Reading difficulties and bilingualism

Can decoding difficulties be identified in a second language?

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Doctoral Dissertations at the University of Agder 483

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Dissertation for the degree philosophiae doctor (Ph.D.)

University of Agder
Faculty of Humanities and Education
2024

Doktoravhandlinger ved Universitetet i Agder 483

ISSN: 1504-9272
ISBN: 978-82-8427-200-9

Trykk: Make!Graphics
Kristiansand

Acknowledgements

This thesis results from the will to investigate unanswered questions, leading to taking on tasks one never thought one could handle. Furthermore, with my hand on my heart, I can say that this project would never have reached completion without my two wonderful supervisors! **Oddny Judith Solheim** - thank you for sharing your incredible knowledge, your ability to understand connections long before I do, your patience and enormous ability to remember details, and for never reducing the quality requirements. I am so grateful to you! **Linda Ruth Wheeldon** - thank you for patiently introducing me to your vast field of research, for guiding me with ease through the entire process of creating my assessment tasks, and for having more faith in my English skills than I did. It isn't easy to express how deeply grateful I am that the two of you have been my supervisors. Thank you for creating a safe learning environment that was full of knowledge, laughter, and friendship.

A PhD doesn't exist in a vacuum, and many people deserve a sincere thank you for helping me with a lot of different things over the past four years. First of all, a big thank you goes to **Jan Zandhuis** for programming and setting up the assessment tool - I am eternally grateful for your knowledge and friendly approach. Furthermore, I would like to thank **Allison Wetterlin** for sharing your knowledge of phonology, for helping further than anyone would expect of you, and for so clearly cheering for me and my project.

When researching reading in several languages, you need expert help in the languages you do not master yourself. So, a big thank you goes to **Elżbieta Byrdziak** and **Sebastian Bylicki** for making the Polish tests, and to **Faisal Haji-Abdirahman Aligas** and **Liv Toril Aligas** for making the Somali ones. Also, thanks to **Kirsti Jacobsen**, **Natalia Gil Martinez**, **Huda Ali** and **Maud Pélissier** for lending their voices to my test battery.

It is difficult to do research without informants. Therefore, I send a sincere thank you to all the adult education centres that have helped me with the recruitment, although the data collection was carried out during the stressful times of the pandemic. Many thanks to the Communications Department at UiA, by **Sveinung Mathias Sæbø**, who helped me create recruitment ads on social media. But most of all: heartfelt thanks to all participants who answered the questionnaire and who allowed themselves to be tested in both their first and second language. I am tremendously grateful for this!

This thesis consists of an enormous amount of data that had to be handled. Thank you, **Haris Bosnic,** who managed to get the data into a format I could handle. And thanks to **Jarle Javenes** who saved me many weeks of labour with the help of your Excel skills. Once the data had the correct format, it had to be analysed statistically. That also required a steep learning curve for me. Many thanks to **Mikael André Albrecht** for taking the time during your PhD, to help me with the PCA and for explaining simply complicated statistics to me.

Furthermore, I am very happy for all my nice PhD fellows and colleagues here at UiA. Thank you for cheering, drinking coffee and putting up with the fact that both joys and frustrations have been shared. I am very happy to have such a nice workplace and lovely colleagues.
I am so thankful for **Bjørn Harald Handeland** who, during a lunch break when I was writing my master's, gave me the crazy idea that I could apply for a PhD. Who could have known that a lunch could lead to this?

Finally, I would like to thank my family and friends who have cheered me on endlessly. **Guro** and **Trond Helge**, **Johannes** and **Marte**, **Martin** and **Audny** - you are the base of my life and for that, I am infinitely grateful. Thanks to my extended family and friends who have cheered from both near and far. It feels like I have a "village" that is there for me. And at last - thanks to “**Den Store Ukuleleforeningen**”, which always makes me happy, and reminds me that life has nice things to offer even after one has handed in one's PhD.

Helene Berntsen
Kristiansand, March 2024

Summary in Norwegian

Målet med denne avhandlingen var å utvikle ny kunnskap om lesevansker hos sekvensielle tospråklige voksne og å undersøke om avkodingsvansker kan identifiseres på et andrespråk (norsk). Lesevansker hos sekvensielt tospråklige voksne blir sjelden identifisert fordi vi mangler kunnskap og valide testverktøy for denne gruppen. Dette skjer fordi kartleggingsverktøy (og kartleggings-instruktører) ofte ikke er tilgjengelig på den tospråkliges L1, og fordi resultatene fra L2 tester kan være påvirket av den tospråkliges muntlige ferdigheter på L2. I dette prosjektet er det samlet inn spørreskjemadata om språklig bakgrunn og leseprofiler. I tillegg ble et testbatteri av ekvivalente kartleggingstester utviklet på L1 og L2, for å sammenligne deltakernes resultater på begge språk. En språknøytral dynamisk avkodingstest kalt DOT, var også en del av testbatteriet.

Utvalget i denne studien er sekvensielt tospråklige voksne med engelsk, polsk eller somalisk som L1og norsk som L2 (N=80). Studien undersøker hvorvidt ulike faktorer (sosioøkonomiske forhold, flerspråklighet, norskferdigheter m.m.) påvirker resultatene på avkodingstester som er kartlagt på henholdsvis L1 og L2. I tillegg undersøkes det om det er samsvar mellom L1 og L2 testing, og hvorvidt muntlige ferdigheter på norsk påvirker resultatene på L2. Det undersøkes også om de muntlige språkferdighetene på norsk modererer assosiasjonen mellom L1 og L2 testingen. Til slutt undersøkes det hvorvidt det er mulig å predikere gruppen med lave avkodingsferdigheter (på L1) basert på L2 testingen og DOT.

En Principal Component Analysis (PCA) ble utført på dataene fra spørreskjemaet. Resultatene viste at seks komponenter fra PCA-en predikerte avkodingen i noen av testresultatene på både L1 og L2. Ordlesing på L1 ble signifikant predikert av *Sosioøkonomisk bakgrunn* ($p < .006$) og *Lesevansker* ($p < .001$). L2 Ordlesing ble signifikant predikert av komponentene «*Norwegian engagement*» ($p < .003$) og *Sosioøkonomisk bakgrunn* ($p < .05$). L1 pseudoords-lesing ble predikert av både komponentene *Språk og leseferdigheter på L1* ($p < .007$), *Flerspråklighet* ($p < .04$) og *Sosioøkonomisk bakgrunn* ($p < .02$). Det er svært interessant at L2 pseudoordslesing ikke ble signifikant predikert av noen av de seks komponentene fra PCA-en.

En moderat til sterk korrelasjon ble observert mellom L1 og L2 testene i ordlesing (.68), pseudoordslesing (.64), RAN (.44) og fonemisk bevissthet (.81). Multiple regresjonsanalyser viste at muntlige ferdigheter på L2 (norsk) predikerte unik varians i L2 ordlesing ($p < .001$) og L2 RAN ($p < .001$), men ikke i L2 pseudoordslesing ($p > .95$) og L2 fonemisk bevissthet ($p > .98$). Det var heller ingen signifikante interaksjonseffekter hvor muntlige ferdigheter på L2 modererte assosiasjonen mellom de samme ferdighetene som ble kartlagt på både L1 og L2.

Til slutt ble det gjennomført fire logistiske binominale regresjoner for å undersøke hvilke tester som best predikerte gruppetilhørighet i gruppene lave og vanlige avkodingsferdigheter (kartlagt på L1). Prediksjonsevnen til L2 pseudoordslesing, L2 fonemisk bevissthet og DOT ble undersøkt i tre individuelle regresjoner. Modellen som inkluderte L2 fonemisk bevissthet skilte seg markant ut som den modellen som best predikerte gruppetilhørighet for de med lave avkodingsferdigheter. Hele 70% av de med lave avkodingsferdigheter på L1, ble korrekt identifisert. L2 fonemisk bevissthet forklarte 41,2% av variansen i avkodingsferdighet. DOT forklarte bare 12% av variansen, og 40% av de med lave avkodingsferdigheter på L1 ble korrekt identifisert med denne testen. L2 pseudoordslesing forklarte 27,7% av variansen, men kun 30,3% av de med lave avkodingsferdigheter på L1 ble korrekt identifisert. I en siste logistisk regresjonen ble L2 fonemisk bevissthet, DOT og L2 pseudoordslesing, lagt inn som uavhengige variabler. I denne modellen ble en større del av variansen forklart (49,2%) enn hva variablene forklarte enkeltvis. Andelen korrekt identifisert deltakere med lave avkodingsferdigheter, var imidlertid lavere (60%) enn hva L2 fonemisk bevissthet predikerte alene (70%).

Oppsummert viser funnene som er rapportert i denne avhandlingen at det til en viss grad er mulig å kartlegge avkodings- og leserelaterte ferdigheter på et andrespråk, uavhengig av muntlige ferdigheter på L2. Resultatene viser at fonemisk bevissthet testet med pseudoord på L2, er en lovende test for å kartlegge avkodingsvansker på et andrespråk. L2 pseudoordslesing ble ikke predikert av komponentene fra PCA-en og resultatene fra denne testen var heller ikke påvirket av muntlige ferdigheter på norsk. Funnene som viste at RAN på L2 er betydelig påvirket av muntlige L2 ferdigheter, er også et nytt og viktig funn da det i litteraturen er antatt at denne oppgaven gir et språkuavhengig mål på avkodingsferdigheter. Resultatene mine tyder på at RAN testet på L2 ikke er en valid indikator på lesevansker.

Funnene i denne avhandlingen har implikasjoner for kartleggingen av lesevansker hos sekvensielle tospråklige med et alfabetisk skriftspråk. Funnene antyder at det er mulig å få valide resultater ved testing på et andrespråk så lenge oppgavene består av pseudoord, i stedet for meningsbærende ord. Disse resultatene gir ikke en "easy fix" for identifisering av lesevansker hos sekvensielle tospråklige voksne. Likevel har avhandlingen gitt innsikt i hvordan muntlige L2 ferdigheter påvirker ulike L2-oppgaver, og innsikt i betydningen av pseudoordoppgaver i kartleggingen av sekvensielle tospråklige voksnes leseferdighet. Denne innsikten har klare konsekvenser for kartleggingen av lesevansker på L2 og for utviklingen av nye kartleggingsverktøy å nøyaktig kunne diagnostisere dysleksi hos tospråklige.

Summary in English

The aim of this thesis was to generate new knowledge about reading difficulties in sequential bilingual adults and to investigate whether decoding difficulties can be successfully identified in a second language (Norwegian). Reading difficulties in adult sequential bilinguals are rarely identified because we lack the knowledge and testing tools to identify this group correctly. This is because appropriate tests (and testers) are often not available in a bilingual's L1, and that performance in L2 can be influenced by the bilingual's spoken proficiency in that language. The research involved the collection of questionnaire data about language and reading profiles. In addition, a battery of matched L1 and L2 language tests were developed to compare a bilingual's performance in each of their languages, and a language-neutral dynamic test of decoding called DOT.

The sample tested in this study comprised adult sequential bilinguals with English, Polish or Somali as L1 and Norwegian as L2 (N=80). The study examines whether various factors (socioeconomic conditions, multilingualism, Norwegian skills etc.) influence the results of decoding when assessed in L1 and L2 respectively. In addition, it investigates whether there is a correlation between L1 and L2 testing, whether spoken language proficiency in Norwegian affects the results in L2, and critically whether spoken language proficiency in Norwegian moderates the association between L1 and L2 testing. Finally, it is investigated whether it is possible to predict the group with low decoding skills (in L1) based on L2 test performance and DOT.

A Principal Component Analysis (PCA) was performed on the questionnaire data. The results showed that six components from a PCA predicted decoding in some test results in both L1 and L2. L1 word reading performance was significantly predicted by components related to *socioeconomic background* ($p < .006$) and *reading difficulties* ($p < .001$). L2 word reading performance was significantly predicted by components related to "*Norwegian engagement*" ($p < .003$), and *socioeconomic background* ($p < .05$). L1 pseudoword reading performance was predicted by the *L1 proficiency* component ($p < .007$), as well as by *Multilingualism* ($p < .04$), and *Socioeconomic background* ($p < .02$). Interestingly, performance in L2 pseudoword reading was not significantly predicted by any of the six components from the PCA.

A moderate to strong correlation was observed between L1 and L2 test performance in word reading (.68), pseudoword reading (.64), RAN (.44) and phonemic awareness (.81). Multiple regression analyses showed that L2 spoken proficiency predicted unique variance in L2 word reading ($p < .001$) and L2 RAN ($p < .001$), but not in L2 pseudoword reading ($p > .95$) nor in L2 phonemic awareness ($p > .98$). There was also no significant interaction effect whereas L2 spoken proficiency moderated the association between the same skills assessed in L1 and L2 in any of the L2 tasks.

Finally, four logistic binomial regressions were carried out to investigate which tests best predicted group affiliation for the groups with low and regular decoding skills (assessed in L1). The predictive ability of L2 pseudoword reading, L2 phonemic awareness and DOT was examined in three individual regressions. The model that included L2 phonemic awareness stood out as the model that best predicted group affiliation for those with low decoding skills, as many as 70% of those with low L1 decoding skills were correctly identified. L2 phonemic awareness explained 41.2% of the variance in decoding skills. DOT explained only 12% of the variance, and 40% of those with low L1 decoding skills were correctly identified with this test. L2 pseudoword reading explained 27.7% of the variance, but only 30.3% of those with low L1 decoding skills were correctly identified. In a final logistic regression, L2 phonemic awareness, DOT and L2 pseudoword reading, were entered as independent variables. In this model, a larger part of the variance was explained (49.2%) than the variables explained individually. The proportion of correctly identified participants with low decoding skills was, however, lower (60%) compared to that predicted by L2 phonemic awareness alone (70%).

In summary, the findings reported in this thesis provide evidence that it is possible to some degree to measure decoding and reading-related skills in a second language, regardless of L2 spoken proficiency. The results show that phonemic awareness tested with pseudowords in L2 is a promising task for identifying decoding difficulties in a second language. L2 pseudoword reading was unrelated to the components from the PCA and performance in this task was not influenced by L2 spoken proficiency. The finding that RAN in L2 is significantly influenced by spoken proficiency in Norwegian is also a new and important finding, as it has been assumed in the literature that this task provides a language-independent measure of decoding skills. My results suggest that RAN tested in L2 is not a valid indicator of reading difficulty.

The findings of this thesis have implications for assessing reading difficulties in sequential bilinguals with alphabetic written languages. They suggest that it is possible to get valid results when testing in a second language as long as the tasks consist of pseudowords, rather than meaningful words. These results do not provide an "easy fix" for the identification of reading difficulties in adult sequential bilinguals. However, this thesis has generated new insights into how L2 spoken proficiency affects different L2 tasks, and the importance of pseudoword tasks in the assessment of adult sequential bilinguals. These insights have clear consequences for the assessment of reading difficulties in an L2 and the development of new assessment tools for the accurate diagnosis of dyslexia in bilinguals.

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1. Introduction and Overview

1.1. The Introduction

In modern society, effective reading and writing skills are the cornerstones of active social participation. Having difficulties with reading and writing can therefore have severe consequences for an individual's ability to complete in education, to access the job market and to participate in democratic arenas. Dyslexia is a reading difficulty characterized by unexpected and persistent difficulties in learning to decode and spell (Snowling et al., 2020).
Decoding involves rapidly matching letters or letter combinations (graphemes) to their corresponding sounds (phonemes) and recognizing patterns that form syllables and words (Gough & Tunmer, 1986). Secondary dyslexia problems include the absence of fluent reading, poor reading comprehension, and weak reader self-belief. Even if dyslexia is a persistent learning difficulty that cannot be outgrown, an accumulating research base shows that individuals identified as having dyslexia can improve their reading skills and learn to compensate for their difficulties if they are given the right support (e.g., Arnbak & Elbro, 2000; Galuschka et al., 2020; Rose, 2009; Vender et al., 2022; Zorzi et al., 2012). Such help, however, presupposes being identified - and as knowledge of dyslexia differs across the world, many people with dyslexia are never identified and given the right support. Moving to a new country and learning to read in a new language provides a second/new opportunity to be identified. However, assessing reading skills in a second language (L2) is more challenging than in the first language (L1) because it is difficult to differentiate reading difficulties caused by dyslexia from difficulties caused by low language proficiency in the second language (Geva, 2000). Therefore, sequential adult bilinguals who experience decoding difficulties when acquiring a second language are often told that they need to become more proficient in their L2 before one can investigate the cause of any difficulties. The challenge of identifying decoding difficulties in sequential bilinguals is the starting point for this thesis.

Dyslexia is a reading difficulty that is neurobiological in origin and is characterized by poor decoding and spelling difficulties (e.g., Lyon et al., 2003; Rose, 2009). Learning to read is a complex task and reading is correlated with other skills, which means reading difficulties can co-occur with other difficulties

(Snowling et al., 2020). Having low decoding skills makes it harder to achieve the goal of reading - gaining access to meaning (Ziegler & Goswami, 2005). Dyslexia has been reported in every culture studied (Peterson & Pennington, 2012). However, this does not mean that all cultures have an understanding of what dyslexia is or that reading difficulties are assessed with valid testing tools in all countries and all orthographies (Mather et al., 2020). Dyslexia is understood as a continuum (Rose, 2009). When a reading difficulty is understood as a continuum it can be challenging to assess when a difficulty is dyslexic and when word decoding difficulties have another origin. There are different estimates about the extent of dyslexia ranging from 3% to 17.5% (Shaywitz, 1998; Snowling, 2000). If one, nevertheless, looks at the lowest estimates of the extent of the difficulty, it is still sizable, and it confirms that a large percentage of the population has trouble with decoding. According to Reid and Guise (2017), the key reason to assess people's reading skills is to prevent a sizeable proportion of the population from being unable to achieve or demonstrate their potential because of reading difficulties.

Several different assessment tools are used to identify dyslexia and other word reading difficulties. But even though all the tools are different, they do tap into the same set of skills. It is common to assess various types of reading skills, auditory processing, and visual processing (Mather et al., 2020). This is done because dyslexia is considered a multifactorial difficulty, and when reading abilities are investigated, a holistic approach is needed (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; Wagner, 2018; White et al., 2006). Assessment tools normally test the decoding of words and pseudowords, visual identification of letters and words, reading fluency, spelling, and reading comprehension. Different kinds of phonological skills are also tested, such as phonemic awareness or sound blending, rapid automatized naming (RAN), and auditory working memory (e.g., Hatcher et al., 2002; Kilpatrick, 2015; Mather et al., 2020; Mee Bell et al., 2003; Tops et al., 2012; Warmington et al., 2013). When the results from these tests are assessed, one gets a broad overview of a person's reading and processing skills, and dyslexia can be diagnosed based on these data. However, these tests are used to identify reading difficulties in a person's first language. Identifying reading difficulties in a second language is a much more complex task since bilingual readers have an additional challenge compared to monolingual readers as lexical candidates may be activated in either or both languages (Pélissier et al., 2023). When bilinguals read, there is a transfer between L1 and L2, and not only the target language is active during reading (Dijkstra & Van Heuven, 2002). This is the case for both regular readers and those with reading difficulties and might slow down the reading process in bilinguals.

A bilingual is defined as an individual who actively uses more than one language (Kroll et al., 2015, p. 378) and being some sort of bilingual is more common than being monolingual. Importantly, bilingualism cannot easily be defined as a category (Bialystok et al., 2012, p. 247). Having more than one language active while reading might complicate the bilingual reading process. In addition, it is also known that many factors vary among bilinguals e.g., age of aquation, language use and socioeconomic status and these things also complicate the bilingual reading process. Identifying reading difficulties in a second language (L2) is therefore more challenging because reading difficulties caused by dyslexia and reading difficulties caused by low language proficiency in a second language have similarities (Geva, 2000).

Challenges with assessing dyslexic difficulties in L2 have led to the concern that bilinguals might be under or overrepresented in the group of people diagnosed with dyslexia. In line with this, Deponio et al. (2000) found an extremely low rate of suspected dyslexia among bilingual pupils. Others have questioned whether the use of standard reading measures on bilingual readers may lead to an overidentification of reading difficulties (e.g., Elbro et al., 2012). It has also been argued that reading difficulties in a second language are ignored because of assumptions that the difficulty will disappear when the language skills at L2 improve (e.g., Cline & Frederickson, 1999; Lundberg, 2002). This assumption ignores the fact that dyslexic reading difficulties are different from reading difficulties caused by low L2 proficiency. In Norway, bilinguals who experience reading and writing difficulties are often told to "learn more Norwegian" to be more proficient in L2 before the cause of the difficulty can be investigated. However, "learn more Norwegian" is not a precise unit of measurement, and it only leads to postponing the diagnosis. Widespread assumptions that one must acquire better language skills on L2 to be able to identify reading difficulties in bilinguals have led this group to wait disproportionately long before they are offered adequate help. Therefore, more knowledge about how to correctly assess bilingual reading difficulties is needed.

Studies of bilingual reading have shown that there is a transfer between L1 and L2 reading which opens the possibility of testing reading skills, in a second language. Performance in phonological awareness, but also other reading tasks, has been shown to transfer from L1 to L2 (e.g., August et al., 2009; Durgunoğlu et al., 1993; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018). Giving reading instructions in L1 improves phonological awareness and letter-sound knowledge in L2 (Vaughn et al., 2006). Moreover, literacy instructions given in a language other than L1 can improve decoding skills in L1 (Piper et al., 2016). A review of dyslexia in global contexts found that reading difficulties in L1 will transfer to L2 (Maunsell, 2020). This opens up an opportunity to investigate whether reading difficulties can be identified in a second language.

Several unsolved challenges are present regarding the assessment of reading and reading difficulties in a second language. A key challenge concerns the influence of L2 proficiency on the results when reading difficulties are examined in a second language. In addition, Hedman (2012) highlights three others. Firstly, if test scores from a standardized test for L1 readers are presented as valid scores for L2 readers one can experience test bias. When the norming is based on a group other than L2 readers, there is no real basis for comparison. Secondly, language proficiency and vocabulary may be distributed unevenly across languages, and L2 testing might not be representative of the subject's actual knowledge. This might lead to the overidentification of bilinguals as having reading disabilities. Thirdly, socioeconomic factors can cause low scores on some tests. Many tests are designed for the educated middle class, and people from underprivileged socioeconomic backgrounds with less reading experience may gain lower scores on standardized tests. Invalid results on bilingual reading may result in misjudgements of bilinguals' reading difficulties (e.g., Deponio et al., 2000; Elbro et al., 2012). These issues highlight the lack of assessment tools and standardized tests for bilingual reading. Such a deficiency makes it difficult for practitioners to properly assess bilingual reading difficulties.

Several possible solutions have been proposed to minimize the effect of language proficiency in the identification of bilingual reading difficulties. The first is to assess the subjects' reading skills in their first language (e.g., Durgunoğlu, 2002; Everatt et al., 2004) or to use comparable tests in both their first and second language when tested (e.g., Wagner et al., 2005). To carry out comparable assessments in L1 and L2 would make it possible to investigate whether the core of the reading difficulties is similar in both languages. This is the ideal approach but is unfortunately not feasible in the field of practice. There are more languages than there are validated dyslexia tests (e.g., Elbro et al., 2012; Mather et al., 2020). For practitioners, there would be significant difficulties in implementing and interpreting test results even if there were valid tests in all languages. It would require professionals with adequate knowledge of how to operate each test, in addition to knowledge of each language and its reading systems. Also, there is a lack of comparable tests in all languages, and it would require the development of tests in most languages. There are several challenges in developing comparable tests. One of the most obvious is to create tests that would compare reading within different writing systems such as alphabetic (e.g., Norwegian), logographic (e.g., Chinese), or syllabic (e.g., Japanese) writing.

To meet the previously described challenges of assessing decoding skills in adult L2 learners, researchers at the University of Copenhagen have developed a test that is a language-neutral dynamic test of decoding (Elbro et al., 2012). In Norway, the dynamic test of decoding is called DOT, based on the Danish test name Dynamisk ordblind test, the Dynamic word blindness test. DOT is designed as a new dyslexia test with the smallest possible language bias to be used for assessing dyslexia in adults regardless of their L1 and experience in L2 (Elbro et al., 2012, p. 174). As the test is dynamic and changes according to the participants' answers, it provides an opportunity to explore the test subject's *potential* for learning to read an alphabetic orthography. Elbro et al. (2012) showed that respondents with Danish as L2 scored comparably to respondents who had Danish as an L1 on this test. This means that respondents with dyslexic difficulties scored poorly on this test, regardless of their L1. Respondents without dyslexic difficulties had high scores on the test, regardless of their L1. These results are promising for the future identification of dyslexia in L2.

Even though DOT has shown promising results, there is still a need to better understand how to identify reading difficulties in bilinguals and how to distinguish between reading difficulties caused by low proficiency in L2 and reading difficulties caused by decoding difficulties. In the last decades, we have gained more knowledge about dyslexia in general, but the bulk of dyslexia research has focused on dyslexia identified in first languages. There is some research on dyslexia and bilingualism, but it is limited (e.g., Frederickson & Frith, 1998; Hedman, 2012; Maunsell, 2020; Miller Guron & Lundberg, 2003; Siegel, 2008).

In the present thesis, I search for indicators of decoding difficulties in adult sequential bilinguals, that are unaffected by proficiency in Norwegian. The sample includes sequential bilinguals with English, Polish, or Somali as their L1. The orthographic depth differs in these languages, but they all make use of the alphabetic writing system as does the Norwegian language. This enables a comparison of reading skills across the languages.

This PhD-project has several components. It consists of a questionnaire developed to assess bilingual profiles relating to reading behaviour and skills. Participants self-reported their skills related to language, education, reading, and whether they had experienced reading difficulties, through a questionnaire. Second, a series of tests were constructed to assess reading-related skills in both L1 and L2. I investigated traditional indicators of decoding difficulties as used when diagnosing dyslexia in L1 (Mather et al., 2020). Matched tests of word reading, pseudoword reading, RAN, and phonemic awareness were made in Norwegian, English, Polish, and Somali. Participants were tested both in their L1 and Norwegian (L2). Working memory and processing speed tests (non-language specific) were also included based on the traditional approach to identifying dyslexia. Finally, participants' performance on the language-neutral DOT was tested (Elbro et al., 2012). To investigate its efficacy in predicting low decoders in an adult sequential bilingual sample.

1.2. The aim of this project

The overall goal of this PhD project is to investigate how the decoding skills of bilingual adults with Norwegian as a second language can be assessed and to determine whether low-performing decoders can be identified by L2 tests. The studies reported in this thesis investigated bilingual reading within the framework of traditional indicators of dyslexia (e.g., Mather et al., 2020; Mee Bell et al., 2003; Tops et al., 2012). Participants' reading skills were tested in both L1 and L2 with comparable tests to determine whether the results correlate across languages (Wagner et al., 2005), and to determine how the level of spoken Norwegian proficiency affects decoding and reading-related skills tested in L2. The combination of traditional tests of dyslexia in both L1 and L2, with the language-neutral test (Elbro et al., 2012), constitutes a novel approach to examining bilingual reading difficulties that aim to extend our knowledge of bilingual reading and to contribute to our understanding of how to identify reading difficulties in adult bilinguals.

1.3 Overview of this thesis

The theoretical and empirical backgrounds relevant to reading, dyslexia, and bilingualism are discussed in the next four chapters. Chapter Two is concerned with the process of reading and the manifestation of dyslexia. There is an ongoing debate about whether a definition of dyslexia should first and foremost define dyslexia as a concept for research, or instead should help practitioners identify people with dyslexia. In this chapter, I will discuss the definition chosen for this project. Chapter Three introduces relevant research into bilingual language processing and Chapter Four focuses on the components of bilingual reading and evidence for the cross-language transfer of reading-related skills. Chapter Five focuses on how dyslexia is detected and the factors that complicate this process in bilinguals.

The next three chapters provide a description of the current study. Chapter Six introduces the key elements of the four languages investigated in this thesis. The research questions and hypotheses to be addressed are then presented in Chapter Seven. Chapter Eight describes the methodology employed, in the study, presenting the sample tested, as well as a detailed description of the test instruments constructed for this research.

The findings of this thesis are presented in three results chapters, each of which investigates different aspects of bilingual reading and reading difficulties. Chapter Nine investigates the factors underlying language and reading profiles and whether these factors can predict reading skills in L1 and L2. Chapter Ten contains an analysis of the relationship between L1 and L2 tests and the effect of

L2 spoken proficiency on L2 decoding tests. Chapter Eleven investigates the best predictors of low decoding performance. The general discussion is presented in Chapter Twelve.

2. Decoding, reading and decoding strategies

2.1. The process of reading

Ziegler and Goswami (2005, p. 3) define reading as the process of understanding speech that is written down. The goal is to gain access to meaning. Ehri (2005) explains that even though print in text fills people's minds with ideas, it has been both a great mystery and a challenge for researchers to understand how people easily learn to read text rapidly. Skilled readers can find it hard to express what happens while they are reading as for them it is an automated process. Early uses of the term "reading skill" suggested it was a simple distinction i.e., something that one either had or lacked (Uppstad & Solheim, 2011, p. 161). However, more modern approaches acknowledge the underlying complexity of the reading process and assume that reading skill is a continuous variable which can vary in many ways. In this chapter, key theories of the reading process are presented with a focus on the process of decoding. Theoretical approaches to dyslexia are then discussed.

A frequently used model for describing reading is Gough and Tunmer's (1986) Simple view of reading (SVR). According to SVR reading comprehension is the product of two factors: decoding and linguistic comprehension. In line with this theory, several studies have found that one can predict reading comprehension by measuring decoding abilities and comprehension of spoken language (e.g., Foorman et al., 2018; Kendeou et al., 2009; Verhoeven & Van Leeuwe, 2008). Gough and Tunmer explained SVR using a pseudo equation: "Reading equals the product of decoding and comprehension, or R = D x C" (Gough & Tunmer, 1986, p. 7).

In SVR decoding is multiplied by linguistic comprehension and the multiplication sign is the important element. If one multiplies one factor by zero, the sum will always be zero. This means that decoding without linguistic comprehension cannot lead to reading comprehension. Decoding is a technical skill and refers to the ability to translate print into speech. This is done by rapidly matching one letter or combinations of letters, to their sounds and recognising the patterns that make syllables and words. Linguistic comprehension refers to the process of interpreting lexical information (words), sentences, and discourses.

Decoding in SVR is strongly connected to understanding the alphabetic principle, which is necessary to be able to read an alphabetic script (Byrne & Fielding-Barnsley, 1989). The alphabetic principle refers to knowing that the sounds that are present in a language are represented by letters when reading. A sound is often referred to as a phoneme, while a letter is referred to as a grapheme. A phoneme in one language can be represented by one or several graphemes and it can occur in several positions. This is the essence of understanding the alphabetic principle. According to Gough and Tunmer (1986) sounding out phonemes from graphemes is a primitive form of decoding. For them, the decoding process also involves being able to isolate words quickly, accurately, and silently. However, they emphasise that decoding is not the same as word recognition since decoding denotes the use of the rules connected to grapheme-phoneme correspondence. They state that beginner readers do not use such rules and that sometimes competent readers also skip them, for example in the recognition of words with irregular spelling-sound correspondences (e.g., yacht). Gough and Tunmer's point is that in an alphabetic orthography, word recognition skill is deeply dependent on knowledge of the rules concerning grapheme-phoneme correspondence. It is not enough to know the characters in an orthography, the rules of spelling-sound are the basis of decoding. They argue that the ability to pronounce, or silently apprehend the pronunciation, of pseudowords (words without meaning, but written within the rules of spelling e.g., plarch) is the purest measure of decoding.

Accuracy in decoding is an important step in developing reading fluency and reading comprehension and it requires adequate training (Rasinski, 2004). The goal is to automatize the decoding process. An automatized decoding process minimizes mental effort during decoding, thereby making more cognitive resources available for comprehension when reading (LaBerge & Samuels, 1974). To achieve automatized decoding, one needs practice. If reading texts with the same vocabulary is repeated several times, the reader will more automatically recognise the units to be decoded. If the reader starts organizing these sub-lexical units or words into groups or phases when reading, the level of reading rises from a less efficient word-by-word reading to a more efficient reading of larger units that are automatized.

Studies show that the SVR model has explained variance in reading for both children and adults with low reading skills (e.g., Barnes et al., 2017; Braze et al., 2007; Catts et al., 2006; Joshi et al., 2012; MacArthur et al., 2010; Talwar et al., 2018). In a study in the US of 222 adults, with a reading level between third and eighth grade, amongst other measures of reading comprehension and decoding were investigated (Talwar et al., 2018). When a four-factor structural equation model was run, they found that decoding ($p < .001$) and listening comprehension ($p < .006$) exhibited significant direct effects on reading comprehension. However, it has been suggested that an additive version of SVR (R = D + C) would explain more variance in reading than the original does (e.g., Conners, 2009; Høien-Tengesdal, 2010). Others argue that the SVR is too simple as a model of the complex process of reading (e.g., Cartwright et al., 2016; Kim, 2020; Uppstad & Solheim, 2011). Nevertheless, the SVR provides a useful description of the core components of the reading process. Moreover, according to Conners (2009), the SVR does not reject that skills such as phonemic awareness (the ability to manipulate individual sounds in spoken words), vocabulary knowledge, and orthographic awareness are also important to reading. It is claimed that in SVR other skills are subskills of either decoding or language comprehension. Importantly for the current thesis, SVR claims that in the early stages of reading, decoding is more predictive of reading skills than language comprehension (Gough & Tunmer, 1986). The sample tested in this study includes readers with both high and low L2 spoken proficiency. Because of this, the test battery does not test language comprehension, as it is assumed that proficiency differences will affect comprehension ability. Instead, and in line with the SVR, the test battery focuses on decoding ability as a more reliable measure of reading skill when L2 proficiency varies.

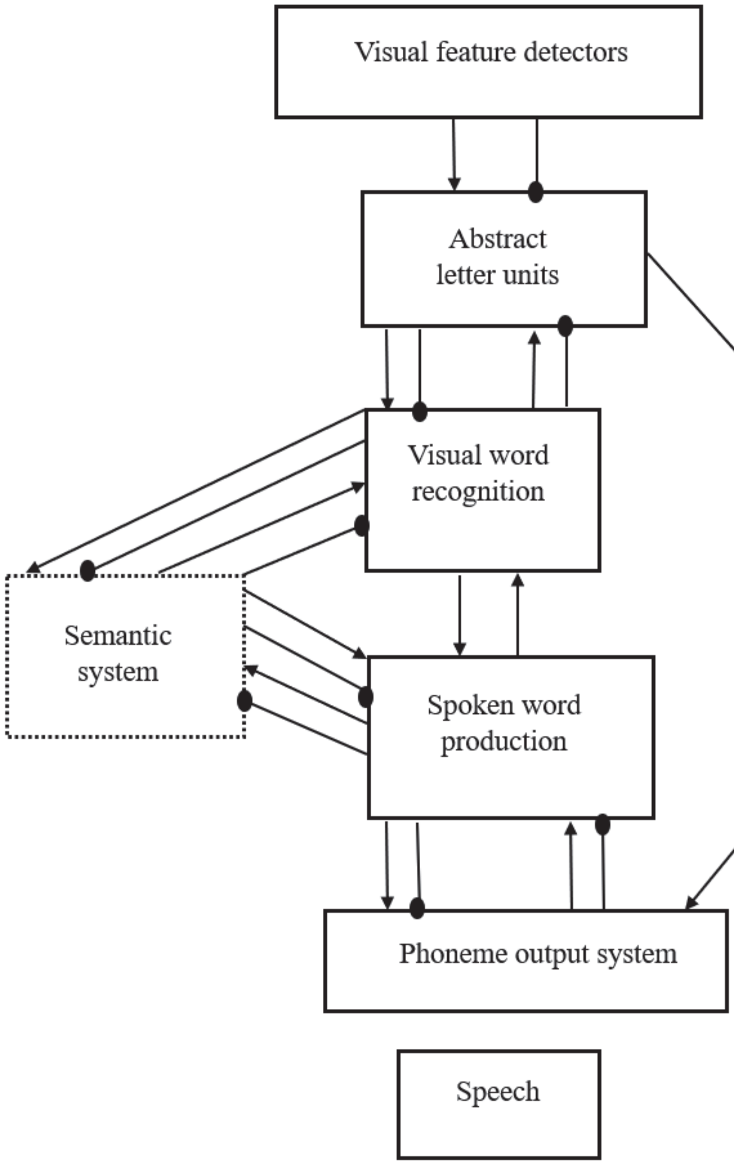
2.2. Word reading strategies

Word recognition is the process of identifying an item or word as familiar (Harley, 2014) and is an essential process for efficient and skilled reading. The processing of familiar and unfamiliar words is different. Words are generally responded to faster than nonwords. Furthermore, nonwords that conform less to the spelling rules of a language are rejected faster than those that follow the spelling rules (Coltheart et al., 1977). These differences are captured in the

Dual-Route Theory (see Figure 1) (Castles, 2006) which proposes that skilled readers have two functionally independent means of processing words (e.g., Castles, 2006; Coltheart, 1978; Coltheart et al., 1993; Coltheart et al., 2001; Morton & Patterson, 1980). They are the lexical- and non-lexical routes and involve direct and indirect lexical access respectively. The lexical route operates by a direct mapping to a word's visual appearances in the reader's stored lexicon (Humphreys & Evett, 1985). In other words, the reader correctly identifies the whole written word and can then transform it into speech. The non-lexical route requires the use of a set of grapheme-phoneme correspondence or sublexical spelling rules to decode written words into their spoken phonemes (Castles, 2006). According to Sheriston et al. (2016), when assessing non-lexical skills, it is best to assess the nonword/pseudoword reading ability since pseudowords will only be correctly pronounced or spelt if the reader can apply grapheme-to-phoneme rules as their decoding strategy – i.e., using the non-lexical route. Pseudoword reading acquires a slower phonological reading strategy but is an index of phonological reading skills (Rack et al., 1992). When investigating a person's acquisition of the lexical route, the ability to read irregular words should be assessed. This is because irregular words can only be pronounced or spelt correctly if they are already stored in the individual's mental lexicon.

Figure 1

The Dual-route cascaded model of visual word recognition and reading aloud (DRC), adapted from Castles (2006)



Note that the stimulation links between units are presented by arrows. Inhibitory links between units are presented by circles. The model must be read from the top and down.

Each route in Dual route theory is composed of several interacting layers, which contain several units (Coltheart et al., 2001). These units are symbolic parts of the model, representing small parts such as words in the orthographic lexicon or letters in the letter unit layers. The units in the different layers interact in two different ways. One is through inhibition and the other is through stimulation of units. Inhibition makes it more difficult for the units to activate other units, whereas stimulation, contributes to the activation of other units. In addition, units may also interact on the same level through lateral inhibition, but lateral inhibition only occurs within the position-specific subsets of units and not between them. In the model, communication between the orthographic lexicon units and the units in the phonological lexicon is one-to-one and only involves stimulation (not inhibition). The only exception is between homophones (words that sound the same but are spelt differently) and homographs (words that have the same spelling but different meanings). The communication between the characteristics and letter layers is unidirectional – from characteristics to letters only.

The lexical route processes familiar words effectively but fails to recognize unfamiliar words or nonwords (e.g., 'gop') (Castles, 2006). In contrast, the non-lexical route sounds out nonwords and regular words accurately if they are following typical grapheme-phoneme correspondences (e.g., 'market'). But in the non-lexical route errors will occur with irregular words that do not conform to standard correspondence rules (e.g., 'yacht'). Therefore, assessing lexical route functioning typically involves testing irregular word reading, as these words can only be read correctly via the lexical route. Non-lexical route functioning is assessed through non-word reading tests, as these items only can be pronounced successfully using non-lexical rules.

Dual route theory explains how skilled readers decode words and nonwords/pseudowords. This model was not designed to aid in the identification of reading difficulties. Nevertheless, knowledge of word reading strategies can help to interpret the symptoms of a reading difficulty, which in turn can lead to better-adapted training in effective reading strategies. The model predicts readers who only use the non-lexical route to not have direct access to the words they read and will therefore be less efficient readers than those who can switch between the lexical (direct route) and non-lexical (indirect) route while reading. We now turn to theories of reading problems.

2.3. Dyslexia

The word dyslexia was first used by a German physician in 1872 (Guardiola, 2001; Thambirajah, 2010) to describe a patient who due to a brain lesion had lost the ability to read. This has later been termed acquired dyslexia and differs from what is now called developmental dyslexia. Developmental dyslexia refers to congenital reading and writing difficulties rather than difficulties caused by injury or diseases. Researchers in Great Britain mentioned “word blindness” in 1895-1896 (Guardiola, 2001; Thambirajah, 2010), and this is considered the first time developmental dyslexia was described. It was described as a disease of the visual system and referred to patients with reading problems.

2.3.1. Characteristics of Dyslexia

Developments in the field of research have led to an increased understanding of what dyslexia is and how such a difficulty can be identified. Although knowledge has increased, there are still aspects of dyslexia that are not understood. Lyon's definition of the difficulty provides an overview of its characteristics and is the one adopted in this thesis.

> Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge (Lyon et al., 2003, p. 2).

Dyslexia is therefore characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities (e.g., Lyon et al., 2003; Rose, 2009). Both the accuracy and speed of word decoding are usually affected, but in adult dyslexics, speed, rather than accuracy, is a more common measure of dyslexic decoding difficulties (Reis et al., 2020). Problems with spelling and word reading have been investigated by a large number of studies (e.g., Padget et al., 1996; Parrila & Protopapas, 2017; Siegel, 2006; Snowling et al., 2020; Wagner et al., 2019), and considered the core difficulty for people with dyslexia.

From the 1970s, it has been thought that a reading difficulty could only be called dyslexia if there was a discrepancy between a person's cognitive ability and their reading ability (discrepancy theory) (e.g., Critchley, 1970; Gjessing, 1977). Hence, people with impaired cognitive abilities could never be identified as having dyslexia, as the definition excluded them. This view has been gradually abandoned (Lyon et al., 2003). In line with this, the Rose report (2009) commissioned by the Secretary of State for Children and written by a British expert group, stresses that “Dyslexia occurs across the range of intellectual abilities” (Rose, 2009, p. 32). The British Dyslexia Association has adopted The Rose reports view (BritishDyslexiaAssociation, 2009) which shows that even user organizations no longer consider the discrepancy between IQ and reading skills to be relevant. The departure from the discrepancy theory has removed the need for an IQ test when identifying dyslexia.

A more recent view is that dyslexia can be identified when decoding and spelling ability is out of line with expectations based on age, experience, and instruction (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Rose, 2009). Parrila and Protopapas propose that “[Dyslexia is] a persistent and unexpected difficulty in developing age- and experience-appropriate word reading skills (Parrila & Protopapas, 2017, p. 333)”. The Rose report (2009) does not so clearly connect decoding skills and expectations. It is however stated that a sign of dyslexia’s severity would be to investigate the response to intervention (RTI) when well-founded methods are used. Lyon et al. argue that the decoding and spelling difficulties should be unexpectedly high in relation to “the provision of effective classroom instruction (Lyon et al., 2003, p. 2)”. Hence, a person with dyslexia will still have word reading difficulties though the quality of the education has been high.

Snowling et al. (2020) emphasize that the core of dyslexia is difficulty in ***learning*** to decode and spell. Therefore, they say it is important that dyslexia is understood within the framework of learning to read. People with this difficulty can establish a basic level of reading and spelling, which allows the possibility that dyslexics can learn to decode, but that they will have persistent problems with reading fluency. A review of reading-related skills in adults with dyslexia in different orthographies (Reis et al., 2020) sums up that decoding difficulty is a lifelong difficulty for people with dyslexia. Even though this group increases their reading comprehension as they grow, they continue to have difficulties with decoding. The dyslexic problem will manifest in poor word reading and pseudoword reading and, as already mentioned, for adults more in speed than accuracy. In addition, longer-term follow-up studies have shown that reading difficulties are persistent into adulthood, affecting the quality of life. Having reading difficulties in adulthood is associated with lower levels of educational attainment, higher rates of unskilled employment, and more frequent periods of unemployment (Maughan et al., 2020).

2.3.2. Developmental dyslexia – neurobiological in origin

Unlike acquired dyslexia, developmental dyslexia is neurobiological in its origin (Lyon et al., 2003) and highly heritable (e.g., Carrion-Castillo et al., 2013; Olson, 2011; Snowling & Melby-Lervåg, 2016; Thompson et al., 2015; Van Bergen et al., 2012). A parent with dyslexia is a strong predictor of the risk of dyslexia in a child. According to Grigorenko (2001), about 40% of parents who have children with dyslexic difficulties have dyslexia themselves, and this proportion is higher for fathers (46%) than for mothers (33%). Several newer studies keep confirming the risk of developing dyslexia is transmitted through the family (e.g., Erbeli et al., 2019; Erbeli et al., 2021; Snowling & Melby-Lervåg, 2016). However, a review that examined children with a family risk of dyslexia, showed that while a family risk of dyslexia increases the occurrence of reading difficulties, the severity of the difficulty can be moderated by protective factors (Snowling & Melby-Lervåg, 2016). Protective factors included strong language skills (vocabulary), good skills related to spoken word production (i.e., RAN), and early mastery of letter-naming skills. In addition, the review showed that the family risk of dyslexia is equal across all languages.

The genetic architecture underlying dyslexia is complex and multifactorial (Carrion-Castillo et al., 2013, p. 214) and nine regions in the human genome have been reported as relevant for dyslexia (Poelmans et al., 2011). In 2000 there was a hypothesis that dyslexia was a disorder of neuronal migration (Galaburda et al., 2006). However, due to new technology and new evidence from molecular,

and functional genetics, it has been argued that the link between dyslexia and neuronal migration should be considered with caution (Guidi et al., 2018) due to methodological issues and difficulties with the replication of findings.
Even though the genetic link to dyslexia has been claimed for several years, the diagnosis of dyslexia has never included investigations of genetics, as there are no genetic tests that easily confirm dyslexia. Instead, an investigation of family history has been important (e.g., Hatcher et al., 2002; Hedman, 2012; Lindgrén & Laine, 2007; Mee Bell et al., 2003). In addition, psychologists and educators have been able to make greater use of standardized testing tools (e.g., Høien, 2012; Lundberg, 2003).

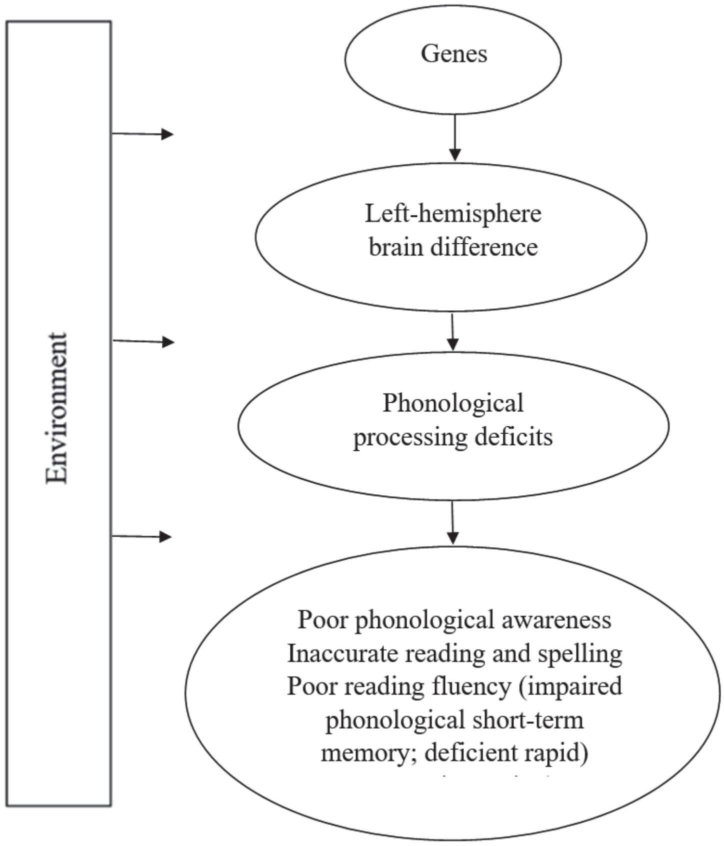
2.4. The Phonological Deficit Hypothesis

For many years, the phonological deficit hypothesis has been the leading explanatory model for dyslexic difficulties (e.g., Lyon et al., 2003; Ramus et al., 2003; Snowling, 1995; Snowling, 1998; Vellutino et al., 2004). The phonological deficit hypothesis claims that dyslectics' have difficulties in analysing the sound structure of languages and that this is the primary source of dyslexic word recognition problems (Swan & Goswami, 1997, p. 18). Ramus (2001, p. 393) describes the phonological deficit hypothesis as specific problems with representing or recalling speech sounds, which leads to difficulty with mapping them to letters. He also argues that the theory is supported by evidence showing that people with dyslexia have difficulty retaining speech in short-term memory, and consciously separating speech into phonemes.

Thambirajah (2010) proposed a model where dyslexia is understood in the framework of three levels of an individual's functioning (see Figure 2). These levels are described as biological, cognitive, and behavioural. The biological level is about inherent abilities and refers to the processes within the brain, while at the cognitive level, one is concerned with the processes underlying the observable difficulty that is connected to the behavioural level. Phonological processing deficits are at the cognitive level. The behavioural level refers to the manifestations of dyslexic symptoms. All levels can be influenced by different environmental factors.

Figure 2

A simplified causal model of developmental dyslexia, adapted from Thambirajah (2010)



Share (2021, p. 5) discusses misconceptions about the phonological deficit hypothesis and emphasizes that today's research establishment has both accepted and institutionalized the role of phonology in reading. He argues that even if one agrees with the phonological deficit hypothesis it does not exclude other non-phonological hypotheses. It is not claimed that the phonological deficit hypothesis accounts for all aspects of reading ability/disability. Moreover, Castles and Friedmann (2014) argue that the term phonological deficit refers to an enormously wide variation of skills that are broadly linked to skills that involve the perception, retention, manipulation, and/or production of speech sounds. These skills can include everything from phonemic awareness at both high and low levels (low level: "say the word "sport" without the /s/ sound" or high level: "swap the first sounds of Harry Potter"), phonological short-term memory ("say "Plaitef" back to me") or how quickly and efficiently one can activate and retrieve phonological representations from memory (RAN). They argue that more research is needed to test the phonological deficit hypothesis. In particular, there is a need for research which is more precise regarding the recruitment of a sample with dyslexia, and which is more specific in the choice of phonological tasks.

In the following sections therefore the different phonological skills that have been investigated regarding the phonological deficit theory are described. They include unclear phonological representations, phonological/phonemic awareness, phonological-short term memory, and rapid automatized naming.

2.4.1. Phonological Representations

The phonological representations hypothesis is sometimes used as a framework when trying to understand how phonological development influences reading development and dyslexia (Goswami, 2000). This hypothesis has emerged from theories of the development of spoken word recognition and production and is concerned with the quality of phonological representation in dyslexic children. When children learn to speak, their vocabulary is limited. Each word is represented in terms of its semantic and phonological information. When the child's vocabulary expands the phonological representations become more fine-grained (Goswami, 2000). Phonological representations are therefore not constant but change over time as vocabulary increases. Nevertheless, words that are acquired at an early stage in life, may have a better phonological representation than words acquired later (Garlock et al., 2001).

The distinctiveness of a word's phonological representation determines how easily one can access it in one's mental lexicon (e.g., Elbro, 1996; Metsala & Walley, 1998; Swan & Goswami, 1997). Elbro et al. (1998, p. 40) define distinctiveness as the relative distance between a phonological representation and its neighbours. For example, submarine is more distinct than sub which overlaps in spoken and written form with more words than submarine (e.g., pub, sum, tub etc.). The distinctiveness of a phonological representation is also associated with its quality and both are important aspects when developing phoneme awareness and therefore reading development (Elbro & Pallesen, 2002). The quality of a phonological representation will influence the number of features the phonological representation has. A poor-quality phonological representation contains less phonetic information. It is hard to perform phonological operations on words if the phonological representation is of poor quality. Moreover, the lack of distinctive, high-quality phonological representation makes words more easily confused with other words (Elbro et al., 1998, p. 40). This is important for reading development since orthography is mapped directly onto phonological representations (Rack et al., 1994). The quality of the phonological representation of individual words has become interesting for dyslexia research since it can influence grapheme-phoneme-recoding.

Orthography transparency refers to the degree to which a written language has regular letter-to-phoneme correspondences. The degree of orthography transparency influences the development of fine-grained phonological representations, and therefore how rapidly one learns to read (Goswami, 2000). Dyslexics, who are proposed to have phonological processing difficulties, may therefore take longer to learn letter-to-phoneme correspondence, especially for more opaque scripts.

2.4.2. Phonological / Phonemic awareness

The terms Phonological and Phonemic awareness are often used to describe the same set of skills, but there is a clear distinction between them. Phonemic awareness is a subset of phonological awareness relating specifically to phonemes, while phonological awareness covers a broader range of phonological units. Phonological awareness refers to skills in identifying and manipulating words, syllables, onsets, and rhymes as units of oral language (Castles & Friedmann, 2014). Phonemic awareness is related to the specific ability to identify or manipulate phonemes in spoken words. Castles and Coltheart (2004) argue that the "awareness" in the term phonological or phonemic awareness is important. This set of skills requires explicit and deliberate processing of speech sounds. Unconsciously discriminating speech sounds, such as in speech perception, is not part of phonological awareness. In most children, phonological awareness develops in the context of reading acquisition. Tasks measuring this ability could vary between phoneme deletion ('say the word ''strap'' without the /s/ sound'), analysing phonemes ("how many sounds is there in the word "think""), isolating phonemes ("what is the first sound in the word "please""), spoonerism ('swap the first sounds of ''tall boy''). A phonemic awareness task requires that the subject shift their attention away from the content of speech to the form of speech (Yopp, 1992) and is therefore considered a complex task. The relationship between phonemic awareness and reading is complex but findings suggest that phonemic awareness as a skill is a central factor in the acquisition of alphabetical reading (e.g., Morais et al., 1987; Wimmer et al., 1991). Phonemic awareness has been shown to be a predictor of reading in children (Landerl et al., 2019). Wimmer et al. (1991) concluded that children who do not develop phonemic awareness quickly when learning to read, have greater difficulties in the reading process than their peers. Typically, children with dyslexia score low for phonological awareness (e.g., Schatschneider & Torgesen, 2004; Soriano & Miranda, 2010). Although the relationship between phonological awareness and reading skills is less clear for adult dyslexics (e.g., Elbro et al., 1994; Hatcher et al., 2002; Tops et al., 2012), adolescents and adult dyslexics also have difficulties in this area (Melby-Lervåg et al., 2012). Together with word- and nonword-reading difficulties, phonological awareness is a lifelong difficulty for people with dyslexia (Reis et al., 2020). Even high-functioning adults with dyslexia, are not able to compensate fully for their phonological deficits in tasks such as spoonerisms and reversals (Tops et al., 2012). But to detect phonological deficits in adults, one needs to use more difficult tasks than with children, that require the manipulation of phonemes. In sum, phonemic awareness is a persistent difficulty and therefore also an important indicator when identifying dyslexia.

2.4.3. Phonological Short-term Memory

In this thesis, memory concepts are discussed in terms of language and reading processes. The memory system of a person can be divided into three types - Working memory, Long-term memory and Short-term memory (Cowan, 2008, pp. 324-325). Working memory (WM) is used to plan and carry out behaviour, and it is often described as a combination of multiple components working together. Examples of the use of WM are when one is solving an arithmetic problem without paper or bringing together the ideas in a long persuasive argument. It is often characterized as an intricate interaction of various components, including short-term memory and other processing mechanisms that facilitate the utilization of short-term memory. Working memory (WM) serves as the cognitive system responsible for planning and executing behaviour.

Long-term memory (LTM) refers to a record of prior events and stored knowledge - including language knowledge, while short-term memory (STM) refers to the ability to hold a limited amount of information temporarily, in an accessible form. There is a limit to how much information can be held in the STM, whereas LTM has both a bigger storage and a longer duration. The difference between STM and WM is less clear since they are related but at the same time it is known that several variables might mediate the difference between them (Aben et al., 2012). It has been proposed that letter, digit and word span tasks tap into STM and that reading, listening and number span tasks tap into WM (Kail & Hall, 2001).

STM is also a multifaceted system. There is a difference between short-term memory that handles visual stimuli (visual STM) and verbal stimuli (verbal STM). While visual short-term memory refers to the ability to hold visual information for a few seconds after a visual display is no longer seen (Logie, 2014), verbal short-term memory refers to one's ability to hold a limited amount of auditory or phonological information temporarily available (Cowan, 2008) and remember it at a later point. A verbal short-term memory difficulty would reduce the amount of phonological information active while reading. This would affect comprehension and make reading more difficult. Verbal short-term memory is often measured by nonword repetition ('say 'Chepnel'' back to me'), long and short word repetition, and digit span (repeating an increasing number of digits) (Castles & Friedmann, 2014).

Together with a phonological deficit, studies have shown that people with dyslexia have a verbal STM impairment (e.g., Tijms, 2004; Trecy et al., 2013). An STM deficit has been found in several studies that have examined memory function in children and adults with dyslexia (e.g., Pennington et al., 1990; Ramus et al., 2003; Tijms, 2004). For example, a study of adults with dyslexia and STM deficits showed that adults with dyslexia have specific difficulties regarding verbal *serial orde*r STM, but not verbal item STM (Hachmann et al., 2014). Serial order STM refers to the retention of several items presented in a specific order. Item STM refers to the retention of a particular item.
Although verbal STM difficulties and dyslexia are linked by research, many questions remain about whether STM is an expression of phonological difficulty or whether it is part of the causal explanation of dyslexia (e.g., Ramus &

Szenkovits, 2008; Snowling, 2000). Trecy et al. (2013) studied impaired short-term memory for order in adults with dyslexia and claimed that STM should be considered as a consequence of the core phonological impairment, and not as a causal factor of dyslexia. A small review of STM impairment and dyslexia (Majerus & Cowan, 2016), shows that twelve out of thirteen studies report that serial order STM impairment is a deficit in both children and adults with dyslexia. Poorly developed serial-order STM abilities increase the risk of learning difficulties in several cognitive domains (Majerus & Cowan, 2016, p. 6). Concurrent serial order STM difficulties and phonological processing difficulties will cause severe deficits in learning phoneme-grapheme-recoding with adverse effects on reading comprehension. According to Majerus & Cowan (2016), it is possible to have severe phonological processing difficulties but not impaired serial order STM skills. This supports the idea that serial order STM is part of the consequences of dyslexia, but not a causal explanation.

2.4.4. Rapid Automatized Naming

Rapid automatized naming, or RAN, refers to tasks involving the rapid naming of familiar stimuli (e.g., digits, colours, or pictures) that are presented continuously (Georgiou et al., 2018). Performance in these tasks is taken to be a measure of how quickly one can access phonological representations. RAN and reading are related because they both require serial processing and active retrieval of specific names. Denckla and Rudel (1976) tested different ways of measuring RAN in 120 children. Their sample included children with dyslexia, children with other learning disabilities than dyslexia, and a control group consisting of children with normal range reading abilities. The RAN tasks were presented in four charts with five items randomly repeated. These items were either colour, numbers, objects, or high-frequency lower-case letters. For all groups in Denckla and Rudel's (1976) study, naming letters and numbers was faster than naming colours and objects. Furthermore, errors in naming these items were extremely rare in all groups, but the time spent naming them varied. Dyslexic children were significantly slower than both children with other learning disabilities and children with normal reading skills. This indicated that slow performance on RAN tasks was specific for children with dyslexia. This was later confirmed in a wide range of studies (e.g., Boets et al., 2010; Fawcett & Nicolson, 1994; Landerl et al., 2019; Landerl et al., 2013). Difficulties with RAN are therefore taken as a predictor of dyslexia in children. Moreover, although adults with dyslexia increase their ability to accurately decode, slow RAN performance is a persistent marker of dyslexia (e.g., Cancer & Antonietti, 2018; Georgiou et al., 2018; Miller-Shaul, 2005).

There are two RAN methodologies: serial RAN and discrete RAN (de Jong, 2011). In serial RAN several rows or columns of items at once, and the participant must name the items aloud as quickly and accurately as possible. The total time spent in naming all items is measured either by a computer or a test instructor. Discrete RAN is carried out by presenting several symbols on a computer, but the test person only sees one item at a time. The time measurement is from when a stimulus is presented on a screen to the onset of naming (naming latency). A participant's mean naming latency is their score for discrete RAN. Serial RAN has been shown to have a stronger relationship to dyslexic difficulties (e.g., de Jong, 2011; Georgiou et al., 2013; Wolf & Bowers, 1999). Serial RAN difficulties have also been shown to be independent of alphabetic language complexity, suggesting that they tap into a language-universal cognitive mechanism that is involved in reading alphabetic orthographies (Landerl et al., 2019). While phonological awareness has been found to be more closely related to reading accuracy, RAN seems to be more strongly related to reading speed/ word reading fluency (e.g., Landerl & Wimmer, 2008; Torppa et al., 2013).

A meta-study of RAN and reading performance provides evidence that RAN performance is related to performance in word reading, nonword reading, text reading and reading comprehension (Araújo et al., 2015). The relationship between RAN performance and reading is stronger for the reading of real words and texts than for nonword reading and reading comprehension. The study also shows that RAN correlates with reading performance regardless of whether the reading performance measure emphasizes phonological or orthographic decoding skills. According to Araújo et al. (2015), RAN has great potential in predicting reading ability since RAN and reading have shared cognitive processes with word reading, text reading, nonword reading and reading comprehension. Moreover, research with different orthographies has shown that RAN can predict reading outcomes in both shallow orthographies (e.g., Lervåg & Hulme, 2009; Rodríguez et al., 2015; Tobia & Marzocchi, 2014), deep orthographies (e.g., Georgiou et al., 2011; Savage et al., 2007; Vander Stappen et al., 2020) and in non-alphabetic languages (e.g., Georgiou & Parrila, 2020; Gharaibeh et al., 2021; Yan et al., 2013).

2.4.5. The Double Deficit Hypothesis of developmental dyslexia

The double deficit hypothesis of developmental dyslexia sorts readers according to the presence or absence of phonological processing deficits and naming speed deficits as measured by RAN (Wolf & Bowers, 1999). It suggests that RAN is a second independent core difficulty for dyslexics, in addition to phonological difficulties. This hypothesis arose from a literature review that identified a group of individuals with dyslexia who showed adequate decoding skills but poor comprehension (Vukovic & Siegel, 2006). For this group, the phonological intervention methods or identification tasks that were usually given to people with dyslexia were not effective. Therefore, the double deficit hypothesis was created, and it classifies readers based on the existence or absence of two fundamental cognitive processes: phonological processing and naming speed.

The double deficit hypothesis proposes subtypes of reading difficulties (Wolf & Bowers, 1999). The severity of a reading difficulty depends on which subtype one belongs to. The phonological-deficit subtype has a phonological deficit together with normal RAN (no speed deficit). The naming speed–deficit subtype has a RAN deficit but normal phonological skills (no phonological deficit). The double-deficit subtype has both RAN and phonological deficits i.e., the most severe reading impairment. Readers with only a phonological deficit would have a moderate reading impairment, and those with only a RAN deficit would show the smallest reading impairment (Vukovic & Siegel, 2006).

It has been argued that there is limited evidence for the double-deficit hypothesis of developmental dyslexia (e.g., McCardle et al., 2001; Vukovic & Siegel, 2006). A critique of the hypothesis has been that the underlying core deficit of naming speed, is poorly specified and that there is no clear evidence for the independence of naming speed deficits from phonological awareness (Vukovic & Siegel, 2006, p. 45). Instead, it has been proposed that slow naming speed is simply another manifestation of a phonological deficit. Nevertheless, no real consensus has been reached on this issue (McCardle et al., 2001). More recent studies have supported the division of children with dyslexia into subgroups proposed by the double-deficit hypothesis (e.g., Norton et al., 2014; Torppa et al., 2012). However, in a recent study by Younger and Meisinger (2020), they found low stability of subgroups based on the double-deficit hypothesis. In this study, they followed 109 elementary students with dyslexia through a school year. Based on the fall assessment students were classified into four different groups: (i) difficulties with phonological awareness, (ii) difficulties with naming speed, (iii) double-deficits (both phonological and naming speed difficulties) and (iv) typically developing readers. Almost half of the children changed subgroups during the school year. The differences between the subgroups with double-deficit and single-deficit reading difficulties disappeared during the spring (Younger & Meisinger, 2020). A large twin study of more than a thousand children from the USA, Australia and Scandinavia also provides some support for the double-deficit hypothesis (Furnes et al., 2019). The results indicate that the most impaired readers have difficulties with both RAN and phonological awareness. According to Furnes et al. (2019), RAN and phonological awareness are two distinct difficulties which have different effects on reading and spelling. Difficulties with phonological awareness are more related to difficulties in spelling, while RAN difficulties are more related to reading speed difficulties. An interesting result of Furnes'(2019) study is that the pattern of findings was similar across the orthographies included in the study, which is fascinating when looking for common features in reading difficulties across different orthographies, as I do in this thesis.

2.4.6. Critique of the Phonological Deficit Model

As reviewed above, impaired phonological skills are an important indicator of dyslexia. However, they are not the only indicator of this difficulty (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; Wagner, 2018; White et al., 2006). Castles and Friedmann (2014) question if the inclusion of many different phonological skills might lead to an imprecise understanding of the deficit. They suggest that it could be more correct to say that dyslexics suffer from some kind of phonological deficit which could be either in phonological awareness, phonological short-term memory, or speed of access to phonological representations.

Snowling and Melby-Lervåg (2016) reviewed children at familial risk of reading disorders. They found that family members who were not themselves affected by

dyslexia had phonological processing deficits to a greater extent than the normal population. This shows that it is possible to have a phonological processing deficit without being identifiable as dyslexic. So even though a phonological processing deficit is part of a dyslexic's difficulty, according to Snowling and Melby-Lervåg, a phonological processing deficit is not equal to dyslexia.
Both Snowling et al. (2020) and Lyon et al. (2003) argue that dyslexia is often caused by problems at the level of phonological representation but also stat that "dyslexia is the outcome of multiple risks which accumulate towards a threshold for what is usually termed diagnosis (Snowling et al., 2020, p. 504. See also Pennington, 2006)". The processes they mention that are at risk are the reading system, semantic knowledge, learning mechanisms, and letter position coding.

Wagner (2018) also raises concerns about relying on one single indicator of dyslexia. He claims that this leads to misdiagnosing people with dyslexia – or worse excludes people from being diagnosed when they do have a decoding difficulty. A position repeated in recent literature (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; White et al., 2006). Although several central dyslexia researchers have argued that phonological difficulties may not be the only indicator of dyslexia, they have not abandoned the claim that dyslexia and phonological difficulties have a clear relationship. For example, Share (2021) stresses that acceptance of the Phonological deficit hypothesis does not require that one rejects other non-phonological causes of dyslexia.

Stein (2018) argues instead that we need to explain the underlying physiological mechanisms that cause phonological failures because the behavioural level of a phonological difficulty is given too much explanatory power (Stein, 2018, p. 315). He argues that dyslexia can be explained by a magnocellular deficit in the brain's visual system. Stein argues that testing low-level magnocellular function instead of high-level reading or phonology will make it possible to distinguish between dyslexia and other reading difficulties. In contrast, Snowling and Melby-Lervåg (2016) and Share (2021) continue to see a phonological processing deficit as an important factor underlying dyslexia although not the only one.

2.5. Dyslexia definitions

As reviewed above, research has provided evidence for different indicators of dyslexia, nevertheless, no consensus for a definition of dyslexia has been reached (Waesche et al., 2011). Critically, there is disagreement on what a definition should include. Researchers and practitioners have different perspectives on dyslexia and that makes it difficult to agree on a definition. Researchers need a definition "to help them form research groups and define dyslexia as a concept" (Protopapas, 2019). Lyon et al. (2003) represent the research perspective and explain that their understanding of dyslexia can be considered a work in progress. When more knowledge is gained, the definition of dyslexia may change. Practitioners who are more concerned with the process of identifying reading difficulties need a definition that provides clear guidelines for identifying people with dyslexia. In line with this, Wagner (2018) argues that the lack of a clear definition is the reason for misdiagnosis and therefore suggests that a broader view of dyslexia, where one combines both causes and consequences, will help practitioners do their job better. Wagner (2018) proposes a combination of three causes and four consequences of dyslexia, that together increase the likelihood of correct identification. The three causes are impaired phonological processing, genetic risk, and environmental influences, while the four consequences are poor decoding (accuracy and fluent nonword decoding), impoverished sight-word vocabulary (e.g., automaticity of real word decoding), poor response to instruction and intervention, and that the listening comprehension is better than reading comprehension when assessed. By doing this Wagner argues that one can estimate the probability of the presence of dyslexia. Moreover, he argues the existing definitions of dyslexia produce dyslexia diagnoses that are not reliable because they rely primarily on one single indicator while including multiple indicators improves the reliability of diagnosis. It is hard to disagree with this statement since it is in everyone's best interest to set reliable diagnoses, and therefore an inclusion of more elements should be welcome. A review of dyslexia around the world states that assessment practice varies in different countries and that it is influenced by the country's definition of dyslexia and available assessment tools (Mather et al., 2020). It seems like most assessment tools investigate the consequences of dyslexia as Wagner (2018) proposed, but the definition difference is the reason why fewer countries investigate the causes.

This underpins the importance of having a clear definition of dyslexia because the definition guides how the assessment of the difficulty is carried out.

Parrila and Protopapas (2017) define dyslexia as a concept, rather than giving definitions for practitioners. “[Dyslexia is] a persistent and unexpected difficulty in developing age- and experience-appropriate word reading skills” (Parrila & Protopapas, 2017, p. 333). In their view, criteria for dyslexia are often associated with a phonological processing deficit, and they have deliberately refrained from using inclusion criteria. By promoting a conceptual definition of dyslexia, Protopapas (2019) emphasizes that clinical guidelines express attempts to operationalize concepts that only researchers and/or practitioners understand. In their view, choosing a definition with clear inclusion criteria would exclude individuals with word reading problems but not a phonological processing deficit from additional resources and support that a diagnosis of dyslexia might give. In other words, they want to broaden the definition of dyslexia to make sure that more individuals get the help they require.

The definition chosen for this thesis is Lyon et al. (2003) as cited in section 2.3. This definition specifies that dyslexia is neurobiological in origin, and it gives characteristics of primary markers of dyslexia and secondary consequences. The primary characteristics are poor spelling and decoding abilities. The secondary consequences can be problems in reading comprehension and reduced reading experience that again can hinder the growth of vocabulary and background knowledge. This makes the definition relevant both for researchers and for practitioners. The definition links dyslexia with a phonological difficulty without emphasizing this as the only explanation for the difficulty.

One could ask if it is important to distinguish between people with dyslexia who have word reading difficulties and those who are poor comprehenders. The answer to that should hopefully be that everyone who struggles with reading difficulties should get the help they need, regardless of the nature of their difficulty. However, Lyon et al. (2003) and Rose (2009) argue that the response to intervention (RTI) is lower for people with dyslexia than for those with other reading difficulties and therefore dyslexia has more serious consequences for those living with this difficulty. Siegel (2006) argues that a considerable number of people with dyslexia have greater challenges in life than those without.

Dyslexia is associated with a large number of adolescent suicide victims and juvenile offenders (Siegel, 2006, p. 585). Such negative outcomes could be reduced by working to reduce the severity of dyslexic difficulties or by educating practitioners on why RTI is lower for this group.

The debate about dyslexia definitions is important because the definitions are leading to the development of assessment tools and thus also for which groups have their reading difficulties identified. There is always a danger that someone is left out if the definitions are too narrow or that people are included on the wrong basis if the definition is too broad. When the definition from Lyon et al. (2003) was chosen for this thesis, is that because it includes both causes and consequences, and it was possible to find marks for measurement for the questionnaire and assessment tool developed in this study. These things are important when bilinguals' reading skills are to be examined, as different school backgrounds, language orthography and the processing of several languages make the assessment more challenging.

3. Bilingualism

A key aim of this thesis is to investigate whether non-fluent bilingual reading is an expression of reading difficulties or an expression of bilingualism. This chapter therefore provides an overview of theories of bilingual language representation and processing. The role of language proficiency in these processes is discussed, and the evidence for bilingual advantages and disadvantages of language processing is reviewed.

Bilingualism cannot be defined as a categorical experience (Bialystok et al., 2012, p. 247) and it has been debated to what extent being bilingual affects reading skills in general and for poor readers especially (e.g., Geva, 2006a; Vender & Melloni, 2021). The term bilingual often refers to a person who actively uses more than one language (Kroll et al., 2015), while monolingual refers to those who know only one language. Yet, individuals are rarely perfectly monolingual or bilingual. Most monolinguals have some experience with another language (e.g., school projects or vacations), and bilinguals have preferred languages or preferred contexts for each language. However, experimental research design often requires that participants be categorized as either monolingual or bilingual and therefore the participants are labelled as one or the other. Nevertheless, it is important to collect detailed information on the characteristics of a bilingual's language experience, also known as their language profile. This information usually includes language dominance, age of acquisition, socioeconomic background, language proficiency levels, and patterns of language use in L1 and L2 (e.g., Li et al., 2006; Luk & Bialystok, 2013). All these factors may affect L2 reading and must be considered when investigating bilingual reading difficulties.

3.1. Bilingual language processing

The discussion of how bilinguals' languages are connected, has long been a matter of debate. Research has investigated whether bilinguals have two separate lexicons for words – in each language - or if all the known languages share one lexicon, and how the languages interact (e.g., Desmet & Duyck, 2007; Gerard & Scarborough, 1989). In the empirical literature there is a great deal of evidence in favour of the non-selective language access hypotheses (Dijkstra & Van Heuven,

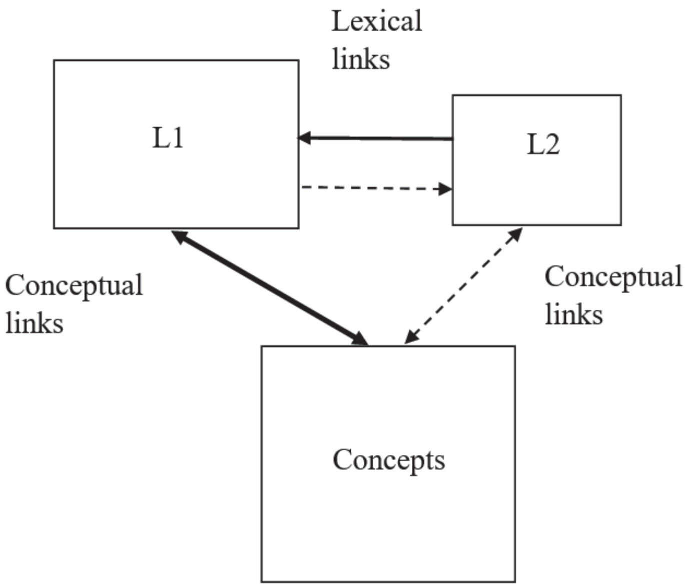
2002) which proposes that the bilingual mental lexicon is integrated across languages (e.g., Desmet & Duyck, 2007; Dijkstra & Van Heuven, 2002; Kroll & Bialystok, 2013; Kroll et al., 2014). This is based on evidence of interaction between bilingual languages, which is present even when bilinguals are highly competent in both languages and also when they are in a strongly monolingual context (Kroll et al., 2012). For example, bilinguals process words that share meaning and sound form in both languages (known as cognates e.g., *film* in Norwegian and English) faster than noncognate words (e.g., *bed* and *seng*), even when processing in one language. Hoshino and Kroll (2008) investigated whether two languages with different scripts would show cross-language activation during picture naming. Spanish-English (same script) and Japanese-English (different script) bilinguals were asked to name cognate and noncognate words in their second language. The results showed that cognates words were named faster in both language groups. This is evidence of cross-language activation of phonology in the non-target language, even when the languages do not share the same script. A similar cognate benefit has been observed in the L2 sentence reading of Japanese-English bilinguals (Allen et al., 2021). Clearly knowing the language in which you are reading based on the script is not sufficient to switch off your other language.

3.2. Bilingualism and language proficiency

As mentioned above, L2 language proficiency is an important variable that differentiates bilinguals. Kroll and Stewart (1994) introduced the Revised hierarchical model (RHM, see Figure 3) of lexical and conceptual representation in bilingual memory. In the RHM they try to explain why there is an asymmetry in translation between L1 and L2 in performance for sequential bilinguals, such that translating from L1 to L2 is influenced by semantic overlap between words but translating from L2 to L1 is not. The model describes the relationship between a bilingual’s languages as a function of language proficiency.

Figure 3

The Revised Hierarchical Model – RHM, adapted from Kroll and Stewart (1994)



In the RHM one assumes that sequential bilinguals have a strong connection between the lexicon of L1 and their conceptual memory. In the early stage of learning L2, the L2 words are attached to this existing system of L1 words. When the L2 learner becomes more proficient in their L2, they build new, direct conceptual links that do not go through L1. This new link goes both ways – from L2 words to concepts and from concepts to L2 words. The lexical link from L2 to L1 is assumed to be stronger than the lexical link from L1 to L2. This is because L2 words were first associated with L1. The link from L1 to conceptual memory is assumed to be stronger than the link from L2 to conceptual memory. The RHM therefore explains the asymmetry in translation performance for sequential bilinguals. This is because translating from L1 to L2 involves concept mediation, whereas translating from L2 to L1 relies on lexical mediation.

Language proficiency is defined as an index of comprehension and production abilities that L2 learners develop across linguistic domains and modalities - to communicate (Tremblay, 2011, p. 340). Proficiency is a phenomenon in both L1 and L2. Adult speakers in L1 may differ in proficiency in many ways e.g., articulation, speaking speed, and self-corrections, but L2 speakers may face more problems in fluent articulation, finding the right words or speaking with correct morphosyntactic form (Kormos, 2006). L2 proficiency is more often used as a unit of measurement than L1 proficiency. In Norway, the level of L2 proficiency regarding speech, reading and writing, can determine whether one is, for example, allowed to study or to become a citizen (UDI, 2022). L1 proficiency does not open and close opportunities in the same way. An assessment of bilingual proficiency skills in L2 is necessary to clarify the level of expectation for language production and understanding. When learning a new language speech production and comprehension is often the first aim of language learning, whereas being able to read or write is a more secondary aim. The Council of Europe has published a framework of Language references (Division, 2001) to make it easier to describe language proficiency across languages. It contains a comprehensive description of what knowledge and skills one must develop to communicate effectively in a language when communicating in speech, reading, and writing. The framework defines three levels of proficiency: Level A for a basic user, level B for an independent user, and Level C for a proficient user. Each level has two sublevels which indicate whether the user is a beginner (sublevel 1) or gaining mastery (sublevel 2). The proficiency level of a bilingual speaker characterized as B1 indicates that the L2 speaker is an independent user but at a beginner's level.

A study on 181 adult L2 Dutch learners and 54 adult L1 Dutch speakers aimed to investigate the construct of L2 speaking proficiency (de Jong et al., 2012). The participants were tested with eight speaking tasks, a vocabulary task, a test on grammatical knowledge, lexical retrieval speed, speed of articulation, sentence building speed and pronunciation. As expected, the results showed that the L1 speakers performed significantly better than the L2 speakers. Furthermore, the efficiency of L2 speakers' articulatory skills was not found to be associated with speaking proficiency, but rather knowledge of vocabulary. The ability to produce correct sentence intonation was considered the best predictor of speaking proficiency. These two variables explained 75.3% of the variance in L2 spoken proficiency. Nevertheless, the authors emphasised that this finding did not mean that the only variables that matter for communicative success are vocabulary and intonation skills. Speaking proficiency is concerned with the ability to requiring the fast processing of knowledge as well as fluent pronunciation.

The age at which a second language is acquired is of great importance when considering proficiency. Age of acquisition has been shown to affect how bilingualism develops as well as the level of proficiency achieved (e.g., Brito et al., 2016; Kim et al., 1997). Adult learners often fail to acquire native-like competence in a second language (e.g., DeKeyser et al., 2010; DeKeyser, 2000) and are therefore perceived as having lower proficiency levels than children who acquire native-like competence in L2. There is a difference in growing up in an environment where two or more, juxtaposed languages are constantly used and being introduced to a second language in adulthood when the first language is well established. According to Luk et al. (2011), the age at which one begins using two languages actively had a negative correlation with language proficiency. This means that the proficiency level of adult L2 learners is expected to be lower than for bilingual children. However, according to Nichols and Joanisse (2016) being young when learning a new language does not always mean that one will develop a high L2 proficiency level since factors such as motivation and environment play a key role in successful L2 acquisition. These factors can also contribute to adult L2 acquisition enabling the strongly motivated to achieve a high level of L2 proficiency.

It is, however, difficult to be precise in measuring proficiency. A recent review of measures of proficiency, argues that the wise thing to do is to use proficiency tools that have been successfully validated in previous studies (Park et al., 2022). This is preferable to relying on achievement levels set by educational institutions. For instance, a course level set at A2 will very likely comprise a wide range of actual proficiencies due to variation across institutions in how they define course levels. In Norway, unfortunately, there are no agreed-upon tools for the accurate measurement of proficiency. There is, however, research showing that self-reported measures of language proficiency are reliable because they correlate highly with behavioural measures of language performance (e.g., Chincotta & Underwood, 1998; Flege et al., 2002; Jia et al., 2002; Marian et al., 2007). The language experience and proficiency questionnaire (LEAP-Q) is designed to collect data on patterns of language use, proficiency and language history in both L1 and L2 (Marian et al., 2007). To assess the suitability of the LEAP-Q questionnaire, the participants were also tested with a battery of standardized behavioural measures of language ability in both L1 and L2. The test battery in the LEAP-Q study had seven different domains that covered a wide range of language skills: a reading fluency test, a passage comprehension test, a productive picture vocabulary test, an oral comprehension test, a sound awareness test, a receptive vocabulary test and a grammaticality judgment test. The results showed that self-reported skills were reliable indicators of language performance. Differences between self-reported proficiency levels in L1 and L2 were reproduced in participants' performance on behavioural measures of linguistic ability. Interestingly, self-reported reading proficiency was a more accurate predictor of L1 proficiency while self-reported speaking proficiency was a more accurate predictor of L2 performance.

Even though studies have shown correlations between behavioural measures of language performance and self-reported level of performance, self-ratings are vulnerable to the prejudice and inconsistency of the participants. Self-ratings also rely on how researchers have framed the questions (Tomoschuk et al., 2019). In a Meta-synthesis of 22 meta-analyses (Zell & Krizan, 2014) an estimate of the relation between the ability to self-evaluate performance (e.g., academical ability, language competence, intelligence and medical skills) and objective performance measures (e.g., standardized test scores, grades and supervisor evaluations) was conducted. The results showed that the relationship between self-reported performance and objective measures was higher when participants were asked to rate their skill in a specific domain rather than a broad domain. This was also the case when performance tasks were objective, familiar, or low in complexity. The individual meta-analytic effects ranged from .09 to .63 showing that there was a spread in the results. The overall mean correlation between self-reported performance and objective measures was moderate (M = .29, SD = .11).

Self-reported performance is frequently used in bilingual research (e.g., Chincotta & Underwood, 1998; Flege et al., 2002; Marian et al., 2007; Tomoschuk et al., 2019; Zell & Krizan, 2014) but opinion is divided on how valid a measure self-reporting is. According to Zell and Krizan (2014), the relationship between self-reported performance and objective measures was higher in performance tasks that were specific, familiar and/or had a low degree of complexity. This indicates that it is important to carefully design the questions you want the participants to self-report on, as it will increase the relationship between self-reported and measured skills. This, together with the studies showing that there is a strong correlation between self-reporting and measured skills (e.g., Chincotta & Underwood, 1998; Flege et al., 2002; Jia et al., 2002; Marian et al., 2007), justifies self-reporting when no other measurement tools of proficiency are available.

3.2.1 Benefits

In the field of special education, bilingualism has often been regarded as a complicating factor as it for instance has been hard to differentiate between word reading difficulties caused by dyslexia and word reading difficulties caused by bilingualism. However, more recently within psycholinguistics, the focus has instead been on the advantages bilingualism offers. Interestingly despite evidence of non-selective language activation, proficient bilinguals make very few errors in language selection. L2 speech errors can be influenced by L1, but this is usually associated with different stages of L2 learning (Poulisse, 2000). The fact that highly proficient bilinguals do not make frequent errors related to the unintended mixing of languages, even though both languages are active, suggests that effective selection mechanisms are in place.

Research has shown that the brain networks that enable cognitive control, differ between bilinguals and monolinguals (e.g., Bialystok, 2011; Green & Abutalebi, 2013). The areas in the brain that control language in bilinguals have an overlap with the areas involved in more general cognitive control (e.g., Abutalebi & Green, 2007; Garbin et al., 2010). It is stated that when bilinguals speak, listen, or write in one language, they must suppress the language that is not in use. Bilinguals must therefore have a control mechanism that helps inhibit irrelevant information from the language that is not being used, and at the same time allow the selection of relevant information in the target language (Kroll et al., 2012). It has been proposed that constant mental juggling involved in the use of this language control mechanism, creates advantages in executive functions in bilinguals compared to monolinguals.

Executive functions refer to the ability to pay attention to relevant information, temporarily hold and manipulate information in mind and perform intentional task shifting (Yu et al., 2021, p. 155). It is an umbrella term that involves high-level cognitive control functions that are involved in all complex mental activities (Lehtonen et al., 2018). Even though a lot of research investigates different forms of executive functions, there is still a lack of clarity on how to define and describe executive functions and their subcomponents (e.g., Jurado & Rosselli, 2007; Lehtonen et al., 2018). Some of the most frequently proposed components of executive functions are working memory (keeping information active until it is to be used), set shifting (the ability to switch rapidly between different response sets) and verbal fluency (this could be category fluency – generation of words from a given category e.g., furniture, or letter fluency - generation of words from a given letter e.g., the letter C) (Anderson et al., 2002). Bilinguals have outperformed their monolingual equivalents on tasks that involve executive function, such as task switching, ignoring irrelevant information, and resolving conflict (e.g., Bialystok et al., 2009; Bialystok & Feng, 2009; Kroll et al., 2013; Luk et al., 2010). These effects are observable in both early bilinguals (learned an L2 by school age) and late bilinguals (becoming bilingual after childhood) (Pelham & Abrams, 2014).

More recent research is, however, questioning whether these advantages are a direct consequence of bilingualism (e.g., Donnelly et al., 2019; Gunnerud et al., 2020; Lehtonen et al., 2018). Some have argued that bilingualism simply provides more opportunities to develop relevant skills rather than training executive functions (Yu et al., 2021). A large-scale study of bilingual adults by Nichols et al. (2020) could not find advantages in executive functions in bilinguals. They tested 11041 participants on a broad battery of L2 executive tasks, including the Stroop test (checks how easily someone can switch their attention to new requirements and, importantly, stop their usual response in favour of an unexpected one), spatial planning, grammatical reasoning, and digit span. No reliable differences in executive functions were observed between monolinguals and bilinguals (Nichols et al., 2020, p. 558). Bilinguals did show a significant advantage in one task (digit span), but the authors emphasise that the standardized effect size was small, less than 0.01. In the L1 tasks, there were no differences between groups. Another large-scale study on children (9 to 10 years old) was also unable to find support for advantages in executive functioning skills in bilingual children (Dick et al., 2019). However, a large-scale study of 5 to 7-year-old children has shown an advantage in executive functions for bilingual children (Hartanto et al., 2019).

A review of 167 independent studies argues that there are several reasons why some studies failed to replicate the results of a bilingual advantage in executive functions (Grundy, 2020). According to this review, when a group difference is observed between monolingual and bilingual performance, bilingual performance is usually better than monolingual performance. This effect is too big to be considered a coincidence. Grundy (2020) also argues that when a bilingual advantage fails to be observed, it occurs in studies that do not make a distinction between simultaneous and sequential bilinguals (Brito et al., 2016), or do not take into account the frequency of language switching (Liu et al., 2019), or the age of L2 acquisition (Yang & Yang, 2016). Moreover, while it is known that proficiency in an L2 has consequences for executive functions (Chen et al., 2014; Xie & Pisano, 2019), many studies do not report the L2 proficiency levels of their sample. Bilinguals who have been highly proficient in L2, but no longer are, are likely to perform differently from highly proficient bilinguals who actively use their L2 (Grundy, 2020). These are examples of why it is important to report the language profile of the bilingual sample in a study. However, the differences between monolingual and bilingual performance, in studies review, are small (often only 30-100 ms in reaction time). Therefore, it is suggested that in the future, research should be concerned about understanding *when* behavioural differences appear between monolinguals and bilinguals rather than describing "advantages".

Finally, bilingualism has also been shown to affect linguistic and cognitive performance across the lifespan. In addition, to improving executive functioning in bilingualism, it also protects against the fall of executive control in ageing (e.g., Bialystok, 2009; Kroll et al., 2014). It has been argued that bilingualism protects against dementia, but in recent years it has emerged that bilingualism may actually mask the observable symptoms of disease. The symptoms of e.g. Alzheimer's disease in bilinguals appear four to five years later than in monolinguals, but the disease is more advanced when it is detected than is common in monolinguals (Alladi et al., 2013).

3.2.2 Disadvantages

In addition to the possibility of cognitive advantages associated with being bilingual, there is also evidence of linguistic disadvantages. Previous studies have shown that on various verbal and nonverbal tasks, monolinguals and bilinguals perform differently. When given verbal tasks that reflect vocabulary knowledge and rapid access to the lexical system, bilinguals are less proficient when compared with monolinguals (Bialystok et al., 2010). Verbal fluency refers to the ability to e.g. name pictures quickly/within a specific time limit (Gollan et al., 2002). On picture naming tasks it has been found that monolinguals perform better than bilinguals (e.g., Bialystok et al., 2008; Gollan et al., 2005; Ivanova & Costa, 2008). When 111 adults were asked to name 50 pictures as fast and accurately as possible, monolinguals named pictures faster than bilinguals (Ivanova & Costa, 2008). The bilingual delay was visible both when bilinguals named pictures in their dominant language, and their second language. They were faster when they named pictures in their dominant language, but overall slower than monolinguals. However, when asked to categorise pictures, bilinguals were not slower than monolinguals (Gollan et al., 2005). Suggesting that the deficit is related to name retrieval.

When testing monolinguals and bilinguals (with a dominant L2) as unselected groups on category fluency (e.g., name as many items of furniture as you can) in the same language, bilinguals perform more poorly than monolinguals (Sandoval et al., 2010). However, the results are more mixed when testing for letter fluency (e.g., name as many words as you can beginning with the letter P). If monolinguals and bilinguals are matched on vocabulary size, instead of tested as unselected groups, then both groups perform equivalently on category fluency, but in letter fluency, bilinguals produce more words than monolinguals (Luo et al., 2010). Bilinguals have a disadvantage when tested with tasks that require verbal processing in comparison to monolinguals. To narrow the gap between monolinguals and bilinguals it is suggested that one should use verbal fluency tasks that require more execution functions (letter fluency) (see Grundy, 2020) instead of category fluency if one wants to examine the effect of bilingualism versus monolingualism.

In children who are learning two languages at once, some studies show that compared to monolinguals, bilinguals have slower language development. This is the case for both vocabulary and grammar development (e.g., Bedore & Peña, 2008; Hoff et al., 2012). When 47 bilingual children were compared with 56 monolingual children (tested at 1 year and 10 months, 2 years and 1 month and 2 years and 6 months) the results showed that monolingual children acquired their single language more rapidly than bilingual children exposed to two languages (Hoff et al., 2012). For children who were exposed to two languages, how quickly a language developed varied with the amount of exposure. Although this is defined as a disadvantage, it is uncertain whether late language development is a greater disadvantage compared to the advantage of mastering several languages.

Furthermore, bilingualism can also have an impact on reading skills. The reading skill level is often influenced by whether one reads in L1 or L2 or how well-developed the second language skills are. Therefore, in the next chapter, we turn to a discussion of bilingual disadvantages in reading.

4. Bilingual reading and bilingual reading problems

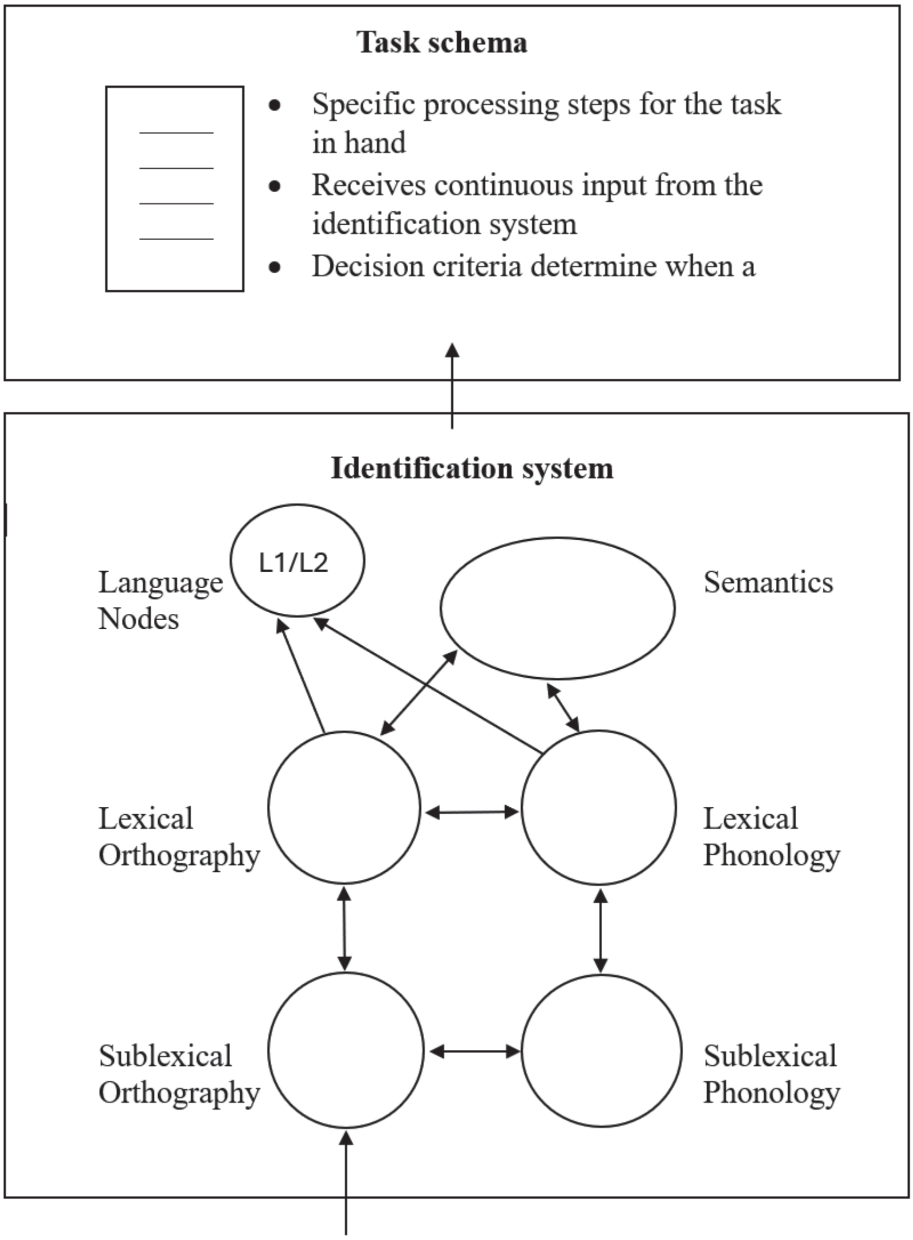
Being a bilingual reader has an additional challenge to monolingual reading, because the lexical candidates to choose may appear from two languages instead of just one (Pélissier et al., 2023). Researchers have also been concerned with whether knowledge learned in one language enhances learning or reading skills in another language (Perkins & Salomon, 1992). Comprehensive literacy instructions in L1 have been shown to improve phonological awareness and letter-sound knowledge in L2 (Vaughn et al., 2006). This finding indicates that L1 and L2 reading are connected. Another study has shown that literacy instructions given in a language that is not L1, improved decoding skills in L1 (Piper et al., 2016). This indicates that cross-language transfer also occurs from L2 to L1. It also emphasises the importance of proper reading instructions. Since bilingual reading has additional challenges to monolingual reading, there is uncertainty about how reading difficulties should be detected in bilinguals. Although there is a transfer of reading skills between languages in bilinguals, much remains to be discovered about what happens during transfer, and how accuracy and response time should be understood as markers of reading difficulties (e.g., Hatcher et al., 2002; Tops et al., 2012). Reduced reading speed is often taken as the key marker of reading difficulties in adults (Reis et al., 2020), although being an L2 learner can also affect reading speed. In this chapter, key aspects of bilingual reading are presented such as juggling several languages when reading, cross-language reading skills and reading difficulties.

4.1. Nonselective activation

As discussed above, an important question about bilingualism relates to how bilinguals control access to their languages. There is evidence that both languages a bilingual person knows are constantly active when one language is being used in reading (Dijkstra & Van Heuven, 2002), listening (Olguin et al., 2019) and speech production (Colomé, 2001). This can lead to ongoing competition in selecting which one of the two (or more) languages to use (e.g., Dijkstra, 2005; Kroll et al., 2014). The Bilingual Interactive Activation Plus model (BIA+, see Dijkstra & Van Heuven, 2002), is a model of non-selective interaction and selection during visual word recognition. The BIA+ model assumes that words are stored in a common lexicon and that word access is not limited to a specific language (see Figure 4). The model starts with an identification system containing the different representations important for identifying a language. These are sub-lexical orthography, sub-lexical phonology, lexical orthography, lexical phonology, language nodes of L1 and L2 and semantics.

Figure 4

The BIA+ model, adapted from Dijkstra and Van Heuven (2002)



The activation of the identification system is initiated by appropriate visual input: letter strings, syllables, or words. Activation of the sublexical orthography and phonology by matching input leads to the activation of different word candidates. The semantic nodes determine which word is presented and lexical nodes send activation to the appropriate language. At the sublexical and lexical levels, activated nodes inhibit competing nodes. The lexical candidates that correspond best to the input, become the most active word unit, inhibit their competitors, and are therefore recognised.

The word identification system produces output for a task/decision system. The task schemas specify at a higher level the instructions for the task to be done (e.g., in which language one is reading). The task schema cannot influence the activation of words directly and can only influence how incoming information is used. Instructions, task demands, or the participants' expectations are considered in a non-linguistic context and can influence the task/decision system. However, linguistic context can interact directly with the word recognition system (e.g., preceding sentence context). Semantic and syntactic aspects of the sentence context can regulate the activation of lexical candidates. If the preceding sentences have been written in a specific language, it is more likely that the lexical candidates are recruited from the same language.

According to the BIA+ therefore, bilingual reading is affected by orthographic lexical representations in both languages, even if the intention is to read in only one language. The speed with which a visual word is recognized will also be influenced by how much the two languages have in common. Cognates, interlingual homographs, and orthographic neighbourhoods will affect word recognition (e.g., Desmet & Duyck, 2007; Kroll et al., 2014). Cognates refer to words that have the same meaning and have a full or partial overlap in form, in both languages (e.g., *piano* in English, and Norwegian). In word recognition and word production tasks, cognates are processed faster than control words (e.g., Caramazza & Brones, 1979; Costa & Santesteban, 2004; Kroll et al., 2014). In contrast, interlingual homographs (also known as false friends) as words with the same form but different meanings across languages ("Gift" in English means a present. In Norwegian "gift" could mean poison or being married). Interlingual homographs can slow lexical access (Dijkstra et al., 1999).

Orthographic neighbourhoods refer to the number of words that can be created by replacing one letter of a word. For example, “chair” has two neighbourhood words – “chain” and “choir”, whereas “car” has nineteen (“cat”, “cap”, “war”, “bar”, “far”, etc). Lexical decisions are slower for words with larger orthographic neighbourhoods (Van Heuven et al., 1998), arguably due to increased competition between candidates for recognition. Interestingly, the effect of neighbourhoods on response time in bilingual reading is due to both the neighbourhood size in L2 and L1. These effects can only be due to bilingual speakers having both languages active when reading (Bialystok, 2011). There is also evidence that the level of proficiency in an L2 affects how the degree of interference observed. Decoding efficiency in both accuracy and the error rate is affected by L2 proficiency level (Koda, 2007).

4.2. Cross-language transfer in bilingual reading

This study is not a standard language transfer study since my interest is specifically in whether decoding difficulties transfer between languages in a transparent way from L1 to L2. Nevertheless, some factors that have emerged from studies of cross-language transfer studies are relevant and have influenced the design of my study. These factors are described in the following sections.

According to Chung et al. (2019), studies on cross-language transfer were in the past concerned with spoken language transfer and studies of literacy aspects first started in the 90s. Studies of cross-language transfer are important because they give insights into the extent to which it can be assumed that skills tested in L2 are comparable to skills tested in L1. There is no dispute about the fact that cross-language transfer happens; all theories agree that aspects of L1 performance influence L2 processing. However, there are differences in approach concerning what is actually transferred between languages (e.g., Chung et al., 2019; Jarvis & Pavlenko, 2008).

In some approaches, the focus has been on the typological aspect of languages. According to Lado (1957), a systematic structural analysis of L1 and L2 language is necessary to predict what will be effortless or challenging for the person learning an L2. In this view, it is possible to predict which elements will be challenging for learning a specific L2 based on the similarities and differences between L1 and L2 (Chung et al., 2019). The transfer is positive when there are similarities between L1 and L2 (e.g., cognates or similar grapheme-phoneme recoding), and correspondingly negative when there are different structures in the first and second language (e.g., different representations of definite nouns).

Other theories focus on cross-language transfer as something that happens when skills or knowledge derived from the L1 directly facilitate or inhibit the development of the same skills in L2 (Pham et al., 2018, p. 207). These theories focus on aspects of metalinguistic awareness about a language system. A lot of studies of metalinguistic awareness investigate learners of a third language (L3) and look for evidence of general language learning competencies (e.g., Angelovska, 2018; Bono, 2011; Falk et al., 2015; Foryś-Nogala et al., 2023). It has been proposed that regardless of the precise function of metalinguistic awareness, this level of awareness serves as a non-structural element that interacts with cross-linguistic transfer (Herdina & Jessner, 2002; Jessner, 2006; Odlin, 1989). Many believe that metalinguistic awareness enables learners to examine linguistic structures by focusing on both their similarities and differences. This ability allows learners to selectively address these structures as a part of their problem-solving approach during communicative tasks (Bono, 2011).

According to Durgunoğlu et al. (2017), there is an overlap between proficiency in L1 and L2 when metacognitive aspects of oral language are considered. Children who can provide high formal definitions in their L1 tend to be able to do the same in L2. The knowledge of what a formal definition requires is therefore present in both languages. In addition, bilingual children's writing tends to be of a similar quality (richness of oral story structure) in their two languages (Durgunoğlu et al., 2002). A review of 27 studies investigated L1 influence on the development of spelling skills in L2 English (Figueredo, 2006). The review found evidence of transfer between L1 and L2 regarding knowledge related to phonological and sound-to-spelling correspondence, and a transfer of cognitive processes, linguistic processes, literacy skills and metalinguistic skills. However, it concluded that transfer between languages may vary and that this variation is due to, among others, L1 proficiency level. This suggests that the investigation of proficiency levels is important in cross-language transfer research.

Finally, more psycholinguistic approaches focus on the underlying cognitive processing skills that facilitate language and literacy skills in L1 and therefore contribute to similar skills in L2 (e.g., Geva et al., 1997; Jared et al., 2013). Executive functions, or cognitive processing skills, such as phonemic awareness, working memory and RAN for example, measure underlying cognitive processing skills to facilitate the development of specific language and literacy skills in L1 and also contribute to similar skills in L2 (e.g., Geva et al., 1997; Jared et al., 2013). In this approach, correlations between performance in parallel tasks in L1 and L2 (accuracy and fluency in decoding), are not automatically interpreted as the transfer of L1 skills acquired in an L1 context, to L2, but to these common underlying processes (Chung et al., 2019). An important finding in bilingual reading is that phonological awareness and reading skills transfer from L1 to L2 (e.g., August et al., 2009; Durgunoğlu et al., 1993; Goodrich et al., 2014; Liow & Poon, 1998; Patel et al., 2022; Wawire & Kim, 2018).

In my study, the aim is not to explain differences in L1 and L2 performance, based on differences in typology between the included L1 and L2 Norwegian. However, it was nevertheless important to be aware of language typology for test construction, and an overview of the critical structural differences in the languages tested is given in Chapter 6. These differences between the languages have been taken into account in the preparation of the assessment tasks to ensure equality between the tests. My study investigates the variance of different L1s, but not the effects of typology on reading performance in L2.

It was also important to account for L2 language proficiency in my study because uncertainty about how L2 spoken proficiency affects behaviour measures in L2, is one of the reasons bilinguals reading difficulties are hard to identify. Therefore, the questionnaire designed for this study contained several questions regarding L1 and L2 proficiency in speaking, writing and reading.

The cognitive aspects of cross-language transfer have been focused on in this thesis, and that is what is discussed in detail in the sections below.

4.2.2. Decoding and cross-language transfer

Decoding is the process of translating print into speech. According to Gough and Tunmer (1986), decoding is also being able to isolate words quickly, accurately, and silently. A meta-study by Yang et al. (2017) reviews 33 studies which reported correlations between L1 (Chinese) and L2 (English) in the domains of phonological awareness, decoding, vocabulary, and morphological awareness. They observed that studies with younger children produced higher correlations between L1 and L2 decoding than studies with primary-grade students. This indicates that age can affect the transfer value of decoding skills between L1 and L2 and it emphasizes the importance of also investigating adults' decoding skills. Yang et al. (2017) found that the meta-correlation between L1 and L2 decoding was moderate. However, English and Chinese have different written languages, and it is possible that there will be a stronger correlation between decoding skills in written languages with similar orthography.

A study of word decoding fluency in L2 (English) and L3 (French) on one side and L1 (Dutch) word and pseudoword decoding on the other, showed that decoding skills increased when L2 proficiency increased (van de Ven et al., 2018). 787 Dutch students with Dutch as their L1, English as their L2 (approximately two years of English language instruction) and French as their L3 (approximately three months of French language instruction) were tested in L1 word and pseudoword decoding and L2 and L3 word decoding. There was a growth in decoding skills when tested six months apart. Increased proficiency in a second language had a positive influence on decoding skills. The study showed that L1 word and pseudoword decoding skills can predict the level of L2 decoding skills, which indicates the presence of cross-language decoding skills between languages with similar orthography.

4.2.3. Phonemic/Phonological awareness and cross-language transfer

Phonological awareness refers to skills related to the identification and manipulation of words, syllables, onsets, and rhymes as units of oral language (Castles & Friedmann, 2014). In the research literature, there is consensus that the acquisition of reading in any language depends on awareness of the phonological structure of the specific language (e.g., Russak & Saiegh-Haddad, 2011; Ziegler & Goswami, 2005). Phonological awareness is an important component of reading development in L2 and also predicts reading difficulties (Genesee et al., 2006).

Saiegh-Haddad and Geva (2008) investigated the link between phonological awareness in English (L1) and Arabic (L2) and the relative role phonological processes had on word and pseudoword reading in both L1 and L2. They tested 43 English-speaking children who spoke English at home but attended a bilingual English-Arabic private school in Canada. Phonemic awareness in both English and Arabic was tested using an English elision task and a parallel test in Arabic that was adapted to the phonological structures of Arabic. In the elision test participants deleted phonological units of varying size (CVC syllables, consonantal clusters, and singleton phonemes) in monosyllabic, di-syllabic, and tri-syllabic words (Saiegh-Haddad & Geva, 2008, p. 487). Accuracy in pseudoword decoding phonological awareness was the only reliable predictor explaining the variance in both languages. There was therefore a relationship between phonological awareness in L1 and L2 and this relationship supports the view that phonological awareness is a cognitive-linguistic construct that is independent of cross-linguistic differences in typology. In addition, the individual differences in phonological awareness in L1 were positively related to individual differences in phonological awareness in Arabic (L2). This result is consistent with cross-linguistic transfer of phonological awareness in L1 and L2 in children. However, there are important differences between children's and adults' reading abilities and it is important to investigate whether the same applies to adults (August, 2006).

Russak and Saiegh-Haddad (2011) examined cross-linguistic relationships between phonological awareness in L1 (Hebrew) and L2 (English) college students. 30 students had reading difficulties, and 30 students were regular readers. Three parallel phonological awareness tasks were developed for both L1 and L2. The three tasks were phoneme isolation, full segmentation, and phoneme deletion of both words and pseudowords. Both groups (those with reading difficulties and the regular readers), showed higher levels of phonological awareness in L1 than in L2 in phoneme isolation and phoneme deletion. Furthermore, the regular readers outperformed those with reading difficulties in both L1 (Hebrew) and L2 (English) in the phonological awareness tasks. The authors argued that this supports the phonological deficit hypothesis (e.g., Lyon et al., 2003; Ramus et al., 2003; Snowling, 1995; Snowling, 1998; Vellutino et al., 2004). Russak and Saiegh-Haddad hypothesized that phonological awareness scores would be lower in pseudowords than in real words for those with reading difficulties, but the results showed that the effect of stimulus words on phonological awareness varied across languages and across the two groups of participants. Only those with reading difficulties found phoneme deletion in L2 (English) harder when the phoneme was within pseudowords, while phoneme deletion in L1 was not sensitive to the difference between words and pseudowords in the phonological awareness task. The authors suggested that L1 pseudoword phonological tasks were easier because participants could adopt a lexical strategy, whereby the activation of the phonological representations of real words helped them to maintain the representations of the pseudowords in memory (Russak & Saiegh-Haddad, 2011, p. 438). It remains a matter of speculations whether pseudoword tasks will highlight a decoding difficulty to a greater extent when testing phonemic awareness in L2, than when tested with actual words in L1.

4.2.4. RAN and cross-language transfer

RAN was introduced and discussed in detail in section 2.4.4. Araújo et al.'s (2015) meta-study on RAN and reading performance demonstrate that RAN is connected to word reading, nonword reading, text reading and reading comprehension, but the connection is stronger to reading real words and text reading than to nonword reading and reading comprehension. The data suggest that RAN correlates with reading performance regardless of whether the measure of reading proficiency emphasizes phonological or orthographic decoding skills. The data also suggest that RAN has the potential for predicting reading ability because RAN and reading share cognitive processes. However, the meta-study includes no data on bilingualism and RAN. Uncertainty therefore remains about how RAN is related to bilingual reading skills.

Several studies have investigated whether the complexity of a language's orthography affects RANs' ability to predict reading outcomes. Research to date has shown that RAN predicts reading outcomes in both shallow orthographies (e.g., Lervåg & Hulme, 2009; Rodríguez et al., 2015; Tobia & Marzocchi, 2014), deep orthographies (e.g., Georgiou et al., 2011; Savage et al., 2007; Vander

Stappen et al., 2020) and in non-alphabetic languages (e.g., Georgiou & Parrila, 2020; Gharaibeh et al., 2021; Yan et al., 2013). Even so, there is still a need to investigate whether RAN tested in L1 and L2 measures the same construct.

Georgiou et al. (2022) investigated if the effect of RAN on L1 could transfer to L2 reading, and whether the proximity in orthographies in L1 and L2 affected the results was also investigated. The study tested 735 university students in eight different languages (Chinese, Japanese, Kannada, Oriya, English, Arabic, Portuguese, and Spanish). For the RAN task, the participants named five digits or five objects, as quickly as possible, in both English (L2) and in their L1. Word reading accuracy and reading fluency were also measured in L1 and L2. The results showed that testing with RAN objects was slower than RAN digits in both L1 and L2. Performance in L2 RAN was slower than L1 RAN. In addition, there was a significant effect of L1 RAN on L2 accuracy in three languages (Chinese, Portuguese, and Spanish). For the same three languages, L2 RAN was a significant predictor of reading fluency in L1. Between the other five languages, no cross-language transfer in RAN was observed. The study concluded that L1 and L2 capture similar processes and that cross-linguistic transfer of skills related to RAN is independent of the orthographic proximity of the two languages the participants were tested in. They also concluded that the RAN tested in L2 was slower than the RAN tested in L1. This indicates that RAN tested in L1 is a more accurate measure than RAN tested in L2. At what language reading-related assessment tasks should be carried out when bilingual reading skills are measured, becomes an important question.

Since RAN is considered a universal marker of developmental dyslexia, Carioti et al. (2022) investigated whether a new version of RAN-tests, called RAN-shapes, could be helpful when investigating reading difficulties in minority-language children. In the RAN-shape task children are asked to rapidly name five standard shapes (heart, circle, triangle, square and star) in Italian. The RAN-shape task was conducted on children with Italian as both their L1 and L2. The RAN-shape task has three trials and the same five shapes are used in all trials. Carioti et al. (2022) argue that by using the same five shapes and naming them in Italian, the task reduces the effect of different proficiency levels in Italian as well as the demand for access to lexical memory. It is also claimed that this methodology avoids the effects of different levels of automation of word naming.

127 children were tested with the RAN-shape task. 64 children had Italian as their L1 and had typical reading development. 43 children were bilinguals born in Italy with non-Italian parents but had attended an Italian school for at least three years. 20 children were monolingual Italian speakers with reading difficulties. In addition to the RAN-shape task, they were also tested with a short battery of tests measuring cognitive skills (non-verbal reasoning) and reading skills (single word and pseudoword reading, and text reading). They found a moderate correlation between reading measures and the three RAN-shape trials. A logistic regression found that all three RAN-shape trials were able to predict group assignment for the children with Italian as their native language, but the study does not report on the group assignment for the bilingual children. The bilingual children underperformed compared to the children with Italian as their L1 in all reading accuracy measures, but there was no difference in the fluency of pseudoword reading. RAN-shape task results did not differ between the bilingual children and the monolingual children with normal reading development. However, the bilingual children performed better than the monolingual children with reading difficulties. The conclusion was that the RAN-shape task was used as an unbiased marker of a neurodevelopmental reading disorder in bilingual/multilingual people. It is worth noting that Carioti et al.'s (2022) study focused on bilingual children who had three to five years of schooling in the language in which the RAN-shape test is administered. It is uncertain whether these results are transferable to adult sequential bilinguals. Taha et al. (2022) investigated the potential for language-dependent and language-independent tasks when identifying the risk of dyslexia in bilingual children. They defined the RAN-shape task (Carioti et al., 2022) as a language-neutral test. It is debatable whether tests, where one uses a second language, can be defined as language-neutral, even if there is a limited range of words. This is especially true when testing adult sequential bilinguals.

4.2.5. Dyslexia and cross-language transfer

A review of dyslexia in global contexts concludes that, in general, reading difficulties in L1 will transfer to L2 (Maunsell, 2020). It is claimed that dyslexia may manifest very strongly in the L2 but very mildly in the L1 and that the reasons for this are many and complex. For instance, if L2 has a more extensive vocabulary with fewer word repetitions, the manifestation of dyslexia could be stronger in L2 than in L1 (Geva & Ryan, 1993). Dyslexic difficulties can be reduced in L1 if the subject acquires compensatory strategies over time, but when introduced to a new language and culture the difficulties may become more visible in L2 (Maunsell, 2020).

One of the few studies to investigate bilingual reading in adults with and without dyslexia, also concluded that dyslexic difficulties are visible in both L1 and L2 (Oren & Breznitz, 2005). The reading difficulties investigated related to both accuracy and response time in word reading and nonsense word reading. When both groups were tested in L1, accuracy was similar for both. When tested in L2, those with dyslexia had worse performance in both accuracy and response time. When different tasks of RAN were introduced to bilingual readers with and without dyslexia, the dyslexic group scored consistently lower than bilinguals without dyslexia. Slow naming speed is a hallmark of dyslexia that studies have shown is persistent into adulthood (Araújo & Faísca, 2019; Araújo et al., 2021). It is the time between offset gaze to an object and the onset of naming in RAN tasks, that is slower for dyslexics than for the control group (Araújo et al., 2021, p. 542). This is probably due to a less optimal mapping of phonological representations onto articulatory commands, and it is possibly caused by deficits in attention control or multi-item coordination. Nevertheless, we do not yet have a clear picture of the relationship between RAN tested in L1 and L2, and how or if, proficiency influences the results of RAN tested in L2.

5. Diagnosing Dyslexia

5.1. Identifying dyslexia by cut-offs or as a continuum?

In many studies, dyslexia is approached as a continuum (e.g., Peterson & Pennington, 2012; Rose, 2009; Snowling et al., 2020; Wagner, 2018). Siegel (2006) argues that; "The distinction between dyslexia and normal reading is arbitrary; where the cutoff point is drawn varies from study to study (Siegel, 2006, p. 581)". Different cut-offs have adverse consequences for dyslexia research, as they could lead to people being included as dyslexics in one study but excluded in another. One can compare this with the obstacles met by Waesche et al. (2011) who used alternative operational definitions of dyslexia on the same sample and demonstrated poor agreement in the identification of people with dyslexia. Arbitrary cut-offs are therefore unhelpful. On the other hand, without a clear cut-off, it is hard to distinguish between normal reading and dyslexia. It is therefore valid to ask how one should distinguish between them.

Wagner (2018) suggests that one could avoid the use of cut-off scores and instead recognize dyslexia as a continuum by describing different degrees of dyslexia. The continuum would then range from a non-degree of dyslexia to mild, moderate and, severe. This idea is supported by the Rose report (2009) which also emphasizes that dyslexia is best understood as a continuum. Snowling et al. (2020) argue that in medical terms there are a lot of diseases that do not have a cut-off point, but no one argues whether a patient should get treatment or not. They also state that "Dyslexia is a dimensional disorder, however, with no clear cut-off from poor reading" (Snowling et al., 2020, p. 508).

Moving towards an understanding of dyslexia as a continuum necessitates changes in the approach to the treatment and support that a dyslexia diagnosis can generate. If everyone is somewhere on a continuum, it should be the perceived need for support that generates help, rather than a diagnosis. However, Snowling et al. (2020) point out that even though there is no clear boundary between having dyslexia and being a poor decoder, there is still a difference between the two groups. The main difference is the response to intervention (RTI), which is lower for people with dyslexia than for poor readers (Lyon et al., 2003; Rose, 2009). Therefore, despite the understanding of dyslexia as a continuum, the possibility remains that there is a difference between a dyslexic difficulty and a more general reading difficulty and that dyslexia may have more serious consequences for those living with this difficulty.

5.2. How to diagnose dyslexia

There seems to be an agreement that when identifying dyslexia one cannot rely on a single indicator, but instead include tests that tap into a wide range of skills related to reading (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; Wagner, 2018; White et al., 2006). This broad approach emphasizes the importance of assessing a person's reading skills as a whole when diagnosing dyslexia. A number of different tasks that investigate decoding are frequently employed such as verbal and non-verbal reasoning, vocabulary, speed of processing, short-term memory, phonological awareness, rapid naming, arithmetic, reading comprehension and spelling (e.g., Hatcher et al., 2002; Hedman, 2012; Lindgrén & Laine, 2007; Mee Bell et al., 2003; Tops et al., 2012). Although these tests are commonly used to identify dyslexia, it is not common to put all of them into one test battery. The studies these examples are taken from make use of a selection of them. Critically, instead of focusing on specific tests, the focus should be on what skills the tests reveal.

Some of the commonly used tests measure speed, accuracy, or a combination of both (Reis et al., 2020). In addition, most of the test batteries also contain some sort of self-report on how the subjects experience their reading skills. It is known that adults are aware of their reading skills, as self-report of reading skills are confirmed by behavioural tests of reading (e.g., Gilger, 1992; Gilger et al., 1991; McGonnell et al., 2007; Schulte-Körne et al., 1997; Snowling et al., 2012; Wolff & Lundberg, 2003). This makes it possible to investigate whether there is a family history of dyslexia based on a questionnaire self-report which is important since a family history of dyslexia is an indicator of dyslexia (e.g., Carrion-Castillo et al., 2013; Snowling & Melby-Lervåg, 2016; Thambirajah, 2010). It is also important to make sure that a reading difficulty is not the result of inadequate reading instruction (Griffin et al., 1998). Questionnaire data can also be used to assess if adequate help and support were given when learning to read.

In Norway, the most common test battery is called LOGOS and it investigates fluency, reading comprehension, listening comprehension, word reading, pseudoword reading, phonemic awareness, short-term memory, rapid naming, vocabulary, processing speed, and spelling (e.g., Høien, 2012; Nergård-Nilssen & Hulme, 2014). It is a computer-based test that only certified instructors are allowed to administer, with the instructor guiding the participant throughout the test. Prior to testing, the participant or their guardian answers questions related to language development, reading instruction, family history and reading difficulties. Logos measures speed and accuracy in the reading tests and uses a combined score for assessment in which accuracy is divided by response time (Høien-Tengesdal & Høien, 2012). An individual's score is assessed against expected results given age and education levels. Logos can be used with children, adolescents, and adults with Norwegian as their native language.

It has been suggested that fewer tasks are needed to identify dyslexia in adults in higher education (Hatcher et al., 2002; Tops et al., 2012). A study of 23 adult participants with dyslexia and 50 without dyslexia revealed that only four tests identified reading difficulties with 95% accuracy (Hatcher et al., 2002). The participants were tested with a total of 17 different tests (Verbal ability by defining words, Non-verbal ability by non-verbal reasoning, Single word reading, Decoding ability in nonsense passage reading, Proofreading, Spelling, Speed of processing, Verbal short-term memory subtests of working memory, Numerical abilities, Spoonerisms by manipulating phonemes, Rapid naming, Semantic fluency, Phonemic fluency, Rhyme fluency, Writing speed by copying sentences, accuracy based on time and Attention and organisational skills). Tests of reading, spelling and pseudoword reading led to an accurate classification of 91.8% of all cases – 78% of dyslexics and 96% of the control group. When the spoonerism task was added, identification of the dyslexic group increased from 78% to 82.45%. With the inclusion of writing speed, 95.9% of cases were correctly classified. The authors concluded that it should be possible to diagnose dyslexia in adults through a small number of tests.

Tops et al. (2012) extended Hatcher et al.'s (2002) study with 200 students who were native Dutch speakers. Hatcher et al. (2002) tested only 73 students from a single English university. Tops et al. (2012) concluded that three tests were enough to diagnose dyslexia in adults: word reading (reading aloud as many words as possible at a limited time), word spelling (correcting words that are spelt wrong and measuring writing speed when writing words read aloud at a limited time), and phonological awareness (spoonerism – switch the first letters in Harry Potter – Parry Hotter, and reversals task – judging whether two spoken words were reversals or not – rac/car). The addition of more tests did not increase the quality of the identification of dyslexia. Together these studies suggest that it is possible to diagnose dyslexia in adults in higher education with fewer tests than for the diagnosis of children. The test battery should include tests of decoding skills – both word reading and nonsense word reading – and should measure both speed and accuracy, together with a test of phonological awareness, and word spelling. The underlying assumption here is that basic skills are established in adults even if they have reading difficulties, whereas children are developing their reading skills.

5.3. Factors that complicate the process of diagnosing bilingual dyslexia

The acquisition of a child's L1 is considered to be a spontaneous and unconscious process (Saville-Troike & Barto, 2016). In contrast, when we learn a new language at a later point in life, we already have a mature L1 system in place. Prior knowledge from L1 can be transferred to L2. This transfer can have both positive and negative effects. Positive transfer occurs when structures from L1 are also appropriate for use in L2 (Chung et al., 2019). Negative transfer occurs when the structures from L1 are inappropriate for the L2.

As discussed in section 4.2, reading skills are transferred between languages. In addition, the bilingual reading process is more complex because all known languages are active during reading (Dijkstra & Van Heuven, 2002). Word recognition in bilinguals is influenced by cognates and interlingual homographs, and by the size of orthographic neighbourhoods in both L1 and L2 (e.g., Desmet & Duyck, 2007; Kroll et al., 2014). It is therefore more difficult to assess whether reading speed is an expression of a reading difficulty or simply an expression of a normal bilingual reading process. In adults, reduced reading speed is often the marker of reading difficulties (Reis et al., 2020), but this may be different for bilinguals who must engage in additional language control processes (Bialystok, 2011). Moreover, decoding efficiency in both speed and accuracy is influenced by language proficiency level (Koda, 2007). A lack of knowledge about how to control for these factors is a major problem in diagnosing dyslexia in bilinguals. For example, there is a moderate to strong connection between RAN and reading performance (Araújo et al., 2015), but we have little knowledge about the relationship between RAN tested in L1 and RAN tested in L2. We therefore do not know if RAN tested in L2 can be trusted as an indicator of reading difficulties.

Miller-Guron and Lundberg (2000) investigated how people with dyslexia read in their L2. The sample was 30 students the age of 17 – 35 who had Swedish as their L1 and English as their L2. 10 were dyslexics who preferred reading in their L2 (English), 10 were dyslexics who preferred reading in L1 (Swedish), and 10 were regular readers that preferred reading in L1 (Swedish). When tested in both L1 and L2 the readers without dyslexia outperformed both the groups with dyslexia. This was the case in both word recognition and word reading efficiency. The dyslexic groups were slower to complete a spoonerism task than those without reading difficulties, and twice as slow in nonsense word reading. The group of people with dyslexia who preferred reading in L2 outperformed the dyslexics who preferred reading in L1, but there was still a difference between L2 readers with and without dyslexia. However, there was also a considerable degree of variance in the dyslexic's L2 word recognition skills and L2 reading ability. This suggests that a reading difficulty in L1 will also be visible in L2 but the scale for dyslexic reading ability in L2 must not be too narrow.

Hedman (2012) investigated if reading difficulties in L2 learners stemmed from dyslexia or issues associated with L2 acquisition. They also showed that second-language learners with dyslexia can have a greater variation in decoding processing than monolinguals without dyslexia. This is in line with other findings from the L2 reading of people with dyslexia (Miller-Guron & Lundberg, 2000). A lack of knowledge concerning variation in dyslexics' L2 decoding processing, is problematic for the diagnosis of dyslexia in L2.

Cross-language transfer studies suggest that phonological awareness and other reading skills transfer across languages (e.g., Chung et al., 2019; Patel et al., 2022; Wawire & Kim, 2018). It has also been argued that reading difficulties should be present in all languages that a bilingual person masters (e.g., Geva, 2006a; Oren & Breznitz, 2005). This suggests that being tested in just one language should provide enough information for the correct diagnosis of dyslexia. However, the factors discussed in this section underline why it is difficult to distinguish between reading difficulties caused by dyslexia and reading difficulties caused by bilingualism. Critically, reduced processing speed is often a persistent indicator of reading difficulty in adults with dyslexia (Reis et al., 2020), however, elements of the bilingual reading process also negatively affect the speed of reading.

5.3.1. Socioeconomics

People are born into families, societies, and cultures, and this affects not only what knowledge is considered important, but also how one relates to society and other people. Socioeconomic status (SES) refers to the financial, social, cultural and human capital resources that are available to a person (Cowan et al., 2012). Socioeconomic status is a complex concept that is hard to define. It is often referred to as a family's resources but also the social position of a household. In that context, the term cultural capital is also often used. Cultural capital has proven to be an important dimension when it comes to the socioeconomic impact of school achievement (Myrberg & Rosén, 2009). The degree to which parents have a formal education or not is a key component of cultural capital (Yang, 2003). When PISA (Programme for International Student Assessment) investigated students' socioeconomic background, they assessed only three components; Parent's education, parents' occupation and the index of home possessions (OECD, 2019). It is known that students' reading performance is influenced by parental education levels. It has been speculated that this is due to differences in the educational expectations and aspirations that parents with different educational backgrounds have for their children (Myrberg & Rosén, 2009). According to the 2018 PISA report, SES advantaged students outperformed disadvantaged students in reading (OECD, 2019). Children from low-SES families (both monolinguals and bilinguals), lag behind Children from high-SES families, in measures of vocabulary, grammar, narrative skills, phonological awareness, and speed of language processing (See Hoff, 2013, for a review). For adults, it is known people with higher education levels read a higher volume at work than those with no formal education beyond high school (Guthrie et al., 1986).

Studies of monolingual children have previously documented that high SES is associated with better linguistic skills (Hoff, 2003, 2006), due to the higher quality of the linguistic environment the children are exposed to. A higher-quality linguistic environment positively influences a child's linguistic and literacy development facilitating the educational levels that can be achieved (Hoff, 2003).

SES has also been shown to be an important confounding factor in some bilingualism studies. For example, according to Morton and Harper (2007), evidence for the bilingual advantage of children was due SES characteristics of the sample tested. Much of this research was conducted on simultaneous bilinguals living in Western countries (e.g., Canada according to Morton and Harper, 2007), where bilingual status was often associated with higher SES and an enriched cultural background. When the bilingual sample in research changed and the children investigated came from families with socioeconomic disadvantages, the advantages of bilingualism were not as clear. Similarly, early evidence for disadvantages associated with bilingualism may be due to the testing of bilingual children with a lower SES background than the monolingual control sample (Barac & Bialystok, 2011). Studies that control for SES when for instance testing IQ, observe no differences between bilinguals and monolinguals.

Bonifacci et al. (2020) investigated literacy skills in bilingual and monolingual children with different SES. 36 children were Italian monolingual, and 22 children were exposed to another L1 than Italian in the family context since birth. All children were in second grade in Italy and were tested for SES levels, decoding and reading comprehension, and spelling. Teachers filled out a questionnaire about the children and the children's parents were interviewed about the children's linguistic history. The results showed that independently of SES, bilingual language minority children were as fluent in reading as monolingual children. Decoding skills were not influenced by SES. However, the results also showed that bilingual children had lower scores in tasks of testing reading comprehension and writing skills. According to the authors, these results were not explained by SES.

There is therefore a lack of clarity in how SES affects bilingual reading skills in particular. Moreover, most research on bilingual reading and socioeconomic status is related to children rather than adults. In line with PISA (OECD, 2019) and other studies on bilingual reading (e.g., Hoff, 2013; Morton & Harper, 2007;

Myrberg & Rosén, 2009), SES measures will also be assessed as part of this project. In the questionnaire developed for this project questions about parents' highest level of education and their occupation are included. The questionnaire is described in detail in Chapter 8.

5.4. Language-independent approaches

Uncertainty remains about which language bilingual reading difficulties can best be tested in. Some have claimed that bilinguals should be tested in both languages they master (e.g., Wagner et al., 2005), while others have claimed that bilinguals' reading skills should be assessed in their first language only (e.g., Durgunoğlu, 2002; Everatt et al., 2004). In this thesis, bilinguals are tested in both L1 and L2 with equivalent tests.

A central claim is that one of the main challenges of dyslexia is learning to connect phonemes and graphemes (Snowling et al., 2020). As mentioned in the introduction to this thesis (Chapter 1), researchers in Denmark have created a language-neutral test that assesses the ability to connect sounds with artificial letters, synthesis them, and use them to read nonsense words (Elbro et al., 2012). According to Elbro et al. (2012), it is possible to make a language-neutral dyslexia test with the smallest possible language bias. DOT is a tool designed to estimate a person's learning potential for the basic processes of reading, rather than their current reading ability. The design of DOT is based on the assumption that dyslexia is a learning disability that affects the acquisition of word identification in reading (Lyon et al., 2003). It measures how much-scaffolded practice it takes to learn to read simple new words written with artificial letters.

DOT has three parts and participants are given a certain number of attempts to master each part. Instructions are given through nonverbal gestures, as DOT is a language-neutral test. The first part is an associated learning task where the participants learn three artificial letters and their association with three sounds that are available in most languages (see Table 1).

Table 1

Artificial letters and their associated sound in DOT, adapted from Elbro et al. (2012)

Artificial letters	Corresponding letter	Sound
╔	S - /s/	As in “sun”
◊	M - /m/	As in “mum”
◘	A - /α/	As in “calm”

The second part of the test involves decoding two-letter nonwords with the newly learned letter-sounds rules, and testing synthesis/phonemic blending. Part 3 is only administered to participants who master part 2. In part 3, the participants are presented with twelve nonsense words made by different combinations of the three artificial letters and their sounds and are asked to read them out loud.

Elbro et al. (2012) present DOT as a dynamic reading measure that is (1) sensitive to dyslexia in an alphabetic orthography, (2) less sensitive than standard reading measures to L2 proficiency and variations in type and amount of schooling, and (3) able to use cut-off points that are valid for both L1 and L2 speakers. 159 adults were tested with DOT, in addition to a traditional measure of word recognition and non-word reading in Danish, and phoneme awareness and nonword repetition. Measures of vocabulary and years in school were also included. The participants were divided into four groups: 1. Native Danish speakers diagnosed with dyslexia: 2. Native Danish speakers who were non-dyslexics: 3. Adult language learners of Danish with possible dyslexia: 4. Adult language learners of Danish who were non-dyslexics. The Danish native speakers with dyslexia had been given an official dyslexia diagnosis before they participated in the study. For the adult learners of Danish with possible dyslexia, teachers rated their reading ability as instructed by the authors of the study. Within the same sample, different reading measures showed significant differences in dyslexia incidences in bilingual readers. In a Danish word reading test, 88% of the participants had a score indicating dyslexia, whereas 48% indicated the same with the DOT test. Hence, DOT measured a lower occurrence of dyslexia in L2 learners compared to standard reading measures tested in L2. In the discussion, the authors expressed concerns that standard reading measures may lead to an overestimation of dyslexia in L2 readers. The results showed that DOT was sensitive to dyslexia since it captured basic difficulties in learning to read words and typical problems with phonological processing. Moreover, DOT was less sensitive than standard reading measures, to L2 proficiency and variations in the amount of schooling. In the DOT test, 76% of the native speakers with a dyslexia diagnosis were unable to form a synthesis of the sounds of the new, artificial letters in DOT. These findings corresponded well with the existing diagnosis, and support the author's claim that DOT measures relevant abilities for the diagnosis of dyslexia. In addition, DOT was highly correlated with non-word reading (.71 in native speakers, and .67 in language learners) and phoneme awareness in non-word tasks (.67 in native speakers, and .52 in language learners). The correlation between DOT and performance in the non-word repetition task was a strong correlation for the native speakers (.65) and moderate (.45) for the language learners. Finally, the same cut-off points in DOT were valid for both L1 and L2 speakers, showing that DOT was valid for all languages included in their study, and providing support for the language-independent nature of the test.

The findings from the DOT (Elbro et al., 2012) are extremely promising. A language-neutral test, that captures the reading skills of all readers, regardless of language proficiency and years of education, would facilitate the work of professionals who need tools for the identification of reading difficulties in bilinguals. A limitation in Elbro et al.'s (2012) study is, however, that only participants with Danish as an L1 had their reading skills tested in their L1 using standard reading measures. The language learners of Danish were tested with DOT and then tested with L2 reading measures. Uncertainty therefore remains about the actual reading skills in L1.

The use of DOT as a part of the assessment of bilingual reading is a new approach in Norway. It is therefore of crucial importance to investigate whether DOT can contribute to identifying reading difficulties in adult sequential bilinguals. Therefore, the DOT is included in the test battery designed for this thesis.

5.5. The situation in Norway: Bilinguals and dyslexia diagnosis

As mentioned in the introduction (Chapter 1), there is no straightforward route to diagnosis for adult bilinguals in Norway who are concerned that they may have dyslexia. The adult learning centres across Norway that are partners in this project, all describe different procedures for assessing dyslexia in bilinguals. They all share a common frustration; there is no agreed procedure for the correct assessment of dyslexia and reading difficulties for bilinguals. Different adult learning centres operate in different systems in the municipalities in the country.

By Norwegian law (Opplæringslova, 1998§ 5-6), PPT (educational psychology service) is required to help schools assess a student's learning outcomes. This means that they must also assess various learning difficulties. In Norway, there is, unfortunately, no testing tool that is standardized for bilingual readers. Logos is one of the most common assessment tools used for diagnosing dyslexia in Norway (Monsrud & Andresen, 2023). However, it is made and normed for those with Norwegian as their first language (e.g., Høien, 2012; Nergård-Nilssen & Hulme, 2014). These norms are unlikely to be valid for people with a first language other than Norwegian (Messick, 1993). The lack of a testing tool for bilinguals is a key reason that it is hard to be diagnosed with dyslexia as a bilingual.

On behalf of The Norwegian Directorate for Education and Training, a testing tool named FLORO has been developed (Bøyesen, 2012). FLORO is an abbreviation for the Norwegian words for multilingual word memory, RAN and word repetition. In FLORO participant’s skills are tested in their L1. For the moment FLORO is available in twenty languages in addition to Norwegian. The purpose of FLORO is *to assist* in the assessment of bilingual and multilingual people with possible language or reading difficulties so that this group can get access to the help described in the legislation. It is emphasized, however, that FLORO is not standardized and that the test results cannot stand alone. The results from FLORO must be used as part of an overall assessment of the test subject's skills. To be able to use FLORO one has to be a certified test instructor, often PPT or schools are not certified. In addition, a possible source of error in FLORO is that the test instructors often test people in languages they do not know, as it is unlikely they are familiar with more than 20 languages.

On behalf of the Ministry of Justice and Emergency Preparedness in Norway, DOT (Elbro et al., 2012) was trialled on a small scale in 2017. This was done because adult learning centres reported that when people had difficulties with second language acquisition it was hard to determine if the cause was dyslexia, low educational background or lack of reading and writing skills. 56 participants with Norwegian as an L2, and 10 participants with Norwegian as an L1 completed the test (Arnesen et al., 2018). The findings suggest that DOT has some accuracy in capturing reading and writing difficulties, but that it might not be precise enough. More research was recommended.

The situation in Norway is therefore non-optimal for bilinguals who wish to be examined for possible reading difficulties. It is somewhat arbitrary whether one gains access to testing, as it can vary across places of residence. Moreover, if access is gained, there are no standardised evaluation procedures: diagnosis is dependent on which professionals one meets and what kind of specialist knowledge they have.

6. The languages in this thesis

This chapter provides a very brief overview of the languages in this thesis. It is a very comprehensive and daunting task to describe all aspects of a language but that will not be necessary here. The focus of this thesis is on bilingual decoding of single words. Thus, the descriptions of languages in this chapter are kept short and only outline the aspects of each language that are relevant to this study.

6.1. Languages in this study

This study investigated speakers of 4 languages, Norwegian, English, Polish and Somali. The inclusion of more than one L1 and only one L2 (Norwegian) opened the possibility to investigate bilingual decoding in a broader sense and to investigate bilingual patterns across several very different languages. At the same time, it also made the statistical analyses more interesting, but also more challenging. Norwegian was not only chosen because the research was carried out in Norway but also because one of my primary goals was to investigate an issue that is relevant to Norwegian society. English, Polish and Somali were chosen for multiple reasons, such as accessibility. Large groups of L1 speakers of these languages live in Norway and thus would hopefully increase the possibility of recruiting enough speakers for the study. Secondly, for ease of comparison and to restrict potential sources of errors, it was necessary to choose languages that have alphabetical orthographies as Norwegian also has. English, Polish and Somali all have alphabetical orthographies – although the length of time the alphabetical orthography has been used in these languages varies. The depth of orthography also varies between these languages.

In the following sections, I will give brief descriptions of the languages included in this study, highlighting the phonology and orthographic systems as they are the most relevant to this thesis.

6.1.1. Norwegian

Norwegian is a North Germanic language closely related to Swedish and Danish (Rehm & Uszkoreit, 2012). Norwegian has many dialects and two official written standards, *Bokmål* and *Nynorsk*, whereas Bokmål is the most widely used (Kristoffersen, 2000). About 87% of the inhabitants of Norway maintain that Bokmål is their preferred written variety (St.meld. nr. 35, 2008). This is why

Bokmål is the written variety chosen for this project. The pronunciation of Norwegian has played a fundamental role in the development of the two written standards. However, there is no official authorised dialect or way of speaking Norwegian (Kristoffersen, 2000), reflected in the fact that there is no standard pronunciation dictionary as is found in the other Scandinavian languages. The multitude of dialects in Norway can be very challenging for learners of Norwegian as a second language.

The Norwegian alphabet is based on the Latin alphabet plus three additional vowels, *æ*, *ø*, *å* making for a total of 29 letters. The alphabet has 9 vowels and 20 consonants. The letters in the Norwegian alphabet are Aa Bb Cc Dd Ee Ff Gg Hh Ii Jj Kk Ll Mm Nn Oo Pp Qq Rr Ss Tt Uu Vv Ww Xx Yy Zz Ææ Øø Åå.

Alongside these letters, Norwegian has a rich phonological system with 24 consonant phonemes and 19-22 vowel phonemes monophthongs according to how the diphthongs are classified. Norwegian has phonological length distinctions on vowels as well as consonant words medially (Kristoffersen, 2000). This is illustrated by the phoneme inventory of the East Norwegian[1] presented below and it is divided into vowel and consonant inventory.

1. Vowel Inventory:
Monophthongs (Kristoffersen, 2000, p. 13)
Long: /iː yː ʉː uː eː øː oː ɑː/
Short: /i y ʉ u ɛ œ ɔ ɑ/

Diphthongs (Kristoffersen, 2000, p. 19)
Common: /æj œj æw/
Marginal: /ɔj ʉj ɑj/

2. Consonant inventory (24 consonant phonemes) (Kristoffersen, 2000, p. 22):

/p b t d ʈ ɖ k g m n ɳ ŋ f s ʂ ç h ɾ l ɽ ɭ ʋ w j/.

[1] East Norwegian is used here because it is the dialect group most intensively studied as well as the variety with most speakers.

The relationship between orthography and phonology in Norwegian is considered to be more transparent than English, but less transparent than other languages, e.g., Finnish and is therefore called a semi-transparent system/language (Solheim et al., 2018). Although there is a great deal of regularity in the sound-letter correspondences in Norwegian, still consonant clusters may be orthographically challenging (Hagtvet et al., 2013). The phonotactics of Norwegian allow consonant clusters of maximally 3 segments word initially or word finally. Norwegian also has words without onset, e.g. *asp* “aspen” (Kristoffersen, 2000). Norwegian is a language with a lexical tone that can differentiate words otherwise phonological identical. Similar to Swedish, most Norwegian dialects have two word-tones or melodies referred to as accent 1 and accent 2 that can differentiate between words such as *aksel* which spoken with accent 1 means “shoulder” and with accent 2 “axel” as in a part of a car. This can also be challenging for L2 learners of Norwegian. The tonal difference is not signified in the written language which could be problematic for reading. It is nevertheless challenging for L2 learners of Norwegian in comprehension and language production.

6.1.2. English

English is also a Germanic language belonging to the West Germanic group of Indo-European languages (Bammesberger, 1992) and is related to Frisian, German and Dutch. It has its origin in the south of England but is today the native language for people in many countries, including mainly the United Kingdom and Ireland, the USA, Canada, Australia, New Zealand and South-Africa. As a second language, English is the most widely learned language in the world.

The English alphabet is based on the Latin alphabet and consists of 26 letters. There are 6 vowels and 20 consonants (Dryer, 2013). The letters in the English alphabet are Aa Bb Cc Dd Ee Ff Gg Hh Ii Jj Kk Ll Mm Nn Oo Pp Qq Rr Ss Tt Uu Vv Ww Xx Yy Zz.

Similar to Norwegian, English also has a rich phonological system with 19 vowel phonemes and 24 consonant phonemes. English has a length contrast in vowels, comparable to Norwegian, but accompanying the length contrast is a tense-lax contrast as well in English. Therefore, long vowels are produced longer than short vowels with tensing in the tongue and short vowels are produced shorter with a lax tongue, e.g., *beat-bit* (Koenig, 1994). There is no length distinction in consonants. The phoneme inventory of Standard Southern British English is illustrated below.

1. Vowel Inventory (McMahon, 2002):
Monophthongs:
Long: /iː ɜː uː ɔː ɑː/
Short: /ɪ ɛ ʊ ʌ ɒ æ /

Diphthongs: /eɪ aɪ ɔɪ oʊ aʊ ɪə eə ʊə/

2. Consonant inventory (McMahon, 2002):

/p b t d k g m n ŋ f v θ ð s z ʃ ʒ h tʃ dʒ ɾ l j w/

The relationship between orthography and phonology in English is not straightforward. English is considered to have a deep orthography which means that there is a significant disagreement between spelling and pronunciation (Kessler, 2003). Letters and phonemes are far from having a one-to-one correspondence in English spelling, and consonant clusters are very common. The phonotactics of English allow onsets of syllables to consist of zero to three consonants and the coda from zero to four consonants.
The English language is not tonal, and pitch changes in words do not change the meaning of words but are used to indicate, e.g., attitude, focus, type of sentence, i.e. questions or statements (Duanmu, 2004).

6.1.3. Polish

Polish belongs to the West Slavic group of the Indo-European languages (Swan, 2002) and is most closely related to Slovak and Czech. Today there are five main territorial varieties of Polish dialects, and contemporary standard Polish is based on the Warsaw variant (Comrie & Corbett, 2002; Dziubalska-Kołaczyk & Walczak, 2010). Standard Polish is spoken or understood throughout the entire country (Swan, 2002). Polish has a long history as a written language. In the 16th

century, Polish orthography established itself in its primary shape, but changes have been made to modernise the language since then (Dziubalska-Kołaczyk & Walczak, 2010).

The Polish alphabet is based on the Latin alphabet and has 35 letters. Of these letters, 9 are vowels and 26 consonants (Sadowska, 2012). The letters *q*, *v*, and *x*, are only present in loan words and are sometimes not included when the Polish letters are counted. In Polish, diacritics are used to mark a specific pronunciation that differs from the pronunciation of a standard Latin letter (Swan, 2002). The letters in the Polish alphabet are Aa Ąą Bb Cc Ćć Dd Ee Ęę Ff Gg Hh Ii Jj Kk Ll Łł Mm Nn Ńń Oo Óó Pp (Qq) Rr Ss Śś Tt Uu (Vv) Ww (Xx) Yy Zz Źź Żż.

Compared to Norwegian, Polish has fewer vowel phonemes with 8 (6 oral and 2 nasal) but has a larger inventory of consonants with 36. Polish does not have a quantity contrast in vowels or consonants. The phoneme inventory for Polish is listed below adapted from Gussmann (2007). It is divided into vowel and consonant inventory.

1. Vowel inventory:
Monophthongs: /i ɨ ɛ a u ɔ/
Diphthongs: /ɛ̃ʷ ɔ̃ʷ/.

2. Consonant inventory:

/m n ɲ l r p b t d k g f v s z ɕ ʑ ʃ ʒ ç x ts dz tɕ dʑ tʃ dʒ w/

Polish has a very rich inventory of positional variants of the consonant phonemes (allophones) that are not listed here (Gussmann, 2007). In writing, the letter "*i*" has a prominent function. It has four different roles (Comrie & Corbett, 2002; Swan, 2002), but the most frequent function is to indicate that a preceding consonant is soft or palatalized. This can happen before the vowel "*i*" or before another vowel. These are examples of positional variants.
The relationship between orthography and phonology is considered to be transparent. The Polish language is viewed as having a shallow orthography (Dębska et al., 2016) and there is regularity in the sound-letter correspondence.

Polish phonotactics like to have consonants in the onset and coda and allow clusters of 4 consonant words initially and up to 5 consonant words finally (Zydorowicz & Orzechowska, 2017). Words beginning with vowels often have an additional gesture like a glottal stop or glide (j, w). Polish is not a tonal language.

6.1.4. Somali

Somali is an Afroasiatic language, belonging to the Cushitic language group. Somali has a long oral tradition (Saeed, 1999), but a relatively short tradition as a written language and therefore differs from the three other languages. Somali has three major dialects that are associated with the north of Somalia, the coast of Somalia (Benaadir) and the central parts of Somalia (Maay). Modern Somali is mostly based on Northern Somali and is often called “Standard Somali” (Husby, 2004; Saeed, 1999), even though it is not standardized. The Northern dialect group encompasses a wider geographically widespread than what the name implies. In 1972 a new standardized orthography for the Somali language was announced by the president. Before this, Somali had no established written tradition and Arabic, Italian and English were used in official written communications. The implantation of Somali as a written language was quite rapid, and there were mass literacy campaigns in several periods from 1972 to 1975 (Husby, 2004; Saeed, 1999).

The Somali language today is based on the Latin alphabet and has 22 consonants and 5 vowels, and the vowels can be long or short (Green, 2021). When written down the long vowels are marked with doubling the vowels (the word “geeri” should be read with a long vowel) (Abdillahi et al., 2006; Husby, 2004). The letters in the Somali alphabet are b t d dh j k g q f s sh kh x c h m n r l w y i/ii e/ee a/aa o/oo u/uu (Green, 2021, p. 25).

The phoneme inventory for Somali is controversial in that it depends on what is considered to belong in the phoneme inventory. According to Green (2021), Somali has both long and short vowels and diphthongs totalling 20 vowel phonemes and 19 consonant phonemes. Green's vowel inventory is so large because Somali has vowel harmony where vowels in a word must match for tense/lax and for his analysis he sees two sets of 5 contrastive short vowels /i e æ ɤ, ɯ/ /ɪ, ɛ, a, ɔ, u/ that all have contrastive long counterparts. The inventory below is based on Saeed (1999) which does not take into account the phonological process of vowel harmony which is more in line with the descriptions of the phoneme inventories of the other languages in this study.

1. Vowel inventory (Saeed, 1999):
Long: /iː eː æː ɐː ʉː/
Short: /i e æ ɐ ʉ/

Diphthongs: /aw aj ej oj ow/.

2. Consonant inventory (Saeed, 1999):

/b m n t̪ k q d̪ ɖ g tʃ dʒ f s ʃ x ħ h ʕ l j ʍ r/

According to Green (2021), Somali not only has a quantity contrast in the vowels but also consonants can be long or short in word medial or word-final position. These will be written with double letters bb, dd, gg, mm, and nn, and correspond to the phonemes /bː/ /dː/ /gː/ /mː/ /nː/. The relationship between orthography and phonology is considered transparent. Somali has a shallow orthography and is considered easily learned by a Somali speaker (Andrzejewski, 1983). It is regularity in the sound-letter correspondences in Somali. Somali does not allow consonant clusters in the onset or the coda.

Somali also has a tone system. When spoken, Somali has a contrast between three tones (Saeed, 1999), but similar to Norwegian, they are not marked in writing. These are High, Low and Falling from high to low. These tones are used to mark lexical as well as grammatical differences, e.g. different tones are used to mark the singular or plural of a noun.

6.2. Chapter Remarks

The purpose of this chapter was to provide a brief overview of the orthography and phoneme inventories of the languages included in this study to give the reader a glimpse of how easy or difficult the decoding process is in each language. In designing the equivalent tests in all four languages, considerations of language similarities and differences were as far as possible taken into account. These considerations were a part of why I claim that the tests developed for this project, are equivalent. For the task of the experiment which was created to be language-independent (working memory), considerations of the phonotactics in all the first languages were taken.

7. The current project

In this chapter, the research question and the hypothesis for this thesis are presented. The research questions come as a result of the theory about reading, reading difficulties and bilingualism, as well as questions that remain after other empirical research has shed light on opportunities and challenges with the theme. Overall, this thesis is about conditions related to reading difficulties and bilingualism. Adults who are sequentially bilingual with English, Polish and Somali as their first language and Norwegian as their second language have answered a questionnaire and then they are tested with equivalent tests in L1 and L2. They have also been assessed with DOT (Elbro et al., 2012) to explore a new approach to examining bilingual decoding skills. To be able to assess whether there is a correlation between testing reading-related skills in L1 and L2 and to investigate whether such results are reliable when tested in a second language, underlying factors related to reading skills, bilingualism and L2 proficiency level must also be investigated.

The research questions are presented below, but the guiding research question for the whole thesis is: " Can decoding difficulties be identified in a second language?”.

7.1. Research question

Previous studies have shown that when people are asked to self-rate their reading behaviour the results correlate with behaviour measures (e.g., Jia et al., 2002; Marian et al., 2007; McGonnell et al., 2007; Snowling et al., 2012). It is also known that reading outcomes are affected by factors such as education, reading experience and socioeconomic background. Consequently, such factors are important to consider when assessing bilinguals' decoding skills. With the research questions below I want to investigate which underlying factors affect the participants' assessment of their skills on reading and language proficiency as well as the results on the equivalent decoding tests. This will be important for understanding which factors can influence the results in second language testing.

The research questions for this project are, therefore:

- RQ1: What are the underlying factors that explain variance in adult sequential bilingual profile data including self-ratings of reading behaviour and proficiency in L1 and L2?

- RQ2: To what degree do individual differences in these underlying factors predict performance in objective tests of decoding skills (word and pseudoword reading)?

The next research questions are formulated based on the assumption that bilinguals must have a high degree of L2 spoken proficiency before reading-related skills can be examined in L2. I therefore investigate whether L2 spoken proficiency does predict unique variance in the objective L2 tests. I investigate whether the association between L1 and L2 testing is moderated by L2 spoken proficiency. The presence of an interaction effect would indicate that the relationship between L1 and L2 word reading differs as a consequence of the level of L2 spoken proficiency. Knowledge about this is important to be able to evaluate whether all bilinguals, regardless of L2 spoken proficiency, can be tested in a second language.

- RQ3a: Does L1 task performance explain unique variance in L2 task performance?
- RQ3b: Does L2 spoken proficiency (Norwegian) explain unique variance in L2 task performance when L1 task performance is considered?
- RQ3c: Does L2 spoken proficiency (Norwegian) moderate the association between L1 and L2 task performance?

These questions are asked in turn of the following tasks: word reading, pseudoword reading, phonemic awareness, and RAN, in order to address RQ4.

- RQ4a: Do the answers to the research questions under RQ3 differ for different measures of reading related skills?

If it is possible to identify bilinguals with low decoding skills using a language-neutral test, then a new and simpler way of identifying this group has been obtained. Investigating DOT's ability to predict low decoding performance is to investigate whether a new approach can contribute valuable insight into the assessment of bilinguals' decoding skills. Another approach is to investigate whether more traditional decoding tests in L2 predict the low decoders. The answer to this question could provide new insight into whether it is possible to identify bilinguals' low decoding skills in a second language.

- RQ5: To what degree does a language-neutral dynamic test of decoding (DOT) predict low L1 pseudoword reading?

- RQ6: To what degree do phonological awareness and pseudoword reading assessed at L2 predict low L1 pseudoword reading?

7.2. Hypothesis

- RQ1: What are the underlying factors that explain variance in adult sequential bilingual profile data including self-ratings of reading behaviour and proficiency in L1 and L2?

In line with previous research, one would predict that reading performance in both L1 and L2 decoding tests will be affected by ratings of language proficiency (Marian et al., 2007). It is less clear how socioeconomic background will affect reading performance as previous research has shown that age can influence whether socioeconomic background has a direct influence on reading ability (Howard et al., 2014). In addition, this thesis aims to add literature by investigating the effects on reading performance of language usage and multilingualism, as well as self-reported reading difficulties but it is not possible to predict how these underlying factors may explain variance.

- RQ2: To what degree do individual differences in these underlying factors predict performance in objective tests of decoding skills (word and pseudoword reading)?

Hypothesis: I expect that underlying factors predict performance in objective tests of decoding skills (Bonifacci et al., 2020; Howard et al., 2014; Oller et al., 2007), but it is uncertain which factors it will be and to what degree.

- RQ3a: Does L1 task performance explain unique variance in L2 task performance?

Hypothesis: The hypothesis for RQ3a is that L1 word reading does explain unique variance in L2 word reading and that L1 pseudoword reading also will explain unique variance in L2 pseudoword reading. Pseudoword reading and word reading are measures of decoding skills and studies have confirmed a correlation between decoding skills in L1 and L2 (e.g., Oren & Breznitz, 2005; Yang et al., 2017). For phonemic awareness, the hypothesis is that L1 phonemic awareness will explain unique variance in L2 phonemic awareness (Goodrich et al., 2014), but it is not clear to what extent. Previous research has shown that there is a cross-linguistic transfer between L1 and L2 phonemic awareness (e.g., August et al., 2009; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018) and this increases the possibility that the same process is being tested in L1 and L2. The stimuli used in the phonemic task is pseudowords and this makes it hard to predict the extent of variance explained. For RAN it is difficult to make a clear hypothesis. Previous research has investigated whether the effect of L1 RAN could transfer to L2 reading (Georgiou et al., 2022), but as far as I know, there are no studies that have compared the results from L1 RAN to L2 RAN and examined the influence of L2 spoken proficiency.

- RQ3b: Does L2 spoken proficiency (Norwegian) explain unique variance in L2 task performance when L1 task performance is considered?

Hypothesis: L2 spoken proficiency will explain unique variance in L2 word reading. The consequence of being fluent in L2 is having a large vocabulary and automatized skills regarding grapheme-to-phoneme correspondences and therefore the ability to quickly recognize most words presented. At a low level of L2 spoken proficiency, the vocabulary will be smaller, and grapheme-to-phoneme conversion will be slower, many words will be perceived as nonwords. Previous studies have shown that increased L2 proficiency has a positive effect on word and pseudoword decoding (van de Ven et al., 2018). It is expected that those with high L2 spoken proficiency will be able to make use of the direct route/lexical route (Castles, 2006) when reading and therefore be more efficient than those with low L2 spoken proficiency who use the indirect route.

In contrast to word reading, however, the prediction is that L2 spoken proficiency will not explain unique variance in L2 pseudoword reading (RQ3b). In pseudoword reading, it is not possible to have direct access to a word since all words are constructed (Castles, 2006). This forces the reader to decode the word through an indirect route when reading. In addition, all the participants are familiar with reading within an alphabetic orthography (see Chapter 6) and can therefore use the strategies they already know to decode unfamiliar words (Byrne & Fielding-Barnsley, 1989).

For L2 phonemic awareness it is predicted that L2 spoken proficiency will not explain unique variance. As mentioned in the hypothesis for RQ3a, only L2 pseudowords were used as stimuli in the L2 phonemic awareness task. This increases the possibility of the task not being influenced by L2 spoken proficiency.

Even though no studies have examined the influence of L2 spoken proficiency on L2 RAN the hypothesis is that L2 spoken proficiency will to some degree explain unique variance in L2 RAN since real words (numbers) are used in this task.

- RQ3c: Does L2 spoken proficiency (Norwegian) moderate the association between L1 and L2 task performance?

Hypothesis: For RQ3c there is no clear hypothesis as this has not been investigated before in word reading. The presence of an interaction effect would indicate that the relationship between L1 and L2 word reading differs as a consequence of the level of L2 spoken proficiency (Norwegian). The situation is the same for this hypothesis applied to pseudoword reading, phonemic awareness, and RAN.

- RQ4: Do the answers to the research questions under RQ3 differ for different measures of reading related skills?

Hypothesis: As seen in the previous hypothesis there is an expectation that there will be a difference in measures of L2 tasks created by pseudowords and real words since L2 proficiency is expected to influence tasks with real words.

- RQ5: To what degree does a language-neutral dynamic test of decoding (DOT) predict low L1 pseudoword reading?

Hypothesis: Due to results from earlier research (Elbro et al., 2012), I do expect the language-neutral test to predict low L1 pseudoword reading.

- RQ6: To what degree do phonological awareness and pseudoword reading assessed at L2 predict low L1 pseudoword reading?

Hypothesis: I am unsure of to what degree phonological awareness and pseudoword reading assessed at L2 predicts low L1 pseudoword reading. The hypothesis for RQ8 relies on the answer to some of the other research questions and is therefore difficult to predict.

8. Method

This chapter provides an overview and description of the instruments and the sample in this project. The measures used in this project were a questionnaire, a dynamic test of decoding, a matched set of tests of reading and reading-related skills in both the first and second language, one language-neutral test, and finally two language-independent tests - processing speed and phonological working memory. In the second part of this chapter, there are descriptive statistics related to the sample and their achievements.

8.1. Measures

The instruments and the languages in each test were carried out, are summarized in Table 2. The tests are presented in the order in which they were carried out.

Table 2

Overview of all measures in this thesis in chronological order

Order	Test	Language
1	A questionnaire	Optional Norwegian or L1
2	The dynamic test	Language neutral
3	Phonemic Awareness	L1
4	RAN	L1
5	Word reading	L1
6	Pseudoword reading	L1
7	Phonological working memory	Language independent
8	Phonemic Awareness	Norwegian (L2)
9	Word reading	Norwegian (L2)
10	Pseudoword reading	Norwegian (L2)
11	RAN	Norwegian (L2)
12	Processing speed	Language independent

The questionnaire was designed to provide a detailed picture of the participants' linguistic background and is thoroughly described in 8.1.1. The questionnaire was available in the participants' L1 (English, Polish and Somali) and their L2 (Norwegian), and it was up to the participants to choose which language they wanted to use (see Appendix 14.4).

The test battery contained cognitive tests where some were directly related to reading such as decoding abilities, while others assessed language skills associated with reading proficiency/dyslexic problems such as the ability to manipulate phonemes or rapidly name digits (e.g., Hatcher et al., 2002; Snowling et al., 1997). The L1 and L2 matched tests were word reading, pseudoword reading, phonological awareness (elision task), and RAN. This selection represents the tasks traditionally used when identifying dyslexia as discussed in Chapter 5. These tests should enable us to build a detailed picture of the participant's decoding skills in their first language. If a decoding difficulty occurs in L1, a decoding difficulty in L2 is likely an actual decoding difficulty and not a result of low proficiency in L2. Conversely, decoding difficulties that only occur in L2, but not in L1, can be assumed to have a cause in proficiency in L2 and not in an actual decoding difficulty. This required matching tests in all languages included in this thesis. Tests in English, Polish and Somali were made according to templates from the Norwegian tests. These tests aimed to have a similar form, degree of difficulty, word frequency, and syllable and phoneme complexity in all languages. Matched tests in L1 and L2 made it possible to examine if testing reading-related skills in L2 is comparable to testing in L1. More knowledge about this may in the future have implications for the field of practice.

The language-independent test (Elbro et al., 2012), was included because it is a new approach to identifying decoding difficulties. A detailed description of this test will be given under point 8.1.9 but it is designed to examine the participant's ability to learn how to decode in an alphabetical orthography by using artificial letters. This corresponds to dyslexia definitions that state that people with dyslexia have difficulties learning to decode (Snowling et al., 2020). It is language-neutral because it contains three sounds that are present in most languages. Therefore, when participants are asked to decode the sounds and artificial letters, there can be no proficiency advantages. This makes it possible to examine whether language skills are associated with reading proficiency.

Combining a language-neutral test with reading at L1 and L2 also allows us to look for a relationship between all three.

Finally, two cognitive tests, processing speed, and phonological working memory were included to examine the underlying cognitive process that might influence a person's reading ability. These language-independent cognitive tests do not involve speech or reading. They use figures or syllables without any meaning, but they are appropriate for all the languages included in this thesis.

The processing speed task was decided to be included in an early phase of my Ph.D.-period. In the beginning of this project, the design was different than what is the final results. Due to COVID-19 restrictions in Norway, it was not possible to carry out the original design. Originally, the plan was to test 240 participants, with a group of dyslexics and a group of regular readers within each language group. The processing speed test was intended to be used as a validation of the groups as I assumed that there should be no group differences between those with and without dyslexia when it came to processing speed. Due to restrictions regarding COVID-19, the design had to be changed and there was no longer a need for validation of group affiliation. For that reason, processing speed is not included in the upcoming analyses in the results chapters (Chapters 9, 10 and 11) as these skills are not relevant to the research questions being asked.

All of the tests, except for the DOT (Elbro et al., 2012), were developed for this project. The individual assessment required a comprehensive one-to-one assessment of respondents.

8.1.1. Questionnaire

The questionnaire was designed to provide a detailed picture of the participants' linguistic background, level of education, reading and writing behaviour, socioeconomic background, language proficiency in both L1 and L2, dyslexia diagnosis, and self-perceived reading difficulties. General inclusion and matching criteria such as age, sex, and native language were also essential parts of the questionnaire. There is evidence that bilingual speakers can self-report their language proficiency in a way that highly correlates with their behavioural performance (e.g., Chincotta & Underwood, 1998; Jia et al., 2002).

8.1.1.1. Design

The questionnaire is based on The Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian et al., 2007). However, significant changes were made to provide data important for this study. The changes to adapt LEAP-Q to this project were first implemented in the Norwegian questionnaire (see Appendix 14.4.1). This was then used as a template when translating the questionnaire into English (see Appendix 14.4.2), Polish (see Appendix 14.4.3), and Somali (see Appendix 14.4.4).

The questionnaire comprises 24 questions and elicits information related to six areas relevant to dyslexia and language background. The first sets of questions elicit information about general inclusion and matching criteria such as age, sex, native language, education, and level of L2. The second set elicits information about language background and language dominance. The third set elicits information about family history, dyslexia diagnosis, and self-perceived reading difficulties. The fourth set examines the participants' reading behaviour in both L1 and L2. The fifth collects the participant's self-rated language proficiency in both L1 and L2. In the final section, information about the participant's socio-economic status is collected.

8.1.1.2 Questionnaire Procedure

The questionnaire was completed with pen and paper, and it was specified that they could ask a teacher or equivalent for help. Participants could also choose whether they wanted to fill out the questionnaire in their L1 or L2. The partners who knew the participants were responsible for the implementation of the questionnaire. For participants recruited from social media, the questionnaire was filled out after reading and signing the consent form and before the dynamic test of decoding and the computer-based testing started. The test instructor could help the participants fill out the questionnaire if needed. Completed forms were checked against the inclusion and exclusion criteria and formed the basis for the individual assessment.

8.1.2. The test battery – reading-related cognitive test

Matched tests on L1 and L2 were carried out on a computer. Native speakers with backgrounds from teaching in adult learning centres in Norway made or assured the quality of the words/pseudowords, used in the test battery. An instructor led the assessment. The participants were assessed in all the L1 tests before they were tested with the L2 test. There was a break between the L1 and the L2 testing. Before each test, a written instruction was displayed on the screen. The instructions were written in the targeted language and an audio file of the text was played at the same time.

8.1.2.1. Phonemic awareness

This test measured subjects' ability to manipulate the phonemes in a pseudoword. They were asked to remove a consonant or complex grapheme from a target pseudoword. For example, the participants were asked to "Say Klosp". Afterwards, they were asked to "Say Klosp without s" → klop. The phonological awareness task was conducted in both L1 and L2. Different sets of stimuli were therefore constructed for each language.

8.1.2.2. Stimuli & design - Phonemic awareness

This task contained eighteen target pseudowords in each language (see Appendix. 14.5). For all languages, there were 4 monosyllabic words and 14 disyllabic words. The position of the phonemes to be removed was kept as similar as possible across the four languages. They could occur in the first or the second syllable in onsets, onsets clusters, offset or offset clusters. The numbers for each position are given in Table 3. The differences between these numbers are due to language constraints, for example, the Somali language does not have consonant clusters. For all languages, there were twelve manipulations in the first syllable and six manipulations in the second syllable.

Table 3

The position of the removed phonemes in the phonemic awareness tasks

Language	First onset	First onset cluster	First offset	First offset cluster	Second onset	Second onset cluster	Second offset	Second offset cluster
Norwegian	3	3	3	3	0	2	3	1
English	3	2	0	7	0	1	2	3
Polish	2	3	5	2	2	1	3	0
Somali	8	0	4	0	3	0	3	0

An English version used in the Experimental Linguistics Laboratory (ELL) at the University of Agder (UiA), was the basis for the development of the Norwegian, Polish, and Somali versions. The Norwegian test was made with inspiration from TOWRE (Torgesen et al., 1999) and Logos (Høien, 2012). The English test was also made with inspiration from TOWRE (Torgesen et al., 1999) and TIWRE (Reynolds & Kamphaus, 2007). Native speakers with backgrounds from teaching in adult learning centres in Norway made pseudowords in Polish and Somali. These were made after investigating the Norwegian and English pseudowords, and by checking each pseudoword against a dictionary in the targeted language to make sure the structure of the pseudoword was the same as in meaning-bearing words. The pseudowords were all pronounceable in the target language. Care was taken to make the pseudowords as similar as possible across languages whilst keeping within the linguistic restraints of each language. The nature of the consonants to be removed on the elision task was also kept as similar as possible across languages as shown in Table 3 above. As mentioned, the Somali language does not have consonant clusters in contrast to Norwegian, English, and Polish (See Chapter 6). Removing a consonant from a consonant cluster is more difficult than removing a single consonant, and the Somali elision task could therefore be easier than the elision task in the three other languages. To increase the level of difficulty, in the Somali task there were two more trials where a complex grapheme was removed than what is the case in the other three languages. The Polish task does not contain any trials with complex graphemes, but it has two trials with language-specific consonants. The consonants and the complex graphemes removed in all languages in the elision task are given in Table 4.

Table 4

The numbers of removed consonants and complex graphemes for each language, in the phonemic awareness tasks

Consonants and complex graphemes	Norwegian	English	Polish	Somali
b	1	0	1	1
d	0	0	1	1
f	0	1	0	0
g	2	0	0	1
j	0	0	2	0
k	1	0	2	1
l	2	3	1	2
m	1	3	0	2
n	3	1	1	1
ń	0	0	1	0
p	2	1	0	0
q	0	0	0	2
r	2	1	2	0
s	3	3	3	1
t	0	2	1	1
w	0	1	2	0
x	0	0	0	1
z	0	1	0	0
ł	0	0	1	0
Total of single Consonants removed	**17**	**17**	**18**	**14**
dh	0	0	0	2
kh	0	0	0	1
kj	1	0	0	0
sh	0	0	0	1
th	0	1	0	0
Total of complex Grapheme removed	**1**	**1**	**0**	**3**

The elision task was entirely auditory so that the participants did not see written versions of the pseudowords. All stimuli and instructions were recorded by native speakers in a sound-attenuated booth (ELL) at the UiA. The recordings were made and edited in Praat version 6.1.16 (Boersma & Van Heuven, 2001) with a sampling rate of 44.1 kh.

8.1.2.3. Procedure - Phonemic awareness

This task was presented on a computer, controlled by an instructor. The order of events on each trial was as follows. The instructions were presented both on the screen and played auditory at the same time. The instructions included an example of the task to make sure the participant understood the assignment. (See the Appendix 14.11 for the full instructions). Both the speed and accuracy of the participant's responses were recorded. Each trial was initiated by the instructor pressing a key on the keyboard. This both started a new trial and the timing of the trial. The same thing (an instructor key press) led to the timing being stopped. After the timing was stopped, the instructor registered the participant's answer as correct or incorrect by pressing 0 or 1. The key 0 was pressed when the answer was correct (zero error), while the key 1 was pressed if the participant answered incorrectly (one error).

8.1.3. Rapid Automatic Naming (RAN)

8.1.3.1. Design

The RAN (Rapid Automatic Naming) task was developed with different versions for L1 and L2. For each language, each task contained two grids of digits. The use of digits allowed the task to be carefully matched across the different languages. For each language, five digits from 1 to 10 were selected such that their names totalled seven syllables in length (See Table 5 for digits selected for each language).

The digits for each language were then entered randomly in a 6x8 grid. In each grid, all monosyllabic number names occurred 10 times. All disyllabic number names occurred 9 times. The total number of syllables in each grid was 66. Two grids were constructed for each language differing only in the order in which the digits appeared (Appendix 14.6). The grids were constructed of black lines on a white background with every second row a light grey.

Table 5

RAN digits selected for each language matched the total number of syllables

Norwegian			**Polish**		
Number	**Syllables**	**Word**	**Number**	**Syllables**	**Word**
1	One	En	**2**	One	Dwa
4	Two	Fire	**3**	One	Trzy
6	One	Seks	**6**	One	Sześć
8	Two	Åtte	**7**	Two	Siedem
9	One	Ni	**10**	Two	Dziewięć
Total	Seven		Total	Seven	

English			**Somali**		
Number	**Syllables**	**Word**	**Number**	**Syllables**	**Word**
1	One	One	**1**	One	Kow
3	One	Three	**2**	Two	Laba
5	Two	Five	**5**	One	Shan
7	Two	Seven	**6**	One	Lix
10	One	Ten	**10**	Two	Toban
Total	Seven		Total	Seven	

It was a desirable principle that the Norwegian numbers should not be the same as the numbers in English, Polish and Somali, as participants would always name both sets, and an interference effect might occur. However, this was not possible for all languages given the need to match syllable length. Therefore, care was taken that there were always one or two overlapping digits in each L1 and the L2 Norwegian set.

8.1.3.2. Procedure - RAN

In the instructions, the participants were told to read the digits aloud as fast and accurately as possible. The instructor of the individual assessment was the one who started and stopped the timing of this task by pressing a key on the keyboard. Each language session comprised two grids and the order of these grids was counterbalanced across participants. Participants were allowed a short rest between grids. The number of errors and the time taken to complete the grid were recorded.

8.1.4. Word and Pseudoword reading

Both word reading and pseudoword reading were designed and carried out in the same way. Participants were to assess whether a written word/pseudoword presented on screen was the same as a word/pseudoword presented auditorily. These tasks had one target word and one foil. Through a single manipulation of spelling, a target word became a foil. See Table 6 for an example.

Tabel 6

Example of stimuli pairs for the word and pseudoword reading tasks

Experiment	Written foil	Auditory target
Words	Bean	Beam
Pseudoword	Tober	Trober

8.1.4.1. Stimuli Word reading

In each language, a set of 40 target words were selected. The sets were matched for word length. In all languages, there were five words with one syllable and fifteen words with two syllables. None of the words was semantically similar and they had a relatively high frequency. The frequency of the words was checked against databases associated with the specific language. The Norwegian words were checked for frequency in a large web-based corpus of Bokmål Norwegian, called NoWac, (UiO, Department of Linguistics and Scandinavian Studies) (Guevara, 2010). NoWac contains about 700 million tokens. For English word frequency, the SUBTLEX-UK was used (Van Heuven et al., 2014). This corpus comprises 201,3 million tokens from 45 099 BBC broadcasts. SUBTLEX-PL was used for the Polish word frequencies (Mandera et al., 2015). This database comprises 101 million tokens from film and television subtitles. The Somali words were checked for frequency in the soWaC database (Guenther & Rinaldi, 2020), a corpus of 71 million words. The soWacs sources have significant input from news, politics, and religious sites on the internet. For this reason, some of the included words were comparatively low frequency, but were included because they are considered well-known words from the everyday speech in Somali. At the same time, the Somali words resembled words included in the Norwegian word reading task since they belong to the same word classes and describe words from everyday life.

For each target word a written foil was selected. The foil was minimally different from the target word. Target and foils were also matched for the number of letters, the number of phonemes, and frequencies (see Table 7 – words and foils selected). It was a goal that the words should belong to the word classes verb, noun, or adjective. This is mostly maintained in all languages, except for one English word which was a preposition, and three Somali words which were adverbs and prepositions. The foils were created through one single manipulation of the target word. For example, one consonant could be removed or added to make a foil. Care was taken to make the manipulations as similar as possible across languages whilst keeping within the linguistic restraints in each language. An overview of the manipulation in all languages in the word reading task is given in Table 8 - Overview of the manipulations in the word reading task.

When constructing the L2 Norwegian word set, I took into consideration that some participants in the sample were likely to be in an early learning phase of Norwegian. The targets and foils were therefore chosen from two textbooks designed for adult immigrants learning Norwegian. Both books were on level A1/A2 (Ellingsen & Mac Donald, 2012; Nilsen & Fjeld, 2009).

Table 7

Matching of target words and foils with letters, phonemes and frequency in the word reading tasks

Norwegian Word reading	**Letters**	**Phonemes**	**Freq. Pr. mill**
Target words gr. 1.	4.60	4.10	40.90
Target words gr. 2.	4.70	4.20	42.30
Total	**4.65**	**4.15**	**39.50**
Foils gr. 1.	4.80	4.30	38.30
Foils gr. 2.	4.90	4.30	40.70
Total	**4.85**	**4.30**	**39.50**

English Word reading	**Letters**	**Phonemes**	**Freq. Pr. mill**
Target words gr. 1.	5.90	4.60	39.89
Target words gr. 2.	5.55	4.50	40.53
Total	**5.73**	**4.55**	**40.29**
Foils gr. 1.	5.80	4.60	39.73
Foils gr. 2.	5.50	4.50	40.84
Total	**5.65**	**4.50**	**40.29**

Polish Word reading	**Letters**	**Phonemes**	**Freq. Pr. mill**
Target words gr. 1.	4.35	4.25	31.55
Target words gr. 2.	4.70	4.55	32.60
Total	**4.53**	**4.40**	**32.08**
Foils gr. 1.	4.50	4.30	33.33
Foils gr. 2.	4.80	4.65	31.70
Total	**4.65**	**4.48**	**32.52**

Somali Word reading	**Letters**	**Phonemes**	**Freq. Pr. mill**
Target words gr. 1.	4.55	4.25	31.62
Target words gr. 2.	4.85	4.05	32.04
Total	**4.70**	**4.15**	**31.83**
Foils gr. 1.	4.50	4.15	32.40
Foils gr. 2.	5.00	4.10	32.05
Total	**4.75**	**4.13**	**32.23**

Table 8

Overview of the manipulations in the word reading task

Manipulations in the word reading task				
	Norwegian	**English**	**Polish**	**Somali**
Altered consonants	5 words	5 words	7 words	7 words
Altered vowels	4 words	6 words	4 words	6 words
Added a consonant	6 words	1 word	5 words	1 word
Changed the order of letters within a word	1 word	1 word	1 word	1 word
Deleted a consonant from a word with a double consonant	1 word	1 word	1 word	
Deleted a consonant	2 words	3 words	2 words	
Changed the first letter of a word	1 word	1 word		
Minimal pairs		2 words		
Added a consonant to make a word with a double consonant				1 word
Changed from long to short vowel				2 words
Changed from short to long vowel				1 word
Total changes	20	20	20	20

The target words were recorded for auditory presentation. A native female speaker of each language produced the targeted words, which were recorded using Praat (Boersma & Van Heuven, 2001).

8.1.4.2. Design – Word Reading

Spoken targets were presented simultaneously together with written words. Each spoken target occurred in two conditions:

1. Condition 1: The spoken target is the same as the written word
2. Condition 2: The spoken target is not the same as the written foil word.

The set of 40 targets in each language was divided into two matched groups of 20. Both group 1 and group 2 had twenty target words and twenty foils. This gave each group forty trials (80 trials in total). All the words were counterbalanced across participants to avoid practice effects on responses to stimuli. Targets occurred in different conditions in each block. To prevent the participants from noticing this the task also consisted of eight fillers that occurred in the same condition both times they were presented.

8.1.4.3. Procedure – Word Reading

This task was presented on a computer and initiated by an instructor. The instructions were presented both on the screen and auditory at the same time. In the instructions, the participants were told to decide as quickly as possible whether the word that was presented auditorily was the same as the word that was presented visually. The participants were pressing the keys “M” or “Z” to respond. The “same” response was always made by the key appropriate for the participant's dominant hand. The participants were given six test trials to make sure that they understood the assignment. (See Appendix 14.11 for the full instructions). Each participant had 40 trials in the word reading task. After every 24^{th} word, the participant was given a short break. Both speed and accuracy were measured by the computer.

8.1.4.4. Stimuli pseudoword reading

The pseudowords were designed to match the spelling rules for the languages in question and to match the word reading task in linguistic difficulty and design. In all tasks, there were five words with one syllable and fifteen words with two syllables. In the process of manipulating a target pseudoword and creating a foil, it was essential to control the change to such an extent that the original pseudoword was manipulated using only one change. The changes were also similar to the changes made in the word reading task.

Table 9

Matching of target pseudowords and foils with letters and phonemes and in the pseudoword reading tasks

Pseudoword reading	**Letters**	**Phonemes**
Norwegian		
Target pseudoword gr. 1.	5.30	4.70
Target pseudoword gr. 2.	5.30	4.70
Total	**5.30**	**4.70**
Foils gr. 1.	5.40	4.70
Foils gr. 2.	5.40	4.70
Total	**5.40**	**4.70**
English		
Target pseudoword gr. 1.	5.80	5.10
Target pseudoword gr. 2.	5.70	5.00
Total	**5.75**	**5.05**
Foils gr. 1.	5.90	5.10
Foils gr. 2.	5.80	5.20
Total	**5.85**	**5.15**
Polish		
Target pseudoword gr. 1.	5.30	4.95
Target pseudoword gr. 2.	5.00	4.85
Total	**5.15**	**4.90**
Foils gr. 1.	5.30	4.95
Foils gr. 2.	5.10	4.90
Total	**5.20**	**4.93**
Somali		
Target pseudoword gr. 1.	5.30	4.10
Target pseudoword gr. 2.	5.00	3.90
Total	**5.15**	**4.00**
Foils gr. 1.	4.90	4.00
Foils gr. 2.	6.60	3.80
Total	**4.75**	**3.90**

The Norwegian pseudowords were derived from well-known assessment tools such as TOWRE (Torgesen et al., 1999) and Logos (Høien, 2012). Some minor changes were made to make it possible to manipulate the pseudoword and still follow the Norwegian rules of writing. A few pseudowords were generated to make the linguistic difficulty level equal in both conditions. The target pseudowords were also assessed against irregularities in the Norwegian languages such as double consonants, consonant congestion (two or more consonants in a row), complex graphemes (two or more letters to make one sound), or letters that are written but are silent when spoken.

The Norwegian pseudowords task was the base for the pseudoword reading task in all the other languages. The manipulations were as similar as possible across languages within the linguistic constraints of each language. An overview of the manipulation in all languages in the pseudoword reading task is given in Table 10.

Table 10

Overview of the manipulations in the pseudoword reading task

Overview of the changes in the pseudoword reading task				
	Norwegian	**English**	**Polish**	**Somali**
Altered consonants	6 words	6 words	6 words	6 words
Altered vowels	5 words	4 words	4 words	4 words
Added a consonant	4 words	5 words	5 words	
Added a vowel	1 word			
Removed a vowel from a diphthong	1 word			
Changed the order of letters within a word	1 word	1 word	1 word	
Deleted a consonant from a word with a double consonant	1 word	1 word	1 word	2 words
Changed the first letter of a word	1 word	1 word	1 word	1 word
Removed a consonant		2 words	2 words	3 words
Altered a diphthong				2 words
Changed from long to short vowel				2 words
Total changes	20	20	20	20

8.1.4.5. Design – pseudoword reading

The design of the pseudoword reading task was identical to the design of the word reading task. Spoken targets were presented simultaneously together with written words. Each spoken target occurred in two conditions:

1. Condition 1: The spoken target is the same as the written pseudoword
2. Condition 2: The spoken target is not the same as the written pseudoword foil

8.6.3.6. Procedure – pseudoword reading

The procedure of the pseudoword reading task was the same as the procedure of the word reading task. (See the appendix for the full instructions. Appendix 14.11).

8.1.5. Phonological Working Memory

8.1.5.1. Stimuli and design

87 language-independent syllables were the basis of constructing 16 trials. Each trial contained two series of language-independent pseudo-syllables and the participants were to decide whether the two series had the same order or not. See Table 11 for an example of a trial.

Table 11

Example of a trial in the Phonological Working Memory task

Experiment	The first series of syllables	The second series of syllables
Language independent syllables	su:f, gi:b, jɑːs, li:l, tɑːb	su:f, li:l, gi:b, jɑːs, tɑːb

To be an effective cognitive test for all language groups included in this project, it needed to be a language-neutral test. By analysing structures in Norwegian (Standwell, 1975), English (Giegerich, 1992), Polish (Gussmann, 2007), and Somali (Orwin, 1994) common vowels and consonants that could appear in syllables in all languages, were found. Three vowels and twelve consonants were the basis of constructing language-independent syllables. Linguistic differences in each language played a part in the placement of vowels and consonants in onsets and offsets within the syllables. It was possible to make syllables with these vowels and consonant combinations: VC, CV and CVC. An overview of vowels, consonants, and placement within syllables is given in Table 12.

Table 12

Overview of vowels, consonants, and placement within syllables in the Phonological Working Memory task

Vowels	Consonants as syllable onset	Consonants as syllable offset
/ɑ/	/b/	/b/
/i/	/d/	/d/
/u/	/f/	/f/
	/g/	/g/
	/j/	/j/
	/k/	/l/
	/l/	/n/
	/m/	/p/
	/n/	/s/
	/p/	
	/s/	
	/t/	

In total, 54 unique syllables were constructed (see Appendix 14.9). To make this task, a total of 87 syllables was needed. Therefore, some syllables occurred several times. 29 syllables occur only one time during the whole task. 18 syllables occurred two times. 6 syllables occurred three times and 1 syllable occurred four times (Appendix 14.9.1).

The syllables were written in phonemic transcriptions and recorded by a woman whose mother tongue is French and who could read a phonetic script. This was done to make sure that none of the included languages would have any advantages. The recordings were made and edited in Praat version 6.1.16

(Boersma & Van Heuven, 2001) in a sound-attenuated booth (ELL) at the UiA. Once the syllables were recorded, they were played to native speakers to validate that the syllables were nonsense and that they were legal syllables in the language in question. When the syllables were put together in series, care was taken to avoid having similar-sounding syllables within one series. When creating a series of syllables that had a different order, the change was always in the middle of the series and never in the first or last syllable. The single sound files were put together as a series of syllables by using MATLAB (Sigmon & Davis, 2004) version 9.8. Each syllable series had a 1.5-second pause between each syllable. This task had increasing difficulty. It started with two trials with four syllables, and it gradually became more difficult. Seven trials had five syllables. Five trials had six syllables and finally, two trials had seven syllables.

8.1.5.2. Procedure – Phonological working memory

Each participant responded to 16 trials. This task was presented on a computer and initiated by an instructor. The instructions were presented both on the screen and auditory at the same time. In the instructions, the participants were told to decide as quickly and accurately as possible whether two series of pseudo-syllables presented auditorily were the same or a bit different. The participants pressed the keys "M" or "Z" to respond. The "same" response was always made by the key appropriate for the participant's dominant hand. When the first series of syllables was presented the number 1 occurred on the screen. When the second series was presented the number 2 was shown. The participants were given two test trials to make sure that they understood the assignment (see the appendix for the full instructions. Appendix 14.11). Halfway through the participants were given a short rest. Both speed and accuracy were measured automatically by the computer.

8.1.6. Processing speed

8.1.6.1. Design and stimuli

The processing speed task was conducted to test the participant's processing speed when the element of language production was removed. This task had three parts with increasing levels of difficulty. Stimuli consisted of various geometric shapes (see Appendix 14.10). All tasks had a fixation cross to mark where the stimuli would appear.

In part one, the task was to respond to one stimulus. The participants were asked to press the key "M" when a triangle appeared on the screen. Stimuli were presented at a random time-varying between 500 and 2000 ms. If participants did not respond within 1000ms of the stimulus onset the next trial started automatically. This part had 40 trials in total.

In part two, the participants got to see two stimuli, a circle, or a triangle and should respond to what they saw. When the circle appeared, they were supposed to press the Z-key. When the triangle appeared, they were supposed to press the M-key. Stimuli were presented at a random time-varying between 500 and 2000 ms. If participants did not respond within 1000ms of the stimulus onset the next trial started automatically. Part two also had 40 trials.

In part three, participants saw two rows of shapes on the screen, one above the other. Their task was to decide whether the rows were the same or not. Stimuli were presented at a random time-varying between 500 and 2000 ms. If participants did not respond within 1000 ms of the stimulus onset the next trial started automatically. In the first, 24 trials, two rows of three different shapes appeared. It started with 24 trials and then the level of difficulty was increased for the last 24 trials. In total 48 trials. They were instructed to respond with a key press to decide whether the rows were the same or different. The participants pressed the keys "M" or "Z" to respond. The "same" response was always made by the key appropriate for the participant's dominant hand. Each part had 6 test trials to make sure the participants understood the assignment.

8.1.6.2. Procedure – Processing speed

This task was presented on a computer and initiated by an instructor. The instructions were presented in the participant's L1, both on the screen and auditorily at the same time. The participants were told that different shapes would appear on the screen, and they were asked to respond as quickly and accurately as possible by pressing the "M" or "Z" keys on the keyboard. Instructions for the whole task were not given at the same time. Each of the three parts started with specific instructions for the task in question. Both speed and accuracy were measured automatically by the computer.

8.1.7. Apparatus

All recordings were made in a sound-attenuated booth in the Experimental Linguistic Laboratory (ELL) at the UiA. The recordings were made and edited in Praat version 6.1.16 (Boersma & Van Heuven, 2001) with a sampling rate of 44.1 kh. A Lenovo ThinkPad T490 was the laptop recording every sound file. The microphone was Sennheiser GSP 350 headphones with a noise-cancelling microphone. The programming software for the whole test battery was Open Sesame (Mathôt et al., 2012) version 3.1.9.

The instructors had laptops onto which the test battery was downloaded. Three laptops were Lenovo T490, and one was an HP ProBook 430 G5. In addition, they had extra monitors and keyboards. This was to ensure that participants had good visual conditions and that they could easily press keys on the keyboard when the test battery required it. The instructor had a wireless numeric keyboard (named Exibel) to start and stop timing and enter the participant's results. The participants used a headset called Turtle Beach Recon 50x to ensure high quality when listening and recording. The instructor had a smaller headphone called Basetech CD-1000VR.

8.1.8. Procedure – Measures

Four testers collected all the data. They were all experienced testers. Everyone attended an individual training day to make sure that all the testing was done in the same way. In addition, they were given a test protocol that gave detailed instructions on how every part of the test battery should be performed (see Appendix 14.11). The assessment was individual with only the participant and the instructor present. The participants sat always in front of an additional monitor, while the test instructor sat on the participants' right side with a view of the monitor. The participants also had an additional keyboard in front of them. The instructor had the numeric keyboard in her hand.

The time spent testing one participant was between 1.5 and 2.5 hours. Every assessment started with filling out the questionnaire if that was not already done, the dynamic test on paper, followed by L1 testing on the computer. The participants were given a fifteen-minute break before they were tested in Norwegian (L2).

8.1.9. Dynamic test of decoding

8.1.9.1. Design and stimuli

The dynamic test of decoding (Elbro et al., 2012) is designed to examine the participant's ability to learn how to decode in an alphabetical orthography. This test claims to be language-neutral because all test instructions during the test are non-verbal and are carried out by showing examples and giving feedback through facial expressions. This test presents three artificial letters that have three sounds that are available in most languages (see Table 1 section 5.4). The dynamic test consists of three parts, and the participants were given a certain number of attempts to master each part. If the test person failed to complete the task on one of the three parts, the task was terminated, and the remaining parts were marked with zero points.

8.1.9.2 Procedure

The first part was an associated learning task where the participants learned the three novel letter shapes and their sounds. The instructor articulated the sounds once while pointing at the letters. The participant repeated what the instructor said the first time. After that, the instructor pointed to the letters and the participants named them. Through the learning phase, the participants were given corrective feedback. If the participant produced the correct letter sounds in three consecutive trials, this part was fulfilled. After a maximum of ten trials, this section was terminated.

The score for this part was the number of correct letter sounds. The maximum score possible was 30 points (If the participant produced the correct letter sounds in three consecutive trials, they were given the maximum score).

The second part involved decoding two-letter nonwords with the newly learned letter-sound synthesis/phonemic blending. The instructor gradually moved single-letter cards together and blended the sounds. The test instructor gave one example, and the participants were invited to put two letters together to make other nonwords. Example: The artificial letters for A and M were placed in front of the participant, and they should be read with a pause between the sounds. Then the letters were moved closer together and the sounds were pronounced with a shorter pause. Finally, the letters were placed right next to each other, and the sounds should be pronounced without pause – AM. This task had both a visual and an auditory element. Corrective feedback was given for a maximum of five trials with the nonwords. This part was fulfilled when the participants named all nonwords correctly in two consecutive trials. If the participant could not complete the task, the testing was terminated and received a zero score, and he or she was not taken through part 3.

If the participant could name all nonwords correctly in two consecutive trials, the score for this part was the total number of nonwords that were read correctly. The maximum score possible was 20 points.

The final part was only administered to participants who mastered part 2. In part 3, the participants were presented with twelve nonwords made by different combinations of the three artificial letters and their sounds and investigated the participants' independent reading of these nonwords. This task contained five nonwords with three letters, six nonwords with four letters, and one nonword with five letters. Corrective feedback was given, but the participants did not receive any help with letter sounds or sound blending. If the participants had three consecutive errors, the testing was terminated.

The score for this part was the number of correct read nonwords. The maximum score possible was 12 points.

8.2. Sample descriptions – data from the questionnaire

This section provides an initial overview of the characteristics of the sample based on the questionnaire. It starts with participants' responses to the questionnaire and these data are summarized to investigate their profile regarding language dominance, educational background, reading problems, L1 reading behaviour, L2 reading behaviour, L1 proficiency ratings and L2 proficiency ratings. And also, to determine the degree to which the three language groups differ regarding these characteristics. A multivariate analysis of variance (MANOVA) was conducted for each of the seven headings mentioned above.

The sample comprised adults between 18 and 64 years old with English, Polish, or Somali as their first languages. The details of this sample are described in the section below. All participants spoke Norwegian as a second language. Some, however, have Norwegian as their L3 or more since some of them were multilingual. Others were bilingual in the way that they only knew their L1 and Norwegian. For categorical reasons, the sample is referred to as bilinguals with Norwegian as L2.

The recruitment process started with finding participants at adult education centres in Norway and upper secondary Schools. By agreement, several adult education centres had undertaken to assist with the recruitment. When the COVID-19 pandemic affected Norway, it became difficult for several of these education centres to carry out recruitment. For that reason, I had to find more ways to recruit participants and I also had to adjust the goal for the size of the sample. A small brochure was made and placed all over the University grounds. The brochure was also given to participants in the project so that they could ask others to sign up. Three different advertisements for the project were posted on the University of Agder's Facebook and Instagram accounts from April to September 2022. These advertisements were aimed at the age group 18 to 40 years and had stated English, Polish or Arabic as their mother tongue. Facebook and Instagram do not have the Somali language as an option, but many Somalis speak both English and Arabic. Therefore, I hoped to reach this group through English and Arabic. These advertisements were one post with information about the study and a picture of me. The second was a short video where I asked participants to join. The third was a small text about the project but the headings of this text were in Polish, Somali or English. The heading said, “Would you like to take part in the research project Dyslexic or just bilingual?”.

The inclusion criteria were that the participants had to be 18 years or above, be able to read in their L1 and have some training in Norwegian reading. And as already mentioned, they had to have English, Polish or Somali as their L1. Furthermore, normal (or corrected to normal) eyesight and hearing were other important inclusion criteria. Uncertainty about the participant's L1, or problems with eyesight or hearing, were exclusion criteria. The questionnaire was the base for assessing whether the participants could be included or excluded. Everyone participating in this study signed a consent form confirming that their participation was voluntary. The consent form was available in all languages (see Appendix 14.3).

8.2.1. Questionnaire – data handling

There was data loss from nineteen participants who had not filled in the questionnaire correctly. Four participants had not assessed their skills related to proficiency in L1 and L2. Four had only partly assessed their reading behaviour in L1 or L2. Two participants had not listed Norwegian as one of the languages they could speak, read and write. However, several of the questions in the questionnaire covered the same areas. This made it possible to fill some of the blank spaces with the information given in other questions in the questionnaire. In those cases, this was impossible to do, the participant was given a missing value.

For two of the participants, it was hard to decide their highest level of education. One had only sat a mark on adult education in Norway as their education. This participant's education level was given a missing value. Another participant also listed adult education in Norway as the highest educational level. This participant had listed how many days a week and how many years they attended. Adult education in Norway is part of primary school education. Due to the number of years, the participant had attended adult education, the level of highest education was set to elementary school.

Five participants had not listed their mothers' highest level of education. Ten participants had not listed their fathers' highest level of education. By investigating questions regarding their parents' employment – an estimate of the level of education required to hold such a position was done. This was done in four cases of the mother's level of education and eight of the fathers' level of education. When it was impossible to make an estimation, the value in the dataset was given a missing value.

As a result of missing information in the questionnaire, the total number of participants may vary from 75 to 80 in the analyses.

8.2.2. Questionnaire data – Description of Sample

The questionnaire data is summarized and described further down. The data is grouped into headings related to language dominance, educational background, reading problems, L1 reading behaviour, L2 reading behaviour, L1 proficiency ratings and L2 proficiency ratings. The main results from the one-way MANOVA are reported along the way for each of the dependent variables. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliners, homogeneity of variance-covariance matrices and multicollinearity. There were some violations noted. Both results and violations are discussed in turn below. To meet the assumptions for doing a MANOVA the independent variable consists of three categorical independent groups (English, Polish and Somali), two or more of the dependent variables in each heading were continuous and the observations in each group were independent. The sample size could have been larger, but the assumptions for using MANOVA are met since there were more cases in each group than the number of dependent variables analysed (Tabachnick & Fidell, 2014).
Because this project has a small sample and unequal *n* values between groups, Pillai's Trac was selected in the multivariate tests (Tabachnick & Fidell, 2014). Pillai's Trac criterion was used instead of Wilks' Lambada to evaluate multivariate significance (Olson, 1976).

8.3.3. Gender, age, and languages

In total, the sample consists of 80 adult participants who had Norwegian as their L2 and English (40 %), Polish (42,5 %) or Somali (17,5 %) as their L1. 3 participants stated that English was one of two L1s. Due to language dominance shown in other questions in the questionnaire, they were nevertheless considered as a part of the English-speaking group. The sample consists of 54 women, 25 men and 1 non-binary. The majority of participants (75%) were between 18 and 40 years old, as can be seen in Table 13. The average age was highest in the English-speaking group, but more similar between the Polish and Somali language groups. See Table 13 for the distribution of age between the language groups.

Table 13

An overview of the participant's age range

Age												
	English (n=32)			Polish (n=34)			Somali (n=14)			Total (N=80)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
Age	38.9	11.3	23-64	33.2	9.9	18-54	31.7	8.3	18-49	35.2	10.6	18-64

Note: Summary of age related to language group and in total

8.2.4. Language Dominance

Six variables were grouped under the heading "Language dominance".
All of them contribute information about the participants' Norwegian oral skills but also about multilingualism and multilingual speaking, reading and writing skills. The relationship between the six variables and the differences between language groups are described in Table 14 below.

Table 14

The Participant's Language Dominance and Multilingualism

Language Dominance and Multilingualism												
	English (n=32)			Polish (n=34)			Somali (n=14)			Total (N=80)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Level of spoken Norwegian (1-7)	3.8	1.7	2-7	5.2	1.3	2-7	4.5	1.6	3-7	4.5	1.6	2-7
2. Language Dominance (0-5)	0.3	0.7	0-3.5	1.3	1.2	0-4	1.2	1.6	0-4	0.8	1.2	0-4
3. Ranking of Norwegian as a spoken lang (1-7)	2.5	1.1	2-7	2.2	0.8	1-4	2.3	0.9	1-5	2.4	0.9	1-7
4. Number of spoken languages(2-8)	3.1	1.2	2-8	3.8	1.0	2-6	3.3	0.8	2-5	3.4	1.1	2-8
5. Number of read languages (2-8)	2.8	1.0	2-6	3.6	0.9	2-6	3.1	0.9	2-5	3.2	1.0	2-6
6. Number of written languages(2-8)	2.5	0.8	1-5	3.4	0.9	2-6	2.8	1.0	1-4	2.9	1.0	1-6

Note: Summary data is shown for the questionnaire response for the three language groups. Since the variables have a different scale within the same area, the scale is marked in parentheses after the variable name in the first column.

The sample self-rated their level of spoken Norwegian (L2) according to The Council of Europe's framework of Language references (Division, 2001). The framework ranges from A1 to C2 whereas A1 and A2 are considered as a level for beginners. Levels B1 to C2 indicate a more proficient user of L2 and this group is categorised as participants with high proficiency in Norwegian. 25 participants (31.3 %) of the sample have low proficiency in Norwegian. 55 participants (68.8 %) have high proficiency in Norwegian.

In the English and Polish language groups the level of spoken Norwegian ranges from A1 to C2. In the Somali group, the lowest level of spoken Norwegian was A2 while the highest was also for this group C2. For statistical reasons, the variable “Level of spoken Norwegian” was recoded. A level below A1 was given the value 1. A1 was given the value 2, and so on. The highest value was 7 and it represents C2.

The English-speaking group had the biggest contribution to those considered with low proficiency in Norwegian. The English-speaking sample was equally divided between those with low and high skills in the level of spoken Norwegian. However, when looking at the total of those with a low level of spoken Norwegian 16 of 25 (64 %) participants have English as their L1.

To investigate language dominance, the samples' language use in both L1 and L2 was investigated. There was a clear tendency that almost every participant used their L1 (English, Polish or Somali) when speaking to their parents. In the Polish group, all 34 (100 %) of the participants spoke Polish with their parents. The same goes for the Somali group; all 14 (100 %) spoke Somali with both their mother and father. In the English group, 30 participants spoke English to their mother (93.75 %). 2 (6.25%) participants spoke another language to their mother. 28 (87.5 %) participants spoke English to their fathers. 3 (9.4 %) spoke another language than English to their father. For 1 (3.1 %) participant it was not relevant to state which language they spoke with their father.

In the Polish group, everyone who had a sibling spoke Polish with their siblings (n=30). In the English group all but one (n=31, 96.9 %) spoke English with their siblings. In the Somali group, 2 (14.3 %) spoke Norwegian with their siblings, 11 (78.6 %) spoke Somali and for 1 (7.1%) participant it was not relevant to give information about siblings.

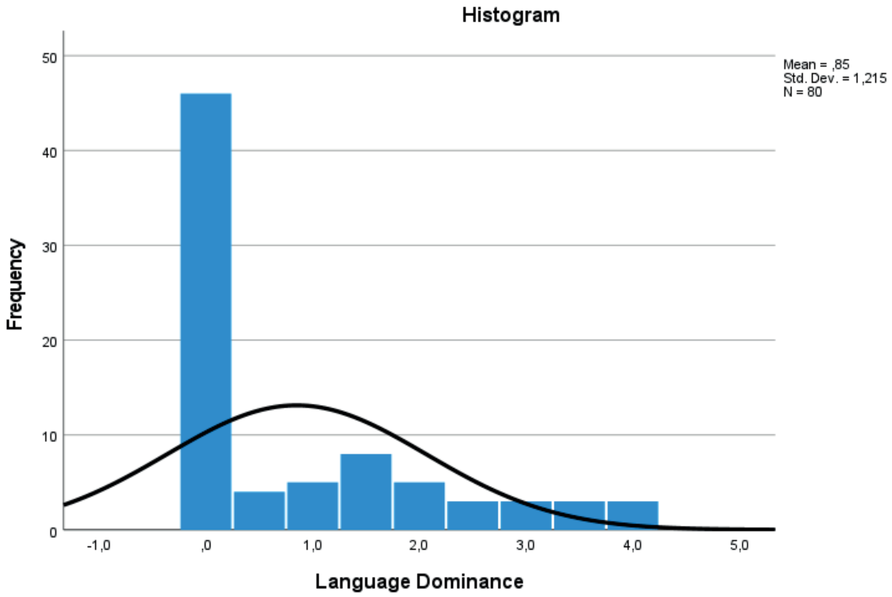
When asked which language they considered as their best-spoken language, 13 (92.9 %) in the Somali group said Somali while 1 (7.1 %) said Norwegian. In the Polish group, 29 (85.3 %) said Polish was their best-spoken language and 5 (17.7 %) said Norwegian. In the English group, 31 (96.9 %) said that English was their best-spoken language. One participant had not filled out the questionnaire correctly and therefore it was not possible to refer correctly to their answer.

In the questionnaire, five questions had information about what languages the participants used in different settings and how they rated the languages they knew. The sample self-reported their skills in speaking, reading and writing in their reported L1 and L2 (Norwegian). A new variable called "Dominant language" was created primarily by investigating the samples' active languages. The goal was to determine language dominance when looking at language use from a broader perspective. If there was doubt about language dominance (the participants had stated that they dreamed, talked to themselves, expressed love/anger or did simple mathematics in both L1 and L2), the information from the self-reporting was used to determine dominance. The participants had put a number on their L1 and L2 skills (speaking, pronunciation, vocabulary, reading, writing, spelling and grammar), and this gave information about proficiency in L1 and L2 and gave a good indication of the dominant language.

The value for the variable language dominance was set to zero if they only had one dominant language (their L1s). The value was 1 if they had one dominant language in addition to their L1s. 46 (57,5 %) participants had only one dominant language and that was their L1. 9 (11.3 %) participants had up to one language, in addition to their L1, as a dominant language. 25 (31.5 %) participants had 1.5 or more languages that they used regularly. As shown in the histogram underneath (see Figure 5), the biggest group of the sample had only one dominant language.

Figure 5

Overview of the participant's dominant languages in addition to L1



The participants rated how well they spoke Norwegian. When rating all the languages they could speak, they were asked to start with the language they knew best. Second, the language they knew the second best and so on. Based on this the variable "Ranking of Norwegian as a spoken language" was made. In addition, they were asked whether they could read or write in the languages they spoke. This made it possible to investigate whether Norwegian were their L2 or not. 53 (66,3 %) participants had Norwegian as the language they knew second best. 6 (7.5 %) participants said that Norwegian is the language they spoke best. In general, the sample could speak more languages than they could read or write. Even though the scale went from 2 to 8 languages, the majority did not speak, read or write more than 4 languages. For speaking, 4 languages had a cumulative percentage of 88.8%. For reading, 4 languages had a cumulative percentage of 90% and for writing it was 93.8%. In total, only 9 (11.4%) participants spoke more than 4 languages. 8 (9.5 %) participants could read more than 4 languages, and 5 (6.3%) could also write in more than 4 languages.

A one-way between-groups multivariate analysis of variance (MANOVA) was conducted to investigate whether there were differences between the three language groups regarding the heading Language dominance. Six dependent variables were used. “Level of spoken Norwegian”, “Language dominance”, “Ranking of Norwegian as a spoken language”, “Number of spoken languages”, “Number of read languages” and “Number of written languages”. The independent variable was the participants' L1.

There was a significant difference between language groups in the combined dependent variables, F (12, 146) = 2.816, p <.002, The Pillai’s Trac = .376, partial eta squared = .19. Because it was a significant result on the multivariate tests of significance, the test of between-subject effects was investigated. Post Hoc comparison using the Bonferroni test showed that there was a significant difference between English and the other language groups in five of six variables. In the level of spoken Norwegian, there was a significant difference between English and Polish F (2, 77) = 6.7, p < .002, partial eta squared = .147. The Polish group had a higher Norwegian proficiency level. In Language dominance there was a significant difference between English and the two other languages F (2, 77) = 7.2, p < .001, partial eta squared = .16. The English group spoke fewer languages than the two other groups and therefore the language dominance was clearer. Between English and Somali, the significant level was p < .04 and between English and Polish, it was p < .002.

In the variable Number of languages, the participant speaks there was a significant difference between English and Polish F (2, 77) = 3.9, p < .023, partial eta squared = .093. For the variable Number of languages, the participant reads there was also a significant difference between English and Polish F (2, 77) = 6.8, p < .002, partial eta squared = .151. At last, there were significant differences between English and Polish in the variable Number of languages the participant the participant writes F (2, 77) = 8.4, p < .001, partial eta squared = .179. The English group spoke, read, and wrote fewer languages than the two other groups.

There were no significant differences between language groups and Ranking of Norwegian as a spoken language.

8.2.5. Educational background – the sample and their parents

There was a large spread in the sample's level of education. It ranged from no education to a PhD. As mentioned under 8.2.1 two participants had not given thorough information about their education and an estimate and a missing value, were therefore made. There were also missing values in the variable describing the mothers' and fathers' highest level of education. As a result, the N-values are 79 on the participants' highest level of education and Mothers' highest level of education and 78 on the fathers' highest level of education. The trend in this data set is, nevertheless, that most of the sample had quite a high level of education. 3.8% had a craft certificate and 24.1 % had upper secondary school as their highest education. 20.3% had taken a bachelor's degree, while 38.0% had a master's degree. In the sample, 5.1% had a PhD, while also 5.1% had lower secondary school. 3.8 % had elementary school as their highest level of education.

Table 15

Educational background for the participants and their parents

Educational Background (Scale 0-4)												
	English (n=32/31)			Polish (n=34)			Somali (n=13)			Total (N=79/78)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Highest level of education	2.2	1.0	0-4	2.3	2.3	1-4	0.9	1.1	0-3	2.0	1.1	0-4
2. Mothers' highest level of education	1.1	0.9	0-4	1.6	0.9	0-3	0.5	0.9	0-3	1.2	1.0	0-4
3. Fathers' highest level of education	1.4	1.2	0-4	1.2	1. 1	0-3	0.8	1.1	0-3	1.2	1.0	0-4

Note: Summary data is shown for the questionnaire response for the three language groups.

There was a wider spread in the results of the mothers' and fathers' highest level of education, than what was the case for the educational level of the 80 participants themselves. In the sample, only eight persons had listed their highest level of education in the lowest categories: None, elementary school or lower secondary school. When grouping the same level of education for the parents of the sample, 18 mothers and 18 fathers belonged to the same group. For statistical reasons, these variables were recoded. No education, elementary school and lower secondary school got the value 0. Craft certificate and upper secondary school got the value 1. A bachelor's degree has a value of 2, while a master's degree god a value of 3. And a PhD got a value of 4.

A one-way MANOVA was conducted to investigate whether there were differences in educational level between the three language groups. Three dependent variables were used to investigate whether there were differences between the three language groups regarding the participant's educational background. These variables were "The participants' highest level of education", "The mothers' highest level of education" and "The fathers' highest level of education". The independent variable was the participants' L1.

The Pillai's Trac showed significant differences in the educational level F (6, 146) = 4.9, $p < .001$, partial eta squared = .17, exposing that there is a statistical difference between language groups. Post Hoc comparison using the Bonferroni test showed that there was a significant difference between Somali and the two other language groups in the two variables. In the participants' highest level of education significant level was $p < .001$ between both Somali and English and Somali and Polish. The Somali group had less education than the English and Polish groups.

In the variable Mother's' highest level of education, there was only significance between Somali and Polish $p < .001$, indicating that the Polish mothers had a higher level of education than the Somali mothers.

There was no significance in the variable Fathers' highest level of education.

8.2.6. Reading problems

As mentioned in the introduction (Chapter 1), it is more challenging for bilinguals to get diagnosed with dyslexia than what is the case for native speakers. Therefore, it was hard to find participants with an official dyslexia diagnosis. To create a variable describing the participants' reading difficulties, both participants with a dyslexia diagnosis and self-experienced reading difficulties were included.

See Table 16 for both the total number of reading problems and how they are spread across language groups.

Table 16

Reading problems reported by participants

	Reading problems											
	English (n=32/31)			Polish (n=34)			Somali (n=13)			Total (N=79/78)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Reading problems diagnosed and experienced (Scale 0-1)	0.2	0.4	0-1	0.3	0.5	0-1	0.3	0.5	0-1	0.3	0.4	0-1
2. L1: Total number of reading problems (Scale 0-6)	0.4	0.9	0-3	0.6	1.2	0-5	0.2	0.6	0-2	0.5	1.0	0-5
3. L2: Total number of reading problems (Scale 0-6)	0.7	1.7	0-6	1.0	1.6	0-5	0.9	1.6	0-5	0.8	1.6	0-6

Note: Summary data is shown for the questionnaire response for the three language groups. The scale is marked in parentheses after the variable name in the first column.

4 (5%) participants confirmed that they had a dyslexia diagnosis and 20 (25.3%) stated that they thought they had reading difficulties even though they were not diagnosed. Those who experienced reading problems were given six examples of different challenges that are usual for people with reading difficulties (trouble

remembering the names of letters, reading slowly, only reading short texts, reading with a stutter, skipping reading words' endings, difficulties with remembering what been read). They were asked to report if these difficulties were present in L1 and L2. These data were quantified with a number from 0 to 6, where 0 has the value of no reading problems, and the value 6 means that the participants experience six of the above-mentioned difficulties. The variables were called "Total number of reading problems in L1" and "Total number of reading problems in L2." The number of participants with confirmed reading difficulties was lower than what I initially wanted for the study. The low number can be explained by a combination of the fact that the data collection was carried out during the COVID-19 pandemic in Norway and that it confirms the thesis theme. It is difficult for bilinguals to have their reading difficulties examined and then receive an official statement confirming the reading difficulties. A one-way MANOVA was conducted to investigate whether there were differences in reading problems between the three language groups. Three dependent variables were used to investigate whether there were differences between the three language groups and experienced reading problems. These variables were reading problems diagnosed and experienced, L1 total number of reading problems and L2 total number of reading problems. The independent variable was the participants' L1.

There were no significant differences between language groups reporting reading difficulties F (6, 152) = 0.75, p = .613, partial eta squared = .03.

8.2.7. L1 Reading behaviour

To examine the sample's reading habits, they were asked how often they read on social media, in books, in newspapers, in comics or if they read at work. The scale went from 0 to 3, where 0 meant never, 1 rarely, 2 every week and 3 every day. They assessed their reading habits both in L1 and in L2. Based on the mean of the whole group, most L1 reading happens on social media. All language groups had the same mean on this task and the standard deviation was also quite similar. Reading newspapers in their L1s is the reading activity with the second highest score, and reading books in L1 is the third. See Table 17 below.

Table 17

Participants self-reported L1 reading behaviour

L1 reading behaviour (Scale 0-3)												
	English (n=32)			Polish (n=34)			Somali (n=13/14)			Total (N=79/80)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Reading Social Media	2.6	0.9	0-3	2.6	0.7	1-3	2.6	0.8	1-3	2.6	0.8	0-3
2. Reading Books	1.5	0.9	0-3	1.6	0.9	0-3	0.8	0.8	0-3	1.4	0.9	0-3
3. Reading Newspapers	2.5	0.9	0-3	2.2	1.0	0-3	1.9	1.1	0-3	2.3	1.0	0-3
4. Reading Cartoons	1.2	1.0	0-3	0.4	0. 7	0-2	0.3	0.6	0-3	0.7	0.9	0-3
5. Reading at work	1.8	1.2	0-3	0.6	0.9	0-3	1.0	1.1	0-3	1.2	1.2	0-3

Note: Summary data is shown for the questionnaire response for the three language groups.

A one-way MANOVA was conducted to investigate whether there were differences in L1 reading behaviour between the three language groups. Five dependent variables were used to investigate whether there were differences between the three language groups and L1 reading behaviour. These variables were L1 reading social media, L1 Reading books, L1 Reading Newspapers, L1 Reading cartoons, and L1 reading at work. The independent variable was the participants' L1.

The results of the one-way MANOVA showed that there was a statistical difference regarding L1 reading behaviour F (10, 146) = 4.7, $p < .001$, partial eta squared = .25. Post Hoc comparison using the Bonferroni test showed that there was a significant difference between language groups in three variables.

In the variable L1 reading books, there was a significant difference between Somali and the two other language groups showing that the Somali group read fewer books, than the Polish and English group. The significant level was p = .025 between Somali and Polish, and p = .026 between Somali and English.

In the variable L1 reading cartoons, there was significance between the English group and the two other languages. The English group read more cartoons than the Somali and Polish groups. Between English and Somali, the significant level was $p = .003$, and $p = .001$ between English and Polish.

In the variable L1 reading at work, there was a significant difference between English and Polish $p < .001$. The English group read in their L1 at work more than the Polish group. There was no significance in the variables L1 reading social media and L1 reading newspapers.

8.2.8. L2 Reading behaviour

Reading behaviour in L2 had similarities with reading behaviour in L1. Based on the mean of the whole group, most L2 reading happens on social media. Reading Norwegian at work was the second-highest reading activity in L2, and reading Norwegian newspapers was the third. Reading Norwegian books was the fourth-highest reading activity, while the mean for reading Norwegian cartoons showed that this was the least applied reading activity.

Table 18

Participants self-reported L2 reading behaviour

L2 reading behaviour (Scale 0-3)												
	English (n=32)			Polish (n=34)			Somali (n=13/14)			Total (N=79/80)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Reading Social media	1.9	1.2	0-3	2.7	0.7	1-3	2.1	1.3	0-3	2.3	1.1	0-3
2. Reading Books	1.0	0.8	0-3	1.0	0.9	0-3	1.1	0.9	0-3	1.0	0.8	0-3
3. Reading Newspapers	2.0	0.9	0-3	2.2	1.0	0-3	1.7	1.3	0-3	2.1	1.0	0-3
4. Reading Cartoons	0.7	0.8	0-3	0.3	0.7	0-2-	0.5	0.9	0-3	0.5	0.8	0-3
5. Reading at work	1.9	1.2	0-3	2.2	1.1	0-3	2.7	0.6	1-3	2.2	1.1	0-3

Note: Summary data is shown for the questionnaire response for the three language groups.

A one-way MANOVA was conducted to investigate whether there were differences in L2 reading behaviour between the three language groups. Five dependent variables were used to investigate whether there were differences between the three language groups and L1 reading behaviour. These variables were L2 Reading social media, L2 Reading books, L2 Reading newspapers, L2 Reading cartoons, and L2 Reading at work. The independent variable was the participants' L1.

Pillai's Trac showed significant differences in L2 reading behaviour F (10, 146) = 2.7, $p < .004$, partial eta squared = .16 revealing that there is a statistical difference between language groups. Post Hoc comparison using the Bonferroni test showed that there was a significant difference between language groups in one variable. In the variable L2 reading social media, there was a significant difference between Polish and English. The Polish group reads the most in L2 (Norwegian) on social media. The significant level was $p = .009$.

8.2.9. L1 Proficiency rating

The sample has rated their proficiency skills regarding speaking (making themselves understood), pronunciation, reading, spelling words, writing a text, grammar, and vocabulary. The scale went from 0 where the value meant no skills, to 10 where the value was set to perfect skills (the scale was none, very low, low, some but there's a lot I can't do, slightly below average, average, slightly above average, good, very good, excellent, and perfect). The sample rating shows that the highest mean score is related to L1 speaking. The second-highest mean score was related to L1 pronunciation. Third was L1 reading, and fourth was L1 vocabulary. The third lowest mean score was L1 spelling words, the second lowest mean score was L1 writing a text and the lowest mean score of L1 skills was L1 grammar.

Table 19

Participants self-reported L1 Proficiency ratings

L1 Proficiency rating												
	English (n=30)			Polish (n=33)			Somali (n=12)			Total (N=75)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Speaking	9.2	0.9	7-10	9.4	1.1	6-10	9.7	0.9	7-10	9.4	1.0	6-10
2. Pronunciation	9.1	1.5	3-10	9.2	1.0	6-10	9.5	1.0	7-10	9.2	1.2	3-10
3. Vocabulary	8.6	1.4	3-10	8.9	1.7	3-10	9.6	1.7	6-10	8.9	1.5	3-10
4. Reading	8.8	1.9	3-10	9.4	1.2	5-10	9.1	1.2	7-10	9.1	1.5	3-10
5. Writing	8.2	2.0	1-10	8.4	1.7	5-10	8.1	2.2	4-10	8.3	1.9	1-10
6. Spelling	7.7	2.1	1-10	8.8	1.5	4-10	8.4	1.9	4-10	8.3	1.9	1-10
7. Grammar	7.7	2.2	2-10	8.4	1.8	3-10	7.6	2.1	4-10	8.0	2.0	2-10

Note: Summary data is shown for the questionnaire response for the three language groups. Mark that due to missing value N=75.

A one-way MANOVA was conducted to investigate whether there were differences in L1 proficiency ratings between the three language groups. Seven dependent variables were used to investigate whether there were differences between the three language groups and L1 proficiency ratings. These variables were L1 speaking, L1 Pronunciation, L1 vocabulary, L1 Reading, L1 writing, L1 spelling and L1 grammar. The independent variable was the participants' L1. Pillai’s Trac showed that there were no significant differences between language groups F (14, 134) = 1.3, p = .203, partial eta squared = .12.

8.2.10. L2 Proficiency rating

In the same way, the sample rated their proficiency skills in L1, they also rated their proficiency in L2 (See 8.2.9). The sample rating shows that the highest mean score was related to L2 reading, L2 speaking and L2 pronunciation. The middle mean score for rating L2 skills was related to L2 spelling and L2 vocabulary. The two lowest-rated L2 skills were writing a text in L2 and L2 grammar.

Table 20

Participants self-reported L2 Proficiency rating

L2 Proficiency rating												
	English (n=30/31)			Polish (n=33)			Somali (n=12)			Total (N=75/77)		
Variable	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*	*Mean*	*St.d*	*Min-Max*
1. Speaking	5.6	2.2	1-10	7.3	2.1	2-10	7.1	1.9	5-10	6.6	2.3	1-10
2. Pronunciation	5.2	1.9	1-9	6.8	1.9	3-10	6.6	2.3	3-10	6.1	2.1	1-10
3. Vocabulary	5.0	1.9	1-9	6.6	2.0	1-10	6.1	2.2	2-10	5.8	2.1	1-10
4. Reading	6.0	1.9	3-10	7.5	2.1	2-10	7.0	1.7	4-10	6.8	2.1	2-10
5. Writing	4.7	1.9	2-8	6.4	2.2	2-10	5.7	2.5	2-10	5.6	2.2	2-10
6. Spelling	5.0	2.1	1-9	6.7	2.3	2-10	5.9	2.2	2-10	5.9	2.3	1-10
7. Grammar	4.3	1.7	2-8	6.3	2.6	0-10	6.0	1.6	3-10	5.5	2.3	0-10

Note: Summary data is shown for the questionnaire response for the three language groups. Due to missing values, there are differences in the numbers. N=75 and N=77.

A one-way MANOVA was conducted to investigate whether there were differences in L2 proficiency ratings between the three language groups. Seven dependent variables were used to investigate whether there were differences between the three language groups and L2 proficiency ratings. These variables were L2 speaking, L2 Pronunciation, L2 vocabulary, L2 Reading, L2 writing, L2 spelling and L2 grammar. The independent variable was the participants' L1. There were no statistically significant differences in L2 proficiency ratings between language groups F (14, 144) = 1.4, p = .142, partial eta squared = .123.

8.2.11 Summary of sample - questionnaire data

The questionnaire data summed up, shows that this project contains 80 adults with English (n=32), Polish (n=34) and Somali (n=14) as their L1 and Norwegian as their L2. The level of spoken Norwegian is between A1 and C2. The English language group has an equal amount of high and low proficiency in L2. The Level of spoken Norwegian was significantly lower in the English-speaking group. Several one-way MANOVAs showed that there were no significant differences between the three language groups in the headings

"Reading problems", "L1 Proficiency rating" and "L2 Proficiency rating". There was a significant difference between Somali and the two other language groups in the heading "Educational background". In the Somali group, fewer participants had higher education and that was also the case for the Somali mothers. There were furthermore significant differences in the headings "Language dominance", "L1 reading behaviour" and "L2 reading behaviour". In "Language dominance" the English language group knows fewer languages than the two other language groups. In "L1 reading behaviour" the Somali group reads fewer books than the two other groups. The English group reads in their L1 at work to a greater extent than the other two groups. They also read more cartoons than the Polish and Somali groups. When it comes to "L2 reading behaviour", the Polish group reads more L2 (Norwegian) on social media than the other two groups.

8.3. Sample description – data from the test battery

This section provides an initial overview of the characters of the sample based on the computer-based test battery. 80 participants were tested with equivalent tests on L1 and L2 on a computer. The results of these are described and summarized below. These tests were Phonemic awareness, Pseudoword reading, Word reading and RAN. Processing speed and Working memory tests were language-neutral and were therefore only assessed once. An analysis of variance (MANOVA) was conducted on each test to investigate if there were differences between language groups. One of the assumptions for doing a MANOVA is that there should be no significant outliers (Tabachnick & Fidell, 2014). Since this project investigates reading skills in adults with and without reading difficulties, it was difficult to remove the outliers as reading difficulties can lead to a score that is far below the average. For that reason, the outliers have not been removed from the decoding and reading-related tests (Statistics, 2015). Furthermore, the variables were scaled and mean-centred when they were transformed into z-scores. A combined score was made of both time and accuracy. The accuracy score for each participant was divided by the participants' RT on correct given answers. The combined score was also transformed into z scores. This is in line with how Høien-Tengesdal and Høien (2012) made combined scores in Logos. Others have emphasized the need for measuring both RT and accuracy in research involved with testing cognitive skills (Draheim et al., 2016). A review on adult reading difficulties states that a common practice in addressing adult reading difficulties is to assess accuracy, response time or a combination of both (Reis et al., 2020). A combined score makes it possible to include two important indicators for efficient reading, and therefore get broader information about the participants' reading skills.

8.3.1 Test Data Handling

In the computer testing, there was a technical problem for two participants. A technical error was discovered in some of the Norwegian results for one participant. In L2 word reading, pseudoword reading, working memory and processing speed, all the result scores were zero, while the response time was plausible. When I looked at the results from the other tests, as well as considering the probability of not getting a single correct answer to all these tasks in a row, it was clear that the results on these three subtests were not valid. The results of all the L1 tests, as well as L2 phonemic awareness, had a logical relation and they appear to be believable. This was because both the time spent and the degree of accuracy were similar to the results of the other sample. For that reason, these results were kept, while L2 word reading, L2 pseudoword reading, and processing speed were given missing values for both response and time spent to ensure the most correct result possible.

Another participant had no correct answers when working memory was tested. As a result, it was impossible to get a number when computing the mean in response time for the correct answered items. The value was therefore set as a missing value. In total, four participants had zero correct answers when processing speed was tested. Not getting a single answer correct is an unusual result when the total of trials is 128. Therefore, the results were not reliable, and they were set as missing values instead. One participant had a result on accuracy in the first processing speed tests, that was regarded as an outlier and therefore not possible to include in the analyses. This participation was therefore given a missing value. Altogether, this is why the total number of participants varies between 75 and 80 in the analysis.

8.3.2. Computer Assessment data -Description of sample

The skills tested on the computer in both L1 and L2 were Phonemic Awareness, Pseudoword reading, Word reading and RAN. Both the sum score/accuracy, the mean of the response time on correct answers and a combined score of accuracy and mean of response time on correct answers, are presented below for Phonemic Awareness, Pseudoword reading and Word reading. In the accuracy score, a high number means that few mistakes were made on this task. In the mean of response time the measure is milliseconds (ms), and a low number means that the task was done fast. This is often an indicator of the task not being too hard to do/no indication of difficulties in the process. For RAN, response times for grids 1 and 2 are presented and a total score where the response times for grids 1 and 2 are combined. A low number means that the task has been done quickly and indicates easy access to naming the required digits. The results for the L1 tests and L2 tests are presented in two tables – Tables 21 and 22.

Table 21

Computer assessed data – L1

L1 computer assessed data								
	English (n=30/32)		**Polish** (n=34)		**Somali** (n=14)		**Total L1** (n=78/80)	
L1 Phonemic Awareness	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-18)	11.4	4.1	16.4	2.0	9.4	4.3	13.2	4.4
Response Time (ms)	2809	912	2313	797	2869	1372	2609	984
Combined score Z scores	-.395	.771	.645	.892	-.663	.829	.000	1.00
Cronbach's alpha	.84		.68		.82			
L1 Pseudoword Reading	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-80)	68	7.9	74.9	2.9	61.5	6.9	69.8	7.8
Response Time (ms)	1621	690	1352	195	1717	636	1523	540
Combined score Z scores	-.275	.939	.587	.758	-.817	.834	.00	1.00
Cronbach's alpha	.92		.58		.82			
L1 Word Reading	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-80)	76.3	5.3	74.8	3.2	65.1	7.1	73.7	6.3
Response Time (ms)	1276	395	1215	164	1426	263	1276	299
Combined score Z scores	.359	.793	.213	.740	-1.03	.823	.045	.922
Cronbach's alpha	.91		.65		.88			
L1 RAN	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Mean RT Grid 1 (ms)	21274	7595	21068	5585	27103	5415	22206	6756
Mean RT Grid 2 (ms)	22160	12932	19935	4127	26330	5648	21944	9119
L1 RAN Total Z score	-.260	.520	-.205	.613	.604	.696	-.083	.669

Note: Summary data is shown for the computer-assessed L1-tests for the three language groups and as a total L1 score for the whole group.

A one-way MANOVA was conducted to investigate whether there were differences in the objective L1 tests between the three language groups. Four dependent variables were used to investigate whether there were differences between the objective tests and language groups. The four dependent variables were the combined score for L1 word reading, L1 pseudoword reading, L1 phonemic awareness and the total time on L1 RAN. The independent variable was the participants' L1.

There were significant differences in all the four independent variables F (8, 148) = 10.571, $p < .001$, partial eta squared = .364.
L1 phonemic awareness F (2, 76) = 18.079 $p = .001$. L1 pseudoword reading F (2, 76) = 16.354 $p = .001$. L1 word reading F (2, 76) = 11.692 $p = .001$. L1 RAN F (2, 76) = 3.468 $p = .036$.
For significant main effects, post hoc pairwise comparison, the Bonferroni test was used. L1 Phonemic awareness accuracy showed that the significant difference was between Polish, and the two other language groups and the significant level was $p < .001$ for both Somali and English. The Polish group had more similar results and less scattering than the other two groups. In L1 pseudoword reading there were significant differences between all three language groups. Between Polish and Somali and Polish and English the significant level was $p = . 001$. Between Somali and English, the significant level was $p = . 04$. In L1 word reading the significant differences were between the Somali language group and both Polish and English. The significant level was $p = .001$ between Somali and Polish on one side and Somali and English on the other.

For the results of L2 testing see Table 22.

Table 22

Computer assessed data – L2

L2 computer assessed data								
	English (n=31/32)		**Polish** (n=33/34)		**Somali** (n=14)		**Total L2** (n=78/80)	
L2 Phonemic Awareness	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-18)	12.3	4.6	14.8	2.4	9.3	4.5	12.9	4.2
Response Time (ms)	2758	811	2626	920	4204	1743	2955	1205
Combined score Z scores	-.056	0.975	.429	.766	-.913	.963	.00	1.0
Cronbach's alpha							.85	
L2 Pseudoword Reading	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-80)	66,0	7.0	64.7	13.9	63.0	7.7	64.9	10.6
Response Time (ms)	1561	473	1512	330	2064	693	1629	504
Combined score Z scores	.163	.818	.139	1.06	-.700	.957	.00	1.0
Cronbach's alpha							.96	
L2 Word Reading	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-80)	67.6	6.1	68.1	12.6	68.9	7.8	68.0	9.6
Response Time (ms)	1424	343	1330	214	1684	542	1430	360
Combined score Z scores	-.056	.777	.373	.830	-.473	1.04	.050	.898
Cronbach's alpha							.96	
L2 RAN	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Mean RT Grid 1 (ms)	26993	6619	21531	4820	26476	6127	24582	6331
Mean RT Grid 2 (ms)	27191	6819	21352	4566	25980	6602	24498	6459
L2 RAN Total Z score	.312	.911	-.498	.715	.271	.991	-.043	.926

Note: Summary data is shown for the computer-assessed L2 tests for the three language groups and as a total L2 score for the whole group.

A one-way MANOVA between language groups and L2 reading skills were conducted. Pillai's Trac shows significant differences F (8, 144) = 4.960, p = .001, partial eta squared = .216 exposing that there is a statistical difference between language groups.

The MANOVA showed that there were significant differences between language groups in all four L2 tests. L2 Phonemic awareness F (2, 74) = 12.080 p <.001. L2 pseudoword reading F (2, 77) = 4.625 p =.01. L2 Word reading F (2, 74) = 5.167 p =.008. L2 RAN total time F (2, 77) = 8.888 p =.001.

For significant main effects, post hoc pairwise comparison, the Bonferroni test was used. L2 Phonemic awareness accuracy shows that the significant difference was between Somali and the two other language groups. The Somali group had lower accuracy and a higher response time. Between Somali and Polish the significant level is p = .001 on one side and p = .01 between Somali and English on the other. In L2 Pseudoword reading the significant difference was also between Somali and the two other language groups. Between Somali and Polish the significant level is p = .03 on one side and p < .02 between Somali and English on the other. The Somali group had a higher response time in the L2 Pseudoword reading. In L2 Word reading the significant difference only between Somali and Polish p = .007, and that was also the case for L2 RAN total time. The Polish group responded quite quickly to this task. The significant difference was between Somali and Polish p = .017

For the language-neutral computer-based tests, see Table 23. Processing speed had three tasks and the results are a combined score from all three tasks.

Table 23

Computer assessed data - Language-neutral

	Language-neutral tasks							
	English (n=31)		**Polish** (n=32/34)		**Somali** (n=12/14)		**Total** (n=75/79)	
Processing speed	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-128)	121.9	4.3	122.8	2.7	115.5	7.0	121.2	5.0
Response time	1285	190	1285	142	1658	255	1345	227
Combined score z-score	.216	.956	.238	.769	-1.2	.852	.00	1.0
Cronbach's alpha							.99	
Working Memory	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
Accuracy (0-14)	7.9	2.1	8.3	2.0	7.8	1.6	8.0	2.0
Response time	950	524	935	427	1223	675	992	520
Cronbach's alpha							.27	

Note: Summary data is shown for the computer-assessed language-neutral test for the three language groups and as a total score for the whole group.

A one-way MANOVA between language groups and the language-neutral tasks assessed on the computer was conducted to investigate if language differences had an impact on the results. Pillai's Trac shows significant differences F (8, 142) = 7.024, p = .001, partial eta squared = .284 exposing that there is a statistical difference between language groups.

There were significant differences regarding processing speed -both accuracy and mean of response time on correct items. In processing speed accuracy, the result was F (2, 73) = 15.719 p < .001, and on processing speed(RT) F (2, 73) = 119.14 p < .001. Post Hoc pairwise comparison the Bonferroni test was used to investigate the significant differences. In processing speed accuracy, the significant level was p < .001 between Somali and both Polish and English. The Somali group had a larger standard deviation in their results than the other two groups, which indicates that this group had a greater spread in their results. There

was no significant difference between Polish and English. The same goes for processing speed(RT). The significant differences are also here between Somali and Polish on one side $p < .001$, and Somali and English on the other $p < .001$. In general, the Somali group has a slower response time than the Polish and English groups.
There were no significant differences between language groups and the working memory task. Working memory accuracy F (2, 76) = 0.41 $p > .66$ and Working memory(RT) F (2, 76) = 1.72 $p > .19$

As mentioned in Section 8.1, Processing speed is not included in the further analysis in the results chapters (Chapters 9, 10 and 11) because of changes in design caused by Covid-19.

8.4. Sample description – data from The Dynamic test of decoding -DOT

The dynamic test (DOT) was carried out on paper. The results from DOT are therefore presented on their own.
The dynamic test of decoding (Elbro et al., 2012) has three parts, also referred to as rounds. For each round, there is a score for single items. In the second round, there is also a round score. In the analysis in the results chapters a combined score of single items from rounds 2 and 3 was used and therefore also reported in Table 24 below.

Table 24

Dynamic test of decoding – DOT, round scores

	Dynamic test of decoding- DOT							
	English (n= 32)		**Polish** (n= 34)		**Somali** (n= 14)		**Total** (n= 80)	
	Mean	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*	*Mean*	*St.d*
DOT Round 1 Single items (max 30)	27.4	4.4	27.9	2.1	25.7	3.9	27.3	3.6
DOT Round 2 Single items (max 20)	15.3	8.2	17.3	6.4	11.8	9.2	15.6	7.9
DOT Round 3 Single items (max 12)	8.7	4.7	10.2	3.9	6.2	5.1	8.9	4.6
DOT round 2 Round score (max 5)	3.6	2.0	4.2	1.6	2.6	2.1	3.7	1.9
DOT 2 and 3 combined Single items (max 32)	23	12.9	27.5	10.3	18.0	14.1	24.3	12.4
Cronbach's alpha DOT 2 and 3 combined							.98	

A one-way ANOVA between language groups and DOT was conducted to investigate if there were differences between language groups on the variable used in the analysis – DOT 2 and 3 combined. The assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances (p = .01). Therefore, Welch's test was investigated. There were no statistically significant differences in the DOT score between the different language groups, Welch's F(2, 33.236) = 2.796, p = .075.

8.5. Reliability of test scores

To check the reliability of the test battery, the level of internal consistency was investigated using Cronbach's alpha (Tabachnick & Fidell, 2014). According to Ursachi et al. (2015, p. 681) a generally accepted rule is that a Cronbach's alpha value of 0.6-0.7 indicates an acceptable level of reliability. The internal consistency on an item level was checked in the L1 tests, L2 tests, the language-neutral test, and DOT. It was not possible to check the RAN scores for a

Cronbach's alpha because RAN in each language only contained two items (i.e. the response durations for the two number grids). All the L2 tests had high reliability with a Cronbach's alpha at .85 in L2 phonemic awareness, and .96 in both L2 pseudoword reading and L2 word reading. The L1 tests were checked for reliability in each language. Both the English and Somali L1 tests had high reliability. English L1 phonemic awareness had a Cronbach's alpha of .84, English L1 pseudoword reading of .92 and English L1 word reading of .91. For the Somali L1 tests the Cronbach's alpha was of .82 in L1 phonemic awareness, of .82 at in L1 pseudoword reading and .88 in L1 word reading. Even though all the tests were constructed using the same criteria, the Polish tests had slightly lower reliability than the other tests but were still within, or approached the accepted reliability boundaries. The Cronbach's alpha for Polish L1 phonemic awareness was .68, Polish L1 pseudoword reading of .58 and Polish word reading of .65.

For the language-neutral cognitive tests, there was a large difference in reliability. For Processing speed the reliability was quite high with a Cronbach's alpha of .99. For Working Memory, reliability was .27, well below the accepted boundary. It was therefore not possible to include this test in further analyses.

The reliability on DOT items was very high with a Cronbach's alpha of .98.

8.6. Validations of tests and test scores

Validity is a judgment on the degree to which the result of an assessment is adequately supported by empirical evidence and is theoretically justified (Messick, 1989). The validity of test results is crucial for their accurate interpretation. A test battery developed and standardized for one group of people cannot automatically be applied to another group with the assumption that the results will be valid. Inaccuracies in the identification of dyslexia in bilinguals can occur, because tests developed for L1 speakers are applied to L2 speakers, resulting in invalid test results (Hedman, 2012). In order to determine the validity of test results in L2 Norwegian, separate matched L1 tests in English, Polish and Somali were conducted for this thesis. This allowed the relationship between L1 and L2 performance to be directly investigated.

There has been a change in how the issue of validity is approached. Previously, one talked about whether a test or test results were valid. Now the focus has shifted, and the discussion is about the extent to which the *conclusion* based on the test results is valid (Messick, 1989). Messick (1993) introduces the concept of construct validity. Construct validity refers to the evidence base on which the interpretation of test results is based. In other words, construct validation is concerned with how to validate a conclusion made based on test scores and determine to what degree several pieces of evidence support the conclusion. If the interpretation of test results has a vague theoretical basis, the construct validity will bring both clarity and support to the meaning of test scores (Messick, 1993, p. 9). A construct is an abstract concept that must be operationalized to be measured as a skill. The investigation of decoding skills is dependent on finding a methodology that renders them measurable. It is important that the right construct is being measured by a test or test battery. According to Messick (1993), construct validation has two major threats. The first is when a test is too narrow and therefore has lost important aspects of a construct. This is called construct underrepresentation. The second threat is called construct irrelevant variance. This happens when a test is too broad and contains redundant elements related to other constructs than the one to be examined. Construct irrelevant can also refer to method deviation when a response to a test is given in a way that is not relevant to the construct.

Construct irrelevant variance is a major concern when tests developed for L1 speakers are conducted with L2 learners, or when new tests for L2 speakers are developed. I have taken several steps to minimise such concerns in this project. First, in the design of decoding tasks in all languages, I removed the element of language production, as different L2 proficiency can affect the construct decoding negatively (see Section 8.3 for additional information about the tests). Instead of reading out loud, the sample responded by pressing the keys on the keyboard. In the RAN tasks the element of language production was kept due to the nature of the task. Second, the L1 and L2 tests were matched as far as possible. The words included were checked for frequency to make sure that the participant decoded words with a similar frequency in all languages.
All of the tasks in the test battery on the computer were specially developed for this project. Finally, all tests had written instructions, but they were also read aloud to participants to ensure that potential reading difficulties would not be the

cause of any misunderstandings. The sample was first presented with tests and test instructions in their L1. Therefore, when participants were tested in their L2, they were familiar with how to conduct the test. In addition, an instructor was present during the tests and could spot any misunderstandings as they occurred.

Identifying reading difficulties is a complicated task, but the degree of difficulty increases when facing bilingualism because of a lack of knowledge and appropriate measurement tools. It was therefore essential to develop a novel assessment tool to be able to research this topic. Every effort has been made to make the assessment tool reliable, and the assessment of the results valid. In this thesis, I have tried to be as detailed and transparent as possible in the reporting of the methodology and analyses employed. This is necessary for the accurate interpretation of the findings, as well as for future replications important for verifying the results.

8.7. Ethical Considerations

In Norway, The National Research Ethics Committee for Social Sciences and Humanities (NESH), is responsible for national research ethics guidelines. These guidelines have been followed in my project (NESH, 2022). Before the data collection, this project, and its associated data processing plan, received ethical approval from The Norwegian Centre for Research Data, then NSD, now SIKT, reference number 134327 (see Appendix 14.1,).

Secure processing of personal data is an essential part of good scientific practice. Appropriate educational institutions assisted in the recruitment of suitable participants for this project and stored the participants' personal data. Prior to recruitment, a Data Processing Agreement was made between me, and the institutions involved (see Appendix 14.2). These institutions were already approved to handle the participants' data as they were recruiting students at their institutions. The agreement ensured that data processing was conducted following the European Parliament's rules. This is part of the University of Agder's routines for obtaining and storing personal data. For those who were recruited via the Internet, names and contact information were kept on paper and a computer without an internet connection, which was securely stored in a locked cabinet. All participants who took part in the study were assigned an identification number (ID) and all assessment data was labelled with this ID. The connection key with name and number was shredded when the data collection period ended. All collaborating partners have confirmed that the connection key and consent forms were destroyed when the data collection was complete, and the data are therefore anonymised.

There was an ethical consideration concerned with the fact that teachers or employees at educational institutions, recruited participants to this study. There is a possibility that the participants felt that they were obligated to join this study because their teachers asked them. The relationship between a teacher and a student has an uneven power balance that can negatively affect participants. A consent form was therefore given to all participants and was signed before data collection began. The participants could choose whether they wanted to read this in Norwegian or their first language (see Appendix 14.3). Some of the participants were given an oral review of the consent form if they expressed that reading difficulties made it difficult to read the entire text. This was done to ensure that the participants understood that participation was voluntary, that they had the opportunity to withdraw from the study if desired and that they understood the purpose of the study. The consent form also made it clear that there were no negative consequences if the participants chose not to participate. The participants had the opportunity to withdraw their contribution until the data were anonymised. The sample in this study were also adults. Adults are referred to as people 18 years or older, according to Norwegian law (Vergemålsloven, 2010). It was therefore assumed that the participants could decide if they wanted to participate or not, and that these measures safeguarded the participants' interests.

In the questionnaire, a few questions were concerned with the participant's parents. This was done to establish the participant's dominant language and socioeconomic background. These questions were important because they were an essential part of assessing reading behaviour and language proficiency (e.g., Goswami et al., 2005; Høien & Lundberg, 2012). However, this information may be considered as private information and the parents as a third party, did not have the opportunity to give consent for the use of this information. In NESH's guidelines, the importance of privacy and family life is stated (NESH, 2022). It is crucial to protect third parties from possible negative consequences and to protect their privacy. However, it is difficult to imagine that questions about linguistic background and educational level could be perceived as negative for a third party. For most people, neither their educational level nor their first language is considered secret information, and therefore negative effects of this information are not expected. Importantly, the data handling producers employed make it difficult to identify the third party. The SIKT ethical approval states that the third-party information is handled according to the applicable rules and that it is done in an ethically sound manner (see Appendix 14.1). It is stated that: "*The project will process personal data about third parties based on a task of public interest*". This project has emphasised the participant's anonymity, and this means that the anonymity of the third party is also well protected.

This study investigates reading difficulties and for that reason, it was necessary to ask questions about the diagnosis of dyslexia. In the questionnaire, the participants were asked if they had a dyslexia diagnosis or a self-perceived reading difficulty. In the guidelines from NESH, it is stated "*The right to privacy encompasses, among other things, information about diseases and health* (NESH, 2022, p. 25)". It is of great importance to treat health information with great care. Having a diagnosis can mean that you belong to a vulnerable group and that therefore extra care should be taken when researching this group. In NESH, it is emphasized that the integrity and interests of vulnerable groups must be protected. At the same time, it is acknowledged that excessive protection of disadvantaged and vulnerable groups can lead to the lack of inclusion of the perspectives of vulnerable groups in research (NESH, 2022, p. 29). This would mean that society would not gain relevant knowledge about important issues. In this project, the declaration of consent and the anonymisation of the data have safeguarded the interests of the participants.

Finally, the aim of this thesis has been to present the results of this research accurately, neutrally, transparently, and comprehensively.

9. What factors are underlying language and reading profiles, and how do they predict reading skills in L1 and L2?

The research reported in this chapter aims first to determine the underlying factors in the language and reading profiles data collected in the questionnaire - and second to explore how these factors relate to performance in the objective tests of word and pseudoword reading skills in L1 and L2. There is a need to understand more about how bilingual profile factors influence reading skills in both L1 and L2.

Bilinguals can differ in their language profiles in many ways, such as in L1 and L2 proficiency levels, the age of acquisition of L2, and the way it is used, as well as in educational level and socioeconomic factors (as discussed in Chapters 3 and 4). These variables can affect performance in objective tests of language skills and are an important part of bilingual profiling. It is therefore important to determine the key characteristics of any sample of bilinguals tested (see Grundy, 2020 for a review on the importance of bilingual profiling in research). To date, most research has focused on spoken language skills and usage (e.g., Ivanova & Costa, 2008; Luk & Bialystok, 2013; Wigdorowitz et al., 2022). While there are some studies on bilingual profiling and reading, the scope is limited (e.g., Bonifacci et al., 2020; Howard et al., 2014; Oller et al., 2007). The aim of the research reported here was to investigate which characteristics of bilingual profiles significantly influence reading performance.

Bilingual profiling typically employs questionnaires which ask participants to self-report their skills and typical language use. There is evidence that self-reported language proficiency is a reliable indicator of performance (e.g., Chincotta & Underwood, 1998; Flege et al., 2002; Jia et al., 2002; Marian et al., 2007) (For elaboration see Section 3.2 e.g., Marian et al. (2007) study on LEAP-Q). However, most previous research has investigated the relationship between self-reported language proficiency and spoken proficiency (e.g., Anderson et al., 2018; Marian et al., 2007). It is known that the level of proficiency in a second language affects the bilingual language processing system and that language proficiency and language exposure are important variables (Abutalebi et al., 2001). When reading in a second language, and becoming a proficient reader, both L2 proficiency and the quality of received reading instructions will affect the outcome (e.g., Friesen & Frid, 2021; Gottardo, 2002). There is evidence that children who speak a minority language can achieve native-like performance in L2 decoding skills (word and nonsense word reading) after 1-2 years of schooling (August & Shanahan, 2017). However, less is known about the factors that predict successful L2 reading performance in adult sequential bilinguals.

Research on bilingualism and reading has focused on a variety of linguistic processes such as cross-linguistic transfer (e.g., De Ramírez & Shapiro, 2007; Długosz, 2023), reading in different orthographies (e.g., Arab-Moghaddam & Sénéchal, 2001; Tainturier et al., 2011; Yeung, 2016; Ziegler & Goswami, 2005) or bilingual reading comprehension (e.g., Jiao et al., 2019; Smith et al., 2018; Spätgens & Schoonen, 2019; Trapman et al., 2014). Little research to date has investigated the effect of bilingual profiles on reading accuracy and speed in L1 and L2. When bilingual profiling and reading form a part of a study, they are often secondary topics in these studies. The effect of bilingual profiling is most often related to cognitive processes rather than reading skills (e.g., Bialystok, 2010; Grundy, 2020; Laketa et al., 2021; Studenica et al., 2022). Some studies control for factors related to bilingual profiles when examining specific reading-related skills and bilingualism, but the bilingual profile data itself is rarely the focus and is therefore not extensively analysed. When Kuo et al. (2016) examined the relationship between bilingualism and phonological awareness they stated that the sample groups were compatible in terms of age, parents' level of education and nonverbal IQ. These factors are part of a bilingual's profile but were used as a control variable and were not investigated in the study. Similar ways of using bilingual profile data as control variables in bilingual reading are common in many studies (e.g., Bonifacci & Tobia, 2016; Zhang & Ke, 2020). It is less common to investigate how individual differences in bilingual profiles influence reading speed and accuracy in L1 and L2 reading.

When studies have investigated the effects of bilingual profile variables, the focus has been on children and not adults (e.g., Bonifacci & Tobia, 2016; Hoff, 2013; Zhang & Ke, 2020). For example, children from low-SES families have been compared with children from high-SES families (both monolinguals and bilinguals). Children from low-SES families lag behind in measures of vocabulary, grammar, narrative skills, phonological awareness, and speed of language processing (See Hoff, 2013, for a review). As an example of bilingual profiling, Howard et al. (2014) investigated the importance of a number of factors in bilingual children's L2 reading development including, socioeconomic status (SES), languages in use, and literacy practices (both at home and school). They employed a hierarchical regression model which showed that some of these factors are predictors for L2 reading accuracy and some are predictors for L2 reading comprehension. The study's sample included 292 Spanish-speaking kindergarteners, 85 Spanish-speaking third graders and 70 Spanish-speaking fifth graders in different settings of language use in L1/L2 in the USA. In the first part of the study, parents filled out a comprehensive questionnaire that elicited information about children's schooling history, parents' birthplace, ethnicity, schooling, employment, SES, home language (languages spoken by the child and languages spoken to the child), and literacy practices. In the second part, information about the students' schooling history was elicited from school records and teacher interviews. Finally, the students were tested with an assessment battery consisting of a picture vocabulary test, a measure of oral-language proficiency, letter-word identification, and a measure of reading accuracy (all subtests of the Woodcock Language Proficiency Battery-Revised, Woodcock, 1991). When SES, home- and school language were controlled for, the L2 vocabulary was a significant predictor of L2 reading accuracy. Associations between SES, home- and school languages and literacy environments differed across grad levels. For the third graders, only vocabulary knowledge in both L1 and L2 significantly predicted L2 word reading, while SES, school language and vocabulary knowledge significantly predicted reading comprehension. For the fifth graders home language, home literacy, and vocabulary (L1 and L2, but L2 to a lager extent) significantly predicted L2 word reading and L2 reading comprehension, but SES did not. Therefore, different factors predicted the outcome for accuracy and comprehension at different stages of reading development. This is an important finding when considering reading difficulties since decoding abilities and reading comprehension are usually a part of the assessment of reading skills, but decoding skills are considered the most important (e.g., Hatcher et al., 2002; Tops et al., 2012). It is therefore important to determine if different factors influence different components of bilingual reading in different age groups.

As discussed in Chapter 5, phonological awareness and reading skills do transfer from L1 to L2 (e.g., August et al., 2009; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018) and from L2 to L1 (Piper et al., 2016). A study of Chinese adults showed that phonological processing skills can be assessed in their L2 to predict L2 reading performance (Harrison & Krol, 2007). Difficulty with phonological processing is one of the core elements defining reading difficulties (e.g., Hatcher et al., 2002; Lyon et al., 2003; Tops et al., 2012) and being able to assess these skills in L2 increases the likelihood of identifying reading difficulties in bilinguals. Bilingual speakers can accurately self-report their language proficiency, as it has been shown that self-report significantly predicts their behavioural performance (e.g., Chincotta & Underwood, 1998; Jia et al., 2002; Marian et al., 2007). The same goes for the self-reporting of reading difficulties (e.g., Gilger, 1992; Gilger et al., 1991; McGonnell et al., 2007; Schulte-Körne et al., 1997; Wolff & Lundberg, 2003). Snowling et al. (2012) investigated the relationship between self-reported reading difficulties in adults (dyslexia or self-perceived reading difficulties) and the results on assessed word- and nonword reading. They found that adults who reported themself as dyslexic/or having severe reading difficulties gained lower scores on objective measures of literacy skills. In their study, 417 adult participants rated their skills on a Self-Report scale made for ADHD (Kessler et al., 2005) which also contained questions about reading difficulties. Participants in Snowlings' (2012) study then completed objective tests from TOWRE (Torgesen et al., 1999), measuring their accuracy and fluency in word and nonword reading. Those participants who reported a reading difficulty gained lower scores on the Reading scale than those who did not. However, the participants in the Snowling et al. (2012) study were all tested in their L1. Little research to date has investigated self-report of reading difficulties in bilinguals and there is still uncertainty about how accurately a self-reported reading difficulty predicts reading performance in L2. It is therefore important for the field of practice to determine whether there is a correspondence between reading skills in L1 and L2 as well as a correlation with self-report of reading difficulties. To investigate reported reading difficulties in bilinguals as an underlying factor is therefore of interest when trying to predict reading skills in L2.

The questionnaire developed for this study had several questions about education level and reading behaviours. Clearly, how often one reads will affect one's reading skills (Mol & Bus, 2011). People with higher education tend to read at a higher volume at work than those with no formal education beyond high school

(Guthrie et al., 1986). Moreover, students' reading performance is influenced by their parent's education (e.g., Myrberg & Rosén, 2009; Xie & Pisano, 2019), and other socioeconomic factors (OECD, 2019). These are therefore factors I expected to influence both L1 and L2 reading. According to Hedman (2012), several pitfalls can lead to an incorrect interpretation of L2-tested reading skills. Low socioeconomic background, unevenly distributed language proficiency across languages and testing reading skills in only L2, may generate a false estimate of reading skills. It is possible that bilinguals can be identified as weaker readers than is the case, if socioeconomic background is not taken into consideration, or if bilinguals are only tested in their second language. This emphasizes the importance of investigating underlying factors that may influence bilingual reading.

In summary, the research reported in this chapter aimed to shed light on profile components that contribute to bilingual reading performance. First a Principal Component Analysis (PCA) (Tabachnick & Fidell, 2014) of the questionnaire data is reported and the resulting components are described and discussed. Second, these components are used as predictors for participant's performance in the word and pseudoword reading tasks in both L1 and L2. Multiple regression analyses were used to investigate to what degree the PCA components predict the outcome of the L1 and L2 reading results.

The research questions addressed in this chapter are as follows:

- RQ1: What are the underlying factors that explain variance in adult sequential bilingual profile data including self-ratings of reading behaviour and proficiency in L1 and L2?

- RQ2: To what degree do individual differences in these underlying factors predict performance in objective tests of reading skills?

In line with previous research, one would predict that reading performance in both L1 and L2 reading tests will be affected by ratings of language proficiency and educational level. It is less clear how socioeconomic background will affect reading performance as previous research has shown that age can influence whether socioeconomic background has a direct influence on reading ability. In addition, this study aims to add to the literature by investigating the associations between reading performance, language usage and multilingualism, as well as self-reported reading difficulties.

9.1. Principal Component Analysis

To address RQ1, the questionnaire data was examined. A Principal Component Analysis was conducted to reduce the large set of variables in the questionnaire to a smaller set of components that accounted for most of the variance in the data set.

9.1.2. Preparing the Data

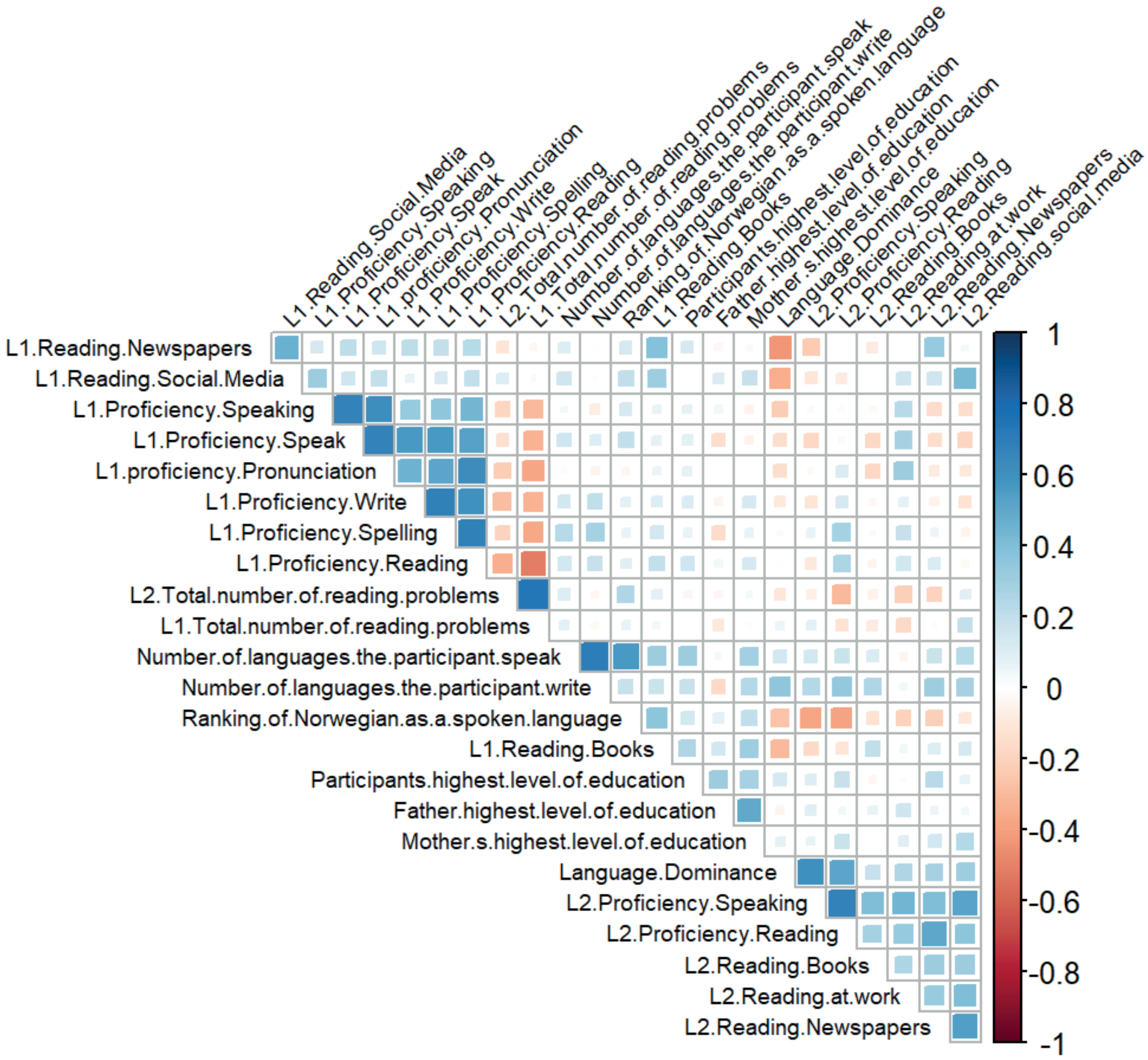
34 variables from the questionnaire were subjected to a principal components analysis (PCA) using IBM SPSS Statistic version 29. To prepare the data set for the PCA, the variables were transformed into z-scores. For a PCA, the variables should ideally be continuous (with fixed distances between each value). However, according to Tabachnick and Fidell (2014), in practice, variables are often treated as continuous in multivariate statistics if the underlying scale is thought to be continuous but the measured scale is actually ordinal (as is the case for some of the variables used in the PCA reported here e.g., educational level). This is confirmed by several studies (Anderson et al., 2018; Mann & de Bruin, 2022; Marian et al., 2007). 9 participants had missing values which were replaced by the variable mean (79 values in total).

Three variables were removed because there was uncertainty about the validity of their contribution. After careful assessment, "L1 reading cartoons" and "L2 reading cartoons" were removed because there is reason to assume that cartoons are a Western phenomenon and that the answers to these questions are culturally conditioned. To avoid cultural bias in the PCA a decision was made to remove these variables. "L1 reading at work" was also removed because in Norway there are greater opportunities to speak English or Polish at work than Somali. In many workplaces in Norway, English is used alongside Norwegian, as the working language. Furthermore, there are also large work environments where many of the employees speak Polish. There are fewer opportunities to find large working environments where it is possible to use Somali in everyday work.

The remaining data was entered into a correlation matrix using Pearson's r. All variables showed at least one required correlation of above 0.3 therefore none were removed. Variables with a correlation of 0.8 or higher were considered to measure the same construct, and one of the two correlated variables was removed. Seven variables were removed based on this criterion. The estimated level of spoken Norwegian correlated $r = 0.81$ with L2 speaking proficiency. The estimated level of spoken Norwegian was removed in favour of the Norwegian speaking proficiency variable because the participants had rated their skills in the latter with a number from 0 to 10 - a wider scale than the scale in the first item (A1-C2). L2 speaking proficiency also correlated highly with both L2 pronunciation proficiency ($r = 0.8$) and L2 vocabulary proficiency ($r = 0.85$). The variable L2 speaking proficiency was retained because it related to a more general ability. The correlation between the Number of languages the participants read and the Number of languages the participants speak was $r = 0.89$. The variable Number of languages the participants speak was kept because this construct was judged to be a more important measure of multilingualism. L1 spelling proficiency and L1 grammar proficiency correlated at $r = 0.8$. The variable L1 spelling proficiency was kept since spelling is a more relevant difficulty in adults with reading problems. L2 reading proficiency correlated highly with L2 writing proficiency ($r = 0.81$) and L2 spelling proficiency ($r = 0.86$). L2 reading proficiency was kept as it is the most relevant variable, and the two other variables were removed. The reduced dataset contained 24 variables and the final correlation matrix is shown in Figure 6.

Figure 6

Correlation plot of the final data used in the PCA



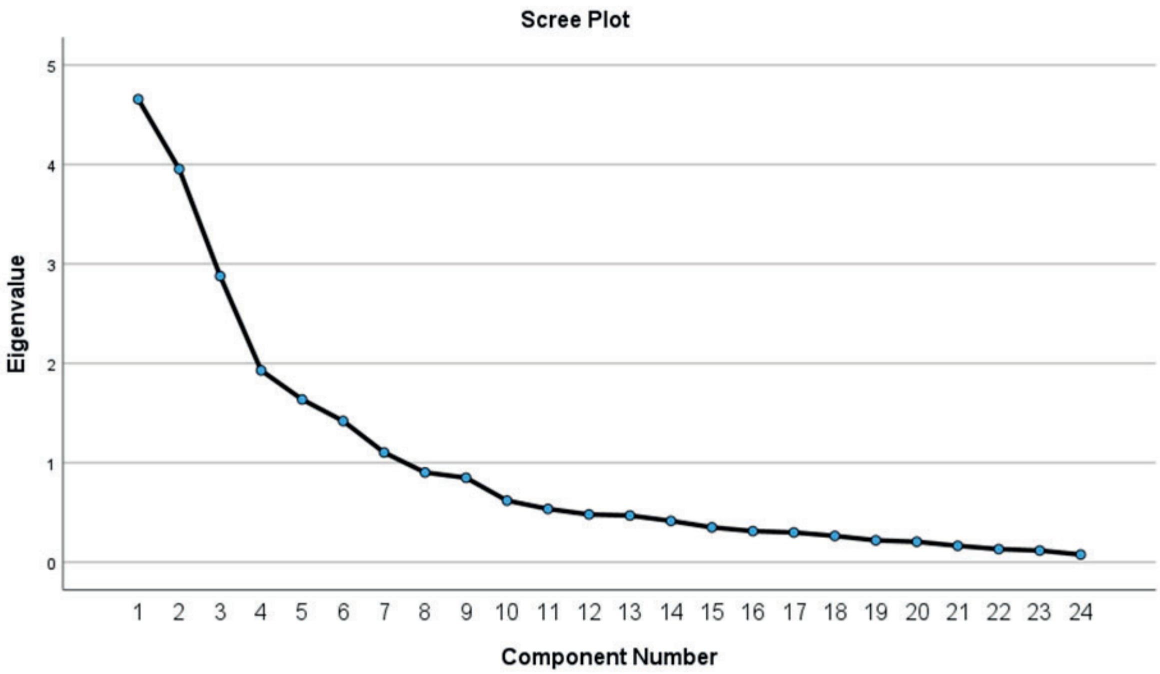
9.1.3. PCA Suitability Measure

The remaining 24 variables were tested for PCA eligibility. This was done with Bartlett's test of sphericity (Bartlett, 1950; Bartlett, 1951), and with the Kaiser-Meyer-Olkin (KMO) test for Sampling Adequacy (Kaiser, 1970, 1974; Kaiser & Rice, 1974). Bartlett's test was significant ($n=80$, $p< .001$) and the KMO was 0.64, above the 0.6 that is considered the minimum appropriate value for factor analysis (Tabachnick & Fidell, 2014).

Kaiser's criterion recommends retaining components with an eigenvalue greater than 1.00 (eigenvalue > 1.00) (Kaiser, 1960). Principal components analysis revealed the presence of seven components with eigenvalues exceeding 1, explaining a total of 73.3 %. The Screeplot also supports seven components with an eigenvalue exceeding 1. See Figure 7 below.

Figure 7

Scree plot showing eigenvalues of components



There were no correlations between the factors greater than 0.22, therefore a varimax rotation algorithm was used. All of the components except the 6th comprised some variables which also loaded onto other components. The double loadings led to a quite low reliability score in each component using Cronbach's alpha (Cronbach, 1951) (see Table 25. The score is in parentheses). Therefore, variables in multiple components were removed from the component where it had the lowest loading. The resulting components are shown in Table 25.

Table 25

The PCA components and the proportion of variance they explain. The variables retained for each component and the associated Cronbach's α are in bold.

Component 1 **L1 Proficiency**		Component 2 **Norwegian engagement**		Component 3 **Multilingualism**		Component 4 **L1 Reading for leisure**	
Variable	*Load*	*Variable*	*Load*	*Variable*	*Load*	*Variable*	*Load*
L1 Proficiency Vocabulary	**0.88**	**L2 Proficiency Speaking**	**0.81**	**Number of languages the participant speaks**	**0.86**	**L1 Reading Newspapers**	**0.85**
L1 Proficiency Pronunciation	**0.85**	**L2 Proficiency Reading**	**0.81**	**Number of languages the participant writes**	**0.82**	**L1 Reading social media**	**0.71**
L1 Proficiency Speaking	**0.78**	**L2 Reading Newspapers**	**0.71**	**Ranking of Norwegian as a spoken language**	**0.56**	**L1 Reading books**	**0.54**
L1 Proficiency Spelling	**0.69**	**L2 Reading social media**	**0.67**	L1 Reading books	0.38	L2 Reading Newspapers	0.43
L1 Proficiency Reading	**0.69**	**Language dominance**	**0.64**	L1 Proficiency Spelling	0.33	L2 Reading social media	0.31
L1 Proficiency write	**0.63**	**L2 Reading at work**	**0.53**			Language dominance	-0.55
L2 Reading at work	0.36	Number of languages the participant writes	0.31				
L1 Total number of reading problems	-0.36	L2 reading books	0.31				
		Ranking of Norwegian as a spoken language	-0.54				
Proportion Variance	16.4%	Proportion Variance	14.9%	Proportion Variance	10.4%	Proportion Variance	9.4%
Cumulative Variance	16.4%	Cumulative Variance	31.4%	Cumulative Variance	41.7%	Cumulative Variance	51.2%
Cronbach's *α* (0.73)	**0.88**	Cronbach's *α* (0.73)	**0.82**	Cronbach's *α* (0.68)	**0.74**	Cronbach's *α* (0.53)	**0.65**

Component 5 **Reading Problems**		Component 6 **Socio-economic background**		Component 7 **L2 Reading**	
Variable	*Load*	*Variable*	*Load*	*Variable*	*Load*
L2 Total number of reading problems	**0.83**	**Father's highest level of education**	**0.86**	**L2 reading books**	**0.69**
L1 Total number of reading problems	**0.80**	**Mother's highest level of education**	**0.74**	L2 Reading at work	0.45
L1 Proficiency write	-0.33	**Participant's highest level of education**	**0.57**	L2 Reading social media	0.31
L1 Proficiency Reading	-0.40			Participant's highest level of education	-0.40
Proportion Variance	8.6%	Proportion Variance	7.9%	Proportion Variance	5.5%
Cumulative Variance	59.8%	Cumulative Variance	67.8%	Cumulative Variance	73.3%
Cronbach's *α* (-0.11)	**0.85**	Cronbach's *α* (0.62)	**0.62**	Cronbach's *α* (0.48)	**-------**

Note: Factor analysis of questionnaire data. Rotation Method: Varimax with Kaiser Normalization. Mark that Bold font in variables and loadings marks the remaining variables in the component after the variables were only listed with the highest loading.

9.1.4. Interpretation of Components

The resulting components demonstrate sensible groupings of variables that are relatively straightforward to characterise.
The first component is comprised of variables relating to participants' ratings of their ***L1 Proficiency***. It contains variables of L1 spelling, reading, writing, speaking, vocabulary, and pronunciation.

The second component showed aspects of L2 ***Norwegian engagement***. It refers to L2 speaking, but also to different situations in which reading in their L2 occurs. The variable Language dominance refers to how many languages are used in everyday activities (speaking to themselves, expressing love or anger, doing simple mathematics), and is also an example of situations where one must decide which language to use. A low number in this variable refers to fewer languages active in the participants' minds. As mentioned in 8.2.4, 66.3% of the participants have Norwegian as their L2 and a low number on language dominance reflects having L1 as a dominant language and Norwegian as their L2. These variables are therefore understood as a measurement for having Norwegian as a second language. This component therefore contains variables describing both traditional markers for L2 language proficiency and situations where Norwegian is used.

The third component was named ***Multilingualism***. This component comprises variables concerned with how many languages are in active use by the participant.

The fourth component has loadings of L1 reading behaviour in the participant's spare time. The variables in this component are concerned with reading books and newspapers, and with reading on social media. The component is therefore called ***L1 reading for leisure***.

The fifth component clearly relates to ***Reading Problems***. This component contains the two variables the number of reading difficulties listed by the participants.

The sixth component has loadings from variables concerning the participants and the participants' parents' highest level of education. Parents' level of education affects a person's socio-economic background and can be an underlying factor in literacy. The sixth component is therefore called ***Socioeconomic background***.

The final column is called ***L2 reading*** but cannot be characterized as a component because it only comprises one variable. It will therefore not be included in any further analyses.

9.2. Regression Analyses

The analyses in this section address RQ2 by investigating the relationship between the six components from the PCA and the objective tests of reading. The objective tests of interest are Word reading and Pseudoword reading in both L1 and L2. For both word reading and pseudoword reading a combined score of accuracy and RT was used. Four standard multiple regressions were conducted.

9.2.1 Assumptions for multiple regressions

Before multiple regressions could be carried out, there were several assumptions about the data set that needed to be investigated (Tabachnick & Fidell, 2014). There are different opinions on the minimum sample size required to conduct multiple regressions as well as different ways to calculate the required sample. Tabachnick and Fidell (2014) suggest $N \geq 50 + 8m$, where "m" refers to the number of independent variables. With six independent variables, the resulting minimal sample size is = 98 participants. Others have suggested $n \geq 20 + 5m$ (Khamis & Kepler, 2010), which requires = 50 participants. The sample size for this project is 80 participants which falls between these estimates, therefore some caution may be necessary when interpreting the results.

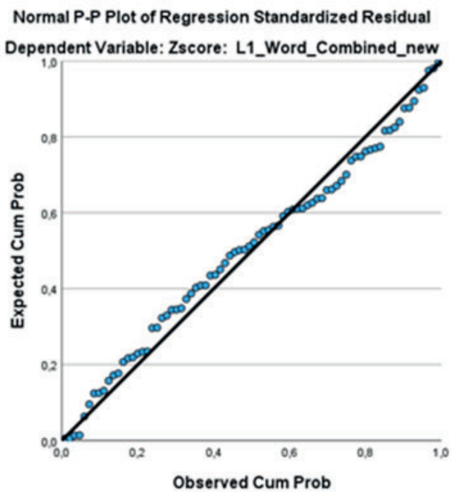
All variables were transformed into z-scores and the data set was checked for normality. Scores beyond +/- 3.3 standard deviations from the mean were considered outliers in L1 and L2 word reading and pseudoword (Tabachnick & Fidell, 2014). When checking for outliers one participant had a missing score due to technical difficulties on all four tests. One had an outlier score in L1 word reading and one had an outlier score in L2 word reading. Following the removal of these participants, the data were normally distributed. The resulting residual plots for all four tasks are shown in Figure 8.

Figure 8

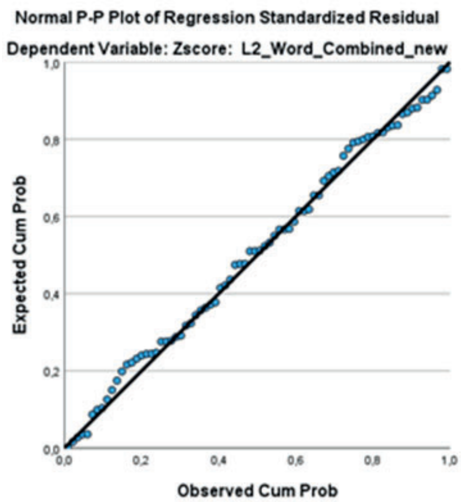
Residual plot from regression, decoding tasks

Residual plot from regression

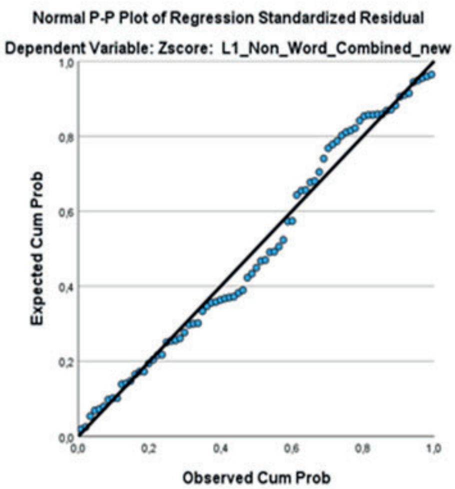
A - L1 word reading



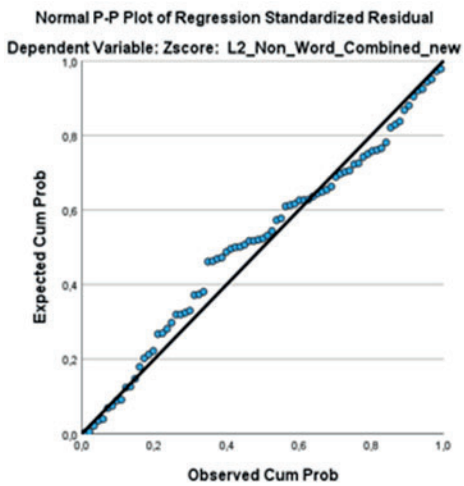
B - L2 word reading



C - L1 pseudoword reading



D - L2 pseudoword reading



9.2.2. Multiple Regression Report

A multiple linear regression model was used to test if individual levels of the six PCA components significantly predicted performance in decoding skills in L1 and L2. Six components from the PCA (independent variables) were tested against four dependent variables which were a combined score of accuracy and RT in L1 and L2 word and pseudoword reading (see Section 8.3 for details of the combined score calculation).

The variables entered in multiple linear regressions were first checked for correlations using Pearson's *r*. The variables entered in the correlation matrix were the L1 and L2 test results from the test battery described in Chapter 8: word reading, pseudoword reading, phonemic awareness and RAN. In addition, also the language-neutral tests processing speed and DOT were included, and the six components of the PCA. This was done to give an overview of the correlation between the components from the PCA/questionnaire and the rest of the test battery. The correlation matrix is presented in Table 26 below. In the multiple regressions only the decoding tests, word reading and pseudoword reading in L1 and L2 are investigated.

Table 26

Correlations Test battery and PCA components

Variable	n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. L1 word	78	---															
2. L1 pseudoword	79	.72**	---														
3. L1 PA	80	.50**	.65**	---													
4. L1 RAN	79	-.51**	-.36**	-.28*	---												
5. L2 word	78	.68**	.76**	.54**	-.27*	---											
6. L2 pseudoword	79	.63**	.64**	.35**	-.25*	.70**	---										
7. L2 PA	80	.59**	.63**	.81**	-.36**	.51**	.43**	---									
8. L2 RAN	79	-.13	-.31**	-.38**	.44**	-.41**	-.15	-.36**	---								
9. Processing speed	75	.66**	.52**	.39**	-.34**	.46**	.53**	.42**	-.07	---							
10. DOT	80	.15	.36**	.38**	-.11	.11	.13	.49**	-.19	.30**	---						
11. L1 proficiency (1)	80	.15	.40**	.10	-.07	.25*	.29**	.09	.16	.31	.06	---					
12. Norwegian engagement (2)	80	-.07	.13	.23*	.08	.40**	.00	.16	-.61**	.13	.05	-.01	---				
13. Multilingualism (3)	80	.18	.29**	.24*	-.27*	.22	.21	.24*	-.22	.16	.19	.15	.22	---			
14. L1 reading for leisure (4)	80	.04	.06	-.03	-.15	-.06	.01	.08	.16	-.03	.11	.26*	-.05	.22	---		
15. Reading problems (5)	80	-.31**	-.31**	-.19	.23*	-.28*	-.26*	-.27*	-.01	-.06	-.02	-.40**	-.10	.08	.01	---	
16. SES (6)	80	.38**	.30**	.36**	-.33**	.27*	.20	.41**	-.23*	.34**	.28*	.02	.17	.20	.16	-.05	---

**Correlation is significant at the .01 level. * Correlation is significant at the .05 level.

9.2.2.1. Regression analyses of L1 word reading

The multiple regression model output for L1 word reading is reported in Table 27. As can be seen, the model significantly predicted L1 word reading F (6, 71) = 4.6, p< .001, adj. R^2 = .220. Only two of the six components significantly predicted reading performance. ***Reading problems*** negatively predicted performance while ***Socioeconomic background*** had a significant positive relationship.

Table 27

Multiple regression, L1 word reading

L1 word reading	*B*	95% Confidence Interval for B		*SE B*	*β*	*p*
		LL	UL			
Model 1(R^2=.28, *adj.* R^2=.22)						
Constant	.045	-.139	.229	.092		.63
L1 proficiency	.000	-.060	.060	.030	.001	.99
Norwegian Engagement	-.058	-.121	.004	.031	-.194	.07
Multilingualism	.083	-.024	.190	.054	.166	.13
L1 reading for leisure	-.037	-.159	.085	.061	-.065	.55
Reading Problems	-.197	-.334	-.060	.069	-.323	<.006**
Socioeconomic background	.207	.090	.323	.058	.372	<.001***

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *p < .05. ** p < .01. *** p < .001.

9.2.2.2. Regression analyses of L2 word reading

The multiple linear model output for L2 word reading was also significant F (6, 71) = 5.6, p<.001, adj. R^2 = .27 (see Table xx). Both ***Norwegian Engagement*** and ***Socioeconomic background*** positively predicted performance.

Table 28

Multiple regression, L2 word reading

L2 word reading	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model 1(R^2=.32, *adj.* R^2=.27)						
Constant	.051	-.123	.225	.087		.56
L1 proficiency	.051	-.006	.107	.028	.202	.08
Norwegian Engagement	.093	.034	.152	.030	.317	<.003**
Multilingualism	.073	-.029	.174	.051	.149	.16
L1 reading for leisure	-.086	-.201	.029	.058	-.156	.14
Reading Problems	-.102	-.232	.027	.065	-.173	.12
Socioeconomic background	.109	-.001	.219	.055	.206	<.05*

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

9.2.2.3. Regression analyses of L1 pseudoword reading

The third multiple linear regression analysis tested L1 pseudoword reading. The overall multiple regression model was significant F (6, 72) = 5.5, $p < .001$, adj. $R^2 = .258$. Three components were significant. ***L1 Proficiency, Multilingualism*** and ***Socioeconomic background*** positively predicted performance.

Table 29

Multiple regression, L1 pseudoword reading

L1 pseudoword reading	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model 1(*R^2*=.32*, adj. R^2*=.26*)*						
Constant	.000	-.193	.193	.097		1.0
L1 proficiency	.087	.024	.150	.032	.312	<.007**
Norwegian Engagement	.012	-.053	.078	.033	.038	.71
Multilingualism	.121	.008	.233	.056	.223	<.04*
L1 reading for leisure	-.067	-.195	.061	.064	-.109	.30
Reading Problems	-.121	-.265	.023	.072	-.184	.10
Socioeconomic background	.148	.026	.270	.061	.264	<.02**

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

9.2.2.4. Regression analyses of L2 pseudoword reading

The multiple regression model for L2 pseudoword reading was significant F (6, 72) = 2.7, $p = .019$, adj. $R^2 = .117$ (See Table 30), but none of the individual components significantly predicted performance.

Table 30

Multiple regression, L2 pseudoword reading

L2 pseudoword reading	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model 1(R^2=.19, *adj.* R^2=.12)						
Constant	.000	-.211	.211	.106		1.0
L1 proficiency	.060	-.009	.128	.034	.214	.09
Norwegian Engagement	-.025	-.097	.047	.036	-.076	.49
Multilingualism	.103	-.020	.225	.061	.190	.10
L1 reading for leisure	-.071	-.210	.069	.070	-.115	.32
Reading Problems	-.123	-.281	.034	.079	-.187	.12
Socioeconomic background	.183	-.025	.242	.067	.180	.11

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

9.3. Summary and Discussion

The aim of the research reported above was to investigate the characteristics of bilingual profiling that significantly influence reading performance. There are characteristics of a bilingual profile that are known to affect reading performance in children, but less is known about which characteristics influence adult reading performance. Given the uncertainty about how to identify reading difficulties in a second language, it is important to identify the characteristics of importance when the results of objective reading tests are interpreted.

The PCA yielded informative components that were simple to characterise. The six components were ***L1 proficiency***, ***Norwegian engagement***, ***Multilingualism***, ***L1 reading for leisure***, ***Reading problems*** and ***Socioeconomic background.*** Multiple regressions were then conducted to test the predictive value of the PCA components for the objective tests of reading skills. Many aspects of the findings are in line with the predictions and with previous findings.

First, the ***Socioeconomic background*** component significantly predicted performance in L1 and L2 word reading, and L1 pseudoword reading. Only L2 pseudoword reading was not predicted by this component. These findings are largely in line with previous research. A low socioeconomic background has a negative effect on reading skills (e.g., Bonifacci et al., 2020; Droop & Verhoeven, 2003; OECD, 2019). In advance, I had no clear hypotheses for how ***Socioeconomic background*** would affect L2 reading performance since previous research had shown that socioeconomic factors did not affect fifth graders' L2 word reading (Howard et al., 2014). Nevertheless, the effects of ***Socioeconomic background*** on L2 word reading are in line with previous research on children (e.g., Bonifacci et al., 2020; Droop & Verhoeven, 2003). The regression model for L2 pseudoword reading yielded no significant effects for any component suggesting that performance in this task is least influenced by characteristics of bilingual profile. It is however clear from the data reported here that the influence of ***Socioeconomic background*** need not decrease in adulthood as some previous studies proposed (Howard et al., 2014). Moreover, Howard et al. (2014) found that Socioeconomic factors affected reading comprehension in children more than decoding skills. The quality of the linguistic environment is supposed to be better in a high socioeconomic status, and also influence children's linguistic and literacy development facilitating the educational opportunities that can be achieved (Hoff, 2003). It is logical that this may affect the results related to comprehension in children, but it should also be able to affect the results in adults. In contrast to Howard et al.'s (2014) study, the results from the PCA showed that in adults ***Socioeconomic background*** predicted decoding performance in three out of four decoding tasks. Reading comprehension was not assessed in the current study. There is reason to believe that if it were, ***Socioeconomic background*** would also have predicted comprehension in adults as the quality of linguistic environment should also affect adults. When only decoding skills were a part of the test battery, and these skills were significantly predicted by ***Socioeconomic background***, this shows that there is a difference in testing children and adults and the importance of investigating bilingual profiling in adults.

The ***Norwegian engagement*** component predicted performance in L2 word reading. L2 word reading will naturally be influenced by proficiency level in L2. It has been confirmed by previous studies that the level of L2 proficiency affects

L2 reading (e.g., Admiraal et al., 2006; Geva, 2006b; Jeon, 2012; Jiang, 2011). L2 reading provides training in decoding more letter combinations compared to only reading in L1. Knowing several languages leads to increased linguistic awareness which has been shown to benefit language learning (e.g., Angelovska, 2018; Bardel & Falk, 2007). It is again interesting that ***Norwegian engagement*** did not predict pseudoword reading in L2. If ***Norwegian engagement*** does not affect L2 pseudoword reading, then this task might be promising in terms of being a test of decoding skills that is unaffected by L2 proficiency level.

Multilingualism predicted L1 pseudoword reading. This is probably due to bilinguals increased knowledge of orthographic structures and therefore wider decoding experience than monolinguals. This experience seems to have a positive effect on decoding in L1 pseudoword reading. The BIA+ model (Dijkstra & Van Heuven, 2002) states that sub-lexical orthographic knowledge is the first factor of an identification system that helps bilinguals decide which language a word belongs to. Having multiple languages to draw orthographic structures from appears to improve the decoding of pseudowords in L1. It is less clear why ***Multilingualism*** does not predict L2 pseudoword reading because arguably, the benefits of multiple orthographic codes should be the same. Based on the results for L1 pseudoword reading, ***Multilingualism*** positively predicts this task. Furthermore, ***L1 proficiency*** also significantly predicted L1 pseudoword reading, together with ***Socioeconomic background*** and ***Multilingualism.*** It is a sensible result that ***L1 proficiency*** significantly predicts L1 pseudoword reading. Pseudoword reading is a measurement of decoding skills or a measurement of technical reading skills that does not include comprehension. When participants have self-rated their L1 reading proficiency to be at a high proficiency level, this is reflected in the results of L1 pseudowords. It looks like ***L1 proficiency*** is capturing more of the sub-lexical knowledge needed to decode L1 pseudowords than what is the case of decoding L1 words. This is also in line with Marian et al. (2007) findings in LEAP-Q. In that study, L1 reading proficiency was a strong predictor of L1 proficiency.

The PCA component ***L1 reading for leisure*** did not significantly predict performance on the outcome of any of the objective tests. When it comes to ***L1 reading for leisure***, it is possible that this does not affect adults as much as it does children. It is known that reading ability increases for children who are exposed to print more often than what is the case for children who do not read for leisure (Mol & Bus, 2011), and therefore one could expect that ***L1 reading for leisure*** also should predict reading outcomes in adults. It is possible that the difference in ***L1 reading for leisure's*** influence between adults and children is concerned about reading development. One can expect that adults' reading development is completed and is therefore not affected by reading for leisure in the same way as children who are in a phase of reading development.

Finally, the component of greatest interest is ***Reading Problems.*** The multiple regression showed that ***Reading Problems*** predicted performance in L1 word reading. Previous research has shown that there is cross-language transfer and that reading difficulties should be visible in both languages bilinguals use (e.g., Geva, 2006a; Harrison & Krol, 2007; Miller-Shaul, 2005; Oren & Breznitz, 2005). There is also a relationship between self-reported reading difficulties in adults (dyslexia or self-perceived reading difficulties) and the results of objective reading tests (e.g., Gilger, 1992; Gilger et al., 1991; McGonnell et al., 2007; Schulte-Körne et al., 1997; Snowling et al., 2012; Wolff & Lundberg, 2003). It was therefore expected that self-reported reading difficulties should predict performance in objective tests at least in L1. In addition, research on bilingualism has shown that people have an accurate picture of their language skills in L2 when they are asked to self-report (e.g., Chincotta & Underwood, 1998; Jia et al., 2002; Marian et al., 2007). It is therefore surprising that the component ***Reading problems*** did not predict L2 word reading or pseudoword reading in either L1 or L2 in the regressions. However, in the correlation matrix that investigated the relationship between the test battery and the PCA components (see Table 26 in Section 9.2.2), ***Reading problems*** were significantly correlated with both L1 (-.31) and L2 (-.28) word reading, L1(-.31) and L2 (-.26) pseudoword reading, and L2 (-.27) phonemic awareness, but they did not become significant in the regression models when other independent variables were included. In other words, there is a relationship between ***Reading Problems*** and the test battery, but other variables in some of the regressions equalized the explained variation. It is also worth noting that the participants with different languages in this study come from different cultures and educational institutions. In the review by Mather et al. (2020), it emerged that different countries relate differently to how they understand the term dyslexia and how the difficulty is widespread. This may have led to the participants having different perceptions of how they would characterise a reading difficulty and thus underreporting their reading difficulties, which may have influenced the regressions.

Another explanation for the lack of predictability in the component ***Reading Problems*** is that this result is an effect of a small sample size and that a bigger sample would yield a different result. Similarly, it is possible that the sample that had an official dyslexia diagnosis was too small. I had to rely on the participant's self-reported reading problems. Self-rating data are also dependent on how researchers have framed the questions, and it is possible that the questions about reading problems were not fine-grained enough. The ***Reading problems*** component does not comprise any detailed information about the nature of reading difficulties involved and therefore cannot be used as an identification of a difficulty alone. Furthermore, since the component ***Reading problems*** did not predict L2 word reading or L2 pseudoword reading, it is important to investigate if L2 proficiency influences these objective tests to be able to distinguish between L2 proficiency level and decoding abilities in bilinguals.

10. Decoding, RAN and phonemic awareness assessed in L1 and L2, and associations with L2 spoken proficiency ratings.

In this chapter, I investigate how decoding, RAN and phonemic awareness assessed in L2 are associated with corresponding skills in L1 and L2 (Norwegian) spoken proficiency ratings. Specifically, I investigate whether reading and reading-related skills assessed in L2 tap into the same cognitive processes as when assessed in L1, and the degree to which L2 scores are affected by Norwegian language proficiency (L2 spoken proficiency). I also investigate whether the relationship between skills assessed in L1 and L2 is moderated by Norwegian spoken language proficiency. The reading skills investigated are the equivalent L1 and L2 tests from the test battery described in Chapter 8 (phonemic awareness, pseudoword reading, word reading and RAN).

Decoding is a vital part of reading, and reading difficulties often become visible when decoding skills are examined. Decoding is the process of translating print into speech. In decoding one rapidly matches phonemes to graphemes and recognizes patterns in a specific language to access a word. These patterns can relate to whole words or sublexical structures such as syllables. Decoding is being able to read isolated words quickly, accurately, and silently (Gough & Tunmer, 1986, p. 7). According to Elbro et al. (1994, p. 207), there is strong evidence that decoding single words and pronounceable nonwords is a lifelong struggle for adults with reading difficulties. (For elaboration see Section 2.2 about Dual-Route Theory). A study of 158 adults sought to characterize dyslexia by looking at their current level of reading as adults (Elbro et al., 1994). When testing word reading and pseudoword reading, they found that adults with reading difficulties were poor readers of pseudowords, and that pseudoword reading performance most clearly distinguished between adults with and without reading difficulties. There was also a relationship between self-reported difficulties and pseudoword reading.

Both word and pseudoword reading tasks are measures of decoding skills, but of course, L2 proficiency can influence whether a word is perceived as a word or a pseudoword. For L2 learners with low L2 proficiency, many real words will be perceived as pseudowords. Those in an early phase of reading development (low proficiency level) may therefore lack direct access when reading words (See

Section 4.2.2 for an elaboration of van de Ven et al.'s (2018) study of word decoding fluency in L1, L2 and L3), and rely more on a non-lexical route. This means that bilingual word reading processes are influenced by the proficiency level in the relevant language. At the same time, it opens the possibility that pseudoword reading in L2 is a more accurate measure of bilingual decoding skills than word reading. However, it is known that one cannot rely on one single factor when investigating reading difficulties (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; Suárez-Coalla & Cuetos, 2015; Wagner, 2018; White et al., 2006) and one should therefore measure more than just pseudoword reading.

A key reason why the identification of reading difficulties in L2 speakers is challenging is the lack of clear data on how L2 proficiency affects the results when a bilingual's reading skills are tested in L2. A common question is whether L2 testing requires a certain proficiency level in the second language for the test results to be valid. Proficiency is defined as an index of comprehension and production abilities that L2 learners develop across linguistic domains and modalities – in order to communicate (Tremblay, 2011, p. 340). Proficiency level in a second language affects the bilingual language processing system, and language exposure is an important variable in gaining L2 proficiency (Abutalebi et al., 2001) (See Section 3.2). The focus here is the relationship between L2 proficiency and the decoding process in a second language.

RAN is a reading-related skill that is strongly connected to the identification of reading difficulties (Carioti et al., 2022). RAN is a test of how quickly a person can name familiar stimuli that are presented continuously (Georgiou et al., 2018). There is a moderate to strong connection between RAN and reading performance in a monolingual setting (Araújo et al., 2015), but less is known about the validity of RAN when tested in L2. (For an elaboration of RAN see Sections 2.4.4 and 4.2.4). Georgiou et al. (2022) investigated if the effect of RAN could transfer from L1 to L2 reading (See Section 4.2.4 for an elaboration of the study), and they concluded that L1 and L2 RAN capture similar processes and that the cross-linguistic transfer of skills related to RAN is independent of the orthographic proximity of the two languages. However, they also showed that L2 RAN performance was slower than L1 RAN performance suggesting that L1 RAN might be the more accurate measure. Nevertheless, there is still uncertainty about how L2 spoken proficiency affects L2 RAN, and whether L2 RAN is a good predictor of reading difficulties.

Phonological skills are another important skill that is associated with reading. A study of Chinese adults showed that phonological processing skills can be assessed in their L2 to predict L2 reading performance (Harrison & Krol, 2007). The participants were bilinguals with no reading difficulties and bilingual participants "at risk" of having reading difficulties. The study found that L2 nonword repetition predicted L2 word recognition and L2 nonword reading performance. In addition, the rhyme discrimination task in L1 had a moderate correlation with phoneme deletion performance in L2 ($r = .52$). Both rhyme discrimination and phoneme deletion require phonological processing and therefore this finding is consistent with a relationship between L1 and L2 phonological processing. As mentioned in Section 4.2, prior research has confirmed that phonological awareness and reading skills do transfer from L1 to L2 (August et al., 2009; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018) and from L2 to L1 (Piper et al., 2016) (see also Chapter 4 and 9). Having word- and pseudoword reading difficulties, together with difficulties in phonological awareness, is considered a lifelong deficit for adults with dyslexia (Reis et al., 2020), and these are therefore important skills to measure when investigating reading difficulties in adults.

Oren and Breznitz (2005) investigated bilingual reading in both L1 and L2, in an attempt to verify whether Hebrew (L1) and English (L2) are processed in the same manner by adult bilingual regular readers (n=25) and bilingual dyslexic readers (n=25). The sample had Hebrew as L1 and English as L2. They completed similar tests in L1 and L2, and to investigate decoding skills, tasks of word reading and pseudoword reading were conducted. When looking at the results of the regular readers they found that there was a strong correlation between the L1 and L2 performance (correlations ranging from $r = .55$, $p < .05$ to $r = .83$, $p < .001$). These correlations were observed even though Hebrew and English have different alphabets. According to the authors, this indicates consolidated patterns of processing across languages and suggests that competence in L2 relates to competence in L1.

Taken together, prior research has confirmed that phonological awareness and reading skills do transfer from L1 to L2 (e.g., August et al., 2009; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018) and from L2 to L1 (Piper et al., 2016) (see Chapters 4 & 9). However, less is known about how L2 proficiency – or the lack of L2 proficiency – affects the results of L2 reading tests. It can be assumed that people with high L2 proficiency will achieve better results on L2 testing than those with low L2 proficiency. Having a high L2 proficiency level means having a larger vocabulary, which in turn means that decoding is easier as more phonemes and sublexical structures are known. With high L2 proficiency, more words may be decoded via the lexical route/direct route. However, there is a knowledge gap about whether L2 proficiency moderates the relationship between skills assessed in L1 and L2. Such a moderation effect would indicate that testing in a second language is unsuitable because the L2 proficiency level disrupts the relationship between L1 and L2 testing, i.e., if performance interacts with L2 proficiency, one cannot be sure that one has tested the same skill in both languages.

In this Chapter, four multiple linear regressions are reported, one for each of the four variables described above (word reading and pseudoword reading, phonemic awareness and RAN). The skills assessed in L2 serve as the dependent variable. In each regression, there are three independent variables: the L1 measure of the same skill, the level of spoken Norwegian (L2 spoken proficiency) and an interaction term between L1 skill and L2 spoken proficiency. L2 spoken proficiency refers to the participant's self-reported levels (a number between 0 and 10) of how well they speak Norwegian. Transfer from L1 to L2 is investigated by analysing how much of the variance in a particular L2 skill (e.g., L2 phonemic awareness) is explained by the corresponding skill when assessed in L1 (L1 phonemic awareness). The degree to which L2 spoken proficiency affects L2 reading and reading-related skills is investigated by analysing whether the level of L2 spoken proficiency explains unique variance in the L2 skill. Finally, the interaction term, tests whether L2 spoken proficiency moderates the relationship between L1 and L2 skills. A significant interaction between L1 skill and L2 proficiency on the corresponding L2 skill would indicate that the relationship between skills assessed in L1 and L2 is affected by the level of proficiency in spoken Norwegian.

The research questions addressed in this chapter are as follows:

- RQ3a: Does L1 task performance explain unique variance in L2 task performance?
- RQ3b: Does L2 spoken proficiency (Norwegian) explain unique variance in L2 task performance when L1 task performance is considered?
- RQ3c: Does L2 spoken proficiency (Norwegian) moderate the association between L1 and L2 task performance?

These questions are asked in turn of the following tasks: word reading, pseudoword reading, phonemic awareness, and RAN, in order to address RQ4.

- RQ4a: Do the answers to the research questions under RQ3 differ for different measures of reading related skills?

For word reading, the hypotheses are as follows. L1 word reading will explain unique variance in L2 word reading (RQ3a). This is based on studies confirming that there is a correlation between decoding skills in L1 and L2 (e.g., Oren & Breznitz, 2005; Yang et al., 2017).

L2 spoken proficiency will explain unique variance in L2 word reading (RQ3b). The consequence of being fluent in L2 is having a large vocabulary and automatized skills regarding grapheme-to-phoneme correspondences and therefore the ability to quickly recognize most words presented. At a low level of L2 spoken proficiency, the vocabulary will be smaller, grapheme-to-phoneme conversion will be slower, and many words will be perceived as nonwords. Previous studies have shown that increased L2 proficiency has a positive effect on word and pseudoword decoding (van de Ven et al., 2018). It is expected that those with high L2 spoken proficiency will be able to make use of the direct route/lexical route (Castles, 2006) when reading and therefore be more efficient than those with low L2 spoken proficiency who use the indirect route.

For RQ3c there is no clear hypothesis as this has not been investigated before in word reading. The presence of an interaction effect would indicate that the relationship between L1 and L2 word reading differs as a consequence of the

level of L2 spoken proficiency (Norwegian). The situation is the same for this hypothesis applied to pseudoword reading, phonemic awareness, and RAN.
For pseudoword reading it is also predicted that L1 pseudoword reading will explain unique variance in L2 pseudoword reading (RQ3a). Pseudoword reading and word reading are measures of decoding skills studies have confirmed a correlation between decoding skills in L1 and L2 (e.g., Oren & Breznitz, 2005; Yang et al., 2017).

In contrast to word reading, however, the prediction is that L2 spoken proficiency will not explain unique variance in L2 pseudoword reading (RQ3b). In pseudoword reading, it is not possible to have direct access to a word since all words are constructed (Castles, 2006). This forces the reader to decode the word through an indirect route when reading. In addition, all the participants are familiar with reading within an alphabetic orthography (see Chapter 6) and can therefore use the strategies they already know to decode unfamiliar words (Byrne & Fielding-Barnsley, 1989).

For phonemic awareness, the hypothesis is that L1 phonemic awareness will explain unique variance in L2 phonemic awareness (Goodrich et al., 2014), but it is not clear to what extent (RQ3a). It is also predicted that L2 spoken proficiency will not predict unique variance in L2 phonemic awareness (RQ3b). Previous research has shown that there is a cross-linguistic transfer between L1 and L2 phonemic awareness (e.g., August et al., 2009; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018) and this increases the possibility that the same process is being tested in L1 and L2. In addition, only L2 pseudowords were used as stimuli in the L2 phonemic awareness task and therefore the stimuli were unfamiliar to the whole sample. This increases the possibility of the task not being influenced by L2 spoken proficiency.

Clear predictions are difficult to make for RQ3a for performance in RAN. There are too few studies comparing L1 and L2 RAN to base prediction on. However, the hypothesis for RQ3b is that L2 spoken proficiency will to some degree explain unique variance in L2 RAN since real words (numbers) are used in this task. Previous research has investigated whether the effect of L1 RAN could transfer to L2 reading (Georgiou et al., 2022), but as far as I know, there are no studies that have compared the results from L1 RAN to L2 RAN and examined the influence of L2 spoken proficiency.

Finally, as is clear from the task-based predictions above, different answers for the research questions under RQ3 are predicted based on the characteristics of the different measures of reading-related skills investigated (RQ4).

10.1. Preliminary analyses

The analysis reported in Chapter 9 showed that there were associations between SES and L1 and L2 word and pseudoword reading. Chapter 8 also reported differences between the language groups on educational level and cognitive skills. A two-way MANOVA was therefore conducted to explore the impact of educational level and language group on the L2 skills that would serve as dependent variables in the regressions for the research questions under RQ3. A direct effect, or an interaction effect between education and language group in any of the four L2 constructs, leads to the inclusion of this construct as an independent variable in regression for that specific construct. Thus, controlling for that particular construct in the regressions. Before the two-way MANOVA, preliminary assumptions testing was conducted to check for normality, linearity, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted (Tabachnick & Fidell, 2014). The sample size is not equal and due to this Pillai's Trace will be used in the analysis (Statistics, 2013).

The dependent variables in the two-way MANOVA were the variables that serve as the dependent variables in the four regressions: L2 word reading, L2 pseudoword reading, L2 phonemic awareness and L2 RAN. Independent variables were language groups (English, Polish and Somali) and educational level (two categories: Lower level of Education and Higher level of Education).

When the results for the dependent variables were considered as a whole, there was no statistically significant interaction between education and language group $F(8,138) = .717$, $p = .676$, partial $\eta^2 = .040$.

Regarding the main effect of educational level, the only difference in reaching statistical significance was in L2 RAN $F(1,71) = 4.2$, $p = .045$, partial $\eta^2 = .056$. Post Hoc comparisons using the Bonferroni test showed that there was a significant difference between the Polish group and the Somali group ($p = .016$), and the Polish and English groups ($p = .001$). The Polish group was faster than the two other groups.

Regarding the main effect of language groups, there was a significant effect on Phonemic awareness, word reading and RAN. The significant main effect of Language groups on L2 Phonemic awareness was $F(2,71) = 8.7$, $p = .001$, partial $\eta^2 = .197$. Post Hoc comparison using the Bonferroni test showed that there was a significant difference between the Polish and Somali groups ($p = .001$) and the Somali and English groups ($p = .010$). The Polish group had the highest scores and a smaller standard deviation in their results than the other two groups, which indicates that this group had less dispersion in their results. The Somali and the English groups had quite similar standard deviations, but the Somali group had a mean score that indicated a larger dispersion in their results.

For L2 word reading, there was also a significant main effect of language groups, $F(2,71) = 3.1$, $p = .053$, partial $\eta^2 = .079$. Post Hoc comparison yielded only a significant difference between the Somali and Polish groups ($p = .008$). The Polish group had a higher score than the Somali group.

For L2 RAN, there was also a significant main effect of language groups $F(2,71) = 6.7$, $p = .002$, partial $\eta^2 = .160$. There was a significant difference between the Polish group and the Somali group ($p = .016$), and the Polish and English groups ($p = .001$). The Polish group were faster to respond than the two other groups.

Due to the significant effects of educational level and language group, dummy variables were constructed in educational level and language groups and introduced into the multiple linear regressions described below, to control for the effects of these constructs in the regressions.

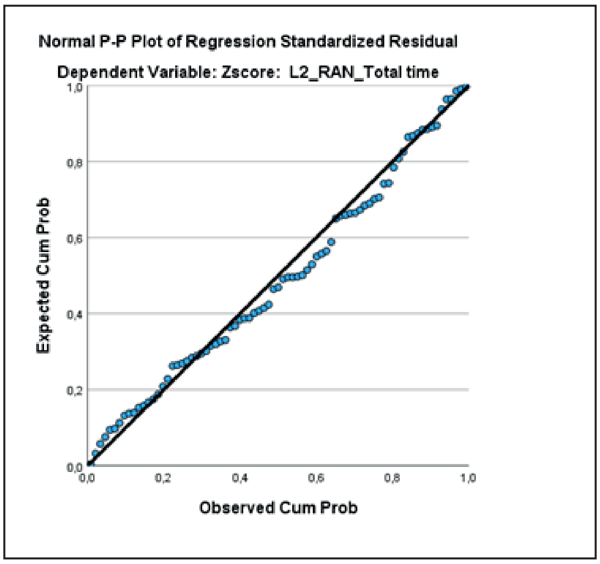
10.2. Multiple Linear Regression - Effect of Norwegian proficiency on reading and reading-related skills?

10.2.1. Assumptions for Multiple Regression

The assumptions for multiple regression are described and met in 9.2.1. All variables were transformed into z-scores and the data set was checked for normality. The linearity for the L2 RAN test was not described in section 9.2.1 and is therefore presented in Figure 9 underneath. The relationship of linearity in L2 RAN was positive and therefore indicated that as the value of the independent variable increases the same was the case for the dependent variable.

Figure 9

The residual plot from regression, L2 RAN Total time



10.2.2. Multiple Regression

The variables entered in the four multiple linear regressions were first checked for correlations using Pearson's *r.* All variables from the test battery described in Chapter 8 (Except working memory. Low Cronbach's alpha has excluded this test) together with the L2 spoken proficiency variable described in the introduction of this Chapter, were checked for correlations[2]. The correlation matrix is presented in Table 26 in Chapter 9.

10.2.2.1. Multiple Regression Analyses of L2 word reading

There is a strong correlation between L2 word reading and L1 word reading ($r = .68$) and a medium correlation between L2 word reading and L2 spoken proficiency ($r = .34$) (see Table 26). All variables were entered simultaneously in a multiple linear regression to determine the degree to which L1 word reading, L2 spoken proficiency, and the interaction between the two explained variance in L2 word reading. The language groups were controlled for by including a dummy variable for Polish and Somali. For ease of interpretation, dummy variables are not included in the tables, but they are in the appendix (see Appendix 14.12.1) See Table 31 for full details.

R^2 for the overall model was 66.6% with an adjusted R^2 of 64.3%. L1 word reading, L2 spoken proficiency and an interaction variable between L1 word reading and L2 spoken proficiency, significantly predicted L2 word reading F (5, 71) = 28.331, $p = .001$. However, for the three independent variables, only L1 word reading and L2 spoken proficiency added statistically significantly to the prediction, $p = .05$.

[2] The processing speed task was also run in the regressions, but for ease of interpretation, it is not included when reported in this chapter (see Section 8.1 for why it is not included). The inclusion of processing speed did not change the patterns in the regressions.

Table 31

Linear Multiple Regression Predicting L2 word reading from L1 word reading and L2 spoken proficiency

L2 word reading	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model (R^2=.666, *adj.* R^2=.643)						
Constant	-.187	-.396	.022	.105		.08
1. L1 word reading	.786	.622	.950	.082	.807	<.001***
2. L2 spoken proficiency	.339	.203	.474	.068	.377	<.001***
3. Interaction L1 word and L2 spoken proficiency	.002	-.334	-.142	.146	-.323	.973

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. **p* < .05. ** *p* < .01. *** *p* < .001.

10.2.2.2. Multiple Linear Regression Analyses of L2 Pseudoword reading

There was a strong correlation between the L2 and L1 tests – L2 pseudoword reading and L1 pseudoword reading (r = .64). There was no correlation between L2 pseudoword reading and L2 spoken proficiency (r = .06) (see Table 26). A multiple regression was run to determine the degree to which L1 pseudoword reading and L2 spoken proficiency and an interaction term between the two predicted L2 pseudoword reading. See Table 32 for full details.

R^2 for the overall model was 42.1% with an adjusted R^2 of 39.8%. Effects of L1 pseudoword reading, L2 spoken proficiency and an interaction variable between L1 pseudoword reading and L2 spoken proficiency, significantly predicted L2 pseudoword reading F (3, 75) = 18.201, p = .001. However, only L1 pseudoword reading added statistically significantly to the prediction, p = .001.

Table 32

Multiple Linear Regression Predicting L2 pseudoword reading from L1 pseudoword reading and L2 spoken proficiency

L2 pseudoword	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model (R^2=.421, *adj.* R^2=.398)						
Constant	.005	-.169	.179	.087		.95
1.L1 pseudoword reading	.663	.483	.843	.090	.663	<.001***
2.L2 spoken proficiency	-.006	-.185	.174	.090	-.006	.95
3.Interaction L1 pseudoword and L2 spoken proficiency	-.088	-.289	-.113	.101	-.081	.39

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

10.2.2.3. Multiple Regression Analyses of L2 Phonemic awareness

There was a strong correlation between L2 phonemic awareness and L1 phonemic awareness ($r = .81$). There was a small correlation between L2 phonemic awareness and L2 spoken proficiency ($r = .12$) (see Table 26). A multiple linear regression, adjusted for differences in language groups, was run to determine the degree to which L1 phonemic awareness, L2 spoken proficiency and an interaction term between the two predicted L2 phonemic awareness. See Table 33 for full details. (For regression including dummy variables, see Appendix 14.12.2)

R^2 for the overall model was 70.7% with an adjusted R^2 of 68.7%. The model including L1 phonemic awareness, L2 spoken proficiency and the interaction variable significantly predicted L2 phonemic awareness F (5, 74) = 35.747, p = .001. L2 spoken proficiency did not significantly predict L2 phonemic awareness, but L1 phonemic awareness (p = .001) and the variables that controlled for language (p = .05), added statistically significantly to the prediction.

Table 33

Multiple Linear Regression Predicting L2 phonemic awareness from L1 phonemic awareness (PA) and L2 spoken proficiency

L2 phonemic awareness	*B*	95% Confidence Interval for B		*SE B*	*β*	*p*
		LL	UL			
Model (R^2=.707, *adj.* R^2=.687)						
Constant	.273	.061	.486	.107		.01**
1.L1 phonemic awareness	.837	.682	.992	.078	.837	<.001***
2.L2 spoken proficiency	-.002	-.138	.134	.068	-.002	.98
3.Interaction L1 PA and L2 spoken proficiency	.017	-.128	.163	.073	.015	.82

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *p < .05. ** p < .01. *** p < .001.

10.2.2.4. Multiple Regression Analyses of L2 RAN

The correlation between L1 RAN and L2 RAN was r = .44. The correlation between L2 RAN and L2 spoken proficiency was stronger (r = -.59) (see table 26). It is worth noting that the correlation was negative, which means that when the L2 RAN score was slow (i.e., the task was done quickly) the L2 spoken proficiency was high. A multiple linear regression, adjusted for differences in language groups and educational level, was run to determine the degree to which L1 RAN, L2 spoken proficiency and an interaction term between the two predicted L2 RAN. See Table 34 for full details. (For regression including dummy variables, see Appendix 14.12.3)

R^2 for the overall model was 67.3% with an adjusted R^2 of 64.5%. Effects of L1 RAN, L2 spoken proficiency and an interaction variable between L1 RAN and L2 spoken proficiency, significantly predicted L2 RAN F (6, 72) = 24.644,

p = .001. Three independent variables, L1 RAN and the variables that controlled for language, added statistically significantly to the prediction, p = .001.

Table 34

Multiple Linear Regression Predicting L2 RAN from L1 RAN and L2 spoken proficiency

L2 RAN	***B***	**95% Confidence Interval for B**		***SE B***	***ß***	***p***
		LL	UL			
Model (R^2=.673, *adj.* R^2=.645)						
Constant	.267	-.028	.561	.148		.08
1.L1 RAN	.786	.563	1.01	.112	.568	<.001***
2.L2 spoken proficiency	-.555	-.690	-.419	.068	-.599	<.001***
3.Interaction L1 RAN and L2 spoken proficiency	-.102	-.297	.094	.098	-.071	.31

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

10.3. Summary and Discussion

This Chapter aimed to shed light on whether L2 reading and L2 reading related tests can be used to assess adult sequential bilinguals' reading performance. It was also important to investigate to what degree the level of spoken proficiency in the respondents' second language affected reading and reading-related skills when assessed in L2. The correlations (Table 26 in Chapter 9) and the regression analyses (in this chapter) investigated whether L1 testing and L2 testing provide evidence for the same level of decoding and reading-related skills. Furthermore, it is important to investigate whether L2 spoken proficiency affects performance in decoding and reading-related skills tested in L2, in order to understand whether L2 results are valid measures of reading and thus reading difficulties.

For **L2 word reading** the multiple regression explained 66.6% of the variance. There was a strong and significant correlation (r = .68) between L1 word reading and L2 word reading. L1 word reading and L2 spoken proficiency both explained a significant variance in L2 word reading, but the standardized beta coefficients showed that L1 word reading was the strongest predictor (L1 word reading β = .807. L2 spoken proficiency β = .377). If L1 word reading predicts L2 word reading this is an indication that word reading, when assessed in L1 and L2, share the same cognitive processes. This is in line with the hypothesis for RQ3a related to word reading. This result is also in line with previous research showing a cross-linguistic transfer of decoding skills between languages (e.g., De Ramírez & Shapiro, 2007; Długosz, 2023; Ziegler & Goswami, 2005). Moreover, as predicted L2 spoken proficiency level affects efficiency in L2 word reading (RQ3b). L2 spoken proficiency does predict unique variance in L2 word reading. This is in line with previous research confirming that the level of proficiency in a second language affects word decoding ability in that language (van de Ven et al., 2018). A low spoken proficiency level in a second language requires a non-lexical route in word reading and therefore bilingual word reading is heavily influenced by the spoken proficiency level in the relevant language. As both L2 spoken proficiency and L1 word reading explain variance in L2 word reading, L2 word reading is a measure that is difficult to use in the identification of bilinguals' reading difficulties. Since L2 spoken proficiency explains so much of the variance, one can assume that L2 word reading will not be a pure measure of decoding ability, but also affected by experience associated with reading in the second language.

The answer to RQ3c is no – L2 spoken proficiency (Norwegian) does not moderate the association between L1 and L2 performance. The interaction term was not significant in the regression model. L2 spoken proficiency affects performance in L2 word reading, but the strength of the relationship between the L1 and L2 performance does not change if the participants have low L2 spoken proficiency.

In **L2 pseudoword reading** the multiple linear regression explained 42,1% of the variance. The preliminary analysis indicated that L2 pseudoword reading was not affected by language groups or educational levels. There was a strong correlation between L2 pseudoword reading and L1 pseudoword reading (r =

.65), and the regression showed that L1 pseudoword reading significantly predicted L2 word reading. The standardized beta coefficients showed that L1 pseudoword reading was a strong predictor (β = .663). Furthermore, L2 spoken proficiency did not predict L2 pseudoword reading (β = -.006). Therefore, the answer to RQ3a is "yes", L1 pseudoword reading does explain unique variance in L2 pseudoword reading.

Turning to RQ3b, as predicted L2 spoken proficiency does *not* predict unique variance in L2 pseudoword reading. The multiple linear regression for L2 pseudoword reading also confirmed that there was an absence of interaction effect of L2 proficiency that moderated the relationship between L1 and L2 pseudoword reading. Therefore, the answer to RQ3c is also "no". According to my results, L2 pseudoword reading is thus a measure of decoding skills that is not affected by spoken proficiency level. These results suggest that pseudoword tasks in a second language might be promising tests of decoding skills in L2. Pronounceable nonsense words cannot be recognized lexically and require a phonological reading strategy (grapheme-to-phoneme correspondences), and are considered as an index of phonological reading skills (Rack et al., 1992).

For **L2 phonemic awareness** the multiple linear regression explained 70.7% of the variance. This is a very promising result. There was a strong correlation between L2 phonemic awareness and L1 phonemic awareness (r = .81), and L1 phonemic awareness did significantly predict L2 phonemic awareness. The standardized beta coefficients showed that L1 phonemic awareness was a strong predictor of L2 phonemic awareness (β = .837). Therefore, L1 phonemic awareness does explain unique variance in L2 phonemic awareness (RQ3a). It is important to highlight that the phonemic awareness tasks in both L1 and L2 comprised pseudowords and therefore this conclusion (and those below) must be limited to these kinds of stimuli.

Interestingly, L2 spoken proficiency did not significantly predict L2 phonemic awareness (β = -.002), which is consistent with L2 performance being equivalent to L1 regardless of L2 spoken proficiency skills. This is in line with prior research showing that phonological awareness does transfer from L1 to L2 (e.g., August et al., 2009; Durgunoğlu et al., 1993; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018). L2 spoken proficiency did not therefore predict unique variance in L2 phonemic awareness when L1 phonemic awareness is considered (RQ3b). The absence of any influence of L2 spoken proficiency on L2 phonemic awareness suggests that phonemic awareness tested in L2 is an expression of actual phonemic skills. The lack of significant interaction effect means that the relationship between L1 phonemic awareness and L2 phonemic awareness is not moderated by how well the participants speak Norwegian.

In the final regression model, the multiple linear regression explained 67,3 % of the variance in **L2 RAN**. There was a medium correlation between L2 RAN and L1 RAN (r = .44). The multiple regression showed that L1 RAN significantly predicts L2 RAN. Therefore, L1 RAN does explain unique variance in L2 RAN (RQ3a). The standardized beta coefficients showed that L1 RAN was a strong predictor of L2 RAN (β = .568) but L2 spoken proficiency also significantly predicted L2 RAN (β = -.599), and the standardized beta coefficients showed that L2 spoken proficiency was the strongest predictor. There was a negative correlation and standardized beta coefficients between L2 RAN and L2 spoken proficiency. In RAN, time is the only performance measurement. So, the negative correlation means that high L2 spoken proficiency relates to better (i.e. faster) RAN performance. L1 RAN significantly predicted L2 RAN, indicating that the same construct was tested in L1 and L2 which is in line with previous research (Georgiou et al., 2022). However, since RAN is a measure of performance speed, RAN tested in L2 has an additional challenge. How quickly one accesses a word should depend on L2 proficiency. Thus, slower RAN performance may reflect an earlier stage of the language learning process rather than relate to reading difficulties per se. When Georgiou et al. (2022) investigated the cross-language contributions of RAN in eight different writing systems, they also found that L2 RAN was slower than L1 RAN. In the hypothesis for RQ3b, there was uncertainty about to what degree L2 spoken proficiency would predict variance in L2 RAN. The answer is “yes” – L2 spoken proficiency predicts unique variance in L2 RAN.

The RAN results indicate that L2 RAN is unsuitable as a measure of bilingual skills related to RAN because the result was strongly affected by L2 spoken proficiency. Furthermore, nor was there an interaction effect of L2 spoken proficiency moderating the relationship between L1 RAN and L2 RAN.

Therefore, in RQ3c the answer is also “no”. L2 spoken proficiency does not moderate the association between L1 and L2 RAN.

For all variables, there was no interaction effect whereby L2 spoken proficiency moderated the association between the L1 and L2 tests (RQ3c). The presence of an interaction effect would have indicated that the relationship between L1 and L2 word reading differs because of the level of L2 spoken proficiency (Norwegian). The absence of such an effect opens the possibility that reading and reading-related skills can be assessed in L2. However, the multiple regression has shown that in some of the L2 tests, L2 spoken proficiency predicts unique variance in the L2 test results. This means that one cannot test all decoding and reading-related skills in a second language without taking L2 proficiency into account. In those tasks where real words are used, L2 spoken proficiency explained unique variance in L2 word reading and L2 RAN, while it did not explain unique variance in L2 pseudoword reading and L2 phonemic awareness (RQ4).

In summary, the aim of the research reported in this chapter was to investigate the relationship between performance in decoding and reading-related skills tested in L1 and L2. The findings demonstrated that tests comprising pseudowords are less affected by L2 spoken proficiency in sequential bilingual adults, and thus more reliable indicators of underlying skills. However, the sample in these analyses’ is relatively small (N=80) and it is possible that different findings would emerge from a larger sample. Nonetheless, the explained variance in L2 phonemic awareness is very high and it is perhaps unlikely that a larger sample would change the results from this test.
The interim conclusion is that, of the tasks analysed in this chapter, only phonemic awareness tested with pseudowords in L2, and L2 pseudoword reading tasks are to be recommended as part of a larger holistic assessment of bilingual reading skills.

11. Prediction of low-performing decoders

In this Chapter, research regarding how to identify low-performing decoders is presented. Low-performing decoders are defined as the 25% in each language group with the lowest score in pseudoword reading in their L1. The pseudoword reading task in question is the L1 pseudoword reading test in the test battery described in Chapter 8. The analyses reported aim to determine the best predictors of group assignment for participants above or below the 25th percentile in performance in this task. The predictors considered were performance in L2 pseudoword reading, L2 phonemic awareness and the language-neutral test DOT (Elbro et al., 2012).

Previous research has shown that there is a correlation between L1 and L2 performance in tests of reading skills for regular readers, while dyslexics were slower, less accurate and more differentially affected when reading in a second language (Oren & Breznitz, 2005). This is in line with research suggesting that second-language learners with dyslexia might have larger variations in decoding processes when tested in L2 (Hedman, 2012). When it comes to testing decoding skills in L2, these results are both promising and challenging. It is promising that there is a correlation between L1 and L2 testing, but it is challenging that the decoding skill has greater variation in bilinguals with reading difficulties than in monolinguals without. This could indicate that low-skilled decoders are harder to identify in L2. To meet this challenge, I will investigate the predictive ability of L2 pseudoword reading and L2 phonemic awareness since the analyses in Chapters 9 and 10 have shown that these tasks in L2 are comparable to corresponding tasks in L1. In Chapter 9 it emerged that L2 pseudoword reading was not influenced by level of education, language group or socioeconomic conditions. In Chapter 10 it was found that neither L2 pseudoword reading nor L2 phonemic awareness was influenced by L2 proficiency. For these reasons, it is important to investigate how well performance in these tasks can predict the group affiliation of the participants with low decoding skills.

Furthermore, an existing approach to assessing reading abilities in bilinguals is also investigated as a predictor of low performance in L1 decoding, namely the language-neutral test DOT, which was designed to have the smallest possible language bias (Elbro et al., 2012). The aim is to gain new insights into how best to identify sequentially bilingual adults with low decoding without recourse to testing in L1.

Some claim that bilinguals' reading skills should be assessed in their first language (e.g., Durgunoğlu, 2002; Everatt et al., 2004). Reading skills assessed in L1 avoid the problem of distinguishing reading difficulties from poor L2 proficiency or limited L2 schooling in the bilingual reader. Testing in L1 is, nevertheless, not always possible. Only a small group of the world's 6-7,000 spoken languages have a writing system and thus testing in L1 will not be possible (Elbro et al., 2012, p. 173). Furthermore, L1 testing requires professionals who can perform L1 testing in the relevant language and who also have enough knowledge to interpret the results. It is not realistic to think this is possible to implement in practice. Therefore, there is a need for new approaches when investigating bilingual reading, that are more feasible than L1 testing.

Assessing decoding and comprehension performance is traditionally a common task when reading skills are investigated. Being successful or efficient in decoding contributes to fast word recognition, resulting in more cognitive resources being available for the complex task of reading comprehension (Ehri, 2005). Conversely, low decoding skills will lead to delays in word recognition and thus negatively affect the cognitive resources of reading comprehension. When adult sequential bilinguals reading and reading related skills are to be investigated, which tasks selected and what cognitive skills to be measured are of great importance. In bilinguals, the L2 proficiency level will affect reading comprehension if one is tested in L2, and thus the decoding skill becomes the most important measure of reading proficiency. To distinguish between high and low decoding skills, one must define a distinction between these skills.

The difference between low and regular decoding skills is not always easy to find. If one is looking into adults and dyslexia, it is known that that is a difficulty that is persistent until adulthood (e.g., Lyon et al., 2003; Rose, 2009). In a review and meta-analysis of 178 studies regarding adults and dyslexia, it was concluded that when reading and reading related skills in adults with dyslexia were assessed, accuracy measures, speed measures or a combination of both were preferred performance indicators (Reis et al., 2020). The review investigated cognitive profiling of adults with dyslexia, measures of reading/writing competence and whether orthographic transparency modulated the reading profile in adults with dyslexia. When they investigated whether speed or accuracy was the best measure to detect adult reading difficulties, it was concluded that accuracy measures somehow was weakened as an indicator of difficulties, in word- and pseudoword reading, phonological awareness and orthographic knowledge. For this group speed measures were more sensitive to differences between adults with and without dyslexia when tested in L1. Furthermore, it was revealed that orthographic transparency was affecting the way reading difficulty was expressed. In opaque orthographies, adult reading difficulties are manifested by both inaccurate decoding and slow reading while in transparent orthographies adult reading difficulties are manifested by slow and effortful reading rather than poor accuracy. This indicates that a language's orthography can provide guidance for which cognitive skill is to be measured or that a combination of accuracy and speed should be considered when the skills of bilinguals from different orthographies are studied.

When identifying adults with reading difficulties it is common to set the cut-off for the low-performing adults at 25 % (e.g., Bar-Kochva et al., 2021; Swanson, 2012). Some studies have raised this limit to 27% (Vukovic et al., 2004). According to Swanson (2012), it is unclear how many adults suffer from reading difficulties, and this makes it challenging to estimate where to set the cut-off between low and regular decoding skills. It is however often stated that reading difficulties or dyslexia is best understood as a continuum and therefore does not have a clear cut-off (e.g., Rose, 2009; Snowling et al., 2020; Wagner, 2018). Siegel (2006) explains that; "The distinction between dyslexia and normal reading is arbitrary; where the cutoff point is drawn varies from study to study (Siegel, 2006, p. 581)". This is possibly of interest in the field of practise, indicating that support measures can be carried out for people with a score outside the traditional limits for the definition of reading difficulties. In research, however, it is important to have a clear cut-off to be able to define group affiliation and thereby gain new insights into the factors that predict it.

There is little worth in deciding on a cut-off value if there is not an available and reliable assessment tool. A language-neutral assessment tool has been introduced as an exciting way to investigate bilingual reading. The DOT (Elbro et al., 2012) was developed as a language-independent test of reading difficulties therefore simplifying the assessment of bilinguals' reading skills (DOT is thoroughly described in Chapter 5.4). DOT aimed to test learning potential for the basic processes of reading, rather than the current reading ability. DOT is considered language-neutral because instructions are given through nonverbal gestures and the phonemes used in DOT are present in most languages.

Even though DOT was originally designed for adults, it has also been used with children as a predictor of word reading difficulties. In a study of 171 children followed from the end of kindergarten to the end of Grade 1, DOT was conducted to investigate the size of its unique contribution to early predictions (Gellert & Elbro, 2017). 82 children at risk of developing word reading difficulties and 89 children not at risk, were a part of the study. 110 children had Danish as their L1, and 61 children had Danish as their L2. At the end of kindergarten predictor measures were taken (DOT, Letter knowledge, phoneme identification, phoneme synthesis, RAN, early word reading, vocabulary, nonverbal IQ). At the end of first grade, the same measures were repeated as in kindergarten, but with the addition of a nonword reading test. The results of the study confirmed that DOT predicted substantial significant additional variance over and above an extensive battery of traditional predictor tests. DOT added a prediction value of 11% when letter knowledge and phoneme identification were controlled for. Even so, the authors emphasize that the prediction value may be limited once a child has been exposed to reading instruction. The results also showed that DOT is a test of specific reading skills and not a test of general verbal abilities or nonverbal IQ. Finally, the study showed that a combination of DOT, letter knowledge and phoneme synthesis yielded good to excellent prediction accuracy of decoding difficulties in Grade 1.

The Gellert and Elbro (2017) study therefore shows that the DOT makes an important contribution to the prediction of decoding difficulties in children. As the authors themselves point out, however, the predictive value in children may lie in the fact that they are tested before they have been exposed to reading instruction. The authors therefore assume the predictive value will decrease when the child has received training in reading. For adults, it is usually the case that reading development is at a much more advanced stage and that the DOT may measure something different than in children. However, the language-neutral dimension of the DOT is of greater importance for adult testing. The fact that the test can be carried out without specific language skills is critical for examining sequentially bilingual adults' decoding skills. The DOT is therefore included in the analyses reported in this chapter along with the L2 pseudoword reading, and L2 phonemic awareness from this thesis. As described above the aim is to determine the best predictors of group assignment for participants above or below the 25th percentile in the L1 pseudoword reading task.

The research questions addressed in this chapter are:

- RQ5: To what degree does a language-neutral dynamic test of decoding (DOT) predict low L1 pseudoword reading?

- RQ6: To what degree do phonological awareness and pseudoword reading assessed at L2 predict low L1 pseudoword reading?

The hypothesis for RQ5 is based on the results of a previous study (Elbro et al., 2012) showing that DOT did predict group belonging to dyslexics and regular readers for those with Danish as both L1 and L2. These results are promising, and the hypothesis for this research question is that DOT will predict low decoding skills for sequential bilingual adults with Norwegian as their L2.
The hypothesis for RQ6 is also based on studies revealing that there is a transfer between all the languages bilinguals know (e.g., August et al., 2009; Goodrich et al., 2014; Liow & Poon, 1998; Wawire & Kim, 2018), and therefore we assume that L2 phonemic awareness and L2 nonword reading predict low decoding skills, but it is uncertain to what degree it has a predicting value.

11.1. Binary Logistic Regression

Four binary logistic regressions were conducted to investigate how to best predict group assignment for participants with low decoding skills and participants with regular decoding skills. To perform a Binary Logistic regression a new variable was constructed. This was a variable identifying the 25% within each language group with the lowest-performing decoding results in L1 pseudoword reading. L1 pseudoword reading was the most precise decoding measure that was available in this project. This new variable was the dependent variable in all regressions. L2 phonemic awareness and L2 pseudoword reading were the independent variables since the multiple linear regression from Chapter 10, revealed that these two tasks tested in L2 were not affected by L2 proficiency. The L2 variables were a combined score of accuracy and response time. A DOT score was included to determine whether a language-neutral test would have a higher prediction accuracy. The score for DOT was the accuracy score for each item in parts 2 and 3 combined. For those who had not completed the requirement of two consecutive rounds in part 2, the item score was set to zero. Three of the logistic regressions investigated the prediction value each independent variable had on the dependent variable. Finally, a logistics regression with all the variables together was conducted, to investigate if the three independent variables together better predicted participants with low decoding skills.

11.2. Assumptions for Binary Logistic Regression

The dependent variable identifying the 25% with lowest decoding skills, in each language group was dichotomous and characterized the sample as above the 25% (value 0) with low decoding performance or a part of the 25% (value 1). The independent variables in the logistic regression were L2 phonemic awareness, L2 pseudoword reading and DOT. The L2 phonemic awareness and L2 pseudoword reading were transformed into z-scores.

According to Statistics (2015), there should be 15 cases per independent variable in a logistic regression as is the case for the current data set. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell procedure (Box & Tidwell, 1962), and the assumptions for linearity were met. There were two standardized residuals with values of respectively 3.6 and 7.5 standard deviations, which were kept in the analysis. These were participants with reading difficulties and the results are therefore logical in terms of standard deviation.

11.2.1. Logistic Regression DOT

A binary logistic regression was performed to determine the effect DOT has on the likelihood that participants fall within the 25% with the lowest decoding skills. The logistic regression model was significant, $\chi^2(1)=6.705$, $p = .01$. This indicates that the model was able to distinguish between those belonging to the group with low decoding skills and the group with normal decoding skills. The model explained 12.0% (Nagelkerke R^2) of the variance in low decoding performance and correctly classified 74.7% of the cases. To see the correlation between DOT, the other tasks in the test battery and L2 proficiency, see Table 26 in Chapter 9.

Table 35

Logistic regression, DOT

Variable	***B***	***SE***	**Wald**	***df***	***p***	**Odds Ratio**	**95% CI for Odds Ratio**	
							Lower	Upper
DOT	-.050	.019	6.707	1	.01**	.95	.92	.99

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

Sensitivity in correctly identifying the low decoders was 40%. Specificity was 86.4% for identifying the normal decoders (See Table 36 below).

Table 36

Classification Table DOT

Variable		Above cutoff	25 % below cutoff	Percentage correct
DOT	Above cutoff	51	8	86.4
	Below cutoff	12	8	40.0
Overall Percentage				74.7

Note: "Below cutoff " refers to the 25% with low decoding performance in L1 pseudoword reading. "Above cutoff" refers to regular decoders.

11.2.2. Logistic Regression L2 pseudoword reading

A binary logistic regression was performed to ascertain the effect L2 nonword reading has on the likelihood that participants are in the group with the lowest decoding skills. This logistic regression model was significant, $\chi^2(1) = 16.412$, $p = .001$, indicating that the model was able to distinguish between those belonging to the group with low decoding skills and the group with normal decoding skills. The model explained 27.7% (Nagelkerke R^2) of the variance in low decoding performance and correctly classified 75.9% of the cases. To investigate the correlation between L2 pseudoword reading, the other tasks in the test battery and L2 proficiency, see Table 26 in Chapter 9.

Table 37

Logistic regression, L2 pseudoword reading

Variable	*B*	*SE*	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
L2 pseudoword reading	-1.175	.333	12.435	1	.001***	.301	.16	.59

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

Sensitivity in correctly identifying the low decoders was 30%. Specificity was 91.5% for identifying the regular decoders.

Table 38

Classification Table L2 pseudoword reading

		Above cutoff	25 % below cutoff	Percentage correct
L2 Pseudoword reading	Above cutoff	54	5	91.5
	Below cutoff	14	6	30.3
Overall Percentage				75.9

Note: "Below cutoff " refers to the 25% with low decoding performance in L1 pseudoword reading. "Above cutoff" refers to regular decoders.

11.2.3. Logistic Regression L2 phonemic awareness

A third binary logistic regression was performed to ascertain the effect L2 phonemic awareness has on the likelihood that participants are in the group 25% with the lowest decoding skills. The logistic regression model was also significant, $\chi^2(1) = 25.872$, $p = .001$, and the model explained 41.2% (Nagelkerke R^2) of the variance in low decoding performance, correctly classifying 86.1% of the cases. To investigate the correlation between L2 phonemic awareness, the other tasks in the test battery and L2 proficiency, see Table 26 in Chapter 9.

Table 39

Logistic regression, L2 phonemic awareness

Variable	*B*	*SE*	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
L2 Phonemic awareness	-1.589	.379	17.522	1	.001***	.204	.10	.43

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

Sensitivity in correctly identifying the low decoders was 70%. Specificity was 91.5% for identifying the regular decoders.

Table 40

Classification Table L2 Phonemic awareness

		Above cutoff	25 % below cutoff	Percentage correct
L2 Phonemic awareness	Above cutoff	54	5	91.5
	Below cutoff	6	14	70.0
Overall Percentage				86.1

Note: “Below cutoff “ refers to the 25% with low decoding performance in L1 pseudoword reading. “Above cutoff” refers to regular decoders.

11.2.4. Logistic Regression with all the three independent variables

A final binary logistic regression was performed to ascertain the effect of all the independent variables together had on the likelihood that participants were in the group with the lowest decoding skills. The logistic regression model was also significant, $\chi^2(2) = 25.87$, $p < .001$, and explained 49.2% (Nagelkerke R^2) of the variance in low decoding performance, correctly classifying 84.8% of the cases.

However, only two of the three predictor variables were significant. These were L2 pseudoword reading and L2 phonemic awareness, (as shown in Table 41)

Table 41

Logistic regression with all three independent variables (DOT, L2 Pseudoword, L2 PA)

Variable	***B***	***SE***	**Wald**	***df***	***p***	**Odds Ratio**	**95% CI for Odds Ratio**	
							Lower	Upper
DOT	-.012	.028	.188	1	.67	.988	.93	1.04
L2 pseudoword	-.936	.397	5.547	1	.02*	.392	.18	.86
L2 PA	-1.233	.447	7.593	1	.006**	.291	.12	.70

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

Sensitivity was 60%, and specificity was 93.2%.

Table 42

Classification Table all three independent variables *(DOT, L2 Pseudoword, L2 PA)*

Variable		**Above cutoff**	**25 % below cutoff**	**Percentage correct**
DOT **L2 Pseudoword reading** **L2 Phonemic awareness**	Above cutoff	55	4	93.2
	Below cutoff	8	12	60.0
Overall Percentage				84.8

Note: "Below cutoff " refers to the 25% with low decoding performance in L1 pseudoword reading. "Above cutoff" refers to regular decoders.

11.3. Summary and Discussion

The aim of this chapter was to investigate how to best predict bilingual low decoders when they are not tested in their native language. Low-performing decoders were defined as the 25% in each language group with the lowest score in L1 nonword reading. Ideally, decoding skills should be tested in participants L1 to avoid the confounds of poor L2 proficiency or limited schooling in the bilingual reader. However, L1 testing is not always feasible. It is therefore important to investigate the efficacy of testing in L2 or by using language-neutral tests. This was the aim of the analyses reported in this chapter.

Four binary logistic regressions were carried out and the results were promising. Three of the regressions investigated each variable's ability to categorise low and regular decoders correctly. The independent variables were DOT, L2 pseudoword reading and L2 phonemic awareness. A fourth logistic regression was carried out with all the variables combined. When tested independently, all variables significantly predicted the low decoding group but to a varying extent (RQ5). The DOT correctly identified 40% of the 25% with the lowest decoding skills and 86.4% of the regular decoders. L2 pseudoword reading only classified 30.3% of the lowest decoders while 91.5% of regular decoders were correctly classified. L2 phonemic awareness performed best as 70% of those with low decoding skills were classified correctly in this model, as well as 91.5% of those with regular decoding skills. When all three variables were run together 60% of the low decoders and 93.2% of the regular decoders were correctly categorised. DOT did not predict group assignment in the model (p = .67), while L2 pseudoword (p =.02) and L2 phonemic awareness (p =.006) were still significant predicters.

It is surprising that DOT individually only explained 40% of the poor decoders. The original aim of DOT was to test for learning potential in the basic processes of reading. It was designed as a dynamic reading measure that is sensitive to dyslexia in an alphabetic orthography, but less sensitive than standard reading measures to L2 proficiency and variations in type and amount of schooling (Elbro et al., 2012). The poor decoders identified in this current study are however not diagnosed dyslexics. It is therefore possible that this study does not contain the correct sample for DOT to emerge as a strong predictor. However, DOT did identify low bilingual decoders, better than L2 pseudoword reading, (40% and 30% respectively). Nevertheless, neither test emerges as a strong sole predictor.

In contrast, L2 phonemic awareness stands out from the other variables as a highly effective predictor of low decoding skills identifying 70% of those with low decoding skills and 91.5% of the regular decoders. It is worth noting that this task was carried out using pseudowords which may be an important factor in this result. Tasks of phonemic awareness that use actual words are more likely to be influenced by L2 proficiency level. L2 phonemic awareness and L2 pseudowords reading categorised the same percentage of regular decoders, however L2 phonemic awareness merges clearly as the best predictor of low decoding skills (RQ5).

The logistic regression with the three variables as a group, provided a better explained variance (49.2%) than any of the variables individually (12%, 27.7% and 41.2%). However, the percentage of low decoders categorised (60%) remained lower than for L2 phonemic awareness (70%) alone (RQ6).
In summary, L2 phonemic awareness emerges as a promising diagnostic for decoding problems. Of course, the proper identification of decoding problems in adult sequential bilinguals', cannot be based on a single task. It has been established that the identification of reading difficulties cannot be determined by one factor alone (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; Wagner, 2018; White et al., 2006). Nevertheless, the findings reported in this chapter suggest that it may be possible to build effective tests or reading problems in an L2, avoiding the need for native language tests and testers.

12. General Discussion

The aim of this thesis was to generate new knowledge about reading difficulties in sequential bilingual adults and to investigate whether decoding skills can be successfully identified in a second language (Norwegian). The research involved the collection of questionnaire data about language and reading profiles. In addition, a battery of matched L1 and L2 language tests was developed to compare a bilingual's performance in each of their languages. This data was used to address several research questions. The first two research questions were concerned with underlying factors that might affect the decoding outcome in both L1 and L2 (RQ1) and whether individual differences in these factors predicted decoding performance (RQ2). The results showed that SES predicted decoding performance in L1 word and pseudoword reading, and L2 word reading, but not in L2 pseudoword reading. Reading problems that were either self-reported or diagnosed, only predicted performance in L1 word reading, but in none of the two L2 tests. It is worth noting that the reading difficulties were significantly correlated with both L1 and L2 word reading, pseudoword reading and phonemic awareness, but they did not become significant in the regression models when other independent variables were also included. Norwegian engagement did as expected predict the performance in L2 word reading, but surprisingly not in L2 pseudoword reading. L1 pseudoword reading was predicted by, L1 proficiency, Multilingualism and SES. The most surprising result was that L2 pseudoword readings were not predicted by any of the underlying factors that were yielded from the PCA and questionnaire data.

The third research question had three parts concerned with first the association between skills when assessed in L1 and L2 (RQ3a), second if the level of second language spoken proficiency would influence the results in L2 testing (RQ3b), and third whether the level of L2 spoken proficiency moderated the association between L1 and L2 task performance (RQ3c). The results showed that L2 proficiency did not moderate the association between L1 and L2 task performance in any of the four tasks (RQ3c) (i.e., absence of interaction effect). It was also clear that there was a strong correlation between L1 and L2 testing in word reading, pseudoword reading and phonemic awareness, and a moderate correlation between L1 and L2 RAN (RQ3a). Furthermore, L2 proficiency did explain unique variance in L2 word reading and L2 RAN, but not in L2 pseudoword reading and L2 phonemic awareness (RQ3b).

The fourth research question was concerned with whether the answers to RQ3 differed for the different measures of reading related skills (RQ4). It was clear from the results that pseudoword tasks were not affected by L2 spoken proficiency. This is an important finding for the assessment of bilingual readers, as concerns about the effects of L2 spoken proficiency on L2 test results are one of the reasons assessments of bilingual reading are considered challenging. The results of RQ4 could possibly mitigate these concerns.

The two last research questions were concerned with how to predict the group belonging to the low-performing L1 pseudoword decoders when assessed with DOT, L2 pseudoword reading and L2 phonemic awareness. DOT did identify low bilingual decoders (RQ5), better than L2 pseudoword reading, but not better than L2 phonemic awareness. The results showed clearly L2 phonemic awareness was the best predictor for the low decoders. This task alone predicted a greater percentage of low decoders than DOT, L2 pseudowords and L2 phonemic awareness combined (RQ6).

This project started with a focus on dyslexia. However, challenges with the recruitment of participants due to the COVID-19 pandemic forced a change of design from a group-based approach to an individual differences approach. In addition, it was difficult to recruit many adult sequential bilinguals with an official dyslexia diagnosis, which in a sense only emphasizes the underlying theme of this thesis – that it is difficult for this group to get a reading difficulty investigated and to gain an official dyslexia diagnosis. It therefore became necessary to change the focus from dyslexia to low decoding performance. However, despite this shift in focus, this study had general novel findings of importance to the research field. Decoding difficulty is a hallmark of dyslexia and extending knowledge on the assessment of this skill remains important to the investigation of bilingual reading difficulties. This research has implications for both theory and methodological approaches to the study of reading difficulties, as well as for the field of practice. These impacts are discussed below, along with the limitations of the present research and suggestions for the direction of further research.

12.1. An Interdisciplinary Approach

The current research program required the development of a novel questionnaire and a series of language-matched tests of decoding and reading-related skills. In addition, a language-neutral test was included in the data collection to investigate more possibilities in the assessment of bilingual reading. The approach therefore combines elements from special education and psycholinguistics.

In the field of special education, it is more common to use existing tests and include them in research (e.g., Logos, TOWRE, Språk 6-16) than develop new tests. In the psycholinguistics research field, however, there is a long tradition of developing tests acquired for the research questions to be addressed. There is a novelty in combining these research traditions, especially in a Norwegian setting, and it facilitated the development of novel equivalent tests for L1 and L2. We know that testing for reading problems in L1 is preferable (e.g., Durgunoğlu, 2002; Everatt et al., 2004), but unfortunately often not possible. In second language testing, there is uncertainty about whether the desired skills are assessed because it is feared that e.g. L2 spoken proficiency has influenced the results. Having the ability to test sequential adult bilinguals with equivalent tests in both L1 and L2 made it possible to address important questions linked to the assessment of bilingual reading skills. The creation of matched tests in L1 and L2 made it possible to examine if testing reading-related skills in L2 is comparable to testing in L1.

12.2. Key Theoretical Implications

The results of this thesis show clearly that the use of pseudoword tasks is beneficial when assessing decoding and phonemic awareness in L2, i.e. L2 pseudowords reduced the effect of L2 spoken proficiency on L2 performance. In SVR (Gough & Tunmer, 1986) decoding refers to the technical part of reading that does not involve linguistic comprehension. The results of this study indicate that linguistic comprehension might still influence L2 decoding to a certain degree if meaning-bearing words are used. It is therefore not insignificant how the decoding skill is measured when assessed in a second language. The strong and significant correlation between L1 and L2 phonemic awareness (.81) and L1 and L2 pseudoword reading(.64) indicates that the same cognitive skills are measured in both languages. Critically, both of these tasks employed pseudowords. Moreover, the multiple regressions showed that L2 spoken proficiency did not explain unique variance in L2 phonemic awareness or L2 pseudoword reading. As the Dual-route theory proposes, processing familiar and unfamiliar words requires two different strategies (e.g., Castles, 2006; Coltheart, 1978; Coltheart et al., 1993; Coltheart et al., 2001; Morton & Patterson, 1980) (see Section 2.2) and processing pseudowords forces the reader to use the non-lexical route/indirect route for word recognition. The non-lexical route is activated by decoding items using a set of rules for grapheme-phoneme correspondence or sublexical spelling rules (Castles, 2006). Pseudoword reading requires a phonological reading strategy (grapheme-to-phoneme correspondences) and this is considered more time-consuming to the reader - but also an index of phonological reading skills (Rack et al., 1992). When assessing non-lexical skills, pseudowords will only be correctly pronounced or spelt if the reader can apply grapheme-to-phoneme rules as their decoding strategy –using the non-lexical route (Sheriston et al., 2016). The participants did not read the pseudowords aloud (see Section 8.1). This decision is also supported by the findings, as RAN task, which involves spoken output, did show an effect of L2 proficiency. The results from this study indicate that pseudoword tasks are beneficial when assessing decoding skills in bilinguals regardless of L2 spoken proficiency.

Pseudoword tasks have been proven beneficial in previous research. Russak and Saiegh-Haddad (2011) examined cross-linguistic relationships between phonological awareness in L1 (Hebrew) and L2 (English). They tested 60 college students with and without reading difficulties (see Section 4.2.3.) and hypothesized that phonological awareness scores would be lower in pseudowords reading tasks than in real word reading tasks, for both groups. However, the results showed that only those with reading difficulties found phoneme deletion in L2 (English) harder when the phoneme was within pseudowords. Phoneme deletion in L1 was not sensitive to the difference between words and pseudowords in the phonological awareness task. The authors suggested that L1 pseudoword phonological tasks were easier because participants could adopt a lexical strategy, whereby the activation of the phonological representations of real words helped them to maintain the representations of the pseudowords in memory (Russak & Saiegh-Haddad, 2011, p. 438). In combination with my results, these findings emphasize the importance of testing bilingual reading difficulties using pseudoword reading tasks in order to avoid the effects of proficiency. In addition, if pseudoword reading tasks in a second language are harder for those with reading difficulties than for unimpaired readers, then the comparison of L1 and L2 performance may help to differentiate between those with and without reading difficulties when assessed in a second language. More research investigating pseudoword reading in bilinguals with and without reading difficulties is necessary before strong conclusions can be drawn, but the results are promising.

In contrast, RAN tested in a second language seems to be less appropriate for assessing bilingual reading as the results showed that RAN performance was influenced by L2 spoken proficiency. In this study, the RAN tasks contained numbers, and therefore real words, from the language in question. In the RHM (Kroll & Stewart, 1994) (see Section 3.1) it is stated that in the early stage of learning L2, the L2 words are attached to the existing system of L1 words. When the L2 learner becomes more proficient in their L2, they build new, direct conceptual links that do not have to be translated from L1. It is possible that when the L2 learner has gained a higher L2 spoken proficiency level and has a direct conceptual link to an L2 word, valid results from L2 RAN testing could be achieved. It is also possible that digit names, in particular, maintain strong L1 links. It is not possible to predict at what L2 spoken proficiency level direct conceptual links to L2 words will occur. The results of my study showed that there was not an interaction effect whereas L2 proficiency moderated the association between L1 and L2 RAN. This is a positive result regarding the possibility of testing RAN performance in L2. However, my results show clearly that self-rated spoken proficiency significantly predicts the outcome of L2 RAN, distinguishing it from L1 RAN performance.

It is worth mentioning that RAN is referred to as a “language-independent task” in one of the few studies that investigated RAN performance in L2 (Carioti et al., 2022). The participants were minority children and five standard shapes (heart, circle, triangle, square and a star) in Italian (the children’s L2) were used. It was argued that by using the same shapes in all the RAN tests, the RAN test became language-neutral and would not require access to lexical memory (see Section 4.2.4), thereby avoiding the effect of automated word naming. Other studies have also referred to Carioti et al.’s (2022) RAN methodology as a “language-independent task" (Taha et al., 2022). Although these studies tested children, my results show that L2 RAN results are heavily influenced by L2 spoken proficiency, strongly suggesting that RAN should not be characterized as language-independent. As long as a task contains real words it is unlikely to be fully language-independent. At best it is a "language-reduced task" that might be suitable for bilinguals with a high L2 spoken proficiency level. There is therefore need for more research on RAN, bilingualism, and L2 proficiency to determine how to best assess RAN skills in a second language.

12.3. Methodological Contributions

As mentioned above, the design of this study included a number of novel components. The consequences of these design decisions are discussed in this section.

12.3.1. Questionnaire

The questionnaire was designed to provide a detailed picture of the participants' linguistic background, level of education, reading and writing behaviour, socioeconomic background, language proficiency in both L1 and L2, dyslexia diagnosis, and self-perceived reading difficulties. General inclusion and matching criteria such as age, sex, and native language were also essential parts of the questionnaire. The questionnaire comprised 24 questions and elicited information related to six areas relevant to reading difficulties and language background. Though significant changes were made, the questionnaire was based on The Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian et al., 2007). The novelty of the questionnaire designed for this study elicited information on bilingual reading as well as bilingual profile. This allowed the examination of the underlying factors that might affect bilingual reading performance, which could then be tested, using an individual differences approach, against performance in objective tests of decoding.

The design of the questionnaire for this study was therefore motivated by the need to understand more about how bilingual profile factors influenced decoding and reading-related skills in both L1 and L2. Bilingual and reading profiles are often secondary topics in research in the field. Bilingual profiling is most often related to cognitive processes rather than to reading skills (e.g., Bialystok, 2010; Grundy, 2020; Laketa et al., 2021; Studenica et al., 2022). The approach used in my study facilitated the investigation of individual differences in bilingual reading. Little research to date has taken this approach to investigate the effects of bilingual profiles on reading accuracy or speed in L1 and L2.

The questionnaire included questions designed to investigate components that are traditionally perceived as facilitators for developing good reading and decoding skills. Some of the questions were related to reading for leisure and results of the PCA in Chapter 9 yielded a component related to L1 Reading for leisure. There is an assumption that choosing to read in everyday life is important to becoming an efficient reader and that the amount of time spent reading in L1 should affect reading performance (e.g., Smith, 2012; Goodman, 2014). For children, studies have confirmed that levels of exposure to print positively predict reading outcomes in both decoding and comprehension (Mol & Bus, 2011). The results from the multiple regressions conducted in Chapter 9 showed that L1 reading for leisure did not predict the outcome on either of the four decoding tasks for sequential bilingual adults (L1 and L2 word and pseudoword reading). This does not mean, however, that reading for leisure in L1 does not have a positive effect on reading skills for adults. It is possible that if reading comprehension was tested, L1 reading for leisure would have predicted the outcome for adults. All we can say, based on my findings, is that adult decoding ability does not appear to be affected by L1 reading for leisure. The sample in this study is too small to draw strong conclusions but they offer new perspectives on how aspects of bilingual profiling might relate to decoding skills. The targeted investigation of bilingual and reading profiles varied out in this study suggests that there may be differences to be considered in the assessment of children and adults and has contributed to the future assessment of decoding skills in adult sequential bilinguals.

The questionnaire also elicited information about SES. It has been suggested that SES has the greatest influence on reading skills at a young age, but that the predictive ability of SES decreases at older ages. Howard et al.'s (2014) study of children showed that socioeconomic factors affected reading comprehension more than word reading and that the impact of SES decreased when the children grew older. In contrast to these findings, the results of my questionnaire showed that SES predicted L1 word reading, L2 word reading, and L1 pseudoword reading in adults. However, SES did not predict L2 pseudoword reading. Similar to the leisure reading behaviour discussed above, it is possible that SES would predict reading comprehension in adults. Nevertheless, it is very interesting that SES predicted L1 and L2 word reading in adults when it did not in children. The reason for this may be that my SES measures included the participants' schooling, which can have greater variations in adults. Decoding differences between someone with a university education and someone with a primary education will be greater than between third and fifth-grade students as reported in Howard et al.'s (2014) study. This increased variation may also increase the predictive power of the SES variable.

The novel findings from my questionnaire also underpin the need to investigate the effect of bilingual profiling on adults' decoding skills. In contrast to Howard et al.'s (2014) study, it does not appear that SES's predictive ability decreases with age in adults. This indicates that SES factors need to be a part of the equation when adult decoding skills are to be investigated, especially when real words form part of the tasks used. At the same time, it is very interesting that SES does not predict L2 pseudoword reading. This finding again suggests that more research is needed into the use of tasks with words and pseudowords, as discussed in Section 12.2, in the assessment of bilingual reading.

12.3.2. Equivalent L1 and L2 tests

The test battery in this study contained cognitive tests where some were directly related to reading such as decoding abilities, while others assessed language skills associated with reading proficiency and dyslexic problems, such as phoneme awareness (e.g., Hatcher et al., 2002; Snowling et al., 1997). L1 and L2 matched tests were word reading, pseudoword reading, phonological awareness (elision task), and RAN. Tests in English, Polish and Somali were made according to templates from the Norwegian tests. These tests aimed to have a similar form, degree of difficulty, word frequency, and syllable and phoneme complexity across languages. The creation of language equivalent tests is challenging and time-consuming. Many differences between the included languages need to be taken into account, e.g. phonological systems and phonotactics (see Chapter 6 for the listing of similarities and differences in the languages in this study). In creating these tests for both L1 and L2, it was important to ensure that they were as similar as possible in terms of word frequency, syllable and phoneme complexity. Similarity in the L1 and L2 tests is an important premise for being able to compare the results, but also difficult to achieve.

The results showed that there was a strong correlation between L1 and L2 testing in word reading, pseudoword reading and phonemic awareness. This was an important result in that it demonstrated a relationship between L1 and L2 testing. This result is a consequence of the participants being tested with equivalent tests. The multiple regressions in Chapter 10 showed that the L1 tests were the variable that explained most of the variance in L2 word reading, L2 pseudoword reading and L2 phonemic awareness. This is promising regarding the possibility of assessing adult sequential bilinguals reading difficulties in a second language in the future. However, as discussed in Section 12.2. pseudoword tasks seem to be more beneficial when testing decoding and phonemic awareness in L2, than tasks with real words.

To my knowledge, my study is the first to investigate RAN performance in bilinguals in both L1 and L2 with equivalent tests, as part of assessment of reading skills. My study has therefore added an important new insight to the assessment of bilingual reading. The results showed a moderate correlation between L1 and L2 RAN, and the multiple regression (Chapter 10) showed that L2 spoken proficiency explained slightly more variance than L1 RAN. As discussed above, it has been assumed that RAN taps into a language-universal cognitive mechanism that is involved in reading alphabetic orthographies (Landerl et al., 2019). It has also been shown that RAN predicts reading outcomes in both shallow orthographies (e.g., Lervåg & Hulme, 2009; Rodríguez et al., 2015; Tobia & Marzocchi, 2014), deep orthographies (e.g., Georgiou et al., 2011; Savage et al., 2007; Vander Stappen et al., 2020) and also in non-alphabetic languages (e.g., Georgiou & Parrila, 2020; Gharaibeh et al., 2021; Yan et al., 2013). Slow RAN performance is a persistent marker of dyslexia in adults (e.g., Cancer & Antonietti, 2018; Georgiou et al., 2018; Miller-Shaul, 2005).

The nature of the RAN task makes it impossible to use pseudoword. For that reason, real L2 words are used, which leads to the possibility of L2 spoken proficiency affecting performance. The results from this study showed that despite a correlation between L1 and L2 RAN, RAN tested in L2 was strongly influenced by L2 spoken proficiency. It is therefore difficult to recommend L2 testing of RAN. Only L1 RAN can be taken as a marker of dyslexia in adults. Slow results in L2 RAN could also mean that one is learning a second language, rather than showing a dyslexic difficulty.

Georgiou et al. (2022) investigated the cross-contributions of RAN to reading accuracy and fluency in young adults (see Section 4.2.4). They concluded that L1 and L2 capture similar processes and that cross-linguistic transfer of skills related to RAN is independent of the orthographic proximity of the languages. However, the L2 RAN performance was slower than the L1 RAN performance, suggesting there are some challenges with how the results on L2 RAN should be interpreted. It is proposed that RAN tests how fast one can access output phonological representations (Georgiou et al., 2018) (for more on RAN see Section 2.4.4.). Speed of output is measured in RAN tasks, but speed is also an important component of language proficiency. When de Jong et al. (2012) investigated the construct of L2 speaking proficiency, both lexical retrieval speed and speed of articulation, were parts of their test battery. Even though their results showed that the efficiency of L2 speakers' articulatory skills was found to be associated with knowledge of vocabulary, speed was still considered an important component of spoken proficiency. Both lexical retrieval speed and speed of articulation are part of the skills measured in RAN testing. A low level of L2 spoken proficiency would affect all speed measures involving articulation. In my data, L2 spoken proficiency (Norwegian) predicted a unique variance in L2 RAN. It is reasonable to assume that this is connected to speed and therefore in line with previous research (Georgiou et al., 2022). However, the novel contribution of my study is that its focus was not on RAN as a predictor of reading performance, but on the validity of L2 RAN results as a predictor of reading performance.

12.2.3. DOT

This thesis compared, for the first time, the prediction of reading difficulties by performance in L1- and L2 decoding tasks, and a language-independent task (DOT). DOT provides a novel approach to the assessment of bilingual reading difficulties (Elbro et al., 2012). By introducing language-neutral tests, the probability that more bilinguals can be identified with a reading difficulty is increased, since the same test can be used for every language group. In this thesis, however, DOT correctly identified only 40% of the 25% with the lowest decoding skills in L1. It must be emphasised of course that this does not mean that DOT is unsuitable as a testing tool. When DOT was trialled on a small scale in Norway, they concluded that DOT had some accuracy in capturing reading and writing difficulties, but that more research was needed to investigate DOT's preciseness (Arnesen et al., 2018). In Elbro et al.'s (2012) study it is emphasized that the positive conclusion for DOT as a promising testing tool is moderated by a few known limitations. The limitations they mention include that a dyslexia diagnosis cannot easily be exported from one language and education system to another, DOT may be confounded with general cognitive ability, and DOT is limited to testing reading in an alphabetic writing system (Elbro et al., 2012, pp. 182-183). These limitations might also explain why the predicting power of DOT is lower in my study compared to the Elbro et al. (2012) study. Another possible explanation is that my study tested only three different L1s. In Elbro et al.'s study 34 different L1's were included, and these languages had different orthographies (e.g., Danish, Arabic, Thai, Urdu, and Chinese). The participants in my study all had L1s with similar alphabetic orthographies and also could read in their L1s. They were therefore familiar with alphabetic decoding making it harder for DOT to predict potential for learning as the participants already were trained in that skill. For adults, the language-neutral part of DOT is more relevant than the prediction of potential learning. In a study on DOT and children in kindergarten, the authors empathized that DOT's predictive value lay in the fact that the children were tested before they had been exposed to reading instructions (Gellert & Elbro, 2017). Furthermore, they assume the predictive value will decrease when children have received training in reading.

It was also interesting to compare DOT with the phonemic awareness tasks in both L1 and L2. Even though the correlation was only moderate, there was a stronger correlation between L2 phonemic awareness and DOT (.49) than L1 phonemic awareness and DOT (.38). This might be due to the fact that phonemes in a second language are less familiar than phonemes in L1. This makes L2 phonemic awareness and DOT more similar since the grapheme-to-phoneme-correspondence in both tasks rely on less automatized skills, than L1 phonemic awareness. A stronger correlation between DOT and L2 phonemic awareness suggests that both tasks investigate skills underlying phonemic awareness and that the common denominator is that the skill is not as established as in a first language. When there is a correlation between L2 phonemic awareness and DOT, this indicates that to some degree the same cognitive skills are measured and therefore DOT remains an interesting testing tool. In future research, it would be interesting to investigate the predictive value of DOT in adults who do not read in their L1, as part of a larger investigation of DOT's predictive value as a language-independent testing tool for adults who do read in their L1.

Finally, my study contained fewer participants with an official dyslexia diagnosis than Elbro et al. (2012). Elbro et al. had 34 native Danish participants with dyslexia diagnoses and 53 Danish learners with possible dyslexia. Due to recruitment challenges, my study tested only 4 participants who had been diagnosed with dyslexia, and 20 participants who self-reported that they had reading difficulties. It is possible that DOT is more sensitive to dyslexic difficulties in particular, and that a bigger sample of participants with dyslexia would have altered the results.

12.3. Implications for the field of practice

Both the theoretical and the methodological implications discussed above have implications for the field of practice. As described in the introduction of this thesis, it is a well-known myth that bilinguals must increase their level of proficiency in the second language before an assessment of reading skills in Norwegian can be carried out. Bilinguals who experience reading and writing difficulties are often told to "learn more Norwegian" to be more proficient in L2 before the cause of the difficulty can be investigated. However, "learn more Norwegian" is not a precise unit of measurement, and it is uncertain what level of L2 proficiency is considered appropriate for L2 testing. First of all, to address the "learn more Norwegian" issue, the results showed that there was no interaction effect whereby L2 spoken proficiency moderated the association between the L1 and L2 tests (RQ3c). The presence of an interaction effect would have indicated that the relationship between L1 and L2 word reading differs because of the level of L2 spoken proficiency (Norwegian). The absence of such an effect opens the possibility for reading and reading-related skills to be assessed in L2. In other words, these result shows that "learn more Norwegian" is not entirely plausible when it comes to assessing L2 reading skills. It is possible to assess reading skills in a second language, but account must still be taken of several factors that can influence the results. One of them is what kind of tests should be used in the assessment of sequentially bilingual adults.

The absence of an interaction effect where L2 proficiency moderated the association between L1 and L2 tasks, is a substantial part of the implications for those assessing reading difficulties. This means that it is possible to assess decoding and reading-related skills in Norwegian, and one can stop using the phrase “you need to learn more Norwegian” before bilingual reading difficulties can be investigated. Despite this, unfortunately, there is no universal testing tool that is finished and ready to use and there are still unanswered questions regarding the assessment of bilinguals reading difficulties. Until valid tests are developed for investigating bilingual reading, the field of practice must use its professional judgment in the assessment of bilingual reading difficulties. But the results from this thesis should help them along the way. When the results showed that L2 phonemic awareness tasks predicted 70% of the low-performing decoders on the L1 pseudoword reading task, this indicates that phonological difficulties could be investigated with a pseudoword phonemic awareness task. When slow speed on RAN tasks traditionally is a marker of dyslexia in adults, these conclusions cannot be drawn if the participant is assessed with RAN tasks in their L2. Tasks of L2 pseudoword reading are not affected by L2 spoken proficiency, SES or other components investigated in the PCA, indicating that this does measure a bilingual’s decoding skills to some extent. However, this cannot be used uncritically as the L2 pseudoword reading task only explained 27.7% of the variance in the prediction of the participants with low decoding skills. Even though this task was not predicted by the six components from the PCA in Chapter 9, the question remains to investigate what the remaining variance percentages consist of.

12.4. Limitations and Future Research

The main limitations of this study reside in the sample tested. The small size of the sample is a result of data collection occurring during the pandemic. Restrictions set by the Norwegian authorities meant that the adult education centres were closed for long periods, or that people were asked to keep a two meters distance. These restrictions severely limited recruitment opportunities. Despite this, results related to L2 phonemic awareness are convincing even with 80 participants. However, it remains possible that other effects would have emerged with a larger sample. Another limitation of the sample is that it contains very few participants diagnosed with dyslexia. Future research will need sufficient resources to assess a larger sample and to find bilingual participants with confirmed dyslexic difficulties.

Another limitation of this study is that only languages with an alphabetic orthography were included. This means of course that conclusions drawn in this thesis are not necessarily directly transferable to other orthographies such as e.g. logographic or syllabic scripts. Due to the usual time and resource limitations of a PhD, it was not possible to include other scripts, but there is still a great need for research investigating the relationship between L1 and L2 with different scripts in a Norwegian setting. Future research should include different orthographies when investigating the use of real words and pseudowords in the assessment of bilingual reading skills.

This study did not include objective tests of the participants' L2 spoken proficiency but relied on their self-ratings of proficiency. This is a potential limitation, as even though self-reported performance is a well-known practice in bilingual research (e.g., Chincotta & Underwood, 1998; Flege et al., 2002; Marian et al., 2007; Tomoschuk et al., 2019; Zell & Krizan, 2014), it adds a possible source of error compared to objective proficiency testing. However, there remains a need for a testing tool that provides a detailed assessment of spoken proficiency in Norwegian. More research is needed to develop such a tool, which would be of great benefit to research on bilingual reading and the influence of L2 spoken proficiency.

One can also discuss whether the decoding tasks should have had a higher degree of difficulty due to the adult population tested (see Section 8.1.4. and Appendix 14.7 and 14.8). Both the word-reading and pseudoword-reading tasks consisted of one- and two-syllable words. This was done so that the participants with a low level of L2 spoken proficiency would be able to do the task. However, it remains possible that this group could have been tested with larger and more complex words. There was no evidence of ceiling effects in the data, however, it is possible that decoding difficulties would have emerged more clearly in participants with a self-reported reading difficulty if more demanding decoding tasks had been used.

There may also be a limitation concerning the question asked about reading problems. Other studies that investigated bilingual reading in adults with and without dyslexia have shown dyslexic difficulties in both L1 and L2 (Oren & Breznitz, 2005). In my results reading difficulties were significantly correlated with both L1 and L2 word reading, pseudoword reading and phonemic awareness, but reading problems were not significant predictors in the regression models when other independent variables were also included. It is possible that this is due to the sample size and the low number of participants with a dyslexia diagnosis. However, another possibility is that different questions in the questionnaire might have produced different results. Future research should try to formulate more or better questions on how participants perceive their reading difficulties.

A final limitation of this study is that only phonological skills as described in the phonological deficit hypothesis are investigated (e.g., Lyon et al., 2003; Ramus et al., 2003; Snowling, 1995; Snowling, 1998; Vellutino et al., 2004). Even though phonological skills are most likely impaired in people with dyslexia, and therefore people with reading difficulties, they may not be the only cause of this difficulty (e.g., Lyon et al., 2003; Parrila & Protopapas, 2017; Saksida et al., 2016; Snowling et al., 2020; Wagner, 2018; White et al., 2006). It has been suggested that it is more correct to say that people with dyslexia suffer from some kind of phonological deficit which could be either in phonological awareness, phonological short-term memory, or speed of access to phonological representations (Castles & Friedmann, 2014). Others have argued that dyslexia is the outcome of several risks including, the reading system, semantic knowledge, learning mechanisms, and letter position coding (Snowling et al., 2020). In my study, only decoding and other phonological skills are investigated. According to the double deficit hypothesis (Wolf & Bowers, 1999), it is possible to have dyslexic difficulties that do not include phonological difficulties, only difficulties with RAN (speed). It is of course possible to be a sequential bilingual adult with other reading difficulties than a phonological impairment. They are however not captured in this study and thus there are no recommendations on how this group can be identified.

12.5. Concluding Remarks

The findings reported in this thesis support the claim that it is possible to measure decoding and reading-related skills in a second language, regardless of L2 spoken proficiency. The best L2 predictor of decoding difficulty tested the ability to manipulate sound structure – a test of phonological awareness and used pseudowords which reduced the impact of L2 proficiency. Of course, while promising, these results do not provide an "easy fix" for the identification of reading difficulties in adult sequential bilinguals. They cannot be quickly or easily transferred to the field of practice. Nevertheless, these results can be used to inform the development of an overall assessment of reading skills and to bring us one step closer to effective practice for testing bilinguals' reading difficulties in an L2. Critically, new insights into how L2 spoken proficiency affects different L2 tasks, and the importance of testing using pseudowords have clear consequences for the assessment of reading difficulties in an L2, and the development of new assessment tools for the accurate identification of reading difficulties in bilinguals.

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14. Appendix

14.1 Approval from SIKT

Sikt

Vurdering av behandling av personopplysninger

Referansenummer	Vurderingstype	Dato
134327	Standard	22.06.2020

Tittel
Dysleksi eller bare flerspråklig?

Behandlingsansvarlig institusjon
Universitetet i Agder / Fakultet for humaniora og pedagogikk / Institutt for pedagogikk

Prosjektansvarlig
Helene Berntsen

Prosjektperiode
03.08.2020 - 30.09.2023

Kategorier personopplysninger
Alminnelige
Særlige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)
Uttrykkelig samtykke (Personvernforordningen art. 9 nr. 2 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 30.09.2023.

Meldeskjema

Kommentar
Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet den 22.06.2020 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde: https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html
Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle særlige kategorier av personopplysninger om helse og alminnelige kategorier av personopplysninger frem til 30.09.2023.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a, jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

Tredjepersonsopplysninger
Det tas høyde for at det vil kunne komme frem opplysninger om tredjepersoner (foreldre og søsken) i forbindelse med besvarelsen av et papirbasert spørreskjema. Behandlingen anses som nødvendig for formålet med prosjektet, da det vil være vanskelig for respondentene å gi beskrivelser uten å identifisere involverte tredjepersoner. Fokus vil være på respondentene og deres norskkunnskaper, og datamaterialet vil anonymiseres ved prosjektslutt.

Prosjektet vil behandle personopplysninger om tredjeperson med grunnlag i en oppgave av allmenn interesse.

Vår vurdering er at behandlingen oppfyller vilkåret om vitenskapelig forskning, jf. personopplysningsloven § 8, og dermed utfører en

oppgave i allmenhetens interesse.
Lovlig grunnlag for behandlingen vil dermed være utførelse av en oppgave i allmenhetens interesse, jf. personvernforordningen art. 6 nr. 1 bokstav e, jf. art. 6 nr. 3, jf. personopplysningsloven § 8.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Så lenge tredjepersoner kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19) og protest (art. 21).

NSD finner at det kan unntas fra informasjonsplikt ovenfor tredjepersoner etter art. 14 nr. 5 b), der personopplysninger ikke har blitt samlet inn fra den registrerte. Vi legger vekt på at personopplysninger kun skal behandles i en kort periode og at datamaterialet publiseres anonymt.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet/pågår i tråd med den behandlingen som er dokumentert.

Lykke til med prosjektet!

Kontaktperson hos NSD: Mirza Hodzic
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

14.2 Databehandleravtale

Databehandleravtale

«Dysleksi eller bare flerspråklig?» og

I henhold til Europa-parlamentets og Rådets forordning (EU) 2016/679 av 27. april 2016 om vern av fysiske personer i forbindelse med behandling av personopplysninger og om fri utveksling av slike opplysninger, samt om oppheving av direktiv 95/46/EF, Artikkel 28 og 29, jf. Artikkel 32-36, inngås følgende avtale

mellom

Universitet i Agder
Helene Berntsen

og

(Databehandler)

1. Avtalens hensikt

Avtalens hensikt er å regulere rettigheter og plikter i henhold til Europa-parlamentets og Rådets forordning (EU) 2016/679 av 27. april 2016 om vern av fysiske personer i forbindelse med behandling av personopplysninger og om fri utveksling av slike opplysninger, samt om oppheving av direktiv 95/46/EF.
Bakgrunnen for inngåelse av denne avtalen er behovet for innhenting av data i forbindelse med forskningsprosjektet «Dysleksi eller bare flerspråklig?».
Hensikten med dette forskningsprosjektet er å få kunnskap om leseferdigheten til personer som ikke har norsk som morsmål, og å undersøke om det er mulig å skille mellom lesevansker forårsaket av dysleksi, og lesevansker forårsaket av lave ferdigheter i norsk.
Avtalen skal sikre at personopplysninger ikke brukes ulovlig, urettmessig eller at opplysningene behandles på måter som fører til uautorisert tilgang, endring, sletting, skade, tap eller utilgjengelighet.
Avtalen regulerer databehandlers forvaltning av personopplysninger på vegne av den behandlingsansvarlige, herunder innsamling, registrering, sammenstilling, lagring, utlevering eller kombinasjoner av disse, i forbindelse med prosjektet «Dysleksi eller bare flerspråklig?»
Ved motstrid skal vilkårene i denne avtalen gå foran databehandlers personvernerklæring eller vilkår i andre avtaler inngått mellom behandlingsansvarlig og databehandler i forbindelse med prosjektet «Dysleksi eller bare flerspråklig?».

2. Instrukser

Databehandler skal følge de skriftlige instrukser for forvaltning av personopplysninger i prosjektet «Dysleksi eller bare flerspråklig?» som behandlingsansvarlig har bestemt skal gjelde.
Databehandler forplikter seg til å overholde alle plikter i henhold til Europa-parlamentets og Rådets forordning (EU) 2016/679 av 27. april 2016 som gjelder ved prosjektet «Dysleksi eller bare flerspråklig?» til behandling av personopplysninger.
Databehandler forplikter seg til å varsle behandlingsansvarlig dersom databehandler mottar instrukser fra behandlingsansvarlig som er i strid med bestemmelsene i Europa-parlamentets og Rådets forordning (EU) 2016/679 av 27. april 2016.

3. Formålsbegrensning

Formålet med databehandlers forvaltning av personopplysninger på vegne av behandlingsansvarlig, er forskningssamarbeid på prosjektet «Dysleksi eller bare flerspråklig?».

Personopplysninger som databehandler forvalter på vegne av behandlingsansvarlig kan ikke brukes til andre formål enn forskningssamarbeid på «Dysleksi eller bare flerspråklig?» uten at dette på forhånd er godkjent av behandlingsansvarlig.

Databehandler kan ikke overføre personopplysninger som omfattes av denne avtalen til samarbeidspartnere eller andre tredjeparter uten at dette på forhånd er godkjent av behandlingsansvarlig, jf. punkt 10 i denne avtalen.

4. Opplysningstyper og registrerte

Databehandleren forvalter følgende personopplysninger på vegne av behandlingsansvarlig i forbindelse med forskningssamarbeid på prosjektet «Dysleksi eller bare flerspråklig?»:

Databehandleren er ansvarlig for:

- å finne deltakere
- informere om prosjektet
- samle inn og oppbevare samtykkeskjema
- dele ut og samle inn spørreskjemaene
- oppbevare navneliste knyttet til koblingslisten
- kontakte deltakerne for videre kartlegging

Utfylt spørreskjema (uten navn, men merket med et nummer) må overleveres til UiA. Databehandleren vil få tilsendt nummererte spørreskjema med en tilhørende nummerert, men tom, deltakerliste. Databehandleren er ansvarlig for å fylle inn og oppbevare navnelisten og å sørge for at det er samsvar mellom nummeret på navnelisten og nummeret på spørreskjemaet. Oppbevaring av samtykkeskjema og evt. koblingsnøkkel, må oppbevares i et låsbart skap.

På forespørsel fra behandlingsansvarlig må databehandleren gi tilgang til samtykkeskjemaene.

Etter endt datainnsamling må databehandleren slette navnelister, koblingsnøkler og samtykkeskjema. Dette vil bli gjort på oppfordring fra behandlingsansvarlig. Databehandleren må da bekrefte at slettingen er gjennomført.

5. De registrertes rettigheter

Databehandler plikter å bistå behandlingsansvarlig ved ivaretakelse av den registrertes rettigheter, jf. Europa-parlamentets og Rådets forordning (EU) 2016/679 av 27. april 2016, kapittel III.

Den registrertes rettigheter inkluderer retten til informasjon om hvordan hans eller hennes personopplysninger behandles, retten til å kreve innsyn i egne personopplysninger, retten til å kreve retting eller sletting av egne personopplysninger og retten til å kreve at behandlingen av egne personopplysninger begrenses.

I den grad det er relevant, skal databehandler bistå behandlingsansvarlig med å ivareta de registrertes rett til dataportabilitet og retten til å motsette seg automatiske avgjørelser, inkludert profilering.

Databehandler er erstatningsansvarlig overfor de registrerte dersom feil eller forsømmelser hos databehandler påfører de registrerte økonomiske eller ikke-økonomiske tap som følge av at deres rettigheter eller personvern er krenket.

6. Tilfredsstillende informasjonssikkerhet

Databehandler skal iverksette tilfredsstillende tekniske, fysiske og organisatoriske sikringstiltak for å beskytte personopplysninger som omfattes av denne avtalen mot uautorisert eller ulovlig tilgang, endring, sletting, skade, tap eller utilgjengelighet.

Databehandler skal dokumentere egen sikkerhetsorganisering, retningslinjer og rutiner for sikkerhetsarbeidet, risikovurderinger og etablerte tekniske, fysiske eller organisatoriske sikringstiltak. Dokumentasjonen skal være tilgjengelig for behandlingsansvarlig.

Databehandler skal etablere kontinuitets- og beredskapsplaner for effektiv håndtering av alvorlige sikkerhetshendelser. Dokumentasjonen skal være tilgjengelig for behandlingsansvarlig.

Databehandler skal gi egne ansatte/studenter tilstrekkelig informasjon om og opplæring i informasjonssikkerhet slik at sikkerheten til personopplysninger som behandles på vegne av behandlingsansvarlig blir ivaretatt.

Databehandler skal dokumentere opplæringen av egne ansatte i informasjonssikkerhet. Dokumentasjonen skal være tilgjengelig for behandlingsansvarlig.

7. Taushetsplikt
Kun ansatte hos databehandler som har tjenstlige behov for tilgang til personopplysninger som forvaltes på vegne av behandlingsansvarlig, kan gis slik tilgang. Databehandler plikter å dokumentere retningslinjer og rutiner for tilgangsstyring. Dokumentasjonen skal være tilgjengelig for behandlingsansvarlig.
Ansatte hos databehandler har taushetsplikt om dokumentasjon og personopplysninger som vedkommende får tilgang til i henhold til denne avtalen. Denne bestemmelsen gjelder også etter avtalens opphør. Taushetsplikten omfatter ansatte hos tredjeparter som utfører vedlikehold (eller liknende oppgaver) av systemer, utstyr, nettverk eller bygninger som databehandler anvender for å levere eller administrere prosjektet «Dysleksi eller bare flerspråklig?».

8. Tilgang til sikkerhetsdokumentasjon
Databehandler plikter å gi behandlingsansvarlig tilgang til all sikkerhetsdokumentasjon som er nødvendig for at behandlingsansvarlig skal kunne ivareta sine forpliktelser i henhold til Europa-parlamentets og Rådets forordning (EU) 2016/679 av 27. april 2016, Artikkel 5 nr.1 bokstav f og Artikkel 32-36.
Databehandler plikter å gi behandlingsansvarlig tilgang til annen relevant dokumentasjon som gjør det mulig for behandlingsansvarlig å vurdere om databehandler overholder vilkårene i denne avtalen.
Ansatte hos behandlingsansvarlig har taushetsplikt for konfidensiell/fortrolig sikkerhetsdokumentasjon som databehandler gjør tilgjengelig for behandlingsansvarlig.

9. Varslingsplikt ved sikkerhetsbrudd
Databehandler skal uten ubegrunnet opphold varsle behandlingsansvarlig dersom personopplysninger som forvaltes på vegne av behandlingsansvarlig utsettes for sikkerhetsbrudd som innebærer risiko for krenkelser av de registrertes personvern.
Varslet til behandlingsansvarlig skal som minimum inneholde informasjon som beskriver sikkerhetsbruddet, hvilke registrerte som er berørt av sikkerhetsbruddet, hvilke personopplysninger som er berørt av sikkerhetsbruddet, hvilke strakstiltak som er iverksatt for å håndtere sikkerhetsbruddet og hvilke

forebyggende tiltak som eventuelt er etablert for å unngå liknende hendelser i fremtiden.
Behandlingsansvarlig er ansvarlig for at varsler om sikkerhetsbrudd fra databehandler blir videreformidlet til Datatilsynet.

10. Underleverandører
Databehandler kan ikke bruke underleverandører i prosjektet «Dysleksi eller bare flerspråklig?».

11. Overføring til land utenfor EU/EØS
Databehandler kan ikke utlevere data til andre land.

12. Sikkerhetsrevisjoner og konsekvensutredninger
Databehandler skal jevnlig gjennomføre sikkerhetsrevisjoner av eget arbeid med sikring av personopplysninger mot uautorisert eller ulovlig tilgang, endring, sletting, skade, tap eller utilgjengelighet.

13. Tilbakelevering og sletting
Ved opphør av denne avtalen plikter databehandler å slette og tilbakelevere alle personopplysninger som forvaltes på vegne av behandlingsansvarlig i forbindelse med prosjektet «Dysleksi eller bare flerspråklig?». Behandlingsansvarlig bestemmer hvordan tilbakelevering av personopplysningene skal skje, herunder hvilket format som skal benyttes.
Databehandler skal slette personopplysninger fra alle lagringsmedier som inneholder personopplysninger som databehandler forvalter på vegne av behandlingsansvarlig. Sletting skal skje ved at databehandler skriver over personopplysninger innen 30 dager etter avtalens opphør. Dette gjelder også for sikkerhetskopier av personopplysningene.
Databehandler skal dokumentere at sletting av personopplysninger er foretatt i henhold til denne avtalen. Dokumentasjonen skal gjøres tilgjengelig for behandlingsansvarlig.
Databehandler dekker alle kostnader i forbindelse med tilbakelevering og sletting av de personopplysninger som omfattes av denne avtalen.

14. Mislighold
Ved mislighold av vilkårene i denne avtalen som skyldes feil eller forsømmelser fra databehandlers side, kan behandlingsansvarlig si opp avtalen med øyeblikkelig virkning. Databehandler vil fortsatt være pliktig til å tilbakelevere og slette personopplysninger som forvaltes på vegne av behandlingsansvarlig i henhold til bestemmelsene i punkt 13 ovenfor.
Behandlingsansvarlig kan kreve erstatning for økonomiske tap som feil eller forsømmelser fra databehandlers side, inkludert mislighold av vilkårene i denne avtalen, har påført behandlingsansvarlig, jf. også punkt 5 og 10 ovenfor.

15. Avtalens varighet
Denne avtalen gjelder så lenge databehandler forvalter personopplysninger på vegne av behandlingsansvarlig.
Avtalen kan sies opp av begge parter med en gjensidig frist på en måned.

16. Meddelelser
Meddelelser etter denne avtalen skal sendes skriftlig til: helene.berntsen@uia.no

17. Lovvalg og verneting
Avtalen er underlagt norsk rett og partene vedtar Kristiansand tingrett som verneting. Dette gjelder også etter opphør av avtalen.

***

Denne avtale er i 2 – to eksemplarer, hvorav partene har hvert sitt.

Sted og dato

På vegne av behandlingsansvarlig	På vegne av databehandler
………………………..	………………………
Helene Berntsen	(Signatur)

14.3 Consent form

14.3.1 The Norwegian consent form

Vil du delta i forskningsprosjektet
" Dysleksi eller bare flerspråklig"?

Vil du delta i et forskningsprosjekt hvor formålet er å undersøke om det er mulig å finne dysleksi hos personer med andre morsmål enn norsk? For å gjøre dette trenger vi å kartlegge leseferdigheten til personer med og uten dysleksi/lese- og skrivevansker. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
Formålet med denne studien er å undersøke om det er mulig å skille lesevansker som skyldes dysleksi, fra lesevansker som skyldes at man leser på et annet språk enn morsmålet. I Norge er det i dag vanskelig å få diagnosen dysleksi dersom man har et annet morsmål enn norsk. Dette er fordi vi både mangler kunnskap og kartleggingsverktøy som gjør det mulig skille mellom dysleksi og lesevansker som er midlertidige fordi man holder på å lære seg norsk. Vi ønsker derfor å undersøke om det er mulig å skille mellom disse vanskene ved å kartlegge personer med og uten dysleksi, men som ikke har norsk som morsmål.

Denne studien inngår i Helene Berntsens doktorgradsstudie, og resultatene vil bli presentert i et vitenskapelig magasin.

Hvem er ansvarlig for forskningsprosjektet?
Universitetet i Agder er ansvarlig for prosjektet, men samarbeider med flere voksenopplæringssentre og andre institusjoner som kartlegger lese- og skriveferdighet, i flere byer i Norge.

Hvorfor får du spørsmål om å delta?
For å kunne forske på problemstillingen, trenger vi deltakere som ikke har norsk som morsmål. For at vi skal få resultater som det er mulig å forske på, har vi begrenset studien til å omfatte personer som har somali, polsk eller engelsk som morsmål. Vi ønsker å sammenlikne resultater fra personer som har fått en dysleksidiagnose, med personer med typiske lese- og skriveferdigheter. I tillegg

trenger vi å sammenlikne resultater fra personer som har språknivå A1/A2 på norsk, med personer som har norsk språknivå fra B1 og over. Vi kommer til å kartlegge ca. 200 personer i dette prosjektet.
Vi samarbeider med flere voksenopplæringssenter og andre institusjoner for å finne deltakere til denne forskningen. Det er våre samarbeidsparter (din voksenopplæring e.l.) som vurderer om du er aktuell for denne studien. Studien starter med å svare på et spørreskjema som handler om språkferdigheter og leseferdigheter. Voksenopplæringssentrene vil være de som har navnelister og personopplysninger – vi i forskningsprosjektet vil ikke ha tilgang til navnelister. Svarene fra spørreskjemaet vil være utgangspunktet for at noen vil bli bedt om å stille til kartlegging av leseferdighet på både norsk og på morsmålet.

Hva innebærer det for deg å delta?
Å delta i denne studien foregår i to deler. Den første delen vil bestå av å svare på et spørreskjema på papir. For noen vil deltakelsen stoppe der, mens andre vil bli valgt ut til kartlegging av leseferdighet.

Dersom du velger å delta i forskningsprosjektet, innebærer det at du fyller ut et spørreskjema som tar deg ca. 15 minutter å fylle ut. Spørreskjemaet inneholder spørsmål om hvilke språk du snakker, og om hvordan du vurderer din egen leseferdighet på både norsk og på morsmålet ditt. Svarene fra spørreskjemaet blir registrert elektronisk, men svarene og navnet ditt blir ikke automatisk koblet sammen.

Deretter vil noen bli valgt ut til kartlegging av leseferdighet. Det er din voksenopplæring e.l. som vil ta kontakt med deg dersom videre kartlegging blir aktuelt. Når vi kartlegger leseferdighet vil du gjøre flere oppgaver som måler ulike ferdigheter knyttet til det å lese. Under noen av oppgavene kommer vi til å spille inn svarene dine på lyd. Dette vil kun bli brukt for å registrere svarene dine. Navnet ditt vil ikke være knyttet til lydfilen – den vil kun være merket med et nummer. Kartleggingen vil ta ca. 1,5 time. Under noen av testene kan det bli tatt opp lyd og resultatene fra testene blir notert fortløpende.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil

da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Hvis du velger å ikke delta, eller å trekke deg fra studien vil det ikke påvirke ditt forhold til skolen eller læreren din.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Det er kun voksenopplæringssenteret eller andre kartleggingsinstitusjonen som har tilgang til dine personopplysninger. Hver skole blir tildelt en rekke nummer, og forskningsgruppa vil kun ha tilgang til et nummer som representerer deg. Spørreskjemaet og kartleggingsresultatene vil bli merket med samme nummer, men helt uten personidentifiserende informasjon.
Det er kun de som er en del av forskningsprosjektet som vil ha tilgang til resultatene.
I publikasjoner vil språknivå, morsmål og leseferdighet beskrives, men det vil ikke være mulig å gjenkjenne enkeltpersoner.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Innsamlingen av data skal etter planen avsluttes høsten 2022, mens hele ph.d.-prosjektet avsluttes september 2023.Etter gjennomført datainnsamling vil samarbeidspartene slette alle navnelister. Resultatene fra spørreskjemaene og kartleggingen vil bli oppbevart, men fordi spørreskjemaene og kartleggingsresultatene ikke er registrert med navn, fødselsdato eller annen identifiserbar informasjon, vil ikke resultatene kunne knyttes opp til enkeltpersoner.

Resultatene fra spørreundersøkelsen og kartleggingsresultatene vil bli oppbevart ut over forskningsprosjektets tidsramme. Men resultatene vil være anonymisert og de kan ikke knyttes opp til deg som deltaker. Vi ønsker å oppbevare resultatene for å kunne gjennomføre senere forskning, da det foreligger lite norsk forskning på dette feltet. Det er kun de som er involvert i dagens forskningsprosjekt som vil ha tilgang til disse dataene.

Dine rettigheter

Etter at datainnsamlingen er ferdig, vil vi ikke ha opplysninger som gjør det mulig å identifisere deg i datamaterialet, da våre samarbeidspartnere vil slette sine navnelister. Men i den perioden som du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitetet i Agder har NSD – Norsk senter for forskningsdata AS - vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Helene Berntsen ved Universitetet i Agder, på epost helene.berntsen@uia.no
- Vårt personvernombud ved Universitetet i Agder: Ina Danielsen, på epost ina.danielsen@uia.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Helene Berntsen
Prosjektansvarlig

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «Dysleksi eller bare flerspråklig?» og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i forskningen ved å fylle ut spørreskjema og å delta i kartlegging av leseferdighet

- ☐ anonyme data kan bli brukt i videre forskning

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. september 2023

(Signert av prosjektdeltaker, dato)

14.3.2 The English consent form

Would you like to take part in the research project "Dyslexia or just multilingual?"

Would you like to take part in a research project where the aim is to investigate whether it is possible to find dyslexia among people with other native languages than Norwegian? In order to do so, we have to assess the reading skills of people with and without dyslexia/reading and writing difficulties. This note provides information on the project's objective and what participation will entail for you.

Objective

The objective of this research is to investigate whether it is possible to distinguish reading difficulties that are due to dyslexia from reading difficulties that are due to reading a different language than one's native language. In Norway it is difficult to be diagnosed with dyslexia if one has a different native language than Norwegian. This is both because we lack the knowledge and assessment tools that make it possible to distinguish between dyslexia and reading difficulties that are of a temporary nature because one is in the process of learning Norwegian. We therefore want to investigate whether it is possible to distinguish between these difficulties by assessing people with and without dyslexia, but who are not native speakers of Norwegian.

This research is a part of Helene Berntsen's doctoral research, and the results will be presented in a scientific journal.

Who is responsible for the research project?

The University of Agder is responsible for the project, but is cooperating with several adult education centres and other institutions that assess reading and writing skills, in several cities in Norway.

Why have you been asked to participate?

In order to research the issue, we need participants whose native language is not Norwegian. In order to obtain results that are possible to research, we have limited the research to include persons who have Somali, Polish or English as their native language. We want to compare results from persons who have been

diagnosed with dyslexia, with persons with typical reading and writing skills. We also need to compare results from people with language level A1/A2 in Norwegian, with people who have a Norwegian language level of B1 and above. We will assess approximately 200 people in this project.
We are partnering with several adult education centres and other institutions to find participants for this research. It is our partners (your adult education centre, etc.) who assesses whether you are a suitable candidate for this research. The study starts with a questionnaire about your language skills and reading skills. The adult education centres will retain lists of names and personal information – those running the research project will not have access to lists of names. The responses from the questionnaire will be the starting point for some being asked to attend an assessment of reading skills in both Norwegian and their native language.

What does participating entail for you?
Participation in this research takes place in two parts. The first part consists of completing a paper questionnaire. For some, participation will end there, while others will be selected to assess reading skills.

If you choose to take part in the research project, this entails that you fill in a questionnaire that takes around 15 minutes to complete. The questionnaire includes questions on which language you speak, and on how you assess your own reading skills in both Norwegian and your native language. The answers from the questionnaire are recorded electronically, but the answers and your name will not automatically be linked.

After this, some will be selected for the assessment of reading skills. It is your adult education centre or other institution who will contact you in the event of further assessment. When we assess reading skills, you will be required to do several tasks that measure different skills related to reading. In some of the tasks, we will make audio recordings of your responses. These will only be used to register your answers. Your name will not be linked to the audio file – it will only be designated with a number. The assessment will take approximately 1.5 hours. Audio may be recorded during some of the tests and the results from the tests are noted continuously.

Participation is voluntary
Participation in the project is voluntary. If you choose to participate, you may withdraw your consent at any time without stating a reason. All of your information will then be deleted. Not participating or withdrawing from the project will have no negative consequences.

If you choose not to participate or to withdraw from the project, it will not affect your relationship to the school or your teacher.

Your privacy – how we store and use your data
We will only use your data for the purposes described in this note. We process the data confidentially and in compliance with privacy regulations.

It is only the adult education centre or other institution that has access to your personal data. Each shool is assigned a series of numbers, and the research group will only have access to a number that represents you. The questionnaire and assessment results will be assigned the same number, but will not contain any information that may be used to identify you.
It is only those involved in the research project who will have access to the results.
In publications, the language level, native language and reading skills will be described, but it will not be possible to identify individuals.

What happens with your data when we complete the research project?
According to plan, the collection of data will be completed in the autumn of 2022, while the entire Ph.D. project will be completed in September 2023. Upon completion of data collection, the partners will delete all lists of names. The results from the questionnaires and assessments will be stored, but because the questionnaires and assessment results are not recorded with names, birth dates or other identifying information, it will not be possible to link the results to individuals.

The results from the questionnaire and assessment results will be stored beyond the scope of the research project. However, the results will be anonymous and may not be linked to you as a participant. We want to store the results in order to conduct further research, as there is little Norwegian research into this area. It is only those who are involved in the current research project who will have access to these data.

Your rights

Once data collection is completed, we will not have information that allows us to identify you in the data material, as our partners will delete their lists of names. However, during the period in which you may be identified in the data material, you are entitled to:

- access to which personal data that is recorded on you,
- rectify your personal data,
- have your personal data deleted,
- request a copy of your personal data (data portability), and
- submit a complaint to the privacy officer or the Data Inspectorate regarding the processing of your personal data.

What gives us the right to process your personal data?

We process your data on the basis of your consent.

On behalf of the University of Agder, NSD – the Norwegian Centre for Research Data - has assessed that the processing of personal data in this project is in compliance with the privacy regulations.

Where can I find more information?

If you have any questions regarding the research or wish to exercise your rights, contact:

- Helene Berntsen at the University of Agder, by e-mail helene.berntsen@uia.no
- Our privacy officer at the University of Agder: Ina Danielsen, by e-mail ina.danielsen@uia.no
- NSD – the Norwegian Centre for Research Data, by e-mail (personverntjenester@nsd.no) or phone: (55 58 21 17).

Kind regards

Helene Berntsen
Project Manager

Declaration of consent

I have received and understood the information on the project "Dyslexia or just multilingual?" and have had the opportunity to ask questions. I consent to:

☐ participating in the research by completing a questionnaire and taking part in an assessment of reading skills

☐ anonymous data being used in further research

I consent to my data being processed up until the project is concluded, around September 2023

(Signed by project participant, date)

14.3.3 The Polish consent form

Czy chcesz wziąć udział w projekcie badawczym "Dysleksja czy po prostu wielojęzyczność"?

Czy chcesz wziąć udział w projekcie badawczym, którego celem jest zbadanie, na ile można diagnozować dysleksję u osób, których językiem ojczystym jest inny język niż norweski? Żeby to ustalić, musimy przyjrzeć się umiejętnościom czytania i pisania u osób z dysleksją i trudnościami w czytaniu i pisaniu oraz u osób bez tych trudności. To pismo zawiera informacje o celach projektu i o tym, na czym polega uczestnictwo w nim.

Cel

Celem tego badania jest zbadanie, czy możliwe jest rozróżnienie trudności z czytaniem i pisaniem spowodowanych dysleksją, od trudności z czytaniem i pisaniem spowodowanych czytaniem w języku innym niż ojczysty. W Norwegii trudno jest obecnie uzyskać diagnozę dysleksji, jeśli Twój język ojczysty jest inny niż norweski. Dzieje się tak dlatego, że brakuje nam zarówno wiedzy, jak i narzędzi do mapowania umożliwiających rozróżnienie dysleksji od takich trudności z czytaniem, które są tymczasowe i związane z trwającą nauką języka norweskiego. Dlatego chcemy zbadać, czy możliwe jest rozróżnienie tych trudności poprzez mapowanie osób z dysleksją i bez dysleksji z uwzględnieniem również tych, których językiem ojczystym nie jest norweski.

Badanie to jest częścią pracy doktorskiej Helene Berntsen, a wyniki zostaną przedstawione w czasopiśmie naukowym.

Kto jest odpowiedzialny za projekt badawczy?

Uniwersytet Agder jest odpowiedzialny za projekt, ale współpracuje z kilkoma ośrodkami kształcenia dorosłych i innymi instytucjami, które mapują umiejętność czytania i pisania w wielu miastach w Norwegii.

Dlaczego jesteś proszony o udział?

Aby zbadać ten problem potrzebujemy uczestników, których językiem ojczystym nie jest język norweski. Aby uzyskać wyniki, które można badać, ograniczyliśmy badanie do osób, których językiem ojczystym jest somalijski, polski lub

angielski. Chcemy porównać wyniki od osób, które otrzymały diagnozę dysleksji z wynikami osób o typowych umiejętnościach czytania i pisania. Ponadto musimy porównać wyniki od osób, które osiągnęły w norweskim poziom językowy A1/A2 z wynikami osób, u których poziom języka norweskiego plasuje się na poziomie B1 i powyżej. Planujemy przebadać na potrzeby projektu około 200 osób.
Przy poszukiwaniu uczestników niniejszego badania współpracujemy z wieloma ośrodkami szkolenia dla dorosłych i innymi instytucjami. Nasz partner współpracujący (np. Twój ośrodek kształcenia dla dorosłych lub inny) oceni, czy jesteś odpowiednim kandydatem do tego badania. Badanie rozpoczyna się od odpowiedzi na pytania w kwestionariuszu, dotyczące umiejętności w zakresie języka oraz czytania. Ośrodki kształcenia dla dorosłych pozostaną w posiadaniu list nazwisk i danych osobowych – my w projekcie badawczym nie będziemy mieli dostępu do list nazwisk. Odpowiedzi z kwestionariusza będą punktem wyjścia do zaproponowania konkretnym osobom, aby wzięły udział w mapowaniu umiejętności czytania i pisania zarówno w języku norweskim, jak w swoim ojczystym.

Co oznacza w praktyce wzięcie udziału?
Udział w badaniu odbywa się w dwóch etapach. Pierwsza część będzie polegać na udzieleniu odpowiedzi na pytania w kwestionariuszu papierowym. Dla części uczestników badanie na tym się zakończy, inni natomiast zostaną wybrani do dalszego mapowania umiejętności czytania i pisania.

Jeśli zdecydujesz się wziąć udział w projekcie badawczym, oznacza to, że wypełniasz kwestionariusz, co zajmie Ci około 15 minut. Kwestionariusz zawiera pytania dotyczące języków, którymi mówisz, oraz własnej oceny umiejętności czytania i pisania zarówno w języku norweskim, jak i w ojczystym. Odpowiedzi z kwestionariusza zostaną zarejestrowane w formie elektronicznej, ale Twoje odpowiedzi oraz imię i nazwisko nie będą automatycznie z nimi powiązane.

Następnie część osób zostanie wybrana do mapowania umiejętności czytania i pisania. Twój ośrodek kształcenia dla dorosłych lub inny skontaktuje się z Tobą, jeśli udział w dalszym mapowaniu będzie aktualny. Mapowanie umiejętności czytania polega na wykonaniu kilku zadań, mierzących różne umiejętności związane z czytaniem. Podczas wykonywania niektórych zadań nagramy Twoje odpowiedzi w formie dźwiękowej. Nagrania zostaną użyte tylko do zarejestrowania odpowiedzi. Twoje imię i nazwisko nie będzie powiązane z plikiem audio — zostanie ono oznaczone tylko numerem. Badanie potrwa około 1,5 godziny. Podczas niektórych badań dźwięk może być rejestrowany, a wyniki badań będą na bieżąco notowane.

Uczestnictwo jest dobrowolne
Udział w projekcie jest dobrowolny. Jeśli zdecydujesz się wziąć udział, możesz wycofać swoją zgodę w dowolnym momencie bez podania przyczyny. Wszystkie informacje o Tobie zostaną wówczas usunięte. Jeśli nie chcesz uczestniczyć w projekcie lub później zdecydujesz się wycofać, nie będzie to miało dla Ciebie żadnych negatywnych konsekwencji.

Jeśli zdecydujesz się nie uczestniczyć lub wycofać się z badania, nie wpłynie to na twoje relacje ze szkołą ani nauczycielem.

Twoja prywatność – sposób przechowywania i wykorzystywania Twoich danych
Będziemy wykorzystywać Twoje dane wyłącznie w celach, które ujawniliśmy w niniejszym piśmie. Dane przetwarzamy w sposób poufny i zgodny z przepisami o ochronie danych.

Tylko ośrodek kształcenia dorosłych lub inna instytucja związana z mapowaniem ma dostęp do Twoich danych osobowych. Każdej szkole zostanie przypisanych szereg numerów, a grupa badawcza będzie miała dostęp tylko do reprezentującego Cię numeru. Wyniki kwestionariusza i mapowania będą oznaczone tym samym numerem, ale bez żadnej informacji umożliwiającej identyfikację.
Tylko osoby realizujące ten projekt badawczy będą miały dostęp do wyników. W publikacjach opisany zostanie poziom języka, język ojczysty i umiejętność czytania i pisania, ale nie będzie możliwa identyfikacja poszczególnych osób.

Co stanie się z Twoimi informacjami po zakończeniu projektu badawczego?
Zbiórka danych ma się zakończyć jesienią 2022 r., natomiast cały projekt doktorski zakończy się we wrześniu 2023 r. Po zebraniu danych partnerzy

współpracujący usuną wszystkie listy nazwisk. Kwestionariusze i rezultaty mapowania będą przechowywane, ale ponieważ wyniki badań nie zostaną zarejestrowane z imieniem i nazwiskiem, datą urodzenia lub innymi identyfikowalnymi informacjami, wyniki nie będą mogły zostać powiązane z osobami fizycznymi.

Wyniki badania i mapowania będą przechowywane przez czas wykraczający poza ramy czasowe projektu badawczego. Jednak wyniki zostaną zanonimizowane i nie będą mogły być powiązane z Tobą jako uczestnikiem. Chcemy zachować wyniki, aby móc przeprowadzać w przyszłości dalsze badania, ponieważ w tej dziedzinie prowadzi się w Norwegii niewiele badań. Tylko osoby zaangażowane w obecny projekt badawczy będą miały dostęp do tych danych.

Twoje prawa

Po zakończeniu zbierania danych nie będziemy mieć informacji, które pozwolą zidentyfikować Cię w zebranych danych, ponieważ nasi partnerzy usuną u siebie listy nazwisk. Jednak w okresie, w którym można Cię zidentyfikować w zebranych danych, masz prawo do:

- wglądu do informacji o swoich zarejestrowanych danych osobowych,
- sprostowania swoich danych osobowych,
- usunięcia swoich danych osobowych,
- uzyskania kopii swoich danych osobowych (możliwość przenoszenia danych) oraz
- złożenia skargi do inspektora ochrony danych lub organu ochrony danych w sprawie przetwarzania swoich danych osobowych.

Co daje nam prawo do przetwarzania Twoich danych osobowych?

Przetwarzamy informacje o Tobie na podstawie Twojej zgody.

Na zlecenie Uniwersytetu Agder Norweskie Centrum Danych Badawczych (NSD) – oceniło, że przetwarzanie danych osobowych w tym projekcie jest zgodne z przepisami o ochronie danych.

Gdzie mogę dowiedzieć się więcej?

Jeśli masz jakiekolwiek pytania dotyczące badania lub chcesz skorzystać ze swoich praw, skontaktuj się z:

- Helene Berntsen na Uniwersytecie w Agder, e-mail helene.berntsen@uia.no
- Naszym inspektorem ochrony danych na Uniwersytecie w Agder: Ina Danielsen, e-mail ina.danielsen@uia.no
- z Norweskim Centrum Danych Badawczych (NSD), e-mail (personverntjenester@nsd.no) lub telefonicznie: 55 58 21 17.

Pozdrawiam serdecznie

Helene Berntsen
Kierownik projektu

Oświadczenie o zgodzie

Otrzymałem i zrozumiałem informacje na temat projektu "Dysleksja czy po prostu wielojęzyczność?" i dano mi możliwość zadawania pytań. Zgadzam się na:

☐ udział w badaniach poprzez wypełnianie kwestionariusza i uczestnictwo w badaniu umiejętności czytania i pisania

☐ wykorzystywanie zanonimizowanych danych w dalszych badaniach

Wyrażam zgodę na przetwarzanie moich danych do czasu zakończenia projektu, czyli ok. września 2023 roku

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(Podpis uczestnika projektu, data)

14.3.4 The Somali consent form

Ma doonaysaa in aad ka qeyb qaadato mashruuca cilmi baarista "Qofka uu dhibka ku yahay qoraalka iyo akhriska ama qofka yaqaan luuqado badan?"

Ma doonaysaa in aad ka qayb qaadato mashruuca cilmi baarista ee ujeedkiisu yahay baaritaanka suurtagalnimada lagu oganayo dhibka qofka aan noorweejiga ahayn ka haysta qoraalka iyo akhrsika?

Si loo hirgeliyo arrinkan waxaa loo baahanyahay in aynu qiimeyn ku sameyno heerka akhriska dadka dhibku ka haysto qoraalka iyo akhriska ama kuwa aan wax dhib ah ku qabin intaba. Qoraalkan waxaanu kuugu soo gudbinaynaa warbixinno lagu cabbirayo hadafka mashruuca iyo waxa ka qayb qaadashadaada kaga mid noqon doonto.

Ujeeddo:
Ujeeddada cilmi baarista ayaa ah baaritaan lagu ogaanayo suurtagalnimada in la kala saaro caqabadaha dhanka akhriska ee ay sababta u tahay dhibka ka haysta qofka qoraallada iyo akhriska iyo in caqabadaha akhriska ay yihiin kuwo keenaya in qofku uu dhib ku qabo luuqadaha qalaad. Waxa arrinkan ugu wacan in aynaan haysan macluumaad inagu fillan ama agabyada lagu qiimeeyo suurtagalnimada in qofku dhib ka haysto qoraalka iyo akhriska ama si ku meel gaar ah ugu jira xaalad dabiici ah sababaysa dhibka akhriska ka haysta qofka nidaanka barashada noorweejiga. Sidaas awgeed waxaanu doonaynaa in aynu baarno haddii ay suuragal tahay in la kala saaro dhibaatooyinkan iyaga oo la qiimaynayo dadka qaba ama aan qabin dhibka qoraalka iyo akhriska qofka, laakiin aan u dhalan luqadda noorweejiga.

Cilmi baaristan waxa ay qayb ka tahay cilmi baare digtooraaga ee Helene Berntsen, sidoo kale natiijooyinkana waxaa lagu soo bandhigi doonaa majaladda cilmiga.

Yaa masuul ka ah mashruuca cilmi baarista?

Jaamacadda Agder waxay masuul ka tahay mashruuca, laakiin waxay la shaqaynaysaa dhowr xarumood oo waxbarashada dadka waa wayn ah iyo mac'hadyo kale oo ku yaal magaalooyin ky yaal waddanka Norway oo iyagana qiimeeya dhibka qoraalka iyo akhriska qofka.

Maxaa u sabab ah in lagu weydiiyo su'aalahan oo ah in aad ka qeyb qaadato?

Si loo baaro halka dhibku ka jiro, waxaanu u baahanahay ka qayb galayaasha aan luqadda ay u dhasheen noorweeji ahayn. Si loo helo natiijooyin ay suuragal tahay in cilmi baaris lagu sameeyo, waxaanu koobnay daraasaddii lagu ogaanayey qofka asal ahaan Soomaali, boolan ama Ingiriiska luuqaddiisu tahay. Waxaanu doonaynaa in aynu isbarbardhigno natiijooyinka dadka qaba dhibka qoraalka iyo akhriska iyo dadka ay sida caadiga ah ay ugu adagtahay qoraalka iyo akhriska.

Waxaanu sidoo kale u baahanahay inaan is barbardhigno natiijooyinka dadka haysta heerka A1/A2 ee luqadda noorweejiga, iyo dadka haysta heerka B1 ee luqadda noorweejiga iyo wixii ka sarreeya. Mashruucan, waxaanu ku qiimayn doonnaa ugu yaraan 200 oo qof.

Waxaanu iskaashi la samaynaynaa dhowr ah xarumaha waxbarashada iyo mac'hadyo kale si aynu ugu helno cilmi baarista ka qayb galayaal. Waxaa inaga dhexeeya iskaashi (xaruntaada waxbarashada ee dadka waa wayn, iwm) oo qiimeyn doona in aad ku habboon tahay daraasaddan iyo in kale. Daraasaddu waxay ku bilaabanaysaa ka jawaabista hal warqad su'aaleed ah oo ka kooban heerka isku filnaashaha dhanka luuqadda iyo akhriska.

Xarumaha waxbarashada dadka waaweyn ayaa hayn doona diiwaanka magacyada ka qeyb galayaasha iyo xogta qofka u gaarka ah. Annaga, cilmi baarayaasha ah wax lug ah kuma yeelan doono magacyada.

Jawaabaha ka soo bixi doona su'aalaha ayaa ah ugu horeyn in qof la weydiin doono in uu ka qeyb qaato daraasaddan lagu ogaan doono isku filnaashaha dhanka akhriska ee luuqadda noorweejiga iyo luuqaddiisa hooyo.

Maxay ka dhigan tahay ka qeyb galkaaga?

Ka qayb galka daraasaddan waxay noqonaysaa laba qaybood. Qaybta kowaad waxay ka kooban tahay ka jawaabista warqadda su'aalaha xog ururinta. Ka qayb qaadayaasha qaar ayaa halkaa ku joojn doona, meesha kuwa kalena loo dooran doono in ay ka sii qeyb qaataan qiimaynta isku filnaashaha akhriska.

Haddii aad doorato inaad ka qayb qaadato mashruuca cilmi baarista, tani waxay ka mid noqon doontaa in aad buuxiso warqadda su'aalaha xog ururinta oo kuugu qaadanaysaa qiyaas ahaan 15 daqiiqo. Warqadda su'aalaha xog ururinta ayaa waxa ay ka kooban tahay su'aalo luqadda aad ku hadasho ah, iyo sida aad u qiimayso isku filnaashaha akhriskaaga ee ah noorweejiga iyo luqadda aad u dhalatay labadaba. Jawaabaha ka soo baxday warqadda su'aalaha xog ururinta ayaa waxaa lagu diiwaan gelin doonaa kombiyuutarka, laakiin jawaabaha iyo magacaaga si toos ah la iskuguma xiriirin doono.

Intaa kaddib, qaar ayaa loo dooran doonaa qiimaynta isku filnaashaha akhriska. Haddii loo baahdo qiimayn dheeri ah waxaa kula soo xiriiri doona xaruntaada waxbarashada dadka waawayn ama kuwa kale oo lamid ah.

Markaan qiimaynayno isku filnaashaha akhriska, waxaad ka jawaabi doontaa dhowr su'aalood oo qiimayn doona isku filnaashaha kala duwan oo xiriir la leh akhriskaaga. Jawaabaha su'aalaha qaar ayaan u soo dhigi doonaa cod ahaan. Sida tan waxaa kaliya oo loo isticmaali doonaa si loo diiwaan geliyo jawaabahaaga. Magacaaga laguma lifaaqi doono codka. Waxaa kaliya oo astaan looga dhigi doonaa lambar. Qiimayntu waxay qaadan doontaa ugu yaraan hal saac iyo bar. Inta qiimaynta lagu gudo jiro waxaa dhici doonta in cod lagaa qaado, iyo in jawaabaha su'aalaha si joogta ah loo sii wado.

Waxaad u leedahay ikhtiyaar in aad ka qeyb qaadato

Ikhtiyaar ayaad u leedahay in aad ka qeyb qaadato mashruuca. Haddii aad doorato in aad ka qayb gasho, waxaad ka noqon kartaa oggolaanshahaaga wakhti kasta oo aad doonto, adiga oo aan wax sabab ah sheegin. Dhammaan macluumaadkaaga waa la masaxayaa markaa. Wax cawaaqib xuma ah kuugu ma yeelanayso haddii aadan ka qeyb qaadanayn ama aad dooratid in aad hadhow dib uga noqotid.

Haddii aad doorato in aadan ka qayb gelin ama aad ka noqoto daraasadda, kuma yeelan doonto wax saamayn ah xaaladdaada xiriir ee aad la leedahay dugsiga ama macalinkaaga.

Asturidda xogtaada – sida aan u kaydino una isticmaalno macluumaadkaaga

Waxaanu keliya u isticmaali doonnaa macluumaadka adiga kuugu saabsan ujeedooyinka aan ku sharraxnay qodobkaan. Waxaanu u habaynaa xogta si qarsoodi ah oo waafaqsan xeerka u gaarka ah.

Waxaa keliya oo ogaan kara xogtaada gaarka ah xarunta waxbarashadda dadka waawayn ama mac'haddada kale. Dugsi kasta waxaa loo qoondeyn doonaa lambarro taxane ah, oo kooxda cilmi baaristu waxay heli doonaan hal lambar oo adiga ku matalaya. Su'aalaha xog uruurinta iyo natiijooyinka qiimeynta waxaa lagu calaamadeeyen doonaa tiro isku mid ah, laakiin gebi ahaan ba iyada oo aan la helin macluumaad shaqsi ahaan oo lagu aqoonsan karo.
Waxaa keliya oo ogaan doona natiijada kuwa qeybta ka ah mashruuca cilmi baarista.
Daabacadaha, heerka luqadda, afka hooyo iyo waxaa lagu sharaxi doonaa isku filnaashaha, laakiin suuragal ma ahaan doonto in la aqoonsado shakhsiyaadka.

Maxaa ku dhici doonaa xogtaada marka aynu dhammayno mashruuca cilmi baarista?

Sida waafaqsan qorshaha xog ururinta waxaa la dhammaystiri doonaa dayrta 2022, halka dhammaan mashruuca Ph.D la dhammaystiri doono bisha Sebtember 2023. Marka la dhammaystiro xog ururinta, shuraakadu waxay masaxi doonaan dhammaan diiwaanka magacyada. Natiijooyinka su'aalaha warqadda xog ururinta iyo qiimaynta waa la kaydin doonaa, laakiin sababtoo ah su'aalaha warqadda xog ururinta iyo natiijooyinka qiimaynta lagu ma diiwaangelinayo magaca, taariikh dhalasho ama macluumaad kale oo lagu aqoonsan karo xogta oo markaa aan algu xiriirin karin natiijooyinka shakhsiyaad.

Natiijooyinka ka soo baxa warqadda su'aalaha xog ururinta iyo natiijooyinka qiimaynta ayaa la kaydin doonaa wakhti go'an oo ka baxsan inta loogu talo galay mashruuca cilmi baarista. Laakiin, natiijooyinka waa la qarin doonaa oo laguguma soo xiriirin doono adiga ka qayb gale ahaan. Waxaan rabnaa inaan kaydino natiijoyinka si aan u awoodno in la qabto cilmi baaris dheeraad ah, maadaama ay jiraan cilmi baaris yar noorweeji ah oo ku saabsan arrimahan.

Waxaa keliya ogaanaya xogta cilmi baarista ee mashruuca kuwa ku shaqo leh ee gacanta ku haya xogaha hadda.

Xuquuqdaada

Kaddib marka xog ururinta la dhammeeyo, ma haysan doonno macluumaad suurtagal inooga dhigaya in aan kugu aqoonsano xogtaada qoraalka ah, maaddaama shuraakadayadu ay masaxi doonto magacyada diiwaankooda. Laakiin, muddada lagugu aqoonsan karo xogta qoraalka ah, waxaad xaq u leedahay:

- in aad heli karto macluumaadka shakhsiga ah ee adiga kuugu saabsan,
- in aad saxan karto macluumaadkaaga sakhsi ahaaneed ee kuugu saabsan,
- in aad masixi karto xogtaada gaarka ah,
- in aad codsato nuqulka xogtaada gaarka ah (xog qaadista), iyo
- in aad u soo gudbiso cabasho wakiilka arrimaha gaarka ah ama hay'adda ilaalinta xogta ee ku saabsan ka shaqeynta xogtaada gaarka ah.

Maxaa xaq inoo siinaya in aan ka shaqeyno macluumaadka adiga kuugu saabsan?

Waxaan uga shaqeynaa xogta adiga kuugu saabsan oggolaanshahaaga.

Howlgalka jaamacadda Jaamacadda Agder (Universitet i Agder) NSD -- Xarunta noorweejiyaanka ee cilmi baarista macluumaadka AS - waxay qiimeeyeen in ka shaqeynta xogta gaarka ah ee mashruucan ay waafaqsan tahay xeerka ilaalinta shakhsiyadeed.

Halkeen ka heli karaa macluumaad dheeraad ah?

Haddii aad qabto wax su'aalo ah oo ku saabsan daraasadda ama aad rabto in aad ku shaqeyso xuquuqdaada, fadlan la xiriir:

- Helene Berntsen ee Jaamacadda Agder (Universitet i Agder), ama emayl ahaan helene.berntsen@uia.no
- Wakiilkeena gaarka ah ee Jaamacadda Agder (Universitet i Agder): Ina Danielsen, emayl ahaan ina.danielsen@uia.no
- NSD – Xarunta Nooweejiyaanka ee xogta cilmi baarista AS, emayl ahaan (personverntjenester@nsd.no) ama telefoon: (55 58 21 17).

Salaan wanaagsan

Helene Berntsen
Maareeyaha Mashruuca

Bayaanka oggolaanshaha

Waxaan helay oo aan fahmay macluumaad ku saabsan mashruuca “Qofka uu dhibka ka haysto qoraalka iyo akhriska ama ah qof luuqado badan ku hadla?” oo fursad u helay in uu su’aalo ku waydiiyo. Waxaan oggolaanayaa:

- ☐ ka qayb galka cilmi baarista aniga oo buuxinaya su’aalaha ka qayb galka iyo ka qayb qaadashada qiimaynta ee isku filnaashaha akhriska

- ☐ xogta qarsoon ayaa loo isticmaali karaa cilmi baaris dheeraad ah

Waxaan oggolaansho siinayaa xogtayda in laga shaqeeyo ilaa mashruuca la dhammaystiro, qiyaastii Sebteember 2023.

(Waxaa saxiixay ka qayb galaha mashruuca, taariikhda)

14.4 Questionnaire

Deltakers nummer:

Dato:

14.4.1 Questionnaire in Norwegian

Spørreskjema

Tusen takk for at du svarer på disse spørsmålene og bidrar til denne forskningen.
Skjemaet kan fylles ut sammen med en lærer.

1. Hvor gammel er du? (hvor mange år) ________________________________

2. Kjønn?
   - ☐ Mann
   - ☐ Kvinne
   - ☐ Ikke-binær

3. Er synet ditt normalt? (Syn korrigert med briller eller linser vurderes som normalt)
   - ☐ Ja
   - ☐ Nei

4. Er hørselen din normal?
   - ☐ Ja
   - ☐ Nei

5. Hva er ditt morsmål/førstespråk? ___________________________________

6. Hva er din utdanning og på hvilket språk ble den gjennomført? Fyll inn i skjemaet:

Utdanningsnivå (sett kryss)	**Hvilket språk var under-visningen på?** (skriv språket)	**Hvor mange dager i uka gikk du på skole?** (skriv tall)	**Hvor mange år?** (skriv tall)	**Hvor mange år var du da du startet?** (skriv tall)
Barneskole				
Ungdomsskole				
Voksenopplæring i Norge				
Fagbrev				
Videregående skole				
Bachelor				
Master				
Ph.d.				

Annet: ______________________				

7. Hvilket nivå er du på i norsk muntlig?
   - ☐ Under A1
   - ☐ A1
   - ☐ A2
   - ☐ B1
   - ☐ B2
   - ☐ C1
   - ☐ C2
   - ☐ Vet ikke

8. Hvilket språk snakket din mor (kvinnelig omsorgsperson) til deg i barndommen?

   ____

9. Hvilket språk snakket din far (mannlig omsorgsperson) til deg i barndommen?

   ____

10. Hvilket språk snakket du med dine brødre eller søstre?

    ____

11. Hva var din mors høyeste utdannelse? _

    ____

12. Hva arbeidet hun med?

    ____

13. Hva var din fars høyeste utdannelse?

    ____

14. Hva arbeidet han med?

____

15. Skriv inn alle språkene du snakker i tabellen. Skriv først det språket du snakker best, og skriv sist det språket du snakker dårligst.

	Språk	**Kan du lese på dette språket?** (Skriv Ja eller Nei)	**Kan du skrive på dette språket?** (Skriv Ja eller Nei)
1			
2			
3			
4			
5			
6			
7			

16. På hvilket språk pleier du å gjøre disse tingene?

Oppgave	**Språk**
Enkel matematikk (telle, plusse)	
Drømme	
Utrykke sinne eller kjærlighet	
Snakke til deg selv	

17. Har du fått diagnosen dysleksi?

☐ Ja
☐ Nei

18. Opplever du at du har lese- og skrivevansker, selv om du ikke har fått diagnosen dysleksi?

☐ Ja
☐ Nei

19. Har noen i din familie dysleksi?

☐ Ja
☐ Nei

☐ Vet ikke

20. Hvilket språk lærte du først å lese på? ________________________________

21. **Svar på dette spørsmålet *kun* hvis du synes det er vanskelig å lese. Hvis det er lett å lese kan du hoppe over det. Sett kryss ved det som er vanskelig**:

	Norsk	**Førstespråk**
Jeg husker ikke navnet på alle bokstavene		
Jeg bruker lang tid på å lese		
Jeg kan bare lese korte tekster		
Jeg leser litt hakkete		
Jeg leser ikke alle endelsene i ordene		
Vanskelig å huske det jeg har lest		
Annet: ___________________________		

22. Hvor ofte leser du ***på norsk*** i hverdagen din? Sett kryss:

	Hver dag	**Hver uke**	**Sjelden**	**Aldri**
Leser aviser, ukeblader eller magasiner (på nettet eller papirutgaver)				
Leser på Facebook eller andre sosiale medier				
Leser bøker (skjønnlitteratur)				
Leser i jobben din				
Leser tegneserier				
Annet:___________________________				

23. Hvor ofte leser du ***på førstespråket*** ditt i hverdagen din? Sett kryss:

	Hver dag	**Hver uke**	**Sjelden**	**Aldri**
Leser aviser, ukeblader eller magasiner (på nettet eller papirutgaver)				
Leser på Facebook eller andre sosiale medier				
Leser bøker (skjønnlitteratur)				
Leser i jobben din				

Leser tegneserier				
Annet:___________________________				

24. Skriv et tall for hvor gode språkferdigheter du har på norsk og på morsmålet ditt.
10= Perfekt
9 = Utmerket
8 = Veldig god
7 = God
6 = Litt bedre enn middels
5 = Middels
4 = Litt under middels
3 = Noe, men det er mye jeg ikke får til
2 = Lav
1 = Veldig lav
0 = Ingen

	Norsk	**Førstespråk**
Snakke (gjøre seg forstått)		
Uttale		
Lese		
Rettskriving av ord		
Skrive en tekst		
Grammatikk		
Ordforråd (Kan du mange ord?)		

Tusen hjertelig takk for at du har svart på disse spørsmålene!

Deltakers nummer:

Dato:

14.4.2 Questionnaire in English

Questionnaire

Thank you very much for answering these questions and contributing to this research. The form may be completed with a teacher.

1. How old are you? (number of years) ______________________________

2. Gender?
   ☐ Male
   ☐ Female
   ☐ Non-binary

3. Do you have normal eyesight? (Vision corrected with glasses or contact lenses is considered normal)
   ☐ Yes
   ☐ No

4. Do you have normal hearing?
   ☐ Yes
   ☐ No

5. What is your mother tongue/native language? ________________________

6. What is your education and in which language was it conducted? Enter in the form:

Education level (enter a checkmark)	**Which language was the education in?** (enter the language)	**How many days a week did you attend school?** (enter number)	**How many years?** (enter number)	**How old were you when you started?** (enter number)
Elementary school				
Lower Secondary School				
Adult education in Norway				
Craft certificate				
Upper Secondary School				
Bachelor				
Master				
PhD				
Other: ______________________				

7. What is the level of your spoken Norwegian?

☐ Below A1
☐ A1
☐ A2
☐ B1
☐ B2
☐ C1
☐ C2
☐ Don't know

8. In which language did your mother (female caregiver) speak to you when you were a child?

____

9. In which language did your father (male caregiver) speak to you when you were a child?

____

10. Which language did you speak with your brothers or sisters?

____

11. What was your mother's highest education?

____

12. What was her job?

____

13. What was your father's highest education?

____

14. What was his job?

____

15. Enter all the languages you speak in the table. Enter the language you know best first, and the language you know least last.

	Language	**Can you read in this language?** (Enter Yes or No)	**Can you write in this language?** (Enter Yes or No)
1			
2			
3			
4			
5			
6			
7			

16. In which language do you usually do these things?

Task	**Language**
Basic mathematics (counting, addition)	
Dream	
Express anger or love	
Speak to yourself	

17. Have you been diagnosed with dyslexia?

☐ Yes
☐ No

18. Do you experience that you have difficulty reading and writing, even though you have not been diagnosed with dyslexia?

☐ Yes
☐ No

19. Does anyone in your family have dyslexia?

☐ Yes
☐ No
☐ Don't know

20. Which language did you first learn to read?

____

21. **Answer this question *<u>only</u>* if you find it difficult to read. If you find it easy to read, you can skip this question. Enter a checkmark next to that which is difficult**:

	Norwegian	**First language**
I can't remember the name of all the letters		
I take a long time to read		
I can only read short texts		
I read a bit stuttering		
I don't read all of the words' endings		
Difficult to remember what I have read		
Other: ____________________________		

22. How often do you read ***Norwegian*** in your everyday life? Enter checkmark:

	Every day	**Every week**	**Rarely**	**Never**
Read newspapers, periodicals or magazines (online or paper editions)				
Read on Facebook or other social media				
Read books (fiction)				
Read at work				
Read cartoons				
Other:____________________________				

23. How often do you read ***in your native language*** in your everyday life? Enter checkmark:

	Every day	**Every week**	**Rarely**	**Never**
Read newspapers, periodicals or magazines (online or paper editions)				
Read on Facebook or other social media				
Read books (fiction)				
Read at work				
Read cartoons				

Other:___________________________				

24. Enter a number for your language skills in Norwegian and your native language.
10= Perfect
9 = Excellent
8 = Very good
7 = Good
6 = Slightly above average
5 = Average
4 = Slightly below average
3 = Some, but there's a lot I can't do
2 = Low
1 = Very low
0 = None

	Norwegian	**First language**
Speak (make yourself understood)		
Pronunciation		
Read		
Spelling words		
Writing a text		
Grammar		
Vocabulary (Do you know a lot of words?)		

Thank you very much for answering these questions!

Deltakers nummer:

Dato:

14.4.3 Questionnaire in Polish

Ankieta

Dziękujemy bardzo za udzielenie odpowiedzi na poniższe pytania i udział w badaniu. Formularz można wypełnić wspólnie z nauczycielem.

1. Ile masz lat? (ukończonych) ____
2. Płeć?
   ☐ Mężczyzna
   ☐ Kobieta
   ☐ Płeć niebinarna
3. Czy Twój wzrok jest normalny? (Wzrok skorygowany za pomocą okularów lub soczewek kontaktowych uważany jest za normalny)
   ☐ Tak
   ☐ Nie
4. Czy Twój słuch jest normalny?
   ☐ Tak
   ☐ Nie
5. Jaki jest Twój ojczysty/pierwszy język?
   ____
6. Jakie masz wykształcenie i w jakim języku je uzyskałeś? Wypełnij tabelę:

Poziom wykształcenia (zakreśl krzyżykiem)	**W jakim języku były prowadzone zajęcia?** (wpisz język)	**Ile dni nauki tygodniowo obejmowała edukacja?** (wpisz liczbę)	**Przez ile lat?** (wpisz liczbę)	**Ile miałeś lat w momencie rozpoczęcia nauki?** (wpisz liczbę)
Szkoła podstawowa				
Gimnazjum				
Edukacja dorosłych w Norwegii				
Szkoła zawodowa				
Szkoła średnia				
Licencjat				
Magisterium				
Doktorat				
Inne: ______________________				

7. Jaki jest poziom Twojej ustnej znajomości norweskiego?

☐ Poniżej A1
☐ A1
☐ A2
☐ B1
☐ B2
☐ C1
☐ C2
☐ Nie wiem

8. W jakim języku Twoja matka (opiekunka) mówiła do Ciebie w dzieciństwie?

____

9. W jakim języku Twój ojciec (opiekun) mówił do Ciebie w dzieciństwie?

____

10. W jakim języku rozmawialiście ze swoimi braćmi lub siostrami?

____

11. Jakie wykształcenie zdobyła Twoja matka?

____

12. Jako kto pracowała? ____

13. Jakie wykształcenie zdobył Twój ojciec?

____

14. Jako kto pracował? ____

15. Wpisz do tabeli wszystkie języki, którymi mówisz. Najpierw wpisz język, w którym mówisz najlepiej, a jako ostatni podaj język, w którym mówisz najsłabiej.

	Język	**Czy potrafisz czytać w tym języku?** (Wpisz Tak lub Nie)	**Czy potrafisz pisać w tym języku?** (Wpisz Tak lub Nie)
1			
2			
3			
4			
5			
6			
7			

16. W jakim języku robisz zazwyczaj następujące rzeczy?

Zadanie	**Język**
Prosta matematyka (liczenie, dodawanie)	
Śnienie	
Wyrażanie gniewu lub miłości	
Mówienie do siebie	

17. Czy zdiagnozowano u Ciebie dysleksję?
    - ☐ Tak
    - ☐ Nie

18. Czy masz wrażenie, że masz trudności z czytaniem i pisaniem, chociaż nie zdiagnozowano u Ciebie dysleksji?
    - ☐ Tak
    - ☐ Nie

19. Czy ktoś w Twojej rodzinie ma dysleksję?
    - ☐ Tak
    - ☐ Nie
    - ☐ Nie wiem

20. W jakim języku najpierw nauczyłeś się czytać? ___________________________

21. **Odpowiedz na to pytanie *tylko* wtedy, gdy masz trudności z czytaniem.** **Jeśli czytanie jest dla Ciebie łatwe, możesz je pominąć. Zaznacz krzyżykiem to, co uważasz za trudne:**

	Norweski	**Pierwszy język**
Nie pamiętam nazw wszystkich liter		
Potrzebuję dużo czasu na przeczytanie		
Potrafię czytać tylko krótkie teksty		
Czytam trochę niepewnie		
Nie czytam wszystkich końcówek w słowach		
Trudno mi zapamiętać to, co przeczytałem		
Inne: ___________________________________		

22. Jak często czytasz w ***języku norweskim*** w swoim codziennym życiu? Zakreśl krzyżykiem:

	Codzie nnie	**Co tydzień**	**Rzadko**	**Nigdy**
Czytam gazety, czasopisma lub magazyny (wydania online lub papierowe)				
Czytam informacje na Facebooku lub w innych mediach społecznościowych				
Czytam książki (literatura piękna)				
Czytam w pracy				
Czytam komiksy				
Inne: ___________________________________				

23. Jak często na co dzień czytasz w swoim ***pierwszym języku*** ? Zakreśl krzyżykiem:

	Codzie nnie	**Co tydzień**	**Rzadko**	**Nigdy**
Czytam gazety, czasopisma lub magazyny (wydania online lub papierowe)				
Czytam informacje na Facebooku lub w innych mediach społecznościowych				
Czytam książki (literatura piękna)				

Czytam w pracy				
Czytam komiksy				
Inne: ____________________________________				

24. Wpisz numer odpowiadający ocenie swoich umiejętności językowych w norweskim i w swoim języku ojczystym.
    10= Idealnie
    9 = Doskonale
    8 = Bardzo dobrze
    7 = Dobrze
    6 = Nieco powyżej przeciętnej
    5 = Przeciętnie
    4 = Nieco poniżej przeciętnej
    3 = Trochę, ale jest wiele rzeczy, z którymi nie daję sobie rady
    2 = Słabo
    1 = Bardzo słabo
    0 = Wcale

	Norweski	**Pierwszy język**
Mówienie (komunikowanie się)		
Wymowa		
Czytanie		
Prawidłowa pisownia słów		
Pisanie tekstu		
Gramatyka		
Słownictwo (Czy znasz dużo słów?)		

Dziękujemy bardzo za odpowiedź na te pytania!

Deltakers nummer:

Dato:

14.4.4 Questionnaire in Somali

Foom su'aaleed

Waad ku mahadsantahay inaad ka jawaabayso su'aalahan oo aad ka qayb qaadanayso daraasad cilmiyeedkan. Foomka waxa lala buuxin karaa macalin.

1. Waa imisa da'daadu? (meeqa sano) ________________________________

2. Jinsigaaga?
   ☐ Nin
   ☐ Haween
   ☐ Nin ma ihi, haween ma ihi

3. Aragga indhahaagu ma yahay caadi? (Isticmaalka okiyaale/muraayado ama bikaaco/lens waxa laga soo qaadayaa inuu yahay caadi)
   ☐ Haa
   ☐ Maya

4. Maqalkaagu ma yahay caadi?
   ☐ Haa
   ☐ Maya

5. Waa maxay luuqadda hooyo /luuqadda koowaad? ____________________

6. Waa maxay waxbarashadaadu oo luuqaddee ayaa lagu baranayey waxbarashada? Ku qor foomka:

Heerka waxbarasho (saar istalaab)	**Luuqaddee ayaa lagu baranayey waxbarashada?** (qor afka)	**Imisa maalmood ayaad toddobaadkii aadaysay dugsiga?** (qor tiro)	**Imisa/ meeqa sano?** (qor tiro)	**Imisa sano jir ayaad ahayd markii aad billowday?** (qor tiro)
Dugsi hoose				
Dugsi dhexe				
Dugsiga dadka waaweyn ee Noorway				
Shahaado xirfadeed				
Dugsi sare				
Bachelor (waxbarasho sare)				
Master (waxbarasho sare)				
Shahaado digtoornimo (Ph.d.)				
Wax kale: ____________________				

7. Heerkee ayaad ka maraysa ku hadalka luuqadda noorweyjiga?
   - ☐ ka hoosaysa A1
   - ☐ A1
   - ☐ A2
   - ☐ B1
   - ☐ B2
   - ☐ C1
   - ☐ C2
   - ☐ Ma ogi

8. Luuqadde ayey hooyadaa (haweenayda ku soo korisay) kugu la hadli jirtay markii aad carruurta ahayd?

   ____

9. Luuqaddee ayuu aabahaa (ninka ku soo koriyey) kugu la hadli jiray markii aad carruurta ahayd

   ____

10. Luuqadde ayaad kula hadli jirtay walaalahaa?

    ____

11. Waa maxay waxbarashada ugu sarraysa ee ay hooyadaa qaadatay?

    ____

12. Maxay iyadu ka shaqayn jirtay?

    ____

13. Waa maxay waxbarashada ugu sarraysa ee uu aabahaa qaatay?

    ____

14. Muxuu ka shaqayn jiray isagu?

    ____

15. Foomka hoose ku qor dhammaan luuqadaha aad ku hadasho. Ugu horraysii luuqadda aad sida ugu wacan ugu hadasho, isla markaana ugu dambaysii luuqadda kuugu dhibka badan in aad ku hadasho.

	Luuqad	**Wax ma ku akhrin kartaa luuqaddan?** (Qor Haa ama Maya)	**Wax ma ku qori kartaa luuqaddan?** (Qor Haa ama Maya)
1			
2			
3			
4			
5			
6			
7			

16. Luuqaddee ayaad ku qabataa hawlahan/waxyaalahan?

Hawl	**Luuqad**
Xisaabta fudud (tirinta, isugeynta)	
Riyada	
Muujinta xanaaqa ama jacaylka	
Marka aad adigu isla hadlayso	

17. Miyaa lagaa helay dhibta la dhaho disleksii (dhibta qofka ka haysato wax qorista iyo akhrinta)?
    - ☐ Haa
    - ☐ May

18. Ma dareensantahay in dhib kaa haysto wax qoridda iyo akhrinta, inkastoo aan kagaa helin dhibta disleksiiga?
    - ☐ Haa
    - ☐ Maya

19. Miyey jiraan dad ka mid ah qoyskaaga oo qaba disleksii?
    - ☐ Haa
    - ☐ Maya
    - ☐ Ma ogi

20. Luuqaddee ayaa ugu horraysay in aad barato akhrinteeda? _______________

21. **Ka jawaab su'aashan *__keliya__* haddii ay kugu adagtahay inaad wax akhriso. Waad ka boodi kartaa haddii wax akhrintu kuu fududahay. Istilaab saar waxa kugu adag**:

	Noorweyji	**Luuqadda koowaad**
Ma wada xasuusto magacayada xuruufta oo dhan		
Wakhti dheer ayaan ku isticmaala wax akhrinta		
Waxaan akhrin karaa keliya qoraallo kooban		
Waxaan u akhriyaa si jarjar ah (aan dareer ahayn)		
Ma wada akhrin karo dhammaadka ereyada		
Waxa igu adag inaan xasuusto wixii aan akhriyey		
Wax kale: ____________________________		

22. Maalmaha caadiga ah, ilaa in intee le'eg ayaad wax ku akhridaa ***__af-noorweyji__***? Istilaab saar:

	Maalin kasta	**Toddobaad kasta**	**In naaadir ah (marar dhif ah)**	**Marna ma dhacdo**
Akhrinta wargeysyada, wargeysyada toddobaadlaha ama wargesyo kale (kuwa internetka ama kuwa daabacan)				
Akhrinta Facebook ama baraha bulshada ee kale				
Akhrinta buugaagta (Sheekooyinka khayaaliga ah)				
Wax ku akhrinta shaqadaada				
Akrinta sawir-kartoonka				
Wax kale:______________________				

23. Maalmaha caadiga ilaa in intee le'eg ayaad wax ku akhrisaa ***luuqaddaada koowaad***? Istilaab saar:

	Maalin kasta	Toddobaad kasta	In naadir ah (marar dhif ah)	Marna ma dhacdo
Akhrinta wargeysyada, wargeysyada toddobaadlaha ama wargeyso kale (kuwa internetka ama kuwa daabacan)				
Akhrinta Facebook ama baraha bulshada ee kale				
Akhrinta buugaagta (Sheekooyinka khayaaliga ah)				
Wax ku akhrinta shaqadaada				
Akhrinta sawir-kartoonka				
Wax kale:______________________				

24. Qor hal tiro oo sheegaysa heerka aqoontaada af-noorweyjiga iyo afkaaga hooyo.
10= Si dhammaystiran
9 = Heer sare
8 = Si aad u wacan
7 = Si wacan
6 = Inyar baan ka fiicanahay dhexdhexaadka
5 = Dhexdhexaad
4 = Inyar baan ka hooseeyaa dhexdhexaadka
3 = Wax waan aqaanaa, laakin waxyaalo badan ayaanan aqoonin
2 = Si hoosaysa
1 = Si aad u hoosaysa
0 = Waxba

	Noorweyji	Luuqadda koowaad
Ku hadalka (in lagu fahmi karo)		
Ku dhawaaqidda		
Akhrinta		
Sax u qoridda ereyada		
Qoridda qorallada		
Naxwaha		
Aqoonta ereyada (Ma taqaanaa ereyo badan?)		

Si weyn ayaad ugu mahadsantahay inaad ka jawaabtay su'aalahan!

14.5 Phonemic awareness

14.5.1 Phonemic Awareness Norwegian

First instruction	Second instruction	Removed sound	The answer	Syllables	In which syllable is the sound removed
Si "kjamt"	Si "kjamt" uten "kj"	kj	amt	1	First - onset
Si "plird!	Si "plird" uten "l"	l	pird	1	First - onset_cluster
Si "plusk"	Si "plusk" uten "s"	s	pluk	1	First - offset_cluster
Si "smeikt"	Si "smeikt" uten "k"	k	smeit	1	First - offset_cluster
Si "pransto"	Si "pransto" uten "n"	n	prasto	2	First - offset
Si "jarstett"	Si "jarstett" uten "s"	s	jartett	2	Second - onset_cluster
Si "nombikk"	Si "nombikk" uten "m"	m	nobikk	2	First - offset
Si "skrauden"	Si "skrauden" uten "r"	r /ʁ/	skauden	2	First - onset_cluster
Si "lapri"	Si "lapri" uten "l"	l	apri	2	First - onset
Si "riplett"	Si "riplett" uten "r"	r /ʁ/	iplett	2	First - onset
Si "gratusk"	Si "gratusk" uten "g"	g	ratusk	2	First - onset_cluster
Si "kreifag"	Si "kreifag" uten "g"	g	kreifa	2	Second - offset
Si "vemin"	Si "vemin" uten "n"	n	vemi	2	Second - offset
Si "trapskait"	Si "trapskait" uten "p"	p	traskait	2	First - offset
Si "arbeskt"	Si "arbeskt" uten "s"	s	arbekt	2	Second - offset_cluster
Si "skroble"	Si "skroble" uten "b"	b	skrole	2	Second - onset_cluster
Si "hurnat"	Si "hurnat" uten "n"	n	hurat	2	Second - offset
Si "kompkal"	Si "kompkal" uten "p"	p	komkal	2	First - offset_cluster

14.5.2 Phonemic Awareness English

First instruction	Second instruction	Removed sound	The answer	Syllables	In which syllable is the sound removed
Say "Klosp"	Say "Klosp" without "s"	s	Klop	1	First - offset_cluster
Say "Jilk"	Say "Jilk" without "l"	l	Jik	1	First - offset_cluster
Say "Thauk"	Say "Thauk" without "th"	th	auk	1	First - onset
Say "Tweln"	Say "Tweln" without "w"	w	teln	1	First - offset_cluster
Say "Liogs"	Say "Liogs" without "l"	l	iogs	2	First - onset
Say "Sploitel"	Say"Sploitel" without "p"	p	sloitel	2	First - onset_cluster
Say "Skrepus"	Say"Skrepus" without "r"	r /ʁ/	skepus	2	First - onset_cluster
Say "Plaitef"	Say "Plaitef" without "f"	f	plaite	2	Second - offset
Say "Jaloom"	Say "Jaloom" without "m"	m	jaloo	2	Second - offset
Say "Trasjoib"	Say "Trasjoib" without "s"	s	trajoib	2	First - offset_cluster
Say "Absumpt"	Say "Absumpt" without "m"	m	absupt	2	Second - offset_cluster
Say"Zablet"	Say"Zablet" without "z"	z	ablet	2	First - onset
Say "Feekna"	Say "Feekna" without "n"	n	freeka	2	Second - offset_cluster
Say "Biltrum"	Say "Biltrum" without "t"	t	bilrum	2	Second - onset_cluster
Say "Lanspung"	Say "Lanspung" without "s"	s	lanpung	2	Second - offset_cluster
Say "Pilpsoy"	Say "Pilpsoy" without "l"	l	pipsoy	2	First - offset_cluster
Say "Rempsluff"	Say "Rempsluff" without "m"	m	repsluff	2	First - offset_cluster
Say "Woftnup"	Say "Woftnup" without "t"	t	wofnup	2	First - offset_cluster

14.5.3 Phonemic Awareness Polish

First instruction	Second instruction	Removed sound	The answer	Syllables	In which syllable is the sound removed
Powiedz "dke"	Powiedz"dke" bez "d"	d	ke	1	First - onset_cluster
Powiedz "brez"	Powiedz "brez" bez "b"	b	rez	1	First - onset_cluster
Powiedz "wajr"	Powiedz "wajr" bez "j"	j	war	1	First - offset_cluster
Powiedz "łówr"	Powiedz "łówr" bez "w"	w	łór	1	First - offset_cluster
Powiedz "walkon"	Powiedz "walkon" bez "l"	l	wakon	2	First - offset
Powiedz "casnek"	Powiedz "casnek" bez "s"	s	canek	2	First - offset
Powiedz "rumna"	Powiedz "rumna" bez "n"	n	rumna	2	Second - onset
Powiedz "mługa"	Powiedz "mługa" bez "ł"	ł	muga	2	First - onset_cluster
Powiedz "tarsa"	Powiedz "tarsa" bez "t"	t	arsa	2	First - onset
Powiedz "jomez"	Powiedz "jomez" bez "j"	j	omez	2	First - onset
Powiedz "ustra"	Powiedz "ustra" bez "s"	s	utra	2	First - offset
Powiedz "myrok"	Powiedz "myrok" bez "k"	k	myro	2	Second - offset
Powiedz "wuzoń"	Powiedz "wuzoń" bez "ń"	ń	wuzo	2	Second - offset
Powiedz "nisor"	Powiedz "nisor" bez "r"	r	niso	2	Second - offset
Powiedz "zopkra"	Powiedz "zopkra" bez "k"	k	zopra	2	Second - onset
Powiedz "rumska"	Powiedz "rumska" bez "s"	s	rumka	2	Second - onset_cluster
Powiedz "barmia"	Powiedz "barmia" bez "r"	r	bamia	2	First - offset
Powiedz "jawle"	Powiedz "jawle" bez "w"	w	jale	2	First - offset

14.5.4 Phonemic Awareness Somali

First instruction	Second instruction	Removed sound	The answer	Syllables	In which syllable is the sound removed
Si "baskuul"	Si "baskuul" uten "k"	k	basuul	2	Second - onset
Si "meys"	Si "meys" uten "m"	m	eys	1	First - onset
Si "liidh"	Si "liidh" uten "dh"	dh	lii	1	First - offset
Si "luugta"	Si "luugta" uten "t"	t	luuga	2	Second - onset
Si "tafuum"	Si "tafuum" uten "m"	m	tafuu	2	Second - offset
Si "shaykoor"	Si "shaykoor" uten "sh"	sh	aykoor	2	First - onset
Si "dhibrec"	Si "dhibrec" uten "dh"	dh	ibrec	2	First - onset
Si "bosic"	Si "bosic" uten "b"	b	osic	2	First - onset
Si "kheysab"	Si "kheysab" uten "kh"	kh	eysab	2	First - onset
Si "leysig"	Si "leysig" uten "g"	g	leysi	2	Second - offset
Si "qem"	Si "qem" uten "q"	q	em	1	First - onset
Si "siqlid"	Si "siqlid" uten "q"	q	silid	2	First - offset
Si "kafdhaan"	Si "kafdhaan" uten "n"	n	kafdhaa	2	Second - offset
Si "diilkash"	Si "diilkash" uten "l"	l	diikash	2	First - offset
Si "xaliig"	Si "xaliig" uten "x"	x	aliig	2	First - onset
Si "simlaq"	Si "simlaq" uten "s"	s	imlaq	2	First - onset
Si "fol"	Si "fol" uten "l"	l	fo	1	First - offset
Si "gildeem"	Si "gildeem" uten "d"	d	gileem	2	Second - onset

14.6 RAN

14.6.1 RAN in Norwegian

Grid 1

6	8	1	9	6	4	8	1
1	6	8	4	1	9	6	9
9	8	9	6	8	1	6	4
4	9	1	9	4	8	4	6
9	1	9	4	1	6	8	6
6	1	8	4	9	1	4	8

Grid 2

9	4	6	1	9	8	4	6
6	9	4	8	6	1	9	1
1	4	1	9	4	6	9	8
8	1	6	1	8	4	8	9
1	6	1	8	6	9	4	9
9	6	4	8	1	6	8	4

14.6.2 RAN in English

Grid 1

3	5	10	1	7	1	3	7
5	3	10	1	3	7	10	7
1	5	7	10	3	1	5	10
7	3	5	10	7	1	5	10
3	5	1	10	3	10	7	1
3	1	7	5	10	3	1	5

Grid 2

5	10	3	1	7	10	5	1
10	1	5	10	3	7	5	10
3	7	1	5	3	10	1	5
7	3	10	1	7	1	3	7
1	7	3	1	5	3	10	3
5	10	7	5	1	10	7	3

14.6.3 RAN in Polish

Grid 1

7	3	6	2	6	10	6	3
2	6	10	2	3	7	2	7
10	2	7	6	3	7	6	2
7	10	3	2	7	3	6	10
3	6	10	6	2	2	10	7
10	2	3	7	3	6	10	3

Grid 2

6	10	7	3	6	2	7	7
2	10	7	3	2	3	7	10
3	2	10	6	2	6	3	2
10	6	2	6	10	7	3	10
3	6	7	3	6	10	6	2
7	3	10	3	2	6	7	2

14.6.4 RAN in Somali

Grid 1

10	1	1	2	5	6	5	2
5	1	10	6	2	6	10	6
5	10	1	6	10	1	2	5
1	6	2	5	6	5	2	1
2	10	2	6	1	10	6	1
10	6	5	1	5	10	2	5

Grid 2

5	6	2	5	1	10	1	6
2	6	1	5	10	6	2	5
10	6	2	6	5	10	2	1
1	10	5	2	1	10	6	2
5	10	6	5	2	1	6	10
1	2	5	6	10	1	5	1

14.7 Word reading

14.7.1 Word Reading Norwegian

Ord 1	Ord-kla	Stav	Bkstv 1	Fon 1	Frekvens	Frek pr m	Feil/Ord 2	Bkstv 2	Fon 2	Ord-kla	Frekvens	Frek pr m	Lydrett	D.kons	Kompl. Gr	Kons.-op	Stum ly
Gud	Sub	En	3	2	80027	114,32	Gul	3	3	Adj	7517	10,7	Ja	Nei	Nei	Nei	Nei
Mas	Verb	En	3	3	3733	5,33	Mus	3	3	Sub	8888	12,7	Ja	Nei	Nei	Nei	Nei
Mat	Sub	En	3	3	103995	148,6	Matt	4	3	Adj	8481	12,12	Ja	Nei/Ja	Nei/Ja	Nei/Ja	Nei
Sol	Sub	En	3	3	24792	35,42	Slo	3	3	Verb	42090	60,1	Ja	Nei	Nei	Nei/Ja	Nei
Glass	Sub	En	5	4	19437	27,77	Glatt	5	4	Adj	7707	11	Nei/Ja	Nei/Ja	Nei	Ja	Nei
Boken	Sub	To	5	5	58372	83,39	Boksen	6	6	Sub	10769	15,4	Ja/Nei	Nei	Nei/?	Ha	Nei
Gjesper	Verb	To	7	6	408	0,6	Gjester	7	6	Sub	14562	20,8	Nei	Nei	Ja	Ja	Ja
Kasse	Sub	To	5	4	4441	6,34	Kaste	5	5	Verb	23477	33,5	Ja	Ja/Nei	Nei	Ja	Nei
Kjøre	Verb	To	5	4	56402	80,6	Kjøpe	5	4	Verb	105206	150,29	Nei	Nei	Ja	Ja	Nei
Jenta	Sub	To	5	5	23428	33,47	Gjenta	6	5	Verb	7156	10,2	Ja/Nei	Nei	Nei/Ja	Ja	Nei/Ja
Øye	Sub	To	3	2	12787	18,27	Øya	3	2	Sub	14267	20,4	Nei	Nei	Ja	Nei	Nei
Krone	Sub	To	5	5	9727	13,9	Kone	4	4	Sub	22249	31,8	Ja	Nei	Nei	Ja/Nei	Nei
Bakken	Sub	To	6	5	35211	50,3	Ballen	6	5	Sub	77647	110,9	Ja	Ja	Ja	Ja	Nei
Kvinne	Sub	To	6	5	50292	71,85	Kinnet	6	5	Sub	2241	3,2		Ja	Ja	Ja	Nei/Ja
Lete	Verb	To	4	4	15627	22,32	Lette	5	4	Adj	16824	24	Ja	Nei/Ja	Nei	Nei/Ja	Nei
Leke	Verb	To	4	4	15671	22,39	Lege	4	4	Sub	29945	42,8	Ja	Nei	Nei	Nei	Nei
Sokker	Sub	To	6	5	3173	4,53	Sukker	6	5	Sub	20145	28,8	Nei	Ja	Ja	Ja	Nei
Mora	Sub	To	4	4	4081	5,83	Moral	5	5	Sub	10315	14,7	Ja	Nei	Nei	Nei	Nei
Bære	Verb	To	4	4	14017	20,02	Lære	4	4	Verb	73970	105,7	Ja	Nei	Nei	Nei	Nei
Flotte	Adj	To	6	5	36967	52,81	Flytte	6	5	Verb	33134	47,3	Nei/Ja	Ja	Ja	Ja	Nei
			4,6	**4,1**	**28629,4**	**40,9**		**4,8**	**4,25**		**26829,5**	**38,3**					
Tak	Sub	En	3	3	61640	88,06	Takk	4	3	Sub	133436	190,6	Ja	Nei/Ja	Nei	Nei	Nei
Dør	Sub	En	3	3	30007	42,9	Dyr	3	3	Sub	61440	87,77	Ja	Nei	Nei	Nei	Nei
Katt	Sub	En	4	3	13489	19,27	Kant	4	4	Sub	7882	11,3	Ja	Ja/Nei	Ja/Nei	Ja	Nei
Fin	Adj	En	3	3	88540	126,49	Finn	4	3	Adj	70766	101,1	Ja	Nei/Ja	Nei	Nei/Ja	Nei
Ga	Verb	En	2	2	81003	115,72	Gal	3	3	Sub	10610	15,2	Ja	Nei	Nei	Nei	Nei
Lilla	Adj	To	5	4	4471	6,39	Lille	5	4	Adj	78846	112,6	Ja	Ja	Ja	Ja	Nei
Fiske	Verb	To	5	5	25540	36,49	Fikse	5	5	Verb	7101	10,1	Ja	Nei	Nei	Ja	Nei
Kroppen	Sub	To	7	6	74198	106	Koppen	6	5	Sub	1501	2,1	Nei	Ja	Ja	Ja	Nei
Føre	Verb	To	4	4	61980	88,54	Føle	4	4	Verb	24949	35,6	Nei/Ja	Nei	Nei	Ja/Nei	Nei
Gjemme	Verb	To	6	4	4119	5,88	Glemme	6	5	Verb	18892	27	Nei/Ja	Nei	Ja/Nei	Ja	Ja
Spiser	Verb	To	6	6	40955	58,51	Spisser	7	5	Verb	2897	4,1	Ja	Nei/Ja	Nei	Ja	Nei
Feire	Verb	To	5	4	9095	12,99	Seire	5	4	Verb	5249	7,5	Ja	Nei	Ja	Nei	Nei
Bøtte	Sub	To	5	4	1720	2,46	Bytte	5	4	Verb	37317	53,3	Ja	Ja	Nei	Ja	Nei
Svare	Verb	To	5	5	40314	57,59	Svarte (far	6	6	Adj	42923	61,3	Ja	Nei	Nei	Ja	Nei
Nyre	Sub	To	4	4	1374	1,96	Nyte	4	4	Verb	15114	21,6	Ja	Nei	Nei	Nei	Nei
Elske	Verb	To	5	5	7131	10,19	Eske	4	4	Sub	2213	3,2	Ja	Nei	Nei	Ja	Nei
Kysse	Verb	To	5	4	3480	4,97	Krysse	6	5	Verb	5038	7,2	Ja	Nei/Ja	Ja/Nei	Ja	Nei
Hjerte	Sub	To	6	5	21477	30,68	Hjerne	6	5	Sub	3907	5,6	Nei	Nei	Ja	Ja	Ja
Falle	Verb	To	5	4	18401	26,29	Fulle	5	4	Adj	22806	32,6	Ja	Ja	Nei	Nei	Nei
Daler	Su	To	5	5	2238	3,2	Damer	5	5	Sub	17390	24,8	Ja	Nei	Nei	Nei	Nei
			4,65	**4,15**	**29558,6**	**42,23**		**4,85**	**4,25**		**28513,9**	**40,7**					

14.7.2 Word Reading English

Ord 1	Ord-kla	Stav	Bkstv 1	Fon 1	Frekvens	Frek pr mi	Feil/Ord 2	Ord-kla	Stav	Bkstv 2	Fon2	Frekvens	Frek pr mil
Beam	Sub	En	4	3	1861	9,24	Bean	Sub	En	4	3	2302	11,44
Booth	Sub	En	5	3	1060	5,27	Boot	Sub	En	4	3	5365	26,65
Pitch	Sub	En	5	3	8050	39,99	Patch	Sub	En	5	3	3440	17,09
Bear	Sub	En	4	2	15194	75,48	Beer	Sub	En	4	2	6002	29,82
Shark	Sub	En	5	3	3003	14,92	Sharp	Adj	En	5	3	7214	35,84
Closing	Verb	To	7	6	4555	22,63	Clothing	Sub	To	8	6	2749	13,66
Reward	Sub	To	6	5	2722	13,52	Record	Sub	To	6	5	26257	130,44
Litter	Sub		6	4	1718	8,53	Letter	Sub		6	4	14340	71,24
Expect	Verb	To	6	7	25044	124,41	Except	Prep	To	6	6	8815	43,79
Simple	Adj	To	6	6	23743	11,77	Sample	Sub	To	6	6	2370	117,95
Connect	Verb	To	7	6	2146	10,66	Collect	Verb	To	7	6	6141	30,51
Bitter	Adj	To	6	4	3097	15,38	Batter	Sub	To	6	4	1240	6,16
Loyal	Adj	To	5	4	1910	9,49	Royal	Adj	To	5	4	24734	122,87
Washing	Verb	To	7	5	5181	25,74	Wishing	Verb	To	7	5	1119	25,74
Content	Sub	To	7	7	3351	16,65	Contest	Sub	To	7	7	4481	22,26
Brother	Sub	To	7	5	20562	102,15	Bother	Verb	To	6	4	5639	28,01
Leaving	Verb	To	7	5	19577	97,25	Leading	Verb	To	7	5	12494	62,07
Exit	Sub	To	4	5	2254	11,2	Exist	Verb	To	5	6	5133	25,5
Winner	Sub	To	6	4	15548	77,24	Winter	Sub	To	6	5	13508	67,1
Sported	Verb	To	7	5	39	0,19	Sorted	Verb	To	6	5	6617	32,87
						-							#DIV/0!
			5,9	**4,6**	**8030,75**	39,89				**5,8**	**4,6**	**7998**	39,73
Lift	Verb	En	4	4	11289	56,08	List	Sub	En	4	4	18176	90,29
Crowd	Sub	En	5	4	11702	58,13	Crow	Sub	En	4	3	890	4,42
Bar	Sub	En	3	2	11216	55,72	Bore	Verb	En	4	2	1158	5,75
Pot	Sub	En	3	3	11628	57,76	Pet	Sub	En	3	3	5780	28,71
Firm	Sub	En	4	3	7020	34,87	Farm	Sub	En	4	3	13079	64,97
Stable	Adj	To	6	6	4062	20,18	Table	Sub	To	5	5	25504	126,7
Drying	Verb	To	6	5	1066	5,3	Dying	Verb	To	5	4	6373	31,66
Liver	Sub	To	5	4	2720	13,51	Lover	Sub	To	5	4	3104	15,42
Feeling	Sub	To	7	5	38817	192,83	Feeding	Verb	To	7	5	5273	26,19
Battle	Sub	To	6	5	17431	86,59	Bottle	Sub	To	6	5	8898	44,2
Towel	Sub	To	5	4	1479	7,35	Tower	Sub	To	5	4	6401	31,8
Alive	Adj	To	5	4	13388	66,51	Arrive	Verb	To	6	4	5912	29,37
Candle	Sub	To	6	6	1230	6,11	Handle	Verb	To	6	6	7908	39,28
Mister	Navn	To	6	5	1962	9,75	Master	Sub	To	6	5	11496	57,11
Metal	Sub	To	5	4	8629	42,87	Medal	Sub	To	5	5	8735	43,39
Pleasant	Adj	To	8	7	3095	15,38	Peasant	Sub	To	7	6	545	2,71
Signing	Verb	To	7	5	2396	11,9	Singing	Verb	To	7	5	13462	66,88
Paying	Verb	To	6	4	13228	65,71	Praying	Verb	To	7	5	1376	6,84
Sitter	Sub	To	6	4	326	0,47	Sister	Sub	To	6	5	16207	23,15
Stocking	Verb	To	8	6	469	2,33	Shocking	Adj	To	8	5	4131	20,52
						-							#DIV/0!
			5,55	**4,5**	**8157,65**	40,52				**5,5**	**4,4**	**8220**	40,84

14.7.3 Word Reading Polish

Ord 1	Oversettelse	Ordklas	Stav	Bkstv 1	Fon 1	Frekven	Frek pr m	Feil /Ord 2	Oversettelse	Ordklas	Bkstvr2	Fon2	Frekvens	Frek pr m	Lydrett	Kompl.	Kons.-op
Grupa	Group	Sub	To	5	5	6439	63,75	Krupa	Groat	Sub	5	5	15	0,15	Ja	Nei	Ja
Piec	Stove	Sub	En	4	4	1117	11,06	Pies	Dog	Sub	4	4	8392	83,09	Ja	Nei	Nei
Leki	Drugs	Sub	To	4	4	3083	30,52	Lekki	Light	Adj	5	5	805	7,97	Ja	Nei	Nei/Ja
Bark	Shoulder	Sub	En	4	4	177	1,75	Brak	Lack	Sub	4	4	11636	115,21	Ja	Nei	Ja
Wiek	Age	Sub	En	4	4	2840	28,12	Wierz	Believe!	Verb	5	4	3400	33,66	Ja/Nei	Nei/Ja	Nei/Ja
Otwórz	Open!	Verb	To	6	5	10086	99,86	Odtwórz	Reproduce!	Verb	7	6	106	1,05	Nei	Ja	Ja
Bak	(Petrol) tank	Sub	En	3	3	324	3,21	Bąk	(Spinning) to	Sub	3	3	50	0,5	Ja	Nei	Nei
Ranny	Injured (he)	Sub	To	5	5	4188	41,47	Rany	Wounds	Sub	4	4	11338	112,26	Ja	Nei	Ja/Nei
Stóp	(Of the) feet	Sub	En	4	4	4517	44,72	Stój	Stop!	Verb	4	4	9774	96,77	Ja	Nei	Ja
Soku	(Of the) juice	Sub	To	4	4	905	8,96	Szoku	(Of the) shoc	Sub	5	4	1675	16,58	Ja/Nei	Nei/Ja	Nei/Ja
Konik	Small / Toy h	Sub	To	5	5	249	2,47	Komik	Comedian	Sub	5	5	168	1,66	Nei/Ja	Ja/Nei	Nei
Karta	Card	Sub	To	5	5	2139	21,18	Kara	Penalty	Sub	4	4	2300	22,77	Ja	Nei	Ja/Nei
Rzeka	River	Sub	To	5	4	1250	12,38	Rzepa	Turnip	Sub	5	4	52	0,51	Nei	Ja	Ja
Kości	Bones	Sub	To	5	5	5521	54,66	Ości	Fishbones	Sub	4	4	33	0,33	Nei	Ja	Ja
Rady	Advice	Sub	To	4	4	10807	107	Radny	Councillor	Sub	5	5	361	3,57	Ja	Nei	Nei/Ja
Woda	Water	Sub	To	4	4	7385	73,12	Wada	Defect	Sub	4	4	394	3,9	Ja	Nei	Nei
Mąka	Flour	Sub	To	4	4	136	1,35	Męka	Torment	Sub	4	4	101	1	Ja	Nei	Nei
Rower	Bicycle	Sub	To	5	5	1554	15,39	Rowek	Groove	Sub	5	5	47	0,47	Ja	Nei	Nei
Rat	(Of the) insta	Sub	En	3	3	200	1,98	Brat	Brother	Sub	4	4	15772	156,16	Ja	Nei	Nei/Ja
Rosa	Dew	Sub	To	4	4	807	7,99	Rasa	Race	Sub	4	4	898	8,89	Ja	Nei	Nei
				4,35	4,25	3186,2	31,55				4,5	4,3	3365,85	33,33			
Pierze	(He/she) wa	Verb	To	6	5	203	2,01	Bierze	(He/she) tak	Verb	6	5	5080	50,3	Nei	Ja	Ja
Sad	Orchard	Sub	En	3	3	344	3,41	Sąd	Court	Sub	3	3	3530	34,95	Nei	Nei	Nei
Cenny	Valuable	Adj	To	5	5	817	8,09	Ceny	Prices	Sub	4	4	1858	18,4	Ja	Nei	Ja/Nei
Pasa	(Of the) belt	Sub	To	4	4	1051	10,41	Passa	Run of luck	Sub	5	5	110	1,09	Ja	Nei	Nei/Ja
Kuter	Fishing boat	Sub	To	5	5	78	0,77	Skuter	Scooter	Sub	6	6	280	2,77	Ja	Nei	Nei/Ja
Styka	(He/she) cor	Verb	To	5	5	91	0,9	Steka	(Of the) stea	Sub	5	5	112	1,11	Ja	Nei	Ja
Grosze	Pennies	Sub	To	6	5	387	3,83	Gorsze	Worse	Adj	6	5	2813	27,85	Nei	Ja	Ja
Spokój	Calm	Sub	To	6	6	33746	334,12	Pokój	Room	Sub	5	5	16140	159,8	Ja	Nei	Ja/Nei
Wskazać	To point	Verb	To	7	7	673	6,66	Skazać	To convict	Verb	6	6	357	3,53	Nei/Ja	Nei	Ja
Prała	(She) was wa	Verb	To	5	5	38	0,38	Praca	Work	Sub	5	5	13648	135,13	Ja	Nei	Ja
Poda	(He/she) wil	Verb	To	4	4	687	6,8	Podda	(He/she) wil	Verb	5	5	457	4,52	Ja	Nei	Nei/Ja
Rok	Year	Sub	En	3	3	14927	147,79	Krok	Step	Sub	4	4	5837	57,79	Ja	Nei	Nei/Ja
Para	Couple	Sub	To	4	4	3509	34,74	Pora	Time	Sub	4	4	6278	8,97	Ja	Nei	Nei
Race	Flares	Sub	To	4	4	260	2,57	Grace	Hoes	Sub	5	5	4069	40,29	Ja	Nei	Nei/Ja
Koc	Blanket	Sub	En	3	3	785	7,77	Kot	Cat	Sub	3	3	3264	32,32	Ja	Nei	Nei
Koza	Goat	Sub	To	4	4	305	3,02	Kosa	Scythe	Sub	4	4	71	0,7	Ja	Nei	Nei
Papier	Paper	Sub	To	6	6	2153	21,32	Papież	Pope	Sub	6	6	867	8,58	Ja/Nei	Nei	Nei
Bar	Bar	Sub	En	3	3	3173	31,42	Bal	Ball	Sub	3	3	2969	29,4	Ja	Nei	Nei
Radzić	To advise	Verb	To	6	5	1177	11,65	Rodzić	To bear/give	Verb	6	5	482	4,77	Nei	Ja	Ja
Stale	Constantly	Adverb	To	5	5	1451	14,37	Stałe	Fixed	Adj	5	5	1189	11,77	Ja	Nei	Ja
				4,7	4,55	3292,8	32,6				4,8	4,65	3470,55	31,7			

14.7.4 Word Reading Somali

Ord 1	Stav1	Bkstv1	Fon1	Frekvens	Frek. Pr mill	Oversett1	Ordklass	Feil/Ord 2	Bkstv2	Fon 2	Frekvens	Frek pr. mill	Oversett 2	Ordklasse2
Bad	En	3	3	5308	74,76	Hav	Sub	Bax	3	3	2903	40,89	gå, vekk	Verb
Sir	En	3	3	3780	53,24	Hemmlighet	Sub	Sar	3	3	2216	31,21	Kutt	Sub
Yeel	En	4	3	524	7,38	Årsak	Sub	Yool	4	3	409	5,76	Blink/mål	Sub
Xoog	En	4	3	12017	169,25	Kraft, styrke	Sub	Xog	4	3	12510	176,2	Informasjon	Sub
Sal	En	3	3	2476	34,87	Bunn	Sub	San	3	3	4264	60,06	nese	Sub
Gaban	To	5	5	518	7,3	Vesle, lille	Adj	Gabal	5	5	282	3,97	stykke	Sub
Darbi	To	5	5	772	10,87	Gjerde, mur	Sub	Derbi	5	5	350	4,93	vegg	Sub
Barta	To	5	5	2978	41,94	Stede	Sub	Birta	5	5	987	13,9	Metallet	Sub
Safar	To	5	5	5853	82,44	Reise	Verb	Safan	5	5	1142	198,24	Hard hud på	Sub
Koore	To	5	4	359	5,06	Sal	Sub	Kore	4	4	626	8,82	høyt, oppe, (	Adverb
Maajo	To	5	4	1443	20,32	mai	Sub	Maaro	5	4	286	4,03	sjanse, mulig	Sub
Gubid	To	5	5	17	0,24	Brenne	Verb	Gurid	5	5	15	0,21	ribbe/plukke	Verb
Calaf	To	5	4	314	4,42	Skjebne	Sub	Calan	5	4	1106	15,58	Flagg	Sub
Dabar	To	5	5	1082	15,24	Knytt !	Verb	Sabar	5	5	124	1,75	Tålmodig	Adj
Keli	To	4	4	1762	24,82	alene, entall	Sub	Kelli	5	4	26	0,37	nyre	Sub
Beri	To	5	5	3075	43,31	En gang	Adverb	Berri	4	4	2575	36,27	I morgen, lar	Sub
Qaro	To	5	5	85	1,2	Størrelse , va	Sub	Qari	4	4	73	1,03	Skjule	Verb
Badi	To	5	5	1548	21,8	Flest	Adverb	Badin	5	5	1818	25,61	vinne	Verb
Go'an	To	4	4	298	4,2	Bestemt	Adj	Go'aan	5	4	728	10,25	Avgjørelse	Sub
Baroor	To	6	5	693	9,76	Gråt/ramask	Sub	Bareer	6	5	633	8,92	tilsiktet	Verb
		4,55	**4,25**	**2245,1**	**31,62**				**4,5**	**4,15**		**32,4**		
Diin	En	4	3	3695	52,04	Religion/ Ski	Sub	Doon	4	3	4121	58,04	Båt	Sub
Jaad	En	3	3	737	10,38	Art/form	Sub	Jaan	4	3	1774	24,99	Trinn	Sub
Ceel	En	4	3	5912	83,27	Brønn	Sub	Ciil	4	2	1324	18,65	Nag	Sub
Guur	En	4	3	1947	27,42	Gifte seg/ fly	Verb	Giir	4	3	103	1,45	Nakke	Sub
Xis	En	3	3	123	1,73	Sinn/bevisst	Sub	Xir	3	3	881	12,41	Lås	Sub
Abaar	To	5	4	1040	14,65	Tørke	Sub	Abaal	5	4	7073	99,62	Belønning	Sub
Kaafi	To	5	4	546	7,69	nok/tilstrekk	Adverb	Koofi	5	4	264	3,72	hatt/lue	Sub
Geeri	To	5	4	1043	14,69	død	Sub	Geri	4	4	173	2,44	Sjiraff	Sub
Daaran	To	6	5	584	8,23	På	Prep	Daran	5	5	8187	115,31	Verre	Adj
Haween	To	6	5	5393	75,96	Kvinner	Sub	Habeen	6	5	8814	124,14	Natt	Sub
Dalab	To	5	5	2865	40,35	Etterspørsel,	Sub	Dahab	5	5	1822	25,66	Gull	Sub
Cadar	To	5	4	254	3,58	Parfyme	Sub	Casar	5	4	333	4,69	Ettermiddag	Sub
Dhuuxa	To	6	4	232	3,27	Beinmargen	Sub	Buuxa	5	4	3236	45,58	Full	Adj
Fariin	To	6	5	4330	60,99	bremse	Verb	Farriin	7	5	1499	21,11	beskjed/bud	Sub
Dhalin	To	6	5	5192	73,13	score, utvirk	Verb	Dhallin	6	4	258	3,63	ung	Adj
Mari	To	4	4	4091	57,62	sveipe	Verb	Maro	5	5	3473	48,92	stoff/klespla	Sub
Arag	To	4	4	6545	92,18	Utseende	Sub	Arar	5	5	223	3,14	Forord	Sub
Kici	To	4	3	927	13,06	Vekke	Verb	Kicin	5	4	1045	14,72	Utløse	Verb
Duqow	To	5	5	32	0,45	Slitasje	Sub	Duqoow	6	5	18	0,25	Eldes	Verb
khabaar	To	7	5	4	0,06	bud	Sub	Khabiir	7	5	887	12,49	ekspert/sakk	Sub
		4,85	**4,05**	**2274,6**	**32,04**				**5**	**4,1**	**2275,4**	**32,05**		

14.8 Pseudoword Reading

14.8.1 Pseudoword reading Norwegian

Nonord 1	Bkstv1	Fon1	Feil/Match	Bkstv2	Fon2	Stav	Lydrett	D.kons	Komp.graf	Kons-oppl	Stum Lyd
Lal	3	3	Laf	3	3	En	Ja	Nei	Nei	Nei	Nei
Pit	3	3	Plit	4	4	En	Ja	Nei	Nei	Ja/Nei	Nei
Gring	5	4	Grang	5	4	En	Nei	Nei	Ja	Ja	Nei
Høs	3	3	Høn	3	3	En	Ja	Nei	Nei	Nei	Nei
Krotti	6	5	Kroffi	6	5	To	Ja	Ja	Nei	Ja	Nei
Bøve	4	4	Pøve	4	4	To	Ja	Nei	Nei	Nei	Nei
Treise	6	5	Treiske	7	6	To	Ja	Nei	Nei	Ja	Nei
Skjapse	7	5	Skjase	6	4	To	Nei	Nei	Ja	Ja	Nei
Bremikk	7	6	Brimekk	7	6	To	Ja	Ja	Nei	Ja	Nei
Hjase	5	4	Hjakse	6	5	To	Nei	Nei	Ja	Ja	Ja
Fruker	6	6	Frunger	7	6	To	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Gjepse	6	5	Gjapse	6	5	To	Nei/Ja	Nei	Ja/Nei	Ja	Nei
Kjara	5	4	Kjala	5	4	To	Nei	Nei	Ja	Ja/Nei	Nei
Hedfert	7	7	Hengfert	8	7	To	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Hjerge	6	5	Hjarge	6	5	To	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Mosse	5	5	Møsse	5	4	To	Ja	Ja/Nei	Nei	Ja/Nei	Nei
Jæmma	5	4	Gjømma	6	4	To	Ja/Nei	Ja	Nei/Ja	Ja	Nei
Fliske	6	6	Flisne	6	6	To	Nei	Nei	Ja/Nei	Ja	Nei
Slife	5	5	Sife	4	4	To	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Felli	5	4	Feli	4	4	To	Ja	Ja/Nei	Nei	Ja/Nei	Nei
	5,25	4,65		5,4	4,65						
Krø	3	3	Kri	3	3	En	Ja	Nei	Nei	Ja	Nei
Jen	3	3	Jeng	4	3	En	Ja/Nei	Nei	Nei/Ja	Nei/Ja	Nei
Pim	3	3	Pid	3	3	En	Ja	Nei	Nei	Nei	Nei
Trung	5	4	Tring	5	4	En	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Ritun	5	5	Ritlun	5	5	To	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Gjesa	5	4	Gjemsa	6	5	To	Nei	Nei	Ja	Ja	Nei
Hvikse	6	5	Hvisme	6	5	To	Nei	Nei	Ja	Ja	Ja
Brinav	6	6	Briav	5	5	To	Ja	Nei	Nei	Nei	Nei
Stjone	6	4	Stjonne	7	4	To	Ja	Nei/Ja	Nei	Ja	Nei
Skrøtte	7	6	Skrøffe	7	6	To	Nei	Ja	Nei	Ja	Nei
Yffen	5	4	Iffen	5	4	To	Ja	Ja/Nei	Nei	Ja/Nei	Nei
Lantrung	8	7	Latrung	7	6	To	Ja/Nei	Nei	Nei/Ja	Ja	Nei
Nador	5	5	Nadur	5	5	To	Ja	Nei	Nei	Nei	Nei
Pate	4	4	Pake	4	4	To	Ja	Nei	Nei	Nei	Nei
Kirve	5	5	Krive	5	5	To	Ja	Ja/Nei	Ja/Nei	Ja	Nei
Drøkke	6	5	Drøke	5	5	To	Ja	Ja/Nei	Nei	Ja	Nei
Skjåle	6	4	Skjyle	6	4	To	Nei	Nei	Ja	Ja	Nei
Preine	6	5	Preive	6	5	To	Nei/Ja	Nei	Ja/Nei	Ja	Nei
Laring	6	5	Laking	6	5	To	Nei	Nei	Ja	Ja	Nei
Puddi	5	4	Pruddi	6	5	To	Ja	Ja/Nei	Nei	Ja	Nei
	5,25	4,55		5,3	4,55						

14.8.2 Pseudoword reading English

Nonord 1	Bkstv1	Fon1	Feil/Match	Bkstv2	Fon2	Stav
Lak	3	3	Las	3	3	En
Stip	4	4	Stirp	5	4	En
Baf	3	3	Bef	3	3	En
Clirt	5	4	Clirf	5	4	En
Dreffing	8	6	Drebbing	8	6	To
Tuver	5	4	Buver	5	4	To
Lunaf	5	5	Lurnaf	6	5	To
Trober	6	5	Tober	5	4	To
Herming	7	5	Hemring	7	6	To
Cendi	5	5	Cendir	6	5	To
Blooder	7	5	Bloober	7	5	To
Stroned	7	6	Strined	7	6	To
Depate	6	5	Devate	6	5	To
Brinben	7	7	Brinblen	8	8	To
Clabom	6	6	Clybom	6	6	To
Plofent	7	7	Plefent	7	7	To
Ganting	7	6	Glanting	8	7	To
Dreker	6	5	Dreger	6	5	To
Grudy	5	5	Gudy	4	4	To
Fipping	7	5	Fiping	6	5	To
	5,8	5,1		5,9	5,1	
Nin	3	3	Nen	3	3	En
Nup	3	3	Nurp	4	3	En
Barp	4	3	Basp	4	4	En
Plin	4	4	Plen	4	4	En
Denort	6	5	Depnort	7	6	To
Nador	5	4	Nadork	6	5	To
Smucrit	7	7	Smugrit	7	7	To
Keling	6	6	Kleing	5	5	To
Craty	5	5	Cratty	6	5	To
Niffing	7	5	Nilling	7	5	To
Dorfent	7	6	Morfent	7	6	To
Fendilt	7	7	Fendit	6	6	To
Wumble	6	6	Wamble	6	6	To
Bata	4	4	Baka	4	4	To
Shartec	7	5	Shratec	7	6	To
Prilling	8	6	Priling	7	6	To
Fema	4	4	Fama	4	4	To
Praining	8	6	Praiming	8	6	To
Fomlas	6	6	Fombas	6	6	To
Zining	6	5	Zinting	7	6	To
	5,7	5		5,8	5,2	

14.8.3 Pseudoword reading Polish

Nonord 1	Bkstv1	Fon1	Feil/Match	Bkstv2	Fon2	Stav	Lydret	D.kons	Komp.	Kons-op
Igr	3	3	Igl	3	3	En	Ja	Nei	Nei	Ja
Plut	4	4	Put	3	3	En	Ja	Nei	Nei	Ja/Nei
Kut	3	3	Kyt	3	3	En	Ja	Nei	Nei	Ja
Mza	3	3	Mta	3	3	En	Ja	Nei	Nei	Ja
Rubby	5	5	Ruppy	5	5	To	Ja	Ja	Nei	Ja
Sapia	5	5	Zapia	5	5	To	Ja	Nei	Nei	Nei
Seko	4	4	Serko	5	5	To	Ja	Nei	Nei	Nei/Ja
Libnić	6	6	Linić	5	5	To	Nei	Nei	Ja	Ja/Nei
Bięścia	7	7	Biaście	7	7	To	Nei	Nei	Ja	Ja
Coka	4	4	Colka	5	5	To	Ja	Nei	Nei	Nei/Ja
Złanać	6	6	Złankać	7	7	To	Ja	Nei	Nei	Ja
Czafa	5	4	Czefa	5	4	To	Nei	Nei	Ja	Ja
Szczygior	9	7	Szczