only 6 Danish, 7 Norwegian and 5 Swedish parents reported that they use English at all when talking to their children. The parents were asked to report in percentages how much they use English when talking to their children. The mean for how much the Danish parents in question used English was 2.83%, the mean for the Norwegian parents was 28.43%, and 4.60% for the Swedish parents. The effect of country is significant ($F (2, 17) = 8.711$, $p = .008$). However, as the total number of parents in each country using English when talking to their children is very low this difference cannot be considered as important when comparing the countries. English is mainly learnt at school. To ensure English acquisition is comparable across countries teaching and teachers will be compared.

Parent talks to child in other language

Five Danish parents, 3 Norwegian parents, and 5 Swedish parents reported to use other languages than their L1 and English when talking to their children. Three Danish parents reported to use German when talking to their children, however two of them reported to use it

1%, and the other one 2%. In one family 80% of all parent-to-child talk was done in Dutch. Finally, there was one family where all parent-to-child talk was done in Icelandic.

Within the Norwegian sample three children had another mother tongue than Norwegian. One had a Lao speaking parent, and one Norwegian-speaking parent. In this family 50% of all parent-to-child talk was done in Norwegian. Another child had Farsi as mother tongue; still 40% of parent to child talk was done in Norwegian.

Out of the 5 Swedish parents reporting to talk to their children in another language than Swedish and English, one reported to use German, however this parent only used German for 1% of all parent-to-child talk. Three Swedish parents reported to use Thai when talking to their children, the parents reported to use this language 30%, 40% and 90% respectively, when they talked to their children.

Parents' mastery of L1

The parents were asked to report on how fluent they are in Danish, Norwegian and Swedish respectively. They could choose between the categories 4 (fluent,) 3 (good), 2 (ok), and 1 (poor). All the Danish parents reported that they speak and understand Danish fluently. The same was the case for all, but one Norwegian parent. However, this parent reported that the other caretaker, the child's mother, spoke Norwegian fluently. In sum, all children in the Norwegian and Danish samples came from homes where at least one of the parents spoke L1 fluently. In the Swedish sample 5 parents reported that they are not fluent in Swedish, however 3 of these have another caretaker who is fluent in L1. The remaining two reported that their level of Swedish is good. All the Danes fell into the category 'fluent', whereas a few Norwegians and Swedes belonged to the category good, while the others were fluent. The difference is significant (χ^2 (4) = 12.69, p = .013), but as only 2 Swedes live in a home without a caretaker that is fluent in L1, the sample is considered comparable. The fact that more Swedes had non-native speaking parents, is in line with PIRLS 2006, where more Swedish than Danish and Norwegian parents reported that neither parent was born in the country. In PIRLS 2006 it was reported that 9 percent of Danish students, 6 percent of Norwegian students, and 13 percent of Swedish came from homes where neither parent was born in the country (Mullis et. al 2007:136).

Parents' mastery of English

When it came to how well parents reported to speak and understand L2, they could choose between the categories 4 (fluent,) 3 (good), 2 (ok), and 1 (poor). Mastery of English did not differ across countries (χ^2 (6) = 10.24, p = .115).

Exposure to L1 outside school

The parents also reported on how much in percent their children are exposed to different languages outside school. No difference across countries was found on how much the children were exposed to L 1outside school (χ^2 (24) = 34.54, p = .076).

Exposure to English outside school

Ten Danish, 13 Norwegian, and 8 Swedish parents reported that their children are exposed to English outside school. No difference is found across countries for how much these children are exposed to English (χ^2 (16)= 22.97, p = .115).

Exposure to other languages outside school

Eleven Danish, 4 Norwegian, and 5 Swedish parents reported that their children are exposed to other languages than their L1 and English. In the Danish sample 9 parents report that their children are exposed to German, the remaining two children that are exposed to other languages are the children that already are reported on where the parents speak Icelandic and Dutch. In the Norwegian sample one child is reported to be exposed to Chinese for 5% of the time, one child is reported to be exposed to Danish (percentage not reported). The remaining two children are the children already reported on where the parents speak Farsi and Lao. All the Swedish children that are exposed to other languages than Swedish and English are from the families already reported on, where one or both of the parents speak another language. The mean for how much exposure is 16.55 percent for the Danes, 25.00 percent for the Norwegians, and 23.50 percent for the Swedes.

Active use of L1 outside school

There is no difference in how much the parents report that their children actively use their L1 ($F(2, 146) = 12.128$, $p = .844$). In all countries, the mean percentage for how much the parents report that their children use their L1 is over 96%. The Danish mean is 97.40 percent, the Norwegian mean is 97.09 percent, and the Swedish mean is 96.50 percent.

Active use of L2 outside school

Very few parents report that their children use English actively outside school, only two Danish, 11 Norwegian, and 4 Swedish parents report that their child uses it. The mean percentage for how much English the two Danish children use English is 10.00 percent, while the same mean for the Norwegians is 8.73 percent, and 11.50 percent for the Swedes. No difference between countries is found ($F(2, 16) = 15.935$, $p= .851$), however a larger number of Norwegian parents report that their child uses it. There is no significant effect from age-band, and no significant interaction between factors.

Other languages used outside school

Five Danes, 3 Norwegians, and 5 Swedes report that their children use other languages than their L1 and English, actively. These are the same children that were reported on under the section "Parent talks to child in other languages", in addition three Danes reported to use German. The mean for how much these children use this language is 21.00 percent for the Danes, 23.33 percent for the Norwegians, and 20.20 percent for the Swedes. There is no difference between countries ($F(2, 12) = .064$, $p = .939$).

Parents' mastery over other languages

Forty-three Danish parents, 19 Norwegian, and 21 Swedish parents reported that they speak and understand other languages than Danish, Norwegian or Swedish, and English. Thirty-seven of the Danish parents, and 13 of the Norwegian parents, and 7 Swedish parents listed German as their third language. Three Norwegian parents, and 5 Swedish parents listed French as their third language. A difference is found as to how fluent the parents speak this

third language (χ^2 (6) = 14.76, p= .022). Most Danish parents reported to speak this third language fluently or good. The majority of the Norwegian and Swedish parents reported to speak this third language ok. It is evident that German is an important foreign language for the Danes.

Nine Danish, 4 Norwegian, and 8 Swedish parents listed a fourth language they speak and understand. Again, 1 Dane, 2 Norwegians, and 2 Swedes listed German. Three Danes, 1 Norwegian and 4 Swedes listed French. There was a difference found for how well the parents from the three countries speak this fourth language (χ^2 (10) =19.53, p = .034). However, as very few parents reported to speak a fourth language, this does not jeopardize the comparison. No parents reported to speak this language fluently, but more Danes reported to be good or ok in this fourth language.

In sum: more Danish parents than Norwegian and Swedish parents report that they speak or understand a third or a fourth language. Moreover, the 43 Danish parents that report to master German as a third language, in average report to master German better than English.

Number of books and children's books at home

Another significant background effect from country was found when the parents reported on how many books, and children's books they had in their home. The parents were asked to report whether they had more than 200 books, scored 5, between 101 and 200 books, scored 4, between 26 and 100 books, scored 3, between 11 and 25 books, scored 2, or between 0 and 10 books, scored 1. A significant difference was found between the countries (χ^2 (8) = 33.60, p= .000). No Norwegian and only one Swede reported to have between 0-10 books, while 6 Danes belonged to this category. Only 3 Norwegians and 3 Swedes reported to have between 11-25 books, while 8 Danes belonged to this category. Sixteen Danes, 8 Norwegians, and 12 Swedes reported to have 26-100 books. Six Danes, 13 Norwegians and 8 Swedes reported to have 101-200 books. The largest group of participants reported to have more than 200 books. However, only 7 Danes belonged to this group, while 35 Norwegians and 15 Swedes reported to have more than 200 books. Figure 2 shows mean for how many books parents from the different age-bands reported to have in each country. The Danish score was lowest for all age-bands, and the Norwegian score is highest for all age-bands. This is in line with other international comparative studies, like PIRLS 2006, where 29 % of Norwegian parents

reported that they had more than 100 books at home, while this only was the case for 25 % of the Danes, and 28% of the Swedes. Also, in PIRLS 2006, 6 % of the Danish parents reported that they had between 0 and 10 books at home. Only 2 % of the Norwegian children came into this category, and 4 % of the Swedes (Mullis et al 2007: 114).

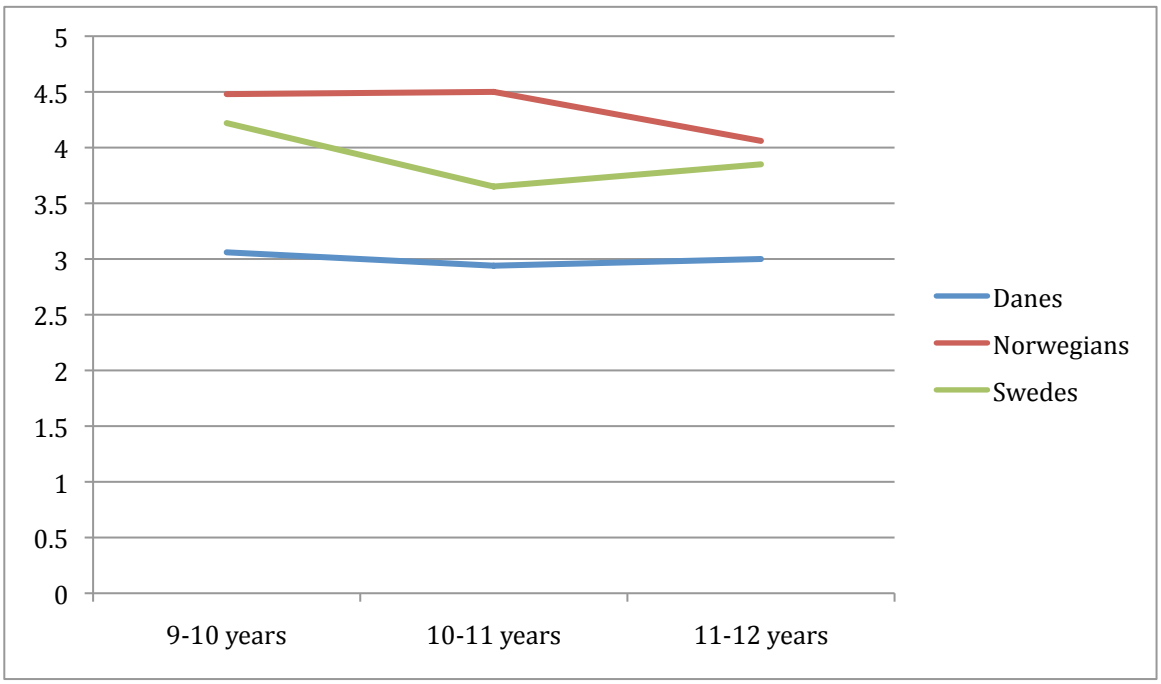

Figure 2. Number of adult books in household.
5=more than 200, 4= 101-200, 3= 26-100, 2 = 11-25, and 1 = 0-10

The participants were also asked to report how many children's books they had in their home. The difference between the countries was not significant (χ^2 (8) = 14.53, p= .069). Figure 3 shows the mean score for how many children's' books the parents reported to have for all age-bands in all countries. Compared to figure 2, illustrating number of books in the home, the differences is smaller when looking at number of children's books. Still, for all age-bands, the Danish parents reported that they had fewer than or equally many children's books as what the Norwegian and Swedish parents reported.

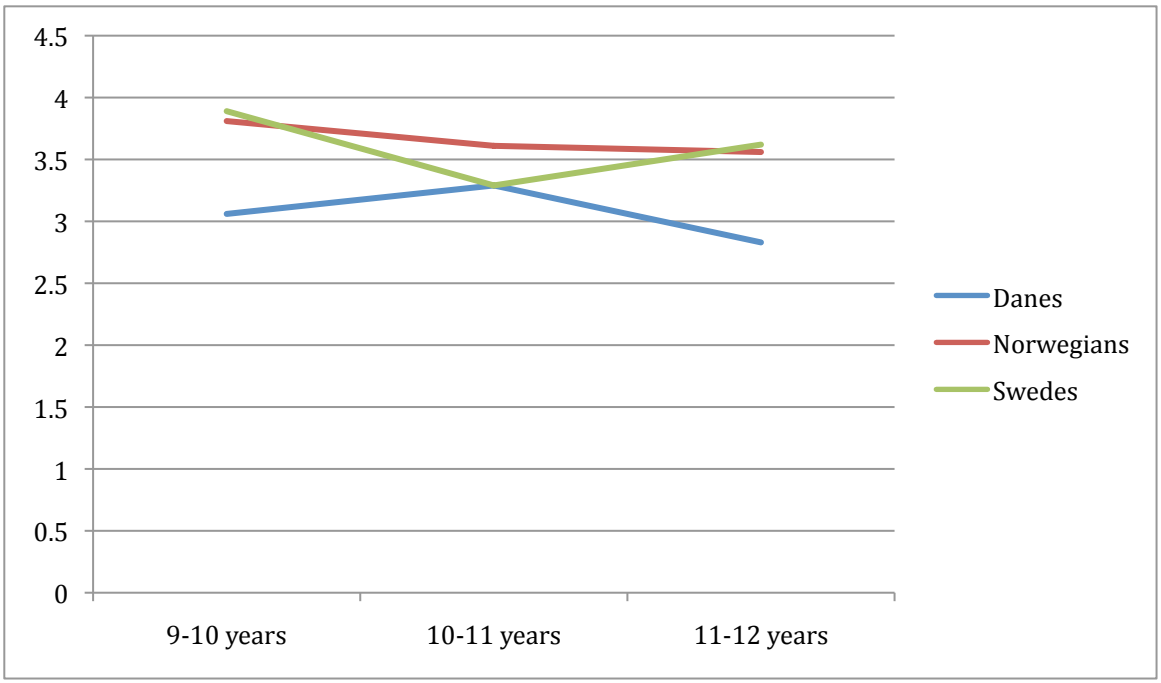

Figure 3.Number of children's books in household.
5=more than 200, 4= 101-200, 3= 26-100, 2 = 11-25, and 1 = 0-10

Summing up

From the background information given from the participants and their parents it is concluded that the three samples are comparable. The Danes are less exposed to written L1 in their homes. Moreover, Norwegian children are exposed to English slightly more than the Danish children, possibly a consequence of the early start.

4.1.2 Teachers and Teaching of English as L2 across the countries

In Denmark one teacher taught English in both the Danish third grade, and the fifth grade. The teacher reported that there was a shift in what activities was preferred when teaching the two age groups, however, oral activities and writing in English was used a lot both for the youngest and the oldest children. Working with grammar was used often for the oldest children, but only now and then for the younger children. Both groups often read aloud, and listened to English-speaking persons on CD, DVD or TV. They seldom used the Internet or watched English movies.

When teaching English, the **Norwegian** teachers in all three grades used oral activities, and reading aloud often. Silent reading was reported to be used now and then for the oldest children, but rarely for the two younger groups. The 5th and 6th grade teachers reported that they listened to English speaking persons on CD, DVD and TV a lot, while the teacher for the youngest children used this activity often. For all the classes, the teachers reported that they rarely watched English movies. The youngest children only wrote in English, and worked with grammar now and then, while the 5th grade teacher used both these activities a lot. The 6th grade teacher reported to use writing in English, and working with translation often. Moreover, the 5th grade teacher reported that the class worked with grammar a lot, while the two other teachers only chose this activity now and then.

In **Sweden**, two different teachers had one group of 4th graders in English each at Långbrott school. They reported that they use oral activities, writing in English, and work with grammar a lot. They reported to read aloud a lot or often, while quiet reading was only used now and then or rarely. Both teachers reported that they rarely watch English movies, and that they rarely or now and then use English pages on the Internet. Listening to English speaking persons was used often or now and then, while translation was used a lot or often.

The two teachers teaching English in 5th grade at Långbrott school, both reported to use oral activities a lot, while reading silent and aloud, English writing and working with grammar was reported to be used often. Both replied that they listen to English speaking persons on CD, TV and DVD now and then. They reported that they rarely used the Internet, and never or rarely watch English movies. Both replied that they work with translation a lot or often.

In sum the preferred activities used in class are comparable for the three countries. The most surprising finding is perhaps in the lowest age-band, where the youngest Norwegians, having more years of English training, still write less than the Danish and Swedish children in age-band 1.

Education and background

The teacher teaching the Danish third and fifth graders, had 35 years experience, and the English education was from the Danish teacher training, Semenariet. The teacher teaching the

Danish 4th graders English was away during the period of data collection. She had been on sick leave for a couple of months, and the children had different substitute teachers.

The fourth grade teacher in Norway teachers did not have any formal education in English, but was an experienced teacher. It is common that English teachers in the four lowest grades do not have any formal training in the language. The English teacher in the Norwegian fifth grade had a bachelor's degree in English language and literature.

The Swedish fifth grade teachers reported to have 20 years experience, and 22 years. They both had teacher training, and one of them reported to have an additional 10p of English. The other teacher reported to have taken an English course in England during a summer holiday.

In sum the teachers are comparable when it comes to teaching and experience.

4.2 Results showing differences in decoding strategies between shallow Norwegian and Swedish, and deep Danish in L1 and L2.

This section will look at errors made when reading L1 and L2. Also, it will examine the errors made on the orthographic learning task, and general performances on the orthographic learning task. Finally, results from tests concerning underpinning psychological variables; orthographic learning, visual memory, and phonological awareness, will be presented. The Norwegian and Swedish sample will be seen as one as this section looks at differences in decoding strategies used when reading deep and shallow orthographies.

4.2.1 Errors in L1 Reading

The errors were categorized into non-word error, real word substitution, ending error, and don't know.

Country		Nonword errors	Realword substitutions	Ending errors	"Don't know"
Denmark	Count	51	28	47	13
	Expected count	53.2	19.7	56	9.4
Norway + Sweden	Count	57	12	68	6
	Expected count	54.8	20.3	58.3	9.6

Table 1. Count and expected count of errors in L1 reading

There was a significant difference between which kind of errors participants from the different orthographies made on the L1 reading task $\chi^2(3) = 13.093$, $p =< .010$ The greatest discrepancy is found for real word substitution and ending errors. The Danish participants make more real word substitution than what is the expected count. The expected count for this category of errors is 19.7, while the real count is 28. The Danish participants also made more

"don't know" responses than the expected count. The Norwegians + Swedes make fewer errors than expected within this category. The Norwegian + Swedish participants make more ending errors than what is expected. The expected count for the Norwegians and Swedes within this category is 58.3, but the actual count is 68. It is in line with the literature that readers of deep orthographies make more real word substitutions

4.2.2 Errors in L2 Reading

The errors were categorized into non-word error, real word substitution, ending error, and don't know.

Country		Nonword errors	Realword substitution	Ending errors	"Don't know"
Denmark	Count	481	46	11	31
	Expected count	499.9	46.9	7.6	14
Norway + Sweden	Count	1096	102	13	15
	Expected count	1077.1	101.1	16.4	31.4

Table 2. Count and expected count of errors in L2 reading

There was a significant difference between which kind of errors participants from the different orthographies made on the L1 reading task $\chi^2(3) = 30.353$, $p =< .001$ The greatest discrepancy is found for nonword errors and the response "don't know". The Norwegian + Swedish participants make 18.9 more nonword errors than expected count. The Danish participants make 17 more "don't know" responses than the expected count.

Summing up: When reading L1 words the Danish participants made more real word substitutions, and "don't know" responses. For L2 reading too, there was a difference between orthographies**.** The Norwegian + Swedish participants made more non-word errors than expected, and the Danish participants made more "don't know" responses. The tendency for the Danish participants to make more "don't know" responses than expected is seen both for L1 and L2.

4.2.3 Errors in the Orthographic Learning Task

Country		Phonological errors	Orthographic errors	Other error	No response
Denmark	Count	194	238	188	129
	Expected count	224.5	279.5	161.2	83.8
Norway + Sweden	Count	540	676	339	145
	Expected count	509.5	634.5	365.8	190.2

Table 3.Count and expected count of error types in the orthographic learning task

There was a significant difference between which kind of errors participants from the different orthographies made on the orthographic learning task $\chi^2(3) = 54.408$, $p =< .001$. The greatest discrepancy is found for the orthographic errors, and no response. For the orthographic error the expected count for the Norwegians + Swedes was 634.5, while the number of occurrences was 676. The Danish participants made fewer mistakes within this category than what was the expected count; the real count was 238, while the expected was 279.5. The Danes made more errors of the category no response than would have been expected if there were no difference between the orthographies. The expected count for the Danes was 83.8, but the real count was 129. The Norwegian + Swedish participants made fewer errors of this kind than expected; the real count was 145, while the expected count was 190.2. A smaller discrepancy was found for phonological errors and "other" errors. The Norwegian + Swedish participants made more phonological errors than the expected count, and the Danes made fewer phonological errors than the expected count. The Danish participants made more "other" errors than expected.

Summing up.

The Norwegian + Swedish participants more orthographic and phonological errors than expected. The Danish participants made more errors of the category no response, and "other", meaning they chose the unrelated foil.

4.2.4 Orthographic learning

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	13.28	4.873	14.14	4.729
Age-band 2	12.00	4.729	16.15	3.973
Age-band 3	15.58	5.664	17.83	5.311
Total	13.38	5.151	15.93	4.828

Table 4.Orthographic learning

The mean for how many items the participants in age-band 1 got correct in the orthographic learning task was 13.28 for the Danes, and 14.14 for the Norwegians + Swedes. For age-band 2, the Danish mean was 12.00, and the Norwegian + Swedish was 16.15. Finally, for age-band 3, the Norwegians +Swedes again got a higher score than the Danes. The mean for the oldest Danes was 15.58, while it was 17.83 for the oldest Norwegians + Swedes. A Manova with L1 vocabulary as the first variable and orthographic learning as the second variable was run. The difference between orthographies was significant (Stepdown $F(1, 163) = 4.43$, $p = .037$). The second Helmert contrast for age-bands too was significant (Stepdown $F(2, 163) =$

3.76, p = .025).

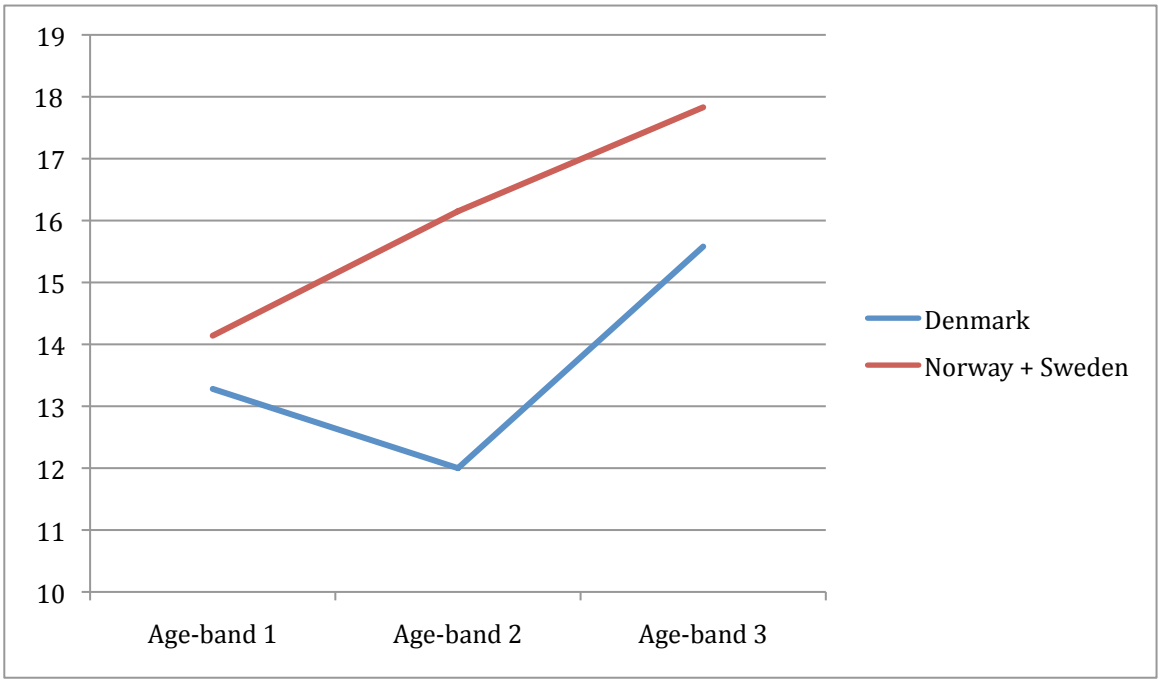

Figure 4.Orthographic learning.

Figure 4 shows the difference in orthographic learning between the Danish participants, and the Norwegian + Swedish.

		OL Correct	**Visual assosiation**	**Visual memory**	**Nonword repetition**
OL correct	Pearson Corr.	1	.268	.209**	.176*
	Sign.		.000	.006	.023
	N.	173	171	173	167
Visual association	Pearson Corr.	.268	1	.241**	.082
	Sign.	.000		.001	.293
	N.	171	171	171	165
Visual Memory	Pearson Corr.	.209**	.241**	1	.024
	Sign.	.006	.001		.756
	N.	173	171	173	167
Nonword repetition	Pearson Corr.	176*	.082	.024	1
	Sign.	.023	.293	.756	
	N.	167	165	167	168

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table 5. Correlations orthographic learning and visual association, visual memory and nonword repetition

Results show that orthographic learning correlates significantly with visual association, (r (169) = .268, p < .000), and with results obtained on the nonword repetition task, r (165) = .176, p = 0.23. There is a correlation between orthographic learning and visual memory, but this correlation is not significant. However, as visual memory is part of what visual association is, and visual association correlates significantly with orthographic learning, visual memory is one of the skills that support orthographic learning.

Number of presentations

Here the number of correct identifications on the orthographic learning task, after one, two, three and four presentations is presented.

One presentation

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	1.89	1.183	2.53	1.453
Age-band 2	2.06	1.110	2.74	1.621
Age-band 3	2.75	1.545	3.40	1.631
Total	2.17	1.277	2.86	1.595

Table 6.Correct identifications after one presentation

After one presentation there is a significant difference between countries when it comes to how many items the participants identified correct (F (1, 172) = 6.630, p = .011). The Danish mean is 2.17, and the Norwegian + Swedish is 2.86. Age-band too is significant, (F (2, 172) = 3.724, p = .026). Table 6 shows that the older participants make more correct responses after one presentation. There is no significant interaction between factors (F (2, 172) = .007, p = .997).

Two presentations

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	3.94	1.731	4.00	1.746
Age-band 2	3.44	2.093	4.51	1.640
Age-band 3	4.83	2.038	5.17	1.740
Total	3.98	1.984	4.52	1.753

Table 7.Correct identifications after two presentation

There is no significant difference between orthographies when it comes to correct responses after two presentations (F (1, 172) = 2.530, p = .114). However, again the Danish participants make fewer correct responses than the Norwegian + Swedish for all age-bands, see table 7. The Danish mean is 3.98 correct responses, and the Norwegian + Swedish mean is 4.52. Age-band is significant (F (2, 172) = 4.447, p = .013); the older participants perform better than the younger. There is no significant interaction between variables (F (2, 172) = 3.455, p = .336).

Three presentations

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	2.50	1.790	2.88	1.651
Age-band 2	2.39	1.650	3.49	1.381
Age-band 3	3.08	1.505	4.20	1.587
Total	2.60	1.660	3.48	1.609

Table 8. Correct identifications after three presentations

Table 8 shows that after three presentations, the mean for the Danish participants is 2.60. The mean for the Norwegian + Swedish participants is 3.48. The reason why the mean for both countries is lower after three presentations than after two, must be because 8 items were

shown twice, and only 7 were shown three times. The difference between orthographies is significant (F (1, 172) = 10.212, p = .002). Age-band is also significant (F (2, 172) = 9.803, p = .021. For both countries the older participants perform better than the younger ones. No significant interaction between factors is found (F (2, 172) = .850, p = .429).

Four presentations

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	4.94	1.626	4.72	1.485
Age-band 2	4.11	1.641	5.40	1.056
Age-band 3	4.92	1.832	5.06	1.697
Total	4.63	1.696	5.07	1.427

Table 9. Correct identifications after four presentations

After four presentations most participants manage to identify the correct non-word. Table 9 shows that the mean for correct responses after four presentations was 4.63 for the Danish participants, and 5.07 for the Norwegian + Swedish participants. No significant difference was found between orthographies or age-bands, (F (1, 172) = 2.474, p = .118; F (2, 172) = .254, p = .776; respectively). There is a significant interaction between variables (F (2, 172) = 3.584, p = .030). This is a result of the Danish participants in age-band 2 scoring a mean of .80 less than both the other age-bands, while among the Norwegian + Swedish participants this age-band scored highest.

Summing up.

The Norwegian + Swedish participants got more items correct for all age-bands, on the orthographic learning task. There is a significant difference on how many items the Danish and the Norwegian + Swedish participants get right after one and three presentations. After four presentations most participants manage to identify the correct non-word.

4.2.5 Visual memory

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	33.22	3.474	31.51	4.137
Age-band 2	32.39	5.078	31.55	5.683
Age-band 3	35.00	2.558	33.94	3.925
Total	33.35	4.034	32.21	4.815

Table 10. Visual memory

Results from the visual memory test showed that the Danes scored higher than the Norwegians + Swedes for all age-bands, see table 10. The Danish mean for all age-bands together was 33.35, while the Norwegian + Swedish mean was 32.21. However the difference between orthographies was not significant ($F (1, 172) = 2.254$, $p = .127$). The oldest participants scored better than the younger ones. The difference between age-bands was significant ($F (2, 172) = 3.515$, $p = .032$). Helmert contrasts showed that the difference only was significant, $p = .012$, between age-band 2 and 3, and no significant difference between age-band 1 and later, $p= .291$. There is no significant interaction between age-band and orthography ($F (2, 172) = .126$, $p = .881$).

4.2.6 Phonological awareness

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	61.6	4.2	60.3	7.4
Age-band 2	57.9	7.4	64.5	3.9
Age-band 3	62.7	2.7	62.9	7.5
Total	60.5	5.6	62.9	6.7

Table 11.Phonological awareness

The means for how many phonemes the participants managed to repeat show that the Danish mean is 60.5 phonemes, with a standard deviation of 5.6. The Norwegian + Swedish mean is 62.9 phonemes, with a standard deviation of 6.7. Table 11 shows means for all age-bands. Then effect of orthography is significant ($F(1, 167) = 4.226$, $p = .041$). The effect of age-band is not significant ($F(2, 167) = 1.814$, $p = .166$) when looking at phonemic awareness. However, there is an interaction between ortography and age-band making the effect less clear-cut ($F(2, 167) = 5.360$, $p = .006$). The results from the non-word repetition task showed that the Danish participants scored higher than the Norwegian + Swedish for the lowest age-band. The mean for the Danes in age-band 1 is 61.6 phonemes, while the Norwegian + Swedish was 60.3. The difference between countries is larger for the two oldest age-bands. For age-band 2, the Danish mean is 57.9, and the Norwegian + Swedish is 64.5. Finally, for Age-band 3, the Danish mean is 60.5, and the Norwegian/Swedish mean is 64.0.

The results for all items were not consistent, which means that some items were biased. Norwegians performed better on some items, while Danes and Swedes did so on others. As this was the case, the test did not measure phonemic awareness in a language-neutral way.

4.2.7. Order and association learning

Total memory of order.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	4.61	1.819	4.51	1.279
Age-band 2	4.78	2.016	4.72	1.747
Age-band 3	4.58	1.790	5.32	1.770
Total	4.67	1.790	4.81	1.626

Table 12. Total memory of ordes

The results from all the language order learning tasks shoved that the Danish participants got an average of 4.67 out of 9 strings correct, while the Norwegian + Swedish participants got an average of 4.81 strings correct, see table 12. After running a Manova with with a stepdown, with the variables L1 vocabulary, nonword repetition, visual memory, orthographic learning

and number of correct on order and association learning, orthography was not significant (Stepdown F (1,165) = .372, p = .007).

Order and association learning: digits.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	1.56	.856	1.47	.667
Age-band 2	1.33	.970	1.50	.863
Age-band 3	1.42	.996	1.76	.855
Total	1.44	.920	1.56	.801

Table 13.Memory of digits

The Norwegian + Swediah participants scored slightly better than the Danish on the task concerning memory of digits. After running a manova with a stepdown, with the variables L1 vocabulary, nonword repetition, visual memory, orthographic learning and total number of correct on order association learning, orthography was not significant (Stepdown F (1, 165) = .094, p= .760).

Order and association learning: symbols.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	1.50	1.043	1.74	.658
Age-band 2	1.89	.676	1.61	.881
Age-band 3	1.83	.718	2.09	.830
Total	1.73	.844	1.79	.812

Table 14.Memory of digits

There is hardly any difference between the Danish and the Norwegian + Swedish participants when it comes to the number of digit strings they can remember. When running a Manova with a stepdown, with the variables L1 vocabulary, nonword repetition, visual memory,

orthographic learning and total number of correct on order association learning, orthography was not significant (Stepdown F (1, 165) = .024, p = .878).

Order and association learning: vowels.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	1.56	7.84	1.30	.914
Age-band 2	1.56	.856	1.61	.802
Age-band 3	1.33	.778	1.47	.861
Total	1.50	.799	1.46	.862

Table 15. Memory of vowels

On the task concerning memory of vowel strings, the Danish participants scored an average of 1.50, while the Norwegian + Swedish participants scored 1.46. Running a Manova with a stepdown, with the variables L1 vocabulary, nonword repetition, visual memory, orthographic learning and total number of correct on order association learning, showed that orthography was not significant (Stepdown F (1, 165) = .000, p = .998).

Correlations

Order learning was believed to be one of the underpinning skills in orthographic learning. However, the correlation between the order learning tests and the orthographic learning task is low, see table 16**.** The correlation between orthographic learning and total order learning is .268. There is no significant correlation between learning the order of digits and orthographic learning, nor is there a significant correlation between learning the order of vowels and orthographic learning. The correlation between learning the order of symbols and orthographic learning is low but significant r (165) = .136, p = 0.06). However, the correlation within association is higher, so association is a real thing.

		Digits	**Symbol**	**Vowels**	**Total**	**Orthographic**

		association	association	association	association	learning
Digits association	Pearsons	1	.254**	.145	.698**	.193*
	Sig.		.001	.058	.000	.011
	N	171	171	171	171	171
Symbol association	Pearsons	.254**	1	.115	.675**	.210**
	Sig.	.001		.135	.000	.006
	N	171	171	171	171	171
Vowels association	Pearsons	.145	.115	1	.633**	.136
	Sig.	.058	.135		.000	.077
	N	171	171	171	171	171
Total association	Pearsons	.698**	.675**	.633**	1	.268**
	Sig.	.000	.000	.000		.000
	N	171	171	171	171	171
Orthographic learning	Pearsons	.193*	.210**	.136	.268**	1
	Sig.	.011	.006	.077	.000	
	N	171	171	171	171	173

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 16. Correlation between orthographic learning and visual association

Summing up

There was no significant difference between users of shallow and deep orthographies in the ability to learn the order of digits, symbols and vowels in a string. Moreover, orthographic learning must be something more than the ability to remember order.

4.3 Effect of Early start

This section will present the outcome when comparing readers of a shallow orthography starting to learn L2 in the 2nd grade to those starting in the 3rd grade, and those who start learning their L2 in the first grade to those starting later, 2nd or 3rd grade.

4.3.1 Early vs. late starting Swedes

	Early starters	Late starters
L2 Spelling	7.10	7.91
L2 word reading acuracy	26.61	27.94
L2 mean log RT (fluency)	3.0539	3.0760
L2 wordsplit	19.79	24.44
L2 vocabulary	.1911	.4550

Table 17. Early vs. late starting Swedes

When comparing Swedish children with an early starting age with those with a later starting age, results from the L2 spelling test showed that the mean for the late starters was spelling 7.91 words correct, while for the early starters the mean was 7.10. The difference between the two groups was not significant.

For word reading too, the late starters performed better than the early starters. The mean for all the late starters was 27.94 words read correct, for the early starters the mean was 26.61 words read correct. Starting age was not significant ($F(1, 61) = .175$, $p = .677$).

There was no significant difference in word reading fluency ($F(1, 59) = .363$, $p = .549$), for all frequency bands taken together. There is no significant difference between the two groups of Swedes for any of the individual frequency bands ($F(1, 62) = .037$, $p = .964$; $F(1, 62) = .005$, $p = .601$; $F(1, 60) = .663$, $p = .419$; $F(1, 58) = 1.541$, $p = .220$).

For silent reading the late starters performed better than the early starters. The mean for how many L2 words the early starters managed to split up was 19.79, and for the late starters it was 24.44. The difference was not significant ($F(1, 65) = .772$, $p = .383$).

For L2 vocabulary, the mean D-prime value for the Swedish children who started in their second grade was .1911, and .4550 for the children who started in their third grade. The difference is not significant (F (1, 63) = 1.201, p = .278). Again no positive effect is found for the early starters. The Swedish children will therefore be seen as one group when compared to the Norwegian children who have 2 or 3 more years of English training than them.

4.3.2. Norwegians vs. Swedes

In his section the Norwegian participants are compared to the Swedish participants on their ability to spell, read and vocabulary knowledge in L2. Both groups have a shallow L1 background, but they different in years of experience with English.

L2 Spelling

	Swedish mean	Std. Deviation	Norwegian mean	Std. Deviation
Age-band 1	4.57	3.06	5.23	2.76
Age-band 2	7.39	2.59	8.68	3.56
Age-band 3	11.29	3.44	10.78	3.14
Total	7.50	3.89	8.03	3.88

Table 18. L2 Spelling – Norwegians vs. Swedes

For L2 Spelling the mean for the Norwegian participants in age-band 1 is 5.23 words read correct, see table 18. For the youngest Swedes, the mean is 4.57 words read correct. The Norwegian mean for age-band 2 is 8.68 words, and for the Swedes in this age-band, the mean is 7.39. For the oldest participants, the mean is 10.78 for the Norwegians, and 11.29 for the Swedes. The Norwegian participants spell more words correct for all age-bands When running a Manova with a stepdown, with the variables L1 vocabulary and L2 spelling, country was not significant (Stepdown F (1, 115) = 1.948, p = .166). Age-band is significant (Stepdown F (2, 115) = 33.659, p < .000). There is no significant interaction between variables (Stepdown F (2, 115) = 1.881, p = .157).

L2 Reading

Silent reading

	Swedish mean	Std. Deviation	Norwegian mean	Std. Deviation
Age-band 1	15.76	8.397	14.14	8.590
Age-band 2	20.00	8.221	21.42	8.572
Age-band 3	33.18	8.884	21.72	7.900
Total	22.05	10.749	18.80	9.099

Table 19. Silent reading L2 – Norwegians vs. Swedes

The results from the silent reading test, word-split, are shown in table 19. The results showed that the Swedish participants performed better for age-band 1 and 3, while the Norwegian participants got a slightly higher mean for age-band 2. For age-band 1 the Norwegian mean was 14.14, and the Swedish was 15.76. For participants in age-band 2 the Norwegian mean was 21.42, while it was 20.00 for the Swedes. The difference between countries is most prominent for age-band 3, here the Norwegian mean is 21.72 and the Swedish mean is 33.18. The mean for all Norwegians was 18.80, and for all Swedes it was 22.05. The difference between countries is significant ($F(1, 124) = 6.43$, $p = .012$), however the advantage is for the late starter, and as the Danes also are late starters, participants from both shallow orthographies will be included when comparing to the deep orthography.

L2 Reading aloud

Accuracy

	Swedish mean	Std. Deviation	Norwegian mean	Std. Deviation
Age-band 1	24.53	6.695	29.68	6.417
Age-band 2	26.85	5.104	32.21	4.404
Age-band 3	31.00	4.257	34.11	5.340
Total	27.27	5.912	31.85	5.340

Table 20. Reading accuracy L2 – Norwegians vs. Swedes

When looking at results obtained at the word-reading test, table 20 shows that the Norwegians read more L2 words correct for all age-bands. The mean for all Norwegians was 31.85, and the mean for all Swedes was 27.27. For age-band 1, the Norwegian mean was 29.68, and the Swedish 24.53. The mean for the participants in age-band 2 was 32.21 for the Norwegians, and 26.85 for the Swedes. The difference between countries was still visible for age-band 3, here the Norwegian mean was 34.11, and the Swedish was 31.00. When running a Manova with a stepdown, with the dependent variables L1 vocabulary, and L2 correct reading, country has a significant effect on L2 word reading (Stepdown F (1, 114) = 23.148, $p < .000$). Age-band too was significant (Stepdown F (2, 114) = 8.157, $p < .000$). There was no significant interaction between variables (Stepdown F (2, 114) = .598, $p = .551$. The Norwegian participants performed better than the Swedes across age-bands, but the difference decreases for the oldest participants.

Fluency

	Swedish mean	Std. Deviation	Norwegian mean	Std. Deviation
Age-band 1	3.0853	.12346	3.1195	.13709
Age-band 2	3.0707	.09771	3.0283	.08572
Age-band 3	3.0102	.06155	2.9864	.11725
Total	3.0648	.09752	3.04823	.12738

Table 21. Reading fluency L2 – Norwegians vs. Swedes

The results from reaction time measurements show that the mean log10 transformed reaction time for words from all frequency bands is 3.0483 for the Norwegians, and 3.0648 for the Swedes. There is no significant difference between countries, even after running a Manova and a step-down test correcting for differences in L1 vocabulary, and the number of mistakes in word reading (Stepdown F (1, 108) = .758, $p = .386$). Age-band is not significant (Stepdown F (2, 108) = 2.124, $p = .125$). There is no significant interaction between the effect from age-band and country (Stepdown F (2, 108) = 2.616, $p = .078$). The scores within each age-band reviles that the youngest Swedes had shorter reaction times than the youngest Norwegians, the mean reaction time for the Norwegians in age-band 1 was 3.1195, while it

was 3.0853 for the Swedes. For age-band 2 and 3, the Norwegian participants had shorter reaction times. The Mean reaction time for age-band 2 was 3.0283 for the Norwegians, and 3.0707 for the Swedes, and for age-band 3 it was 2.9864 for the Norwegians, and 3.0102 for the Swedes.

The reaction times for the most frequent L2 words show that mean reaction time for all Norwegians for this frequency band was 2.9792, and for the Swedes it was 3.0331. A Manova with a stepdown, with the co-variables L1 vocabulary, errors made within frequency band 1, and dependent variable reaction time was run. Country was significant for the number of errors made (Stepdown F (1, 113) = 12.292, p = .001), and reaction time (Stepdown F (1, 113) = 6.246, p = .014). Figure 5 shows mean reaction times for all age-bands for the most frequent English words. For the youngest participants the Swedes had shorter reaction time than the Norwegians, but for the older participants, the Norwegians had shorter reaction times.

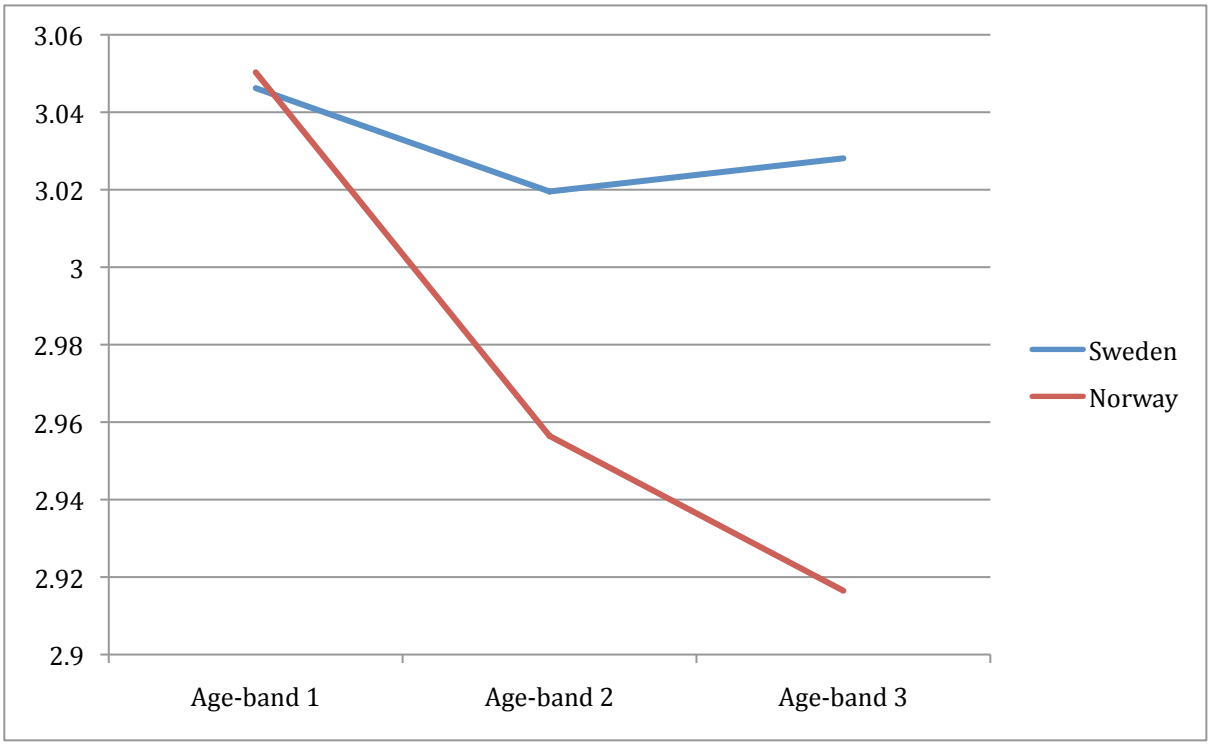

Figure 5. Reaction times for English words in frequency-band 1.Swedes vs. Norwegians.

Country did not have any significant effect on reaction times for any of the other frequency bands (Stepdown F (1, 113) = .751, p = .338; Stepdown F (1, 111) = .016, p = .899; Stepdown F (1, 108) = .225, p = .636).

L2 Vocabulary

	Swedish mean	Std. Deviation	Norwegian mean	Std. Deviation
Age-band 1	-.0663	1.04973	.0833	.81010
Age-band 2	.4129	.72860	.6814	.66569
Age-band 3	.6384	.95475	.8236	.86951
Total	.3230	.92808	.5018	.84016

Table 22. L2 vocabulary – Norwegians vs. Swedes

There is no significant difference between the Norwegian and the Swedish children on the results obtained on the L2 vocabulary test (Stepdown F (1, 116) = 2.273, p = .134). However, table 22 shows that the Norwegian children scored higher for all age groups. For age-band 1 the Norwegian score was .0833, while the Swedish was -.0663. For age-band 2 the Norwegian score was .6814, while the Swedish was .4129. Finally, for age-band 3 the Norwegian score was .8236, while the Swedish was .6384.

Summing up.

There is no significant difference between the Swedes that started learning their L2 in the 2nd grade and the ones that started in their 3rd grade. When comparing the Norwegian participants, who started learning their L2 in the 1st grade, with the Swedish participants there is no significant difference between them when it comes to L2 spelling. However, the Norwegian participants read significantly more words correct, and have shorter reaction times for high frequency words. Starting age and the amount of years with learning L2 does not significantly influence L2 vocabulary.

4.4 Effect of Orthographic depth on L1 Reading, Spelling and vocabulary, and on L2 Reading, Spelling and vocabulary.

When looking into effects of orthographic depth on L1 data from Norway and Sweden will be aggregated, and referred to as Norway + Sweden. In the comparison of the effect a deep or shallow L1 orthography has on L2 reading, spelling and vocabulary, Norway + Sweden will be compared to Denmark wherever starting age was not significant. The Swedish participants will be compared to the Danish when it comes to L2 reading accuracy, and L2 reading fluency of high frequency words, as the Norwegians' early start was beneficial for the results obtained here.

		Orthographic learning	**L1 Spelling**	**L2 Spelling**	**L1 Correct reading**	**L2 Correct reading**
Orthographic learning	Pearson	1	.552**	.526**	.389**	.440**
	Sig.		.000	.000	.000	.000
	N	173	173	173	168	168
L1 Spelling	Pearson	.552**	1	.693**	.692**	.643**
	Sig.	.000		.000	.000	.000
	N	173	173	173	173	168
L2 Spelling	Pearson	.526**	.693**	1	.493**	.655**
	Sig.	.000	.000		.000	.000
	N	173	173	173	168	168
L1 Correct reading	Pearson	.389**	692**	.493**	1	.685**
	Sig.	.000	.000	.000		.000
	N	168	173	168	169	169
L2 Correct reading	Pearson	440**	643**	.655**	.685**	1
	Sig.	.000	.000	.000	.000	
	N	168	168	168	169	169

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

Table 23. Correlations orthographic learning and reading and spelling

Table 23 shows correlations between orthographic learning and reading and spelling. Seeing that orthographic learning correlates significantly with L1 and L2 spelling and reading, orthographic learning will be added as a second variable, after L1 vocabulary when looking at the effect orthography has on spelling and reading.

4.4.1 Spelling L1

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	25.22	7.199	30.12	4.759
Age-band 2	25.44	7.587	32.89	4.478
Age-band 3	29.00	6.353	34.54	4.217
Total	26.25	7.183	32.41	7.183

Table 24. L1 Spelling

The results showed that the overall mean for L1 words spelled correct was 26.25 for Denmark, and 32.41 for Norway + Sweden. The standard deviation was 7.183 for Denmark, and 4.815 for Norway + Sweden. Both countries have a negative skewness, indicating that there are relatively few low values and, that most of the distribution scored higher than the mean. However, as the skewness is only a small negative number, -.374 for Denmark, -.661 for Norway + Sweden, it does not distort the mean and standard deviation. The kurtosis for a standard normal distribution is three. The Kurtosis for Denmark is -.942, indicating less peakedness than expected by a normal distribution. The same goes to a lesser extent for Norway + Sweden with a Kurtosis of -.176.

The difference between countries is visible for all age-bands. For age-band 1 (9-10 year olds), the Danish mean for words read correct is 25.22, and the Norwegian + Swedish mean is 30.12. For age-band 2 (10-11 year olds), the Danish mean is 25.44, the Norwegian + Swedish mean is 3.89. The means for age-band 3 (11-12 year olds) is 29.00 for the Danes, 34.54 for the Norwegians + Swedes. Table 24 shows the means for words spelled correct for

all age-bands. Figure 6 shows that the difference between Denmark and the other two countries is a mean of more than 4 words less for all age-bands.

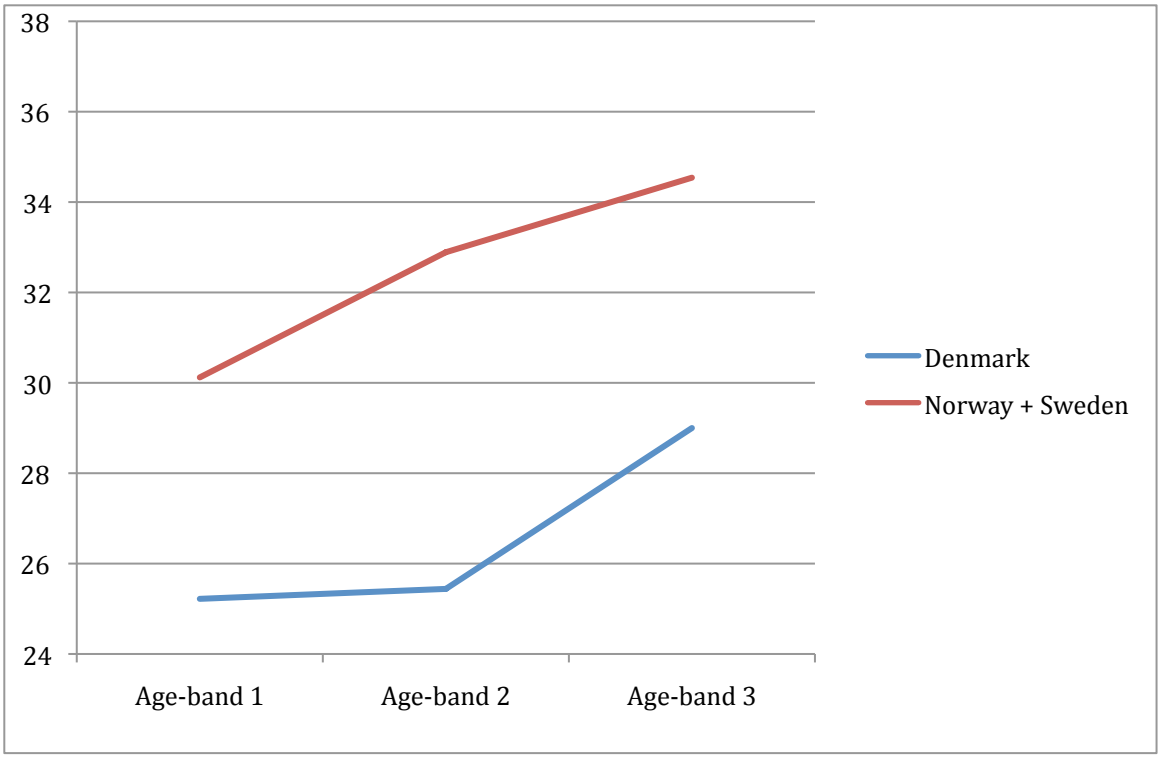

Figure 6. L1 Spelling

A Manova was used for L1 spelling in order to find out whether changes in the co variables resulted in changes in the dependent variables. In the Manova L1Spelling was dependent variable. L1 vocabulary was used as a covariate to control for biased sampling. The results of the Manova with a stepdown showed that the shallow languages spelt significantly more words correct than the deep languages. Orthography had a significant effect on L1 spelling (Stepdown F (1, 163) = 34.08, $p < .000$). Orthography also had a significant effect on L1 vocabulary (Stepdown F (1, 163) = 6.807, $p = .010$). There was a significant effect from age-band 1(Stepdown F (1, 163) =4.74, $p = .031$), meaning that the youngest participants made more mistakes than the older ones. When adding orthographic learning as a second covariate, the effect from both orthography and age-band became smaller (StepDown F (1, 162) = 28.77, $p < .001$; StepDown F (1, 162) = 3.12, $p = .079$), respectively. The fact that the effect decreased when adding orthographic learning shows that orthographic learning skill is part of what explains spelling in L1.

That country still had a significant effect on spelling, even after the influence from orthographic learning was taken away, leaves the orthographic differences between the countries the only significant variable in explaining differences in L1 spelling. Thus, orthographic depth can in part explain differences in L1 spelling. Also, orthographic learning mediates L1 spelling.

4.4.2 Spelling L2

For L2 spelling only the 16 first words were used as a measure for spelling skills in L2. This was done because data was only collected for these words for the youngest Swedes.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	3.33	2.09	4.90	2.93
Age-band 2	5.06	3.80	7.76	3.00
Age-band 3	6.92	3.68	11.03	3.25
Total	4.88	3.46	7.71	3.88

Table 25. L2 Spelling

The results for L2 spelling showed that the overall mean for L2 words spelled correct was 4.88 for Denmark, 7.71 for Norway + Sweden, with a standard deviation of 3.46 for Denmark, and 3.88 for Norway + Sweden. Both countries have a positive skewness, indicating that there are relatively few high values and, that most of the distribution scored below than the mean. The Danish skewness was .888, the Norwegian + Swedish was. 179. The Kurtosis for Denmark was -.129, -.929 for Norway + Sweden.

Figure 7 shows that the difference between countries is visible across age-bands. For age-band 1, the Danish mean for L2 words read correct is 3.33, and the Norwegian + Swedish mean is 4.90. For age-band 2, the Danish mean is 5.06, and the Norwegian + Swedish mean is 7.76. The means for age-band 3 is 6.92 for the Danes, and 11.03 for the Norwegians + Swedes, see table 25. The difference between Denmark and the other two countries increases over time. There is little difference between the numbers of words spelled correct, for the lowest age-band.

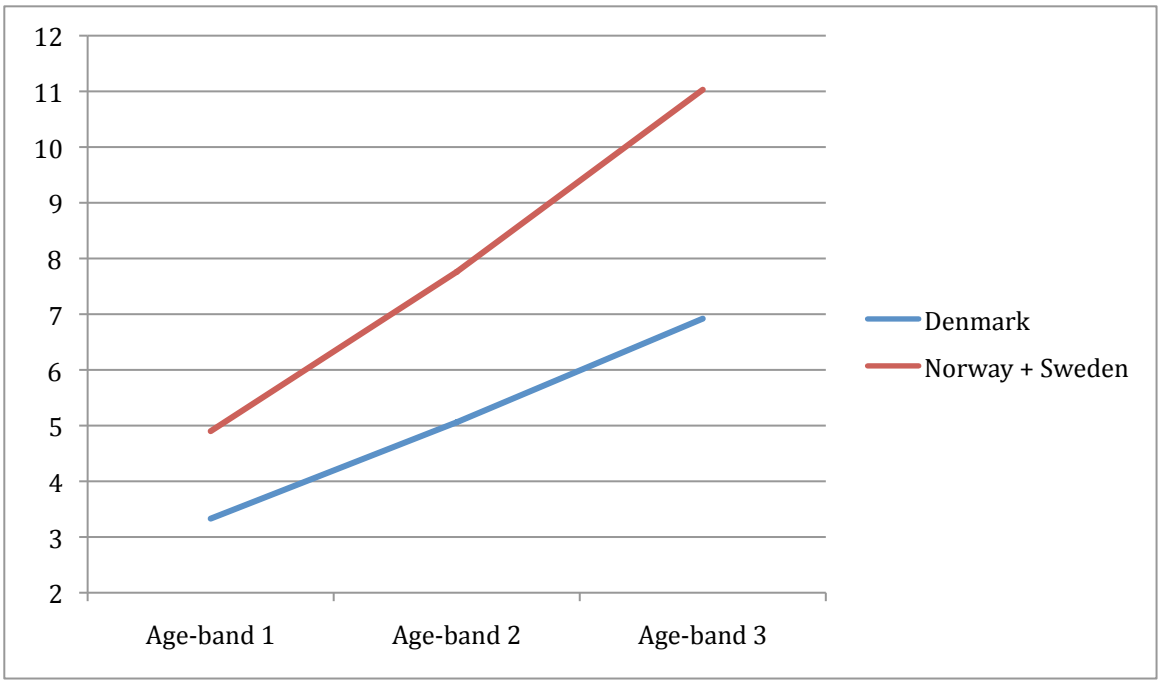

Figure7. L2 Spelling

A Manova was run in for L2 spelling. The same co-variables as used for L1 spelling were used; L1 vocabulary and orthographic learning. After a step-down test with L1 vocabulary as a covariate, orthographic depth has a significant effect on L1 vocabulary (Stepdown F (1, 164) = 5.82, p = .017) and on L2 Spelling (Stepdown F (1, 163) = 20.97, p < .000). Both age-band 1 and 2 have a significant effect on L2 spelling (Stepdown F (1,163) = 34.84, p < .000; Stepdown F (1, 163) = 11.19, p = .001). When adding orthographic learning as a second covariate the effect from orthographic depth remains the same (Stepdown F (1, 162) = 16.25, p < .000) for L2 Spelling, and age-band 1 (Stepdown F (1, 162) = 33.09, p < .000), but is slightly reduced for age-band 2 (Stepdown F (1, 162) = 6.91, p = .009.

That orthography still had a significant effect on L2 spelling, after the influence from L1vocabulary and orthographic learning were taken away, leaves the orthographic differences between the countries and the differences in starting age the only possible explanations for differences in L2 spelling. However as there is no significant difference between the early starters from Norway and the late starters from Sweden, differences in L1 orthography and in orthographic learning are left to explain differences in L2 spelling.

4.4.3 L1 Reading

Silent reading

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	24.44	9.34	27.93	9.91
Age-band 2	23.61	9.59	34.74	10.16
Age-band 3	30.67	8.96	40.14	10.69
Total	25.69	9.60	33.91	11.25

Table 26. L1 silent reading

Table 26 shows that the mean for the Danes in age-band 1 is 24.44, while it is 27.93 for the Norwegians + Swedes. For age-band 2, the mean is 23.61 for the Danish participants, and 34.74 for the Norwegian + Swedish participants. The mean for the age-band 3 is 30.67 for the Danes, and 40.14 for the Norwegians + Swedes.

The results from the word chain test revealed that the Norwegian + Swedish participants performed better than the Danish participants. Using only L1 vocabulary as a covariate shows that there is a significant ($F (1, 163) = 14.85$, $p < .001$) difference between how many words the Danish and the Norwegian + Swedish participants managed to break up. There is an interaction between age-band 1 and orthography (Stepdown $F (1, 163) = 4.30$, $p = .040$), in the shallow orthographies the groups of older participants split up significantly more words than the younger participants, this id not the case for the deep orthography. Both age-band 1 and 2 have a significant effect (StepDown $F (1, 163) = 6.65$, $p = .011$; StepDown $F (1, 163) = 7.99$, $p = .005$; respectively), showing differences between all age-bands. When adding orthographic learning as a second covariate these effects become slightly smaller (StepDown $F (1, 162) = 10.27$, $p = .002$) for effect of orthography, (StepDown $F (1, 162) = 2.47$, $p = .118$) for interaction between age-band 1 and porthography, (StepDown $F (1, 162) = 2.81$, $p = .095$; StepDown $F (1, 162) = 6.06$, $p = .015$) for age-band 1 and 2. This indicates that orthographic learning as well as orthography has an effect on L1 silent reading skill.

Moreover, as is illustrated in figure 8, the difference increases for the older children.

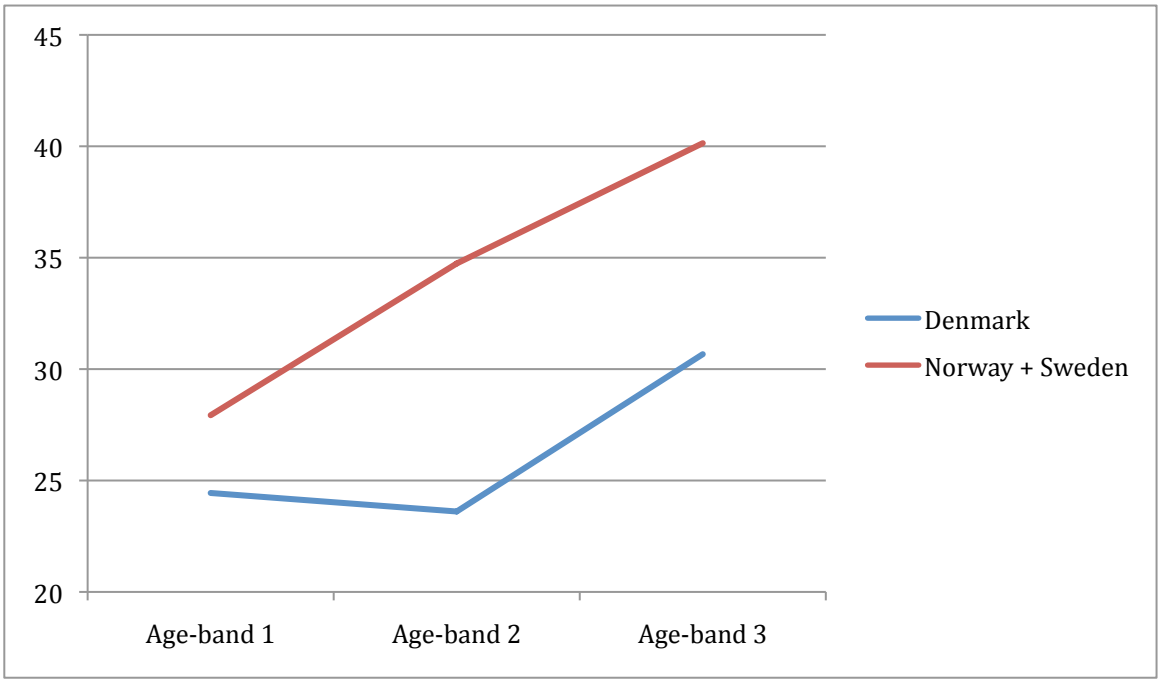

Figure8. L1 silent reading

Oral Reading

The word-reading task gave results on accuracy, how many words were read correct, and fluency, reaction times. When looking at results at the word reading task, the log10 median for reaction times were calculated. Median was used to avoid extreme times to influence the results. 5 log10 medians were measured for all participants for both L1 and L2 reading, log10 median for all reaction times, log10 median for the first 10 words, words 11-20, words 21-30 and 31-40. This way it was possible to see the effect word frequency had on reaction times for L2 words, and the effect word frequency together with word length had on reaction times for reading.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	36.83	3.26	38.49	1.82
Age-band 2	37.06	3.75	38.84	1.61
Age-band 3	37.58	2.71	39.17	1.18
Total	37.10	3.28	38.82	1.59

Table 27. L1 words read correct

Accuracy results showed that there was a ceiling effect for numbers of L1 words read correct, see table 27. Out of forty possible words, the Danish mean was 37.10 words read correct, the standard deviation was 3.28. The Norwegian + Swedish mean was 38.82, with a standard deviation of 1.59. The minimum score for the Danish sample was 28, while it was 33 for the Norwegian + Swedish sample. Participants from all countries achieved the maximum score of 40.

In spite of the ceiling effect, when using only L1 vocabulary as a covariate orthography has a significant effect (Stepdown $F(1, 162) = 14.24$, $p < .000$). The participants with a shallow L1 background read more L1 words correct when corrected for difference in vocabulary. When adding orthographic learning as a second covariate, the effect from orthography is slightly reduced (Stepdown $F(1, 160) = 10.32$, $p = .002$).

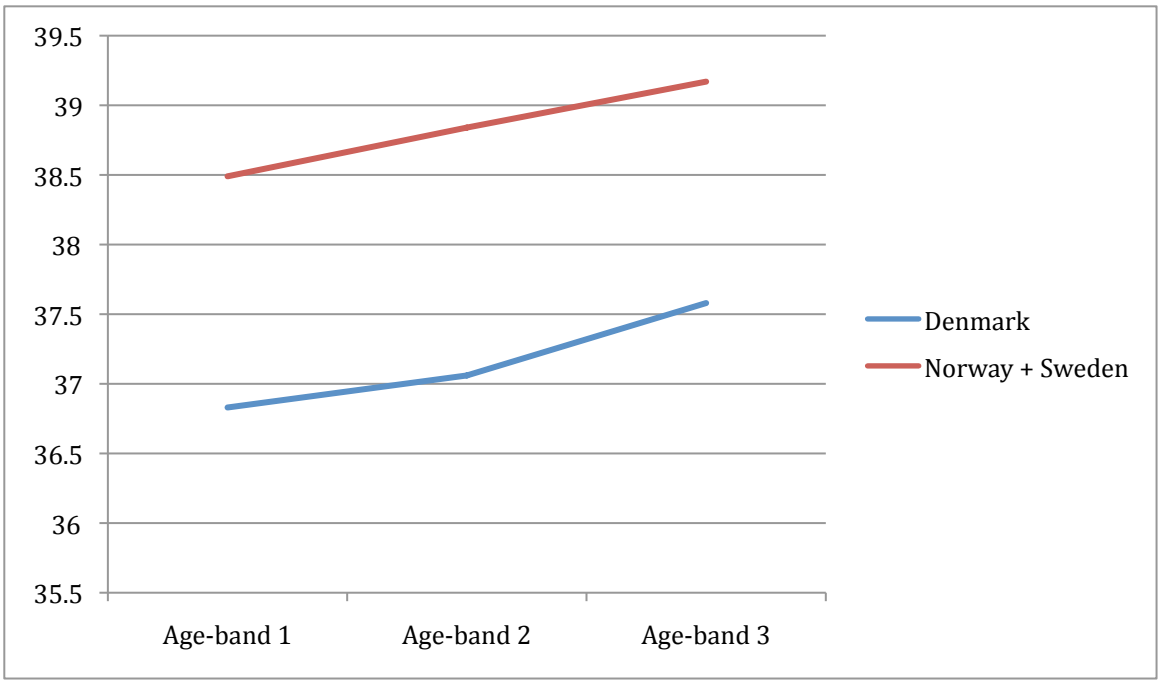

Figure 9. L1 reading accuracy.

Figure 9 shows that the mean for Norwegian + Swedish participants is 1.5 more words read correct than the Danes, for all age-bands.

The effect of age-band for L1 reading accuracy is not significant. This is probably due to the ceiling effect. Still, figure 9 shows that the older participants are more accurate readers than the younger ones.

	Freq. band 1	Freq. band 2	Freq. band 3	Freq. band 4
Danes	9.75	9.90	8.81	8.58
Norwegians + Swedes	9.89	9.88	8.96	8.62

Table 28. Reading accuracy within individual frequency bands

Table 28 shows mean reaction times for individual frequency bands. When looking into individual frequency bands, using L1 vocabulary as covariate, results for the most frequent L1 words show that there is an interaction between orthography and the first Helmert contrast of age-band (Stepdown F (1, 162) = 4.36, p = .038). The youngest Danes perform better than the youngest Norwegians Swedes. There is just no significant effect from orthography (Stepdown

F (1, 162) =3.72, p = .056) for frequency band 1. For frequency band 2, 3 and 4 there is no significant effect from orthography (Stepdown F (1, 162) = .28, p = .598, Stepdown F (1, 162) = .01, p = .934 and Stepdown F (1, 162) = .15, p = .698 respectively).

Fluency

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	3.059	.1048	2.976	.0902
Age-band 2	3.021	.1051	2.940	.0823
Age-band 3	2.999	.1087	2.933	.0770
Total	3.030	.1064	2.950	.0850

Table 29. Overall log_{10} median reaction times

The mean for the overall log10 median reaction times was 3.030 for the Danes, 2.950 for the Norwegians + Swedes, shown in table 29. The results for reaction times, fluency, showed that reaction times for the most frequent, and shortest L1 words, the mean for the Danish log10 median was 2.927. The Norwegian + Swedish mean was 2.874. For frequency band two, the average log10 median reaction times were 2.962 for the Danes, and 2.905 for the Norwegians + Swedes. The log10 median reaction times for frequency band three was 3.072 for the Danes, and 2.978 for the Norwegians + Swedes. The means for the log10 medians for the least frequent L1 words was 3.157 for the Danes, 3.044 for the Norwegians + Swedes.

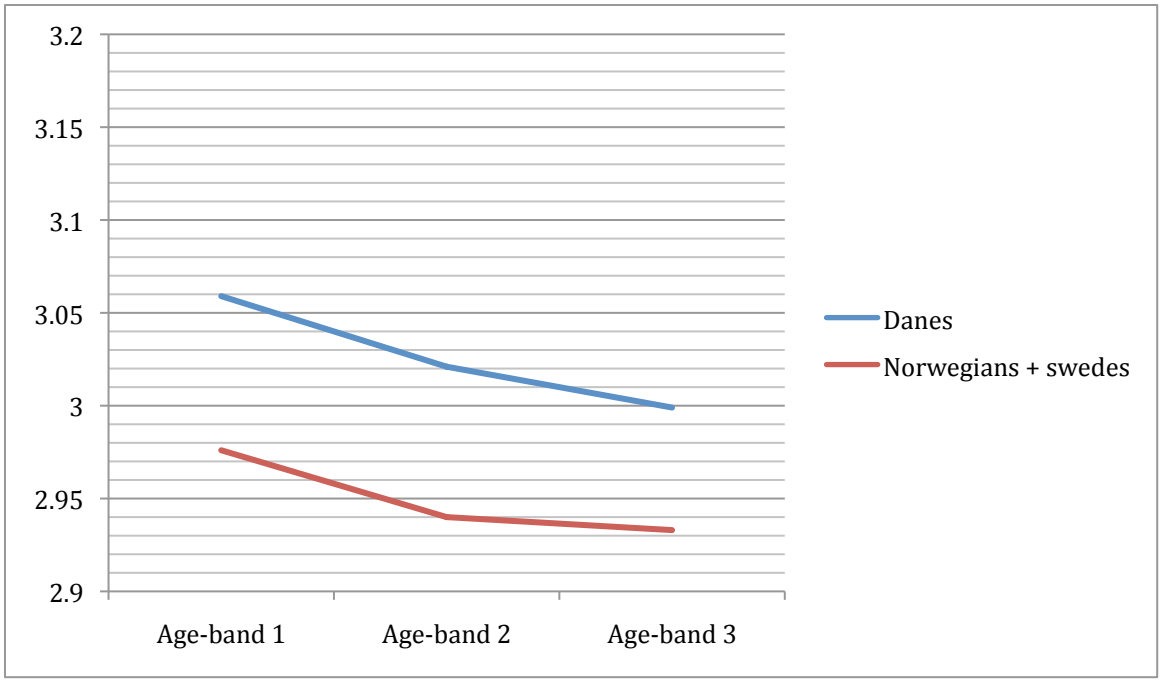

Figure 10. Overall mean log_{10} reaction times

Figure 10 shows the mean for the log10 median reaction times across frequency bands. The illustration shows that the Danish participants use more time between the presentations of words, and correct reading of the same words, than the Norwegian and Swedish participants.

As the reaction times were based on words read correct, the number of mistakes had to be taken into consideration. A Manova, with the dependent variables: L1 vocabulary, L1 words read correct and L1 mean log10 reaction time was run. A significant effect from orthography was found (Stepdown F (1, 161) = 8.21, p = .005) as well as a significant first Helmert contrast of age-band (Stepdown F (1, 161) = 4.41, p = .039). This indicates that the participants with a shallow L1 orthography read L1 words significantly more fluently than readers with a deep L1 orthography, and that the two groups of older participants read faster than the youngest participants. When adding orthographic learning as a second variable, and keeping L1 words read correct as a third variable the effect from orthography is slightly reduced (Stepdown F (1, 159) = 7.03, p = .009), and the first Helmert contrast of age-band is no longer significant (Stepdown F (1, 159) = 3.39, p = .068). Thus, fluency of L1 is mediated orthographic learning.

The converted log10 times are shown in table 30.The times in milliseconds are 1061.7 for the youngest Danes, and 937.2 for the youngest Norwegians/Swedes. For age-band 2, the average median for reaction times for the Danes is 972.7, and 883.1 for the Norwegians +

Swedes. For the oldest participants, the average median reaction time is 984.0 for the Danes, and 916.2 for the Norwegians + Swedes. The difference is 124.5 milliseconds for the youngest participants, 89.6 for age-band 2, and 67.8 for age-band 3.

	Age-band 1	Age-band 2	Age-band 3
Denmark	1061.7	972.7	984.0
Norway+Sweden	937.2	883.1	916.2
Difference	124.5	89.6	67.8

Table 30. Converted log_{10} times - reaction times in milliseconds

When looking at reaction times for individual frequency bands, only L1 vocabulary, and errors within the specific frequency band will be used as covariates.

Running a Manova with a stepdown on L1 mean log reaction time on frequency band 1, show that the effect of orthography was significant for reaction time (Stepdown $F(1, 161) = 12.88$, $p < .000$). The readers of the shallow orthographies read the most frequent words faster than the readers of the deep orthography.

The inversed log 10 times from frequency band 1 is shown in table 31.

	Age-band 1	Age-band 2	Age-band 3
Denmark	880.2	822.2	827.9
Norway + Sweden	749.9	732.8	756.8
Difference	130.0	89.4	71.1

Table 31. Converted log_{10} times frequency band 1 - reaction times in milliseconds

The difference decreases over time, however this is a result of the Norwegians + Swedes not improving. The change within the Danish sample is most prominent between age-band 1 and the other two. Although the difference decreases, the Danes do not catch up with the

Norwegians + Swedes.

For frequency band 2, a Manova with a Stepdown shows that difference between orthographies is significant for reaction times (Stepdown F (1, 161) = 8.55, p = .004). Table 32 shows the inversed log 10 times from frequency band 2. Across all age-bands the Danish participants use more time to read a word correct.

	Age-band 1	Age-band 2	Age-band 3
Denmark	946.9	925.2	860.0
Norway + Sweden	831.8	779.2	794.0
Difference	115.1	146.0	66.0

Table 32. Converted log_{10} times frequency band 2 - reaction times in milliseconds

When running a Manova with a stepdown on L1 mean log reaction time on frequency band 3, the effect from orthography is significant for the reaction time (Stepdown F (1, 161) = 15.31, p < .000). Again the readers of the shallow orthographies read the words faster. There is an effect from the first Helmert contrast of age-band (Stepdown F (1, 161) = 4.80, p = .030). The youngest participants read then words in this frequency band slower than the two groups of older participants.

	Age-band 1	Age-band 2	Age-band 3
Denmark	1266.7	1194.7	1046.9
Norway+Sweden	1037.1	928.6	884.4
Difference	229.6	266.1	162.5

Table 33. Converted log_{10} times frequency band 3 - reaction in milliseconds

Table 33 shows that there are big differences in reaction times for the words in frequency band 3. The Danish participants in age-band 3 have the same reaction time as the Norwegian and Swedish have in age-band 1.

For the longest and least frequent words, a Manova shows that orthography has a

significant effect on reaction times (Stepdown F (1, 161) =18.83, p < .000). There is an effect from the first Helmert contrast of age-band (Stepdown F (1, 161) = 6.96, p = .009). The youngest participants read the least frequent L1 words slower than the older participants.

	Age-band 1	Age-band 2	Age-band 3
Denmark	1626.5	1339.1	1323.8
Norway + Sweden	1232.9	1088.0	997.6
Difference	393.6	251.1	326.2

Table 34. Converted log_{10} times frequency band 4 - reaction in milliseconds

Table 34 shows that the median reaction times for Norwegians and Swedes in frequency band 4 are lower than for the Danes across all age-bands. The youngest Norwegian + Swedish group has shorter reaction times than the oldest Danish group.

4.4.4 L2 Reading

Silent reading

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	13.06	7.471	14.93	8.430
Age-band 2	17.44	10.467	20.57	8.371
Age-band 3	18.25	10.252	27.29	10.808
Total	16.06	9.506	20.51	10.109

Table 35.Silent reading L2

For L2 silent reading, figure 11 shows that the Norwegian + Swedish participants perform better than the Danes for all age-bands. For the L2 word chains test, or silent reading, the mean for the Danes in age-band 1 is 13.06, while it is 14.93 for the Norwegians + Swedes. For age-band 2, the mean is 17.44 for the Danish participants, and 20.57 for the Norwegian + Swedish participants. The mean for the age-band 3 is 18.25 for the Danes, and 27.29 for the

Norwegians + Swedes. With only L1 vocabulary as a covariate the effect from orthography is found (Stepdown F (1, 162) = 5.17, p = .024). The participants with a shallow L1 background split up more L2 words than the participants with a deep L1 background. The first Helmert contrast of age-band is significant (Stepdown F (1, 162) = 14.23, p < .000. When adding orthographic learning as a second covariate and L1 silent reading as a third covariate, the effects become smaller; (StepDown F (1, 160) = 7.18, p = .008) for Helmert contrast of age-band and orthography, (Stepdown F (1,160) = .66, p = .418) for orthography, and (StepDown F (1, 160) = 1.08, p = .015) for the first Helmert contrast of age-band. This indicates that L1 vocabulary and orthographic learning mediate L2 silent reading when differences on the same skill in L1 are corrected for.

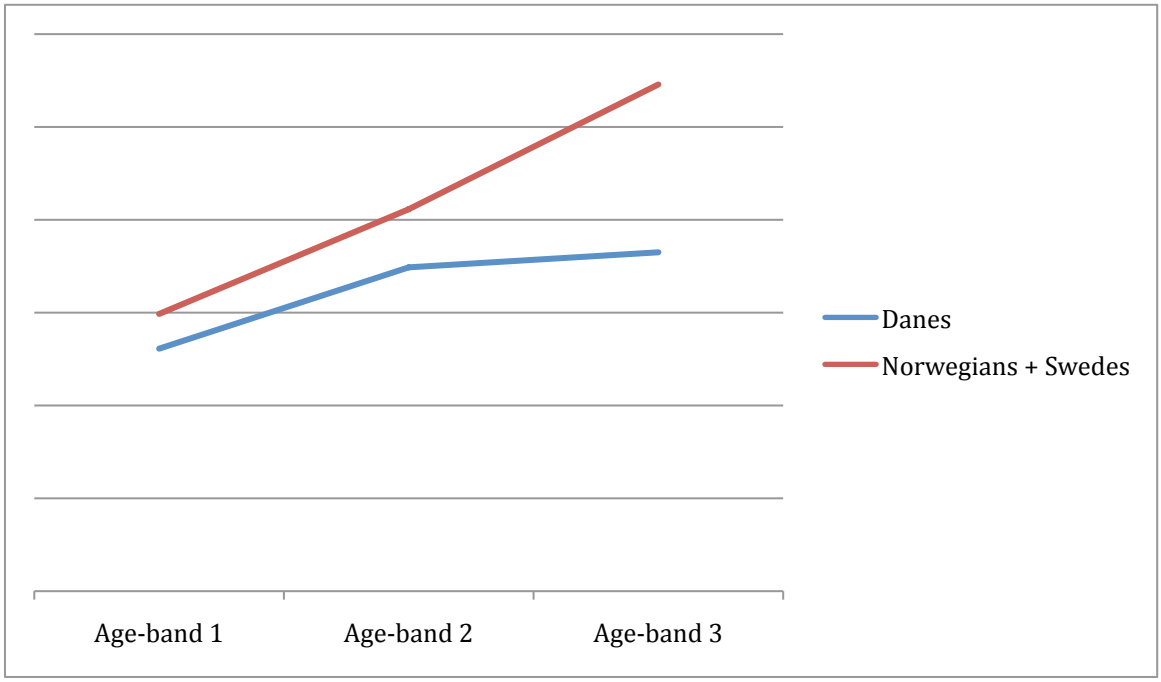

Figure 11. L2 Silent reading

Accuracy

When looking at the effect of orthographic depth on L2 accuracy, Danish and Swedish pupils will be compared to exclude the influence of an early start.

	Danish mean	Std.Deviation	Swedish mean	Std.Deviation
Age-band 1	23.83	7.921	24.53	6.695
Age-band 2	26.78	9.321	26.85	5.104

Age-band 3	29.42	7.645	31.00	4.257
Total	26.33	8.526	27.27	5.912

Table 36. L2 reading accuracy

The accuracy for L2 reading is shown in table 36. The result reviled that the Danish mean for number of words read correct was 26.33, with a standard deviation of 8.5. The Swedish mean was 27.27, with a standard deviation of 5.9. With only L1 vocabulary as a covariate a Manova showed that the effect of orthography is significant (Stepdown F (1, 161) = 18.83, $p < .000$). When adding orthographic learning as a second covariate the effect from orthography disappears (Stepdown F (1, 160) =1.98, $p = .161$). Thus, orthographic learning mediates accuracy of L1 reading. There is an effect from the first Helmert contrast of age-band (Stepdown F (1, 160) =6.07, $p = .015$).

	Freq. band 1	Freq. band 2	Freq. band 3	Freq. band 4
Danes	8.34	6.17	5.91	6.07
Swedes	8.67	6.17	6.17	5.55

Table 37. L2 reading accuracy – individual frequency bands

When looking into the individual frequency bands L1 vocabulary is used as the first variable, results show that the participants with a shallow L1 perform read more words correct for the three groups of most frequent words. The words read correct in each frequency band is 8.34, 6.17, 5.91 and 6.07 for the Danish participants and 8.67, 6.17, 6.17, and 5.55 for the Swedes, see table 37. Orthography is not significant for accuracy for any of the frequency bands.

Fluency

The results for L2 reaction times, fluency, showed that the mean for the overall log10 median reaction times was 3.105 for the Danes, and 3.057 for the Norwegians + Swedes. The difference between countries was significant, .019.

The Danish participants use more time between the presentation of a L2 word and the correct reading of the word than the Norwegian + Swedish participants. The difference increases for the older participants.

	Age-band 1	**Age-band 2**	**Age-band 3**
Denmark	1349.9	1201.2	1275.0
Norway + Sweden	1271.2	1128.2	1023.8
Difference	78.7	73.0	251.2

Table 38. Converted log_{10} frequencies - reaction times in milliseconds

When running a Manova with L1 vocabulary and the number of L2 words read correct as covariates, orthographic depth had a significant effect on reaction times (Stepdown F (1, 91) = 4.94, p = .029. When adding orthographic learning as a second variable, the effect from orthography is no longer significant (Stepdown F (1, 89) = 2.26, p = .136, indicating that orthographic learning influences the reading speed of L2 words. Table 38 shows that the difference in reaction time in milliseconds. For the oldest participants the difference is greatest, the readers with a shallow L1 background are in average 251.2 milliseconds faster than the readers with a deep background.

As an early start had a significant influence on the results for the reaction times for the most frequent L2 words, the Danish participants will be compared with only the Swedish participants, shown in table 39.

	Age-band 1	**Age-band 2**	**Age-band 3**
Denmark	1287.5	1151.3	1065.1
Sweden	1135.1	1046.0	1066.8
Difference	152.4	105.3	-1.7

Table 39. Converted log10 times frequency band 1 - reaction times in milliseconds

A Manova with the dependent variables L1 vocabulary, orthographic learning, L2 error 1 (the number of errors for the 10 most frequent words), and L2 mean log10 reaction time 1 was run. The first Helmert contrast of age-band interacts with orthography (Stepdown F (1, 99) = 4.86, p = .030.) The Danish participants in age-band 2 read these high frequency words slower than the group of the youngest participants, also for the oldest participants the two groups have close to the same reaction times, see table 39. Orthography does not have a significant effect on reading the most frequent L2 words (Stepdown F (1, 99) = .51, p = .479).

Reaction times for L2 words in frequency band 2 once more show that the Norwegian + Swedish children have shorter reaction times for all age-bands, shown in table 40. Table 40 also shows that the difference decreases for the older participants. The mean log10 reaction time for all the Danish participants was 3.163, while it was 3.047 for the Norwegian + Swedish participants. The difference between orthographies is significant (Stepdown F (1, 58) = 8.00, p = .005).

	Age-band 1	**Age-band 2**	**Age-band 3**
Denmark	1599.1	1494.5	1211.4
Norway + Sweden	1223.7	1106.7	1002.2
Difference	375.4	387.8	209.2

Table 40. Converted log10 times frequency band 2 - reaction times in milliseconds.

For frequency band 3 the trend is the same as for the more frequent words, the Norwegian + Swedish children have shorter reaction times than the Danish children. The Danish mean for log10 reaction times in frequency band 3 was 3.112, while the Norwegian + Swedish was 3.053. When converted, this difference is 256.2 milliseconds. The difference between countries increases for the older participants, due to the older Norwegian + Swedish participants decreasing the reaction time. Little difference is found between the youngest and the oldest Danes.

	Age-band 1	**Age-band 2**	**Age-band 3**

Denmark	1305.9	1303.6	1268.0
Norway + Sweden	1254.7	1118.5	1011.8
Difference	51.2	185.1	256.2

Table 41. Converted log10 times frequency band 3 - reaction times in milliseconds.

A manova with the variables L1 vocabulary, orthographic learning, L2 error 3, and L2 mean log10 reaction time 3 was run. Orthography did not have a significant effect on reading speed of the words in frequency band 3 (Stepdown F (1, 155) = 2.09, p = .150).

Finally, for L2 words in frequency band 4 the Danes have longer reaction times than the Norwegians + Swedes. The mean for the Danish log10 median reaction times for the least frequent L2 words was 3.180, while it was 3.121 for the Norwegians + Swedes. Table 42 shows that the Norwegians + Swedes had shorter reaction times for all age-bands. Little difference is found between the oldest and the youngest Danes, while the older participants in the Norwegian + Swedish sample have shorter reaction times than the younger.

A manova with the dependent variables L1 vocabulary, orthographic learning, L2 error 4, and L2 mean log10 reaction time 4 was run. Orthography did not have a significant effect on reaction time (Stepdown F (1, 146) = 3.35, p = .069)

	Age-band 1	**Age-band 2**	**Age-band 3**
Denmark	1629.4	1368.8	1570.4
Norway + Sweden	1488.4	1323.3	1246.1
Difference	141.0	45.5	324.3

Table 42. Converted log10 times frequency band 4 - reaction times in milliseconds.

4.4.5 Vocabulary

L1 vocabulary

For some of the Swedish third graders there was missing data for some of the real words. Using a d-prime instead of Meara's vocabulary size measure enabled these to be compared to

the rest of the sample, by computing the hit rate by dividing number of hits on number of possible hits.

The results showed that the mean for Danish L1 vocabulary was 1.686, with a standard deviation of .716. The Norwegian + Swedish mean was 2.034, with a standard deviation of .8674. The results for all age-bands are shown in table 43.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation
Age-band 1	1.491	.6440	1.831	.7587
Age-band 2	1.676	.7570	1.990	.8844
Age-band 3	1.995	.7057	2.335	.9074
Total	1.686	.7161	2.034	.8674

Table 43. Dprime L1 vocabulary

When looking at differences between orthographies, across the age-bands, the Danish participants score lower than their Norwegian + Swedish counterparts for all age groups. For the lowest age-band the Danish mean is 1. 491, while the Norwegian + Swedish is 1.831. For age-band two, the Danish mean is 1.676, the Norwegian + Swedish mean is 1.990. With the oldest participants, the means are 1.995 for the Danes, 2.335 for the Norwegians + Swedes. The effect of orthography is significant is significant ($F (1, 165) = 3.68$, $p = .019$). The participants with a shallow L1 background are more sensitive

The first Helmert contrast of age-band is significant ($F (1, 165) = .66$, $p = .021$). The older participants are more sensitive to L1 words than the youngest group of participants.

L2 vocabulary

The results for L2 vocabulary showed that the Norwegian + Swedish children were more sensitive to L2 words than the Danish children for all age-bands. The results for all age-bands are shown in table 53.

	Danish mean	Std. Deviation	Norwegian + Swedish mean	Std. Deviation

Age-band 1	-.089	.8651	.012	.9233
Age-band 2	-.104	1.1644	.524	.7084
Age-band 3	-.180	.6939	.734	.9032
Total	-.118	.9355	.409	.8879

Table 44. Dprime L2 vocabulary

For age-band 1 the mean score for L2 vocabulary was -.089 for the Danes, and .012 for the Norwegians+ Swedes. For age-band 2 and 3 the difference increases. The mean for the Danes in age-band 2 is -.104, and .524 for the Norwegians + Swedes in age-band 2. The difference is greatest for the children in age-band 3, where the Danes scored a mean of -.180, and the Norwegians + Swedes scored .734.

When running a Manova with L1 vocabulary as covariate and L2 vocabulary as dependent variables, the effect of orthography is significant (Stepdown F (1, 164) = 10.18, p = .002). There is a significant interaction between the first Helmert contrast of age-band and orthography (Stepdown F (1, 164) = 4.79, p = .030). The interaction is caused by the older Norwegian + Swedish participants being more sensitive than the youngest group, while the opposite is the case for the Danish sample. Even when corrected for differences in L1 vocabulary, there is a differences found between the countries, when looking at L2 vocabulary. The difference increases due to the Norwegian + Swedish children becoming more sensitive to L2 words.

4.5 Good and Poor Readers

In order to assess differences between the really good and the really poor readers within each country, a new variable called reader was created. Both fluency, and accuracy could have been used to determine who the really good and poor readers were, but as there was a ceiling effect on correct reading of L1 words, accuracy was not used. Instead, the variable was based on the participants fluency score for L1 reading; that is their log 10 reaction time for all L1 words. Only participants scoring more or less than one standard deviation above or below the national mean for their age-band were scored either 1, good L1 fluency, or 0, poor L1 fluency on this variable.

A total of 35 participants got the label "Poor L1 fluency", whereas 28 got the label "Good L1 fluency". Within the Danish sample there were 11 readers with poor L1 fluency, 5 of these were in age-band 1, 3 in age-band 2, and 3 in age-band 3. Eight Danish readers got the label "Good L1 fluency", 3 in age-band 1, 2 in age-band 2, and 3 in age-band 3. In the Norwegian sample, 13 participants got the label "Poor L1 fluency" and 13 the label "Good L1 fluency". Seven readers in age-band 1, 3 in age-band 2, and 3 in age-band 3 scored more than or same as one standard deviation below the Norwegian mean for their age-band. Out of the 13 good Norwegian readers, 5 were in age-band 1, 4 in age-band 2, and 4 in age-band 3. For the Swedish participants, the distribution was; 11 readers with "Poor L1 fluency", and 7 readers with "Good L1 fluency". Four participants in age-band 1, 4 in age-band 2, and 3 in age-band 3 had "Poor L1 fluency". Out of the 7 readers with "Good L1 fluency", 2 were in age-band 1, 2 in age-band 2, and 3 in age-band 3. As there are very few participants within each country in the different age-bands, age-band will not be considered in what follows, that is; within each country, two groups will be compared the readers with "Good L1 fluency", and the readers with "Poor L1 fluency".

4.5.1 L1 Spelling

When looking at how well the very good and bad readers performed on the L1 spelling task, there are great national differences. The result for the poor Danish readers is a mean of 20.36 words. The poor Norwegian and Swedish readers spell in average almost 10 words more correct. The Norwegian mean is 29.54, and the Swedish is 30.91. Results show that the difference is less for the good readers. The Danish mean for good readers is 33.75, 35.60 for Norwegians, and 31.71 for Swedes. Figure 12 shows differences in spelling performances

between good and poor readers. Figure 12 shows that differences in spelling between good and poor readers is more prominent in Denmark, where the difference is a mean of 13.36 words. In Sweden there are hardly any difference in spelling performance between god and bad readers, the difference is a mean of 0.80 words. In Norway the difference in spelling performance between good and poor readers is 5.92 words.

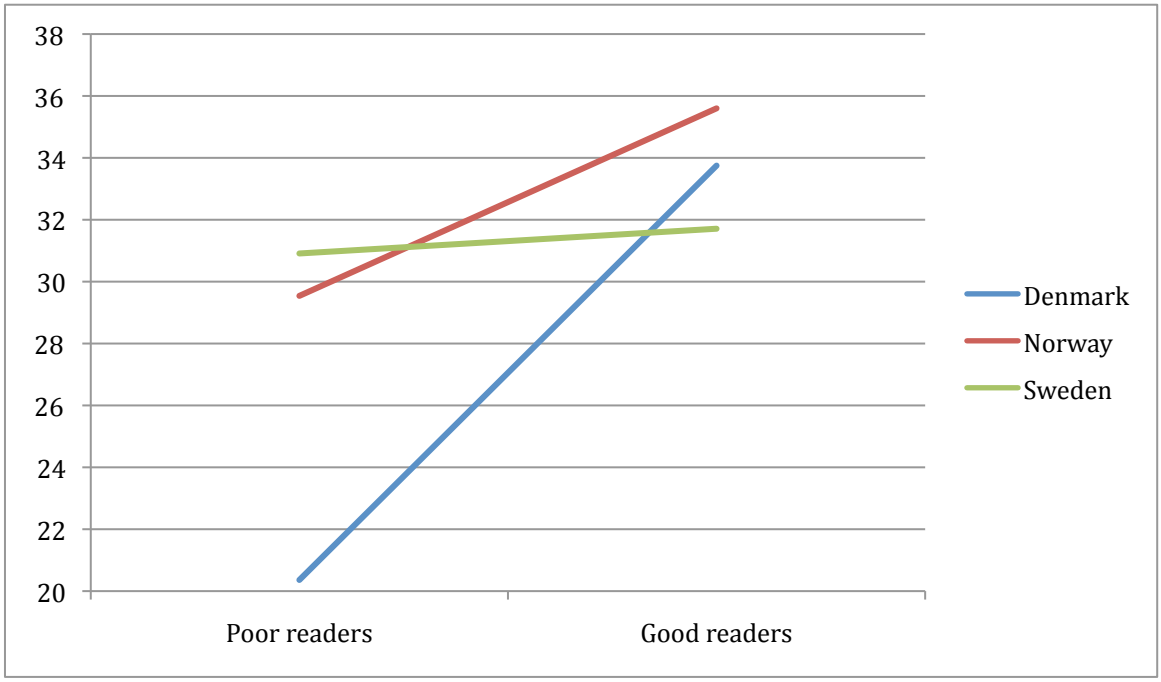

Figure 12. L1 Spelling – poor vs. good readers

When running a Manova with a stepdown with L1 vocabulary as a covariate and L1 spelling as a dependent variable, there is a significant effect from orthography (Stepdown F (1, 32) = 11.89, p = .002) on L1 spelling. There is also an effect of reader (Stepdown F (1, 32) = 21.81, p < .000). There is a significant interaction between country and reader (Stepdown F (1, 32) =4.82, p = .035).

4.5.2 L2 Spelling

The means for how many L2 words the good and bad readers spelled correct was a total of 4.97 words for the poor readers and 9.46 for the good readers. The Danish poor readers got a mean of 3.00, with a standard deviation of 2.37, while the good Danish readers got a mean of 8.25, with a standard deviation of 4.06. The poor Norwegian readers scored a mean of 5.31, with a standard deviation of 2.75, and the good Norwegian readers scored 10.77, with a standard deviation of 3.19. The results from the Swedes showed that the poor readers got a

mean of 6.55, with a standard deviation of 4.37, while the good Swedish readers got a mean of 8.42, with a standard deviation of 3.95.

A Manova with a stepdown with the variables L1 vocabulary, and L2 Spelling was run. The results showed that the effect of reader was significant L2 spelling (Stepdown F (1, 40) = 20.91, $p < .000$). The effect of country was significant (Stepdown F (1, 40) = 7.03, $p = .011$).

Figure 13 shows that there is little difference between the poor and good L1 readers in Sweden as to how well they perform on L2 spelling. For Denmark and Norway, on the other hand, the good L1 readers are better spellers in L2. The good Danish readers perform equally good as the good Swedish readers. The good Norwegian readers perform better than the good readers from both the other countries.

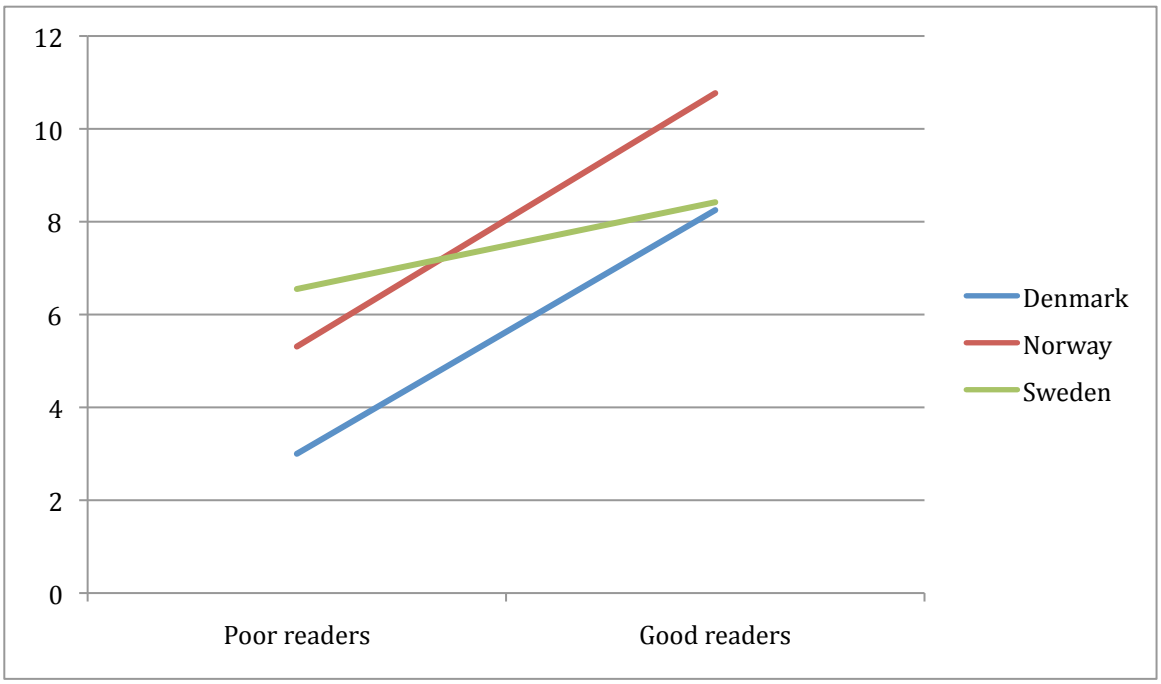

Figure 13. L2 spelling – poor vs. good readers

4.5.3 Reading

L1 accuracy

A univariate analysis showed that the poor Danes read a mean of 33.73 words correct, the poor Norwegians read 37.69 words correct, and the poor Swedes read 37.45 words correct. For the good readers the mean number of words read correct was 39.63 for the Danes, 39.31 for the Norwegians and 39.39 for the Swedes. A Manova with the variables L1 vocabulary and correct word reading with a step down showed that country has a significant effect (Stepdown 1, 40) = 6.42, p= .015). Helmert contrast reveals that the difference between countries only is significant, p= .006, between Denmark and the other two. Reader is significant (Stepdown F (1, 40) = 15.65, p < .000. Moreover, there is a significant interaction between country and reader, (Stepdown F (1, 40) = 8.65, p = .005). For the good readers no difference is found between the countries. The average for all countries is more than 39 items read correct. However, the poor Danish readers read fewer items correct than the poor Norwegian and Swedish readers. Figure 14 illustrated that in average the poor Norwegian and Swedish readers read more than 3 more words correct than the poor Danes.

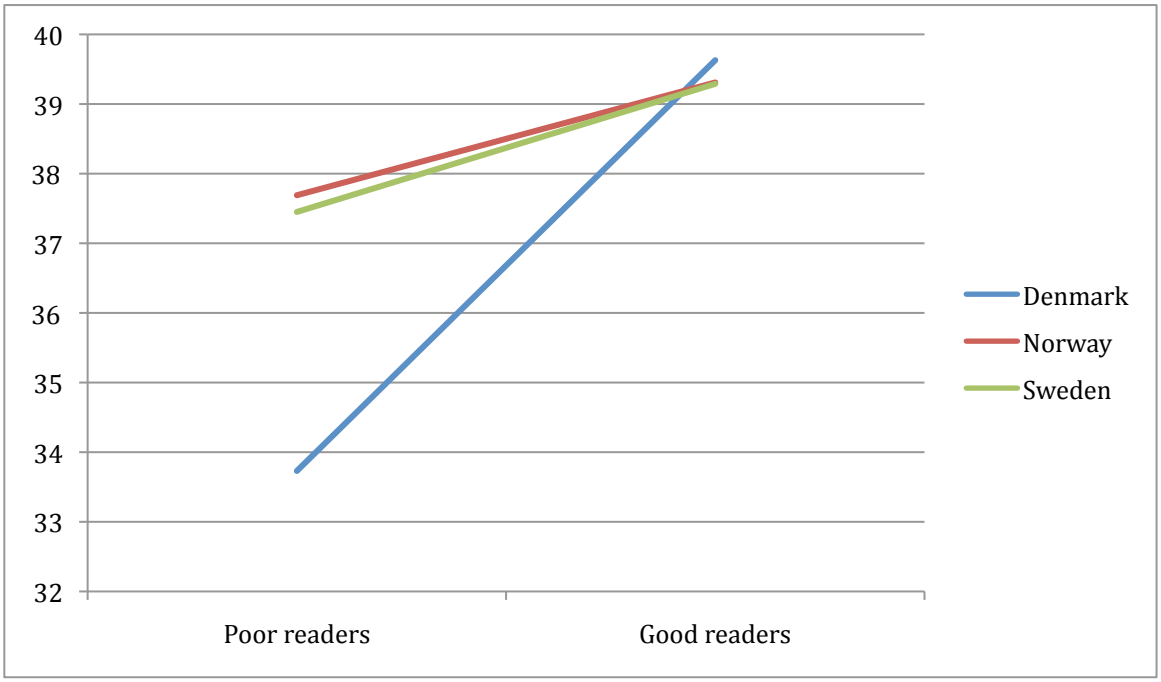

Figure 14. L1 reading accuracy – poor vs. good readers

L2 reading

A univariate analysis of how many L2 words the poor and the good readers read correctly showed great differences between the poor readers. In average, the poor Danes read 17.55 L2 words correctly, the poor Norwegians read 26.54, and the poor Swedes read 24.00 L2 words correctly. For the good readers the average for the Danes was 33.13, 34.00 for the Norwegians, and 27.43 for the Swedes. Figure 14 illustrated that the poor Danish readers are worse readers of L2 than the poor Norwegian and Swedish readers. The good Danish readers on the other hand are better than the Swedes and equally good as the good Norwegian readers.

A Manova with a step down, with the variables L1 vocabulary and L2 words read correct, showed that there is a significant interaction between country and reader (Stepdown F (1, 40) = 4.54, p = .039). This is due to the poor Danes performing worse than the poor Norwegians and Swedes, but the good Danes perform equally good as the good Norwegians, and better than the good Swedes. Reader also has a significant effect (Stepdown F (1, 40) = 24.97, p = .007). Finally, country has a significant effect (Stepdown F (1, 40) = 7.03, p = .011).

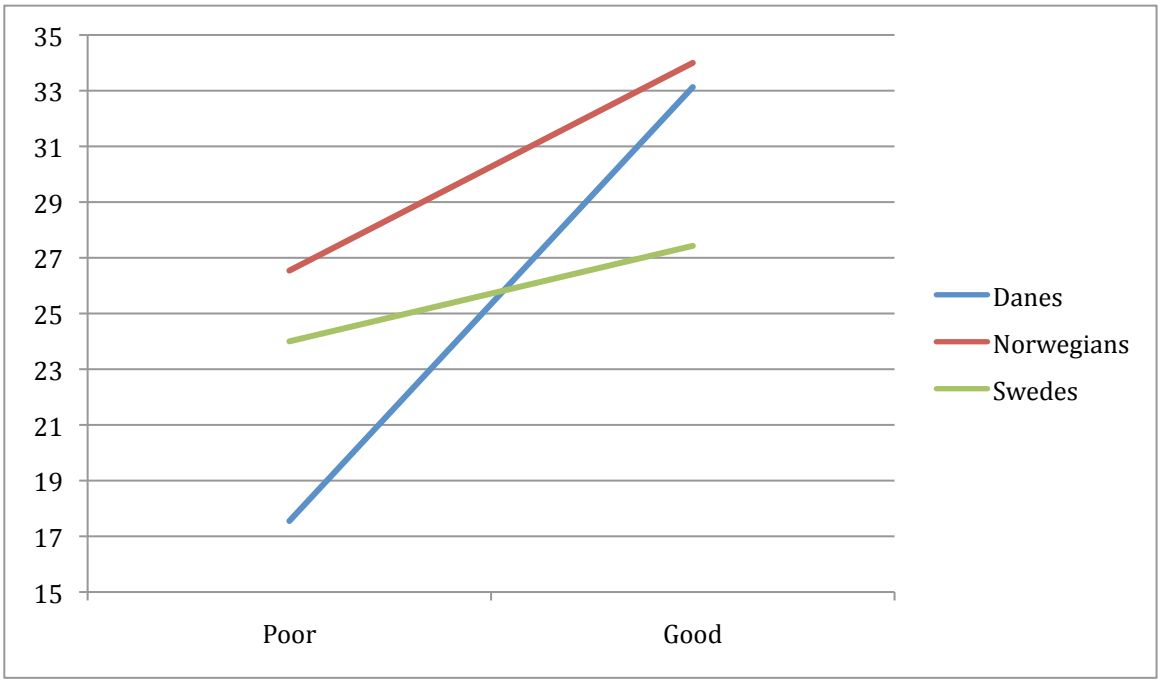

Figure 15. L2 reading –poor vs. good readers

4.5.4 Orthographic learning

The mean for the poor Danes was 11.09, with a standard deviation of 5.52. For the poor Norwegian readers, the score was 12.85, and the standard deviation was 3.31. The Swedish

poor readers scored a mean of 14.36, and the standard deviation was 4.93. The means for the good readers was 18.38 for the Danes, the standard deviation was 3.02, for the Norwegians the mean was 17.54, the standard deviation was 4.14, and for the Swedes, the mean was 19.29, with a standard deviation of 5.63.

A Manova with the dependent variables Dprime L1 vocabulary, and orthographic learning showed that the effect of reader was significant for orthographic learning (Stepdown F (1, 56) = 13,02, p < .000). The effect of country was not significant (Stepdown F (2, 56) = .55, p = .578) Still, figure 16 shows that there is a difference between the poor Danish readers and the poor Norwegian and Swedish readers. Figure 16 also illustrates the connection between bad reading fluency and performance on orthographic learning tasks, the readers with good L1 fluency scored significantly better than the readers with bad L1 fluency, for all countries.

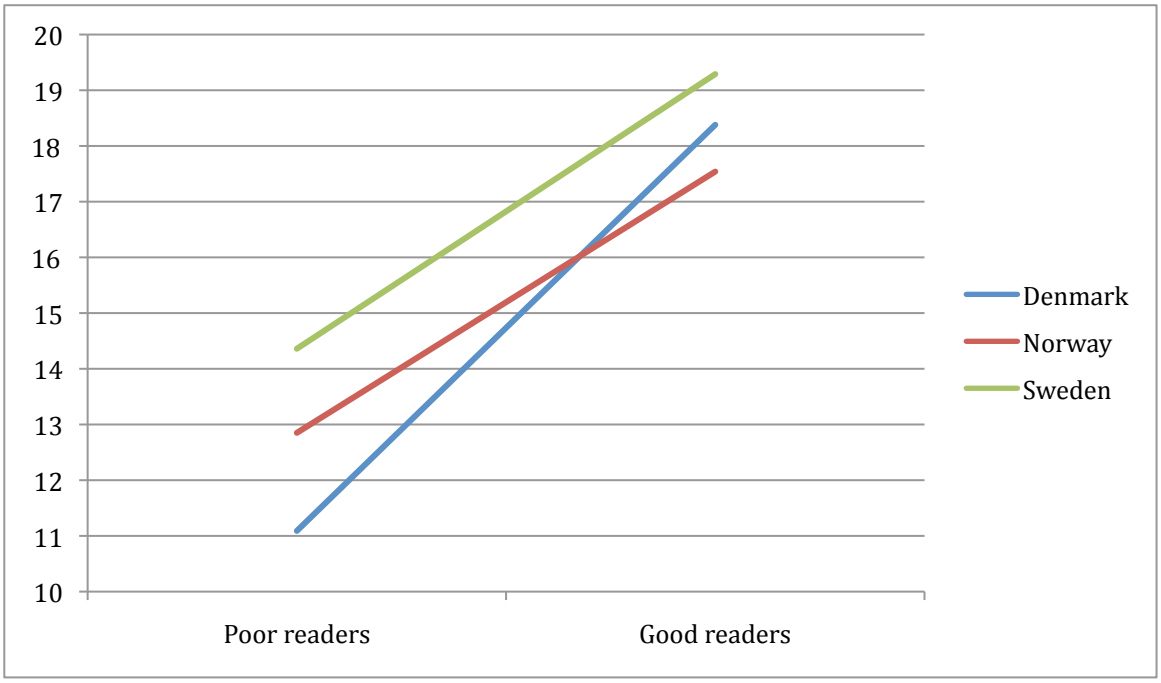

Figure 16. Orthographic learning – poor vs. Good readers

5.0 Discussion

In this chapter the results from the previous chapter will be discussed. The research questions will be discussed in the following order: 1) Differences in L1 decoding strategies between shallow Norwegian and Swedish, and deep Danish, and evidence that these strategies are reflected in L2 decoding strategies. 2) Evidence that the Norwegian and Swedish participants are better orthographic learners than the Danish participants, and comment on which skills support orthographic learning. 3) The age factor in second language learning, does it make a difference for reading, spelling and vocabulary sensitivity when you start learning L2. 4) Discuss whether orthography affects L1 and L1 spelling, reading and vocabulary. Are the Danish learners of English more efficient, and do they make fewer mistakes in word recognition and spelling than Swedish and Norwegian learners because of their experience with a deep orthography, or is it the other way around, that is, are Norwegian and Swedish learners more efficient in acquiring English word recognition and spelling? 5) A discussion of what skills good readers are good at, and find out whether these are the same across languages. And look into how poor readers of different orthographies are impaired.

5.1 Do Danish children use different decoding strategies when reading L1 than Norwegian and Swedish children, and are these decoding strategies reflected in L2 reading?

The first research question concerned whether children with a deep L1 background use different decoding strategies than children with a shallow L1 background. Different reading strategies were believed to be reflected in errors made in word reading. Next, it was questioned whether the reading strategies acquired in L1 would be reflected when learning a deep L2.

When looking at reading strategies, error patterns were used as an indicator of reading strategies. There was a significant difference between orthographies. As expected, the readers of the shallow orthographies made slightly more nonword errors than the readers of the deep orthography. Previous research too has shown the same (Ellis et al. 2004), that readers of a

shallow orthography make more mistakes of this category because they decode from the left to the right, phoneme by phoneme. For real word substitution the Danish participants made more mistakes than expected. This is in line with the orthographic depth hypothesis, and previous research, see Ellis and Hooper 2001. Making real word mistakes characterizes a decoding strategy based on a visual analysis of the input. The Norwegians + Swedes made more ending errors than expected. Ending errors can be considered as orthographic errors, these errors are expected to occur more in better orthographic learners.

The response "don't know" was hardly used at all for the Norwegian and Swedish sample. These children seemed to master skills that enabled them to read almost any L1 word. The response "don't know" was not common among the Danish participants either. Still, the results showed that the Danish participants gave this response more often than the expected count. This is in line with Ellis et al 2004. The response "don't know", means that the participant has no means to decode the word that they are asked to read. As the Danish participants used this response more than the Norwegians + Swedes indicated that the strategy used by the participants using a deep orthography fails more often when facing a word. This might show that in addition to not being good orthographic learners, these readers do not have these words in their vocabulary.

In sum, evidence for differences reading strategies can be found in the outcome.

The next question was whether the decoding strategies acquired when reading L1 are reflected when reading L2. If decoding strategies from L1 are reflected when reading L2, the results would have to show that the participants with a deep L1 background make more errors in the categories real word substitutions and "don't know" responses. Moreover, the Norwegians + Swedes would have to make more nonword errors and ending errors. Ending errors are not however as common in English as in the Scandinavian languages. Results showed that there is a difference in error patterns between the orthographies. For L2 reading too, the readers with a shallow L1 background did make more nonword errors. The readers of the deep orthography did not, however, make more real word substitutions than expected. One reason that the number of real word substitutions was lower than expected among the Danish participants can be because the participants had limited vocabulary. Because they know few English words, and therefore did not have many real words to choose from, they made few real word substitutions. Contrary to when reading L1 words, for L2 it was the readers of the deep orthography that made more ending errors than expected. As with L1 words, the

response “don’t know” was given more often than expected by the Danish participants when reading L2 words.

In sum, the sort of mistakes made in L1 was partly reflected when reading L2. The Danes’ inability to read some L1 words, responding “don’t know”, is reflected when reading L2. There are some words that some of the Danish participants just do not know how to decode. Moreover, the readers with a shallow L1 background make more nonword errors both when reading L1 and L2 words. This means that the decoding strategies acquired in L1, whether it is shallow or deep, are partly reflected when decoding a deep second language.

5.2 Orthographic Learning

There was a significant difference between the orthographies for what kinds of errors were made in the orthographic learning task. Errors in the orthographic learning task were expected to reflect decoding strategies acquired when learning to decode a deep or a shallow orthography. The Norwegian and Swedish participants, having a shallow L1 orthography, were expected to make more errors of the category orthographic errors; these errors indicate that they try to retrieve a word from the lexicon. For older learners and better readers this should be available as they are better at orthographic learning. The Norwegian + Swedish participants were also expected to make more errors of the category phonological error, choosing a word that resembles the target word phonologically.

In line with what was expected, the Norwegian + Swedish participants made more orthographic errors than the Danish participants in the orthographic learning task. This serves to show that the participants with shallow L1 backgrounds tried to retrieve even new words as a whole from the lexicon. Moreover, the Norwegian + Swedish participants made more phonological errors.

The Danes made more errors of the category “other” than what was expected outcome. Such an error indicates that when faces with four alternatives; one correct, one that resembles the correct one phonologically, one that resembles the correct one orthographically, and one that bears no resemblance to the correct one at all, the participant has chosen the unrelated foil. That the Danes made more such errors indicates that they make more guesses, and that they are poor orthographic learners. The Danish participants also gave more blank responses than expected, indicating poor orthographic learning. However, interpreting the blank

responses is not straightforward. A blank response might also indicate that the participant is reluctant to take a chance whenever uncertain; it may be a result of the participant skipping one task without being aware of it. Still, the participants from all countries had the same time limits, and when looking at the number of "other" errors made by the Danes there is no reason to believe they are less willing to take risks than the Norwegian + Swedish participants.

In sum, the participants with a deep L1 background made more guesses, and more blank responses than participants with a shallow L1 background. Moreover, the participants with a shallow L1 orthography used both visual and phonemic clues when learning novel words.

Who were the best orthographic learners? Orthographic learning is one of the skills believed to be supported by phonological reading; therefore Norwegian and Swedish participants were expected to perform best at the orthographic learning task. Moreover, it was expected that learners with a shallow L1 background would need fewer presentations of a word in order to identify it correctly.

The participants with a shallow L1, the Norwegians + Swedes, identified significantly more items correct than the participants with a deep L1, the Danes. This means that learners of a shallow orthography become better orthographic learners than learners of a deep orthography. Moreover, the difference did not decrease over time; instead the participants with a shallow L1 background had a steeper learning curve. These results show that the initial advantage it is to start learning a shallow orthography lasts for several years.

After one presentation the Norwegian + Swedish participants identified significantly more items correct than the Danish participants. A significant difference was also found after three presentations; again the participants with a shallow L1 identified more items correct. There was no significant difference in the number of items identified correct after two and four presentations. After four presentations, participants from both a shallow and a deep orthographic background identified close to 5 out of 7 items correct. Four presentations seem to be the number of presentations needed for learners of both shallow and deep orthographies in order to recognize a new word. The best orthographic learners in shallow orthographies only need an average of three presentations in order to identify a word correctly. For really good orthographic learners, one presentation was enough.

In sum, these results show that learners with a shallow L1 orthography are better orthographic learners. They are able to identify more words correct, and they need fewer presentations of a word before they recognize it than learners with a deep L1 orthography do. When faced with a new word, readers of a shallow orthography have an advantage. They identify the word more easily, and will need fewer presentations of the word before it is stored in the lexicon.

5.2.1 Skills that support orthographic learning

The results on the visual association task does correlate at a significant but small level with results obtained on the orthographic learning task, which means that visual association is part of what orthographic learning is. Moreover, there is a small but significant correlation between results on the visual memory task and the visual association task. As visual memory is part of what visual association is, and visual association is part of what orthographic learning is, it is likely that the Danes, being good at visual memory use their visual skills more on the orthographic learning tasks. However, it seems visual memory is not enough.

There is a low, but significant correlation between phonological awareness and orthographic learning. Seeing that the correlation between phonological awareness and orthographic learning is lower than the correlation between visual association and orthography, indicated that other skills too underpin orthographic learning.

Visual memory

On the visual memory task, the participants with a deep L1 orthography were expected to perform better than the participants with a shallow L1 orthography because they were believed to use their visual skills when decoding words, and therefore improve their visual memory.

The results were in line with what was expected, the participants with a deep L1 had better visual memory than the participants with a shallow L1. However, the difference was not significant. The reason no significant difference was found might be related to a ceiling effect, the tasks were too easy. There would have been greater differences if slides containing 5 and 6 squares were included.

Although no statistically significant difference was found, it is worth noting that the learners with a deep L1 background performed better on the visual memory task. As visual memory is one of the skills that support orthographic learning, it is plausible to conclude that the Danes compensate with their visual memory skills on the orthographic learning task, but that it is not sufficient.

Phonological awareness

The Norwegian + Swedish participants were expected to perform better on the phonological awareness test as readers of shallow orthographies tend to decode words grapheme by grapheme, connecting each grapheme to its corresponding phoneme.

The participants with a shallow L1 background did indeed perform significantly better on the phonological awareness test. It seems becoming literate in a shallow orthography first makes children more phonologically aware.

Visual association

There were no significant differences in between the participants with a shallow L1 and the participants with a deep L1 when it came to their ability to remember the order of strings of digits, symbols and vowels.

The correlation between vowel association and orthographic learning is low, indicating that pronouncability is important when learning new words.

It is interesting to note that the youngest Danes perform better than the youngest Norwegians + Swedes, but for the older participants it is the other way around.

5.3 Effect of Early start

The literature is inconclusive to the question of whether or not an early start is an advantage. The one-year difference between the early starting Swedes, and the late starting Swedes was not expected to influence results significantly. It was expected that the youngest Norwegians would perform better than the youngest Swedes on L2 word reading, spelling and especially on vocabulary. These differences were however expected to decrease for age-band 2 and 3.

No significant difference was found between the two groups of Swedes. If anything, the late starters performed better on all tests, spelling, reading and vocabulary. If a late start is indeed an advantage, it would give the Danes an advantage, as all the Danish participants are late starters. As this goes against the hypothesis that Norwegian + Swedish participants would perform better on all tests related to L2, it is not problematic.

There was no significant difference between the Norwegian and the Swedish participants on the L2 spelling task. In line with what was expected, the Norwegians in age-band 1 and 2 performed better than the Swedes, while for age-band 3 the Swedes outperformed the Norwegians. A reason for the small differences between the performances on the youngest age-bands can be the fact that there has been a focus on oral language for the youngest Norwegians. Also, it needs to be noted that the spelling errors were not analyzed, so that the displacement of one letter was scored the same as not writing anything.

There was no advantage for the early starting Norwegians when it came to silent reading. Instead, the late starting Swedes managed to split up more word chains correct than the early starters.

The Norwegian children read significantly more accurately than the Swedish children for all age-bands. The difference does not decrease. An early starting age, and more exposure to L2 does influence reading accuracy, and three years of training is not enough to catch up with learners with six years of experience. The early starters, the Norwegians, also read high frequency words significantly more fluently. However, this was not the case for the youngest age group. The fact that the youngest Norwegians did not read high frequency words more fluently than the youngest Swedes must be related to the oral focus in the lowest grades. Still, the reason the Norwegian participants in age-band 2 and 3 read high frequency words more fluently shows that this early start assists recognizing high frequent words later on.

For both spelling and word reading the effect of an early start is not visible until age-band 2 and 3. It might be that an early start only is profitable in the long run.

There was no significant difference as to how sensitive Norwegian and Swedish children were to English words. However, as expected the early starting Norwegians perform better than the late starting Swedes for all age-bands, and the difference increased. If the participants had been given an oral vocabulary test, the difference might have been

significant. Because of the oral focus for the lowest grades in Norway, the children might not have been able to recognize words they actually know.

In sum, it cannot be concluded that an early start has the same effect on all skills. It seems an early start has little effect on second language spelling, but that it influences word reading accuracy, and the fluency of high frequency words. The effect of an early start for word reading is not evident until after some years of second language learning. For the development of second language vocabulary an early start again seems profitable, but the late starters soon catch up. The differences on the vocabulary test might have been greater if the participants had been tested on sensitivity of spoken words. That way the early starters might have profited more from the oral focus, moreover difficulties reading the words would not have influences the results.

5.4 Effect of Orthographic depth on L1 Reading and Spelling, and on L2 Reading, Spelling and vocabulary.

There is a strong and significant correlation between spelling and orthographic learning, both for L1 and L2. Moreover, orthographic learning correlates significantly with L1 and L2 reading. Good orthographic learners are better readers and spellers than poor orthographic learners.

5.4.1 Spelling

It was expected that the participants with a shallow L1 background, the Norwegians + Swedes, would perform better than the Danish ones on the tests concerning L1 reading and spelling, because of their shallow orthography, and because they are better orthographic learners. For L2, the participants with shallow L1 backgrounds were again expected to perform better due to them being better orthographic learners, and thus better self-teachers.

There was indeed a significant difference between orthographies when it came to the ability to spell L1 words correctly. The participants spelling words in a shallow orthography did better for all age-bands, and the difference did not decrease. As possible background differences were corrected for using L1 vocabulary as a covariate, the difference between countries must be a result of the shallow orthography. Moreover, the effect from orthography became smaller when orthographic learning was added as a second covariate. This serves to

show that orthographic learning mediates spelling. The difference between the orthographies did not decrease over time, which means that the effect from orthographic depth is long lasting. In addition to orthographic depth influencing spelling, it was found that orthographic learning mediates spelling.

Differences in orthographic depth had a significant impact on the results obtained in the L2 spelling test as well. The Norwegian + Swedish participants performed better than the Danish participants, even after the effect from L1 vocabulary and orthographic learning were taken away. However, adding orthographic learning as a second covariate reduces the effect from orthography, indicating that orthographic learning mediates L2 spelling too.

Orthographic depth of L1 influenced how well participants performed when spelling in English. It was no advantage for the Danish participants that they were accustomed to a deep orthography. The Norwegian + Swedish participants outperformed them due to their superior orthographic learning skills. Thus, learning to read and write in a shallow orthography is an advantage when learning to spell both in the first language, and in a second language. Moreover, the difference increased over time, meaning the effect from orthographic depth is not only long lasting, but also gets stronger as the participants have more experience with English. A possible explanation for these results might be the focus on oral language the first years of English instruction.

A weakness with the spelling tests in both L1 and L2 is that the errors were not categorized. That means that it is not distinguished between a misplaced letter, leaving out a letter and a complete mix-up of letters. Analyzing the errors would have given a more nuanced picture, and could have increased the understanding of how orthographic depth influence spelling in L1 and L2.

5.4.2 Reading

The participants who learned to read and write in a shallow orthography, Norwegian or Swedish, were more accurate and more fluent, in both reading aloud and silent reading, than the children who had learned to read and write in a deep orthography, Danish.

The participants with a shallow L1 background were expected to outperform the participants with a deep L1 background. The result confirmed this expectation, the Norwegian + Swedish participants performed significantly better than the participants with a deep L1 background on the L1 silent reading task. The participants with the deep L1 background did

not catch up with the others, instead the difference increased. These results indicate that learning a shallow orthography first makes you better at splitting up word chains, which is test of silent reading, and that learners of deep orthographies do not manage to reach the same level even when they reach 12 years of age. A possible explanation could be that the Norwegian and Swedish participants were more accustomed to word chain exercises. However, there is no reason to believe they were. They needed as much explanation as did the Danes in order to do the task.

For the L2 silent reading test there is again a significant difference between the group of participants with a shallow L1 background and the participants with a deep L1 background. The difference increases over time. These results indicate that learning a shallow orthography first is an advantage when reading words silently in a second language.

In sum, silent reading skills acquired in one language are transferable to another language. The participants with a shallow L1 orthography were better readers in both L1 and L2.

When looking at results for reading aloud, a significant difference between the participants with a shallow L1 background, and the participants with a deep L1 background was found. The difference between the average for how many words the Norwegian and Swedish participants read and how many words the Danish participants read was 1.7 words. Seeing that there was a ceiling effect, and that there were only 40 words, this is quite a prominent difference in accuracy.

It was expected that the Danish participants would outperform the Norwegian + Swedish participants when reading the most frequent L1 words. However, only he youngest Danes were more accurate than the youngest Norwegians + Swedes for the most frequent words. It seems visual memory is sufficient for reading high frequency words, but that once the Norwegians + Swedes become good orthographic learners they perform better.

There was also a significant difference between orthographies when comparing reaction times when reading L1 words. The Norwegian and Swedish participants had shorter reaction times for all age-bands. It seems reading a shallow orthography enables readers read words quicker. A significant effect from orthography is found for reaction times for all frequency bands. Moreover, reading fluency is mediated by orthographic learning. For the high frequency words, the Norwegian and Swedish participants have significantly shorter

reaction times. As the difference in reaction times for these high frequency words decrease over time, it seems the Danes will catch up. However, after 4 and a half years at school they are still slower than the readers of a shallow orthography. The difference between countries was not believed to be found for these high frequency words. Visual memory was believed to influence results more and thereby assist the Danish participants.

The difference in reaction times increase for the less frequent words. For the least frequent words the difference in reaction times is close to 400 milliseconds for the youngest participants, and 326 for the oldest participants. This is much. Having long reaction times leaves more pressure on short time memory, and will influence comprehension. The differences in reading speed also affect spelling and vocabulary in that children having a slower reading speed will be exposed to less words, and thus they will build up fewer orthographic representations and they will acquire fewer new word meanings.

The interpretation of the results on L1 and reading is that children learning to read and write in a shallow orthography have a long-lasting advantage compared to children learning to read and write in a deep orthography. Orthographic depth does not only affect accuracy and fluency when reading, but will affect comprehension too.

For L2 reading, the Norwegian participants were excluded because their early start influenced L2 reading. The results showed that orthographic depth of L1 did affect accuracy when reading L2 words. Moreover, it is mediated by orthographic learning. The Swedish participants perform better than the Danish for the three most frequent frequency bands. The Danish participants were expected to perform better than the Swedes on the words in frequency band 1, instead the Danes perform better for the least frequent words. This can not be explained by visual memory as these words were low frequency words- The result might be explained by the words being so unfamiliar to the children that the participants with a shallow background had not had a chance to build a orthographic representation of the word.

Orthographic depth of L1 did affect fluency when reading English words in frequency band 2 and words in frequency band 4. The fact that no significant difference was found for the most frequent word can be because the Danes' visual memory aids them here. For the less frequent words visual memory is no longer enough, the fastest readers are the good self-teachers. For the least frequent words, it is likely that most of these words are words that the children never have encountered before. The fact that the readers with a shallow L1

background read these words quicker shows that they use more efficient strategies when reading new and unknown words.

Vocabulary

Orthography plays a significant role for L1 vocabulary. Participants with a shallow orthography were more sensitive to L1 words than participants with a deep orthography. This might have to do with them being better readers and therefore being more willing to read. Also, an indication from the reaction times on the reading test is that if the participants from all orthographies spend the same amount of time reading, the participants reading a shallow orthography will read more words, and thus be exposed to a larger vocabulary. Another explanation might be that because the participants with a shallow L1 orthography were better readers, they are more sensitive to written vocabulary. However, given that the participants were given unlimited time for the task, this is unlikely to influence the results much as any differences in fluency will be taken away.

If L1 vocabulary is indeed influenced by orthography and orthographic learning it would have been interesting to measure oral vocabulary in preschool children. If orthography and orthographic learning influence vocabulary, a representative sample of preschool children from all three countries, with the same amount of exposure to spoken L1 would be expected to have the same sensitivity to L1 vocabulary.

There was a significant difference between the participants with a shallow L1 background and a deep L1 background when it came to sensitivity to English words. Having a shallow L1 orthography, and thus being a better orthographic learner, makes learning English words easier.

The oldest Danes performed worse than the two younger groups. Both the Danes in age-band 2 and in age-band 3 ended up with a negative number, indicating they claimed to know non-words. It seems strange that the youngest Danes should know more English words than the older ones. A possible explanation for this result can be that the youngest participants, knowing they were the youngest ones taking the test, did not feel any pressure to recognize many words, while the older Danes felt they ought to know more words than they did, and were thus more willing to take risks. One would expect the oldest Norwegians and

Swedes to feel the same pressure, however it seems they did in fact know many words and therefore did not feel the need to take as many risks.

A problem with the vocabulary test is that it only gives information about written vocabulary. As the Danish participants had more trouble with word reading, this could influence their ability to recognize words they know on the vocabulary test. Misreading of words can also explain the identifications of non-words as words. It would have been interesting to have a test where the participants were asked whether or not they knew the meaning of spoken words.

In sum, the Danish learners of English are not more efficient than Norwegian and Swedish learners even though they have experience with a deep orthography. Rather, it is the learners accustomed to a shallow orthography that perform best on both reading and spelling of English words. That is, having a shallow L1 orthography is an advantage when learning a second language, even if that second language uses a deep orthography.

5.5. Good and Poor Readers

The poor readers performed significantly worse on the L1 spelling task than the good readers.

There was an interaction between reader and country due to the Swedish good and poor participants having close to the same performance. For the Norwegian and Danish participants the poor readers performed significantly worse on the spelling task than the good readers. The difference between the poor and the good readers is most prominent for the Danish participants. The good Danes are equally good as the good Norwegian readers and better than the poor Swedish readers. The good readers of the deep orthography master their orthography. This serves to show that the Danish mean on the spelling task might have been influenced by a group of very poor spellers. It might also show that poor readers of deep orthographies are more impaired in spelling than poor readers of shallow orthographies.

The same is seen for L2 spelling. Poor Danes perform worse than poor readers in the shallow orthographies, while for the good readers, the Danes perform equally good as the Swedes, but not as good as the Norwegians. Perhaps the fact that the good Norwegians outperform the good Danes and Swedes in L2 spelling show that an early start of learning a second language is an advantage for the good readers.

Poor readers of deep orthographies are more impaired in reading accuracy than poor readers of shallow orthographies. There is no difference between the countries when it comes to the good readers. Again it seems the poor readers of the deep orthography are more impaired than the poor readers of the more shallow orthographies. For L2 reading the result is the same, the poor readers of the deep orthography read significantly fewer words correct in L2 than the poor readers of the shallow orthographies. The good readers read only one word less correct than their Norwegian peers who have learned English for more years, moreover they read more words correct than the good Swedes. It seems that the readers that master their deep orthography also master reading their second language. The question is if this is due to them being good orthographic learners.

For all countries, the good readers performed better on the orthographic learning task than the poor readers did. The difference between the good and poor readers is most prominent for the Danes. The good Danish readers identified 7 more items correct than did the poor Danish readers. The good Danish readers are equally good at orthographic learning as the good readers from Norway and Sweden. It seems in order to become a good orthographic learner; having a deep L1 orthography is more problematic for the poor readers. For the good readers a deep orthography does not seem to be problematic.

6.0 Conclusion

This cross-sectional study has examined the effect orthographic depth of L1 has on orthographic learning, L1 and L2 reading, spelling and vocabulary. Participants from three countries, Denmark, Norway and Sweden, have been compared on these skills. The participants from the shallow orthographies, Norwegian and Swedish were expected to use a different strategy when reading L1 words than the Danes, and this strategy was expected to be reflected when reading L2 words. The participants with a shallow L1 background were expected to be better orthographic learners, to read faster and more accurately in L1 and L2, to spell more words correct in L1 and L2, and to have a more extensive vocabulary in L1 and L2. Finally, the poor readers of the deep orthography were expected to be more impaired by their reading difficulties than the poor readers of the shallow orthographies.

The error patterns were different for the participants from the different orthographies. L2 error patterns reflected L1 error patterns, indicating that reading strategies acquired in L1 are reflected when readingL2.

Errors made within the orthographic learning task also reflected orthography. The participants with a shallow L1 background used both phonological and visual cues when learning novel words. The participants with a deep L1 background, on the other hand made more guesses and blank responses, indicating they were poor orthographic learners. The participants with a shallow L1 background, the Norwegians and Swedes, were better orthographic learners than the participants with a deep L1 background, they made more correct identifications. Moreover, they needed fewer presentations of a word in order to identify it correct.

An early start does not have the same effect on all skills. It influences word reading accuracy, and the fluency of high frequency words. However, the effect of an early start for word reading is not evident until after some years of second language learning. For the development of second language vocabulary an early start again is profitable, but the late starters soon catch up.

The Norwegian and Swedish children, who learn to read in a shallow orthography, read faster and more accurately both in silent reading and reading aloud, than the Danish children who learn to read in a deep orthography. This difference in reading was found both in L1 and in L2. Also, the children with a shallow L1 background spell more words correct in

L1 and L2. Moreover, the Danish children were also outperformed when it come to L1 and L2 vocabulary size. The Danish children knew the meaning of fewer Danish words than the number of words the Norwegian and Swedish children knew the meaning of. It was assessed that reading and spelling skills were mediated through orthographic learning.

Differences in reading speed are believed to influence spelling and vocabulary size. Because they read slower, the Danish children are not exposed to as many words, and do not build as strong orthographic representations, and learn fewer new words.

It was also found that the poor readers of the deep orthography were inhibited more severely by their reading difficulties than poor readers of the shallow orthographies. The good readers of the deep orthography did not have difficulties with their deep orthography.

Implications

These findings have implications for teaching of reading and writing in Denmark. Perhaps words that are spelled regularly should be introduced initially to strengthen their understanding of the link between phonemes and graphemes. Alternatively, seeing that children becoming literate in a shallow orthography first become better orthographic learners, the Danes could learn to read and write in shallow German and deep Danish simultaneously. The Danish sample in this study lived very close to the German border, and from the parent questionnaire it can be gathered that in this area German is a more important second language than English. What is hypothesized is that the Danish children would acquire self-teaching through learning to read German, and that they would transfer the skill to Danish. This study has showed that self-teaching skills acquired when becoming literate in a shallow L1 will transfer to L2, both when literacy in L2 is learned simultaneously as L1 and when L2 is introduced later. It is reasonable to believe the same would happen when learning to read a shallow L2 simultaneously as a deep L1.

Limitations

The current study has some limitations. One of these concerns the design of the study. As the study was cross-sectional, the sample does not tell us anything about the development of the different skills, or about the casual relationship between orthographic learning and fluent

reading and spelling. A longitudinal design would provide data that could give information on the development of different skills, and the casual relationship between skills. Moreover, a longitudinal study, following the same participants for two more years, would give further insight to whether or not the participants with a deep L1 orthography catch up with the participants with a more shallow orthography. In addition, making the study longitudinal, would give more data within the age-band 2 and 3, which would make it easier to draw conclusions. Especially, it would be good to have more data on Danes in age-band 3, as there were relatively few participants in this group.

Another limitation concerns the assessments. The present study only assessed word reading, and not reading for comprehension of content. It would have been interesting to find out how reading speed is affected by orthographic depth, and whether the comprehension is better for the readers of the shallow orthographies. Also, seeing there was a ceiling effect

The vocabulary test that was used in the present study assessed written vocabulary. As reading accuracy differed between orthographies it might have influenced results on the vocabulary test. A test assessing spoken vocabulary would have overcome this problem. Also, a test assessing spoken vocabulary in L2 might have given different results as to whether it is an advantage to start learning a second language early or not, as there is a focus on spoken language from an early age.

The visual memory test might have shown significant difference between orthographies if the assignment had included patterns of five and six squares. Moreover, the task assessing phonological awareness was biased. A test involving repetition of, or writing of nonwords made from cognates could have given better data on the participant's phonological awareness.

Despite these limitations, the present study does make an important contribution to the field of study. By using the Scandinavian countries, and thus enabling for the use of cognates, this study shows that under fully controlled conditions, there is a considerable effect of orthographic depth on L1 and L2 reading, spelling and vocabulary. Moreover, the study shows that children within shallow orthographies become better orthographic learners.

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Appendix I: Information letter to parents

Nr….

Til foreldre og foresatte i klasse …. Ved….skole **Stavanger……2010.**

Forespørsel om å delta i et forskningsprosjekt.

Jeg er masterstudent i Literacy Studies ved Universitetet i Stavanger og holder nå på med den avsluttende masteroppgaven. Jeg studerer hvordan norske, danske og svenske elever tilegner seg engelsk. Målet er å sammenligne hvordan og hvor godt elever fra de ulike landene leser og skriver på engelsk.

For å finne ut av dette ønsker jeg å la elever i 4., 5. og 6. klasse prøve seg på ulike oppgaver. Elevene vil først jobbe med oppgaver samlet i klasserommet, deretter blir de bli tatt ut enkeltvis for å jobbe på en datamaskin. Klasseromsdelen består blant annet av en diktat der elevene blir bedt om å skrive norske og engelske ord. Når elevene jobber på datamaskinen sammen med forsker, blir de blant annet presentert med et ord på en dataskjerm som de blir bedt om å lese høyt. Den individuelle testen tar ca 15 minutter. Elevene kan trekke seg fra testen på et hvilket som helst tidspunkt.

De samme oppgavene blir gitt til alle tre aldersgrupper. De yngste elevene kan derfor finne enkelte aktiviteter vanskelige. Dette blir de orientert om, og blir oppfordret til å gjøre sitt beste.

Alle innsamlede data blir anonymisert når prosjektet er fullført, senest innen 20.mai 2010, og forsker er underlagt taushetsplikt. Klassens lærer vil ikke bli opplyst om elevenes prestasjoner. Prosjektmedarbeidere i ved Universitetet i København og Universitetet i Linkjøping vil ha tilgang det innsamlede datamaterialet, men alle navn vil være erstattet med nummer. De vil ikke ha tilgang til noen navneliste.

Deltakelse er frivillig, men dersom du har lyst til at ditt barn skal være med, er det fint om du krysser av og fyller ut spørreskjema på neste side før lappen leveres til kontaktlærer.

Hvis det er noe du lurer på kan du kontakte meg på 90042611 eller sende en mail til vibekeronneberg@yahoo.no.

Min veileder ved lesesenteret er Victor van Daal victor.v.daal@uis.no

Prosjektet er godkjent av Personvernombudet for forskning, Norsk samfunnsvitenskaplig datatjeneste AS. Prosjekt nr. 23066

……

Samtykkeerklæring, kryss av.

Jeg har lest og mottatt informasjon om studien av barns andrespråk tilegning og ønsker at mitt barn skal delta i undersøkelsen. Jeg er også villig til å svare på spørsmålene som er festet til dette arket. JA_____

Appendix II: Questionnaires (example in Danish)

Elevspøreskema. **Nr._____**

1. Klassetrin:……

2. I hvor mange år har du haft engelsk i skolen? Tæl dette skoleåret som et helt år.

   …….år.

3. Ud over timerne på skolen bruger jeg sprogene: (sæt kryds)

Sprog	Altid	Ofte	Nogen gange	Sjældent
Dansk				
Engelsk				
Modersmål som ikke er dansk (skriv hvilket) …….				
Andet (hvilket) …….				

4. Ud over timerne på skolen læser jeg bøger og/eller blade på følgende sprok: (sæt kryds)

Sprog	Vældig ofte	Ofte	Nogen gange	Sjældent	Aldrig
Dansk					
Engelsk					
Modersmål som ikke er dansk (skriv hvilket)					

……					
Andet (hvilket) ……					

5. Utenom timene på skolen ser jeg på TV eller DVD på følgende språk: (sett kryss)

Sprog	Vældig ofte	Ofte	Nogen gange	Sjældent	Aldrig
Dansk					
Engelsk					
Modersmål som ikke er dansk (skriv hvilket) ……					
Andet (hvilket) ……					

6. Utenom timene på skolen spiller jeg dataspill på følgende språk: (sett kryss)

Sprog	Vældig ofte	Ofte	Nogen gange	Sjældent	Aldrig
Dansk					
Engelsk					
Modersmål som ikke er dansk (skriv hvilket) ……					
Andet (hvilket) ……					

7. Andre steder/ aktiviteter der jeg hører, læser eller taler engelsk: (sæt kryds)

Aktivitet/ sted:	Vældig ofte	Ofte	Nogen gange	Sjældent	Aldrig
……..					
…….					
…….					
…….					

Forældrespørgeskema: **Nr._____**

1. Hvilke(t) sprog taler de voksne i hjemmet med barnet?

Sprog	Ca %
Total	100%

2. Hvilke sprog bliver barnet jævnligt eksponeret for uden for skolen?

Sprog	%	Talt af hvem
Total	100%	

3. Hvilke sprog talerer barnet jævnligt med personer uden for skolen?

Sprog	%	Til hvem
Total	100%	

4. Har barnet bort i andre lande end Danmark og demed blevet eksponeret for andre sprog end dansk?

Sprog	Land	Barnets alder	Hvor længe (måneder)

5. Hvilke sprog taler og forstår du?

Sprog		Flytende	Godt	Ok	Dårligt
Dansk	taler forstår				
Engelsk	taler forstår				
……..	taler forstår				
……	taler				

forstår				
…… taler forstår				

6. Hvilke sprog taler og forstår eventuelt andre omsorgspersoner?
   Hvem:…….

Sprog	Flytende	Godt	Ok	Dårligt
Norsk taler forstår				
Engelsk taler forstår				
…….. taler forstår				
…… taler forstår				
…… taler forstår				

7. Omtrent hvor mange bøger, og børnebøger har I i hjemmet? (sæt kryds)

Bøger:	Børnebøger:
0-10_____	0-10_____
11-25_____	11-25_____
26-100_____	26-100_____
101-200_____	101-200_____
Mer enn 200_____	Mer enn 200_____

Appendix III: Teacher questionnaire (example in Danish)

Engelsk/dansk lærer skole_____ klasse_____

1. Hvilke tekstbøker bruker du i undervisningen?

   _____

   _____

   _____

2. I hvor mange år har du undervist den aktuelle klassen?

   _____

3. Hvor ofte bruker du følgende aktiviteter i undervisningen?

Aktivitet	Veldig ofte	Ofte	Noen ganger	Sjelden	Aldri
Muntlige aktiviteter					
Høytlesing					
Stille lesing					
Høre på engelsktalende personer på cd, dvd eller tv					
Se engelske/danske filmer					
Bruke engelske/danske sider på internett					
Skrive på engelsk/dansk					
Jobbe med grammatikk					
Jobbe med oversettelse					

4. Hvilken formell utdannelse har du i engelsk/dansk?

   _____

   _____

5. Hvor mange års undervisningserfaring har du i faget?

   _____

Appendix IV: Reading and spelling tests

Swedish warmup words

till, som, med, har, de

Norwegian warmup words

til, som, med, har, de

Danish warmup words

til, som, med, har, de

Swedish words

om, vi, sig, blev, vill, hon, da, två, själv, där, flera, mellan, utan, genom, bättre, aldrig, därmed, gjorde, kommit, ute, minuter, president, pengarna, fortsätter, professor, framtiden, levande, tekniska, sekunder, upplevde, litteratur, omsättningen, kandidater, festivalen, sammanhanget, fantastiska, avgöranden, bedrägeri, diskussioner, författarskap

Norwegian words

om, vi, seg, ble, vil, hun, da, to, selv, der, flere, mellom, uten, gjennom, bedre, aldri, dermed, gjorde, kommet, uten, minutter, president, pengene, fortsetter, professor, fremtiden, levende, tekniske, sekunder, opplevde, litteratur, omsetningen, kandidater, festivalen, sammenhengen, fantastiske, avgjørelser, bedrageri, diskusjoner, forfatterskap

Danish words

om, vi, sig, blev, vil, hun, da, to, selv, der, flere, mellem, uden, gennem, bedre, aldrig, dermed, gjorde, kommet, ude, minutter, præsident, pengene, fortsætter, professor, fremtiden, levende, tekniske, sekunder, oplevede, litteratur, omsætningen, kandidater, festivalen, sammenhængen, fantastiske, afgørelser, bedrageri, diskussioner, forfatterskab

Appendix V: Vocabulary tests

English words

amuse, normal, criminal, reward, bend, inform, independent, miserable, admire, deserve, slip, collect, press, likely, niece, provide, terrible, pole, boil, sandy, heap, impress, apartment, grip, exist, snowy, conduct, manager, leisure, glue, humble, scatter, mount, volume, giant, tube, decrease, outline, jug, lessen, tighten, antique, risk, dose, rod, restore, violent, screen, creep, pad, pedestrian, budget, feeble, harden, hook, sorrow, curl, apparatus, outlet, both, origin, cup, warm, born, oppose, rain, weather, climb, harbour, pack, signal, avoid, earn, fond, recommend, sweat, blade, guide, manage, cliff

Norwegian words

disponerer, annonse, kombinerte, gudstjenesten, berørt, demonstranter, fakultet, feilen, gjennombrudd, inspirert, arrangement, avanserte, begått, diskusjonen, adresse, forutsettning, interessante, kritikken, innhold, rettigheter, bidrag, kjøp, forklaring, verdt, pluss, fritt, internasjonalt, utenlandske, biler, halv, lavere, tenker, virker, valgt, spennende, tenke, familien, spille, politisk, skjer, følge, problemer, ofte, ganger, liv, verden, mennesker, hatt, tror, viser, folk, gamle, annet, disse, kom, igjen, hva, tre, fikk, første, der, nye, du, alle, over, mot, nå, være, dette, ved, skal, etter, kan, men, jeg, et, han, den, de, har

Swedish words

disponerar, annons, kombinerade, gudstjänsten, berört, demonstranter, fakultet, felen, genombrott, inspirerad, arrangemang, avancerade, begått, diskussionen, adress, förutsättning, intresanta, kritiken, innehåll, rättigheter, bidrag, köp, förklaring, värd, plus, fritt, internationellt, utländska, bilar, halv, lägre, tänker, verkar, valt, spännande, tänke, familjen, spela, politisk, sker, följa, problem, ofta, gånger, liv, världen, människor, haft, tror, visar, folk, gamla, annat, dessa, kom, igen, vad, tre, fick, första, där, nya, du, alla, över, mot, nu, vara, detta, vid, ska, efter, kan, men, jag, ett, han, den, de, har

Danish words

disponerer, annonce, kombinerede, gudstjenesten, berørt, demonstranter, fakultet, fejlene, gennembrudd, inspirert, arrangementer, avancerede, begået, diskussionen, adresse, forudsætning, interessante, kritikken, indhold, rettigheder, bidrag, køb, forklaring, værd, plus, frit, internationalt, udenlandska, biler, halv, lavere, tænker, virker, valgt, spændende, tænke, familien, spille, politisk, sker, følge, problemer, ofte, gange, liv, verden, mennesker, haft, tror, viser, folk, gamle, andet, disse, kom, I.gen, hvad, tre, fik, første, der, nye, du, alle, over, mot, nu, være, dette, ved, skal, efter, kan, men, jeg, et, han, den, de, har

English nonwords

horobin, pegler, utting, horozone, crole, mealing, sumption, tindley, alden, gow, clarinate, surman, pardoe, effectory, piccolotomy, diversal, vickery, kennard, captivise, darrock

Scandinavian nonwords

vab, ån, im, oller, dap, nak, mekt, landep, iret, stu, gatte, tos, forskling, grøler (N, DK), gröler (S), omtom, gra, ladig, måld, emtanke, porker

Appendix VI: Orthographic learning test (example in Swedish)

Learning Phase:

Äpplen som importeras av FULP är godast.

[Apples imported by FULP are the best.]

Test:

24	Spela tennis med en…….racket.		a. TARKS b. FARKS c. TARKZ d. ZIRKT
25	Äpplen som importeras av ….är godast.		a. FULP b. FUIP c. VULP d. PILF
26	Använd…handskar när du jobbar i trädgården.		a. KIPSER b. IRKIST c. ERKITS d. ERKIST
27	Lek med……handdockor.		a. SLAZK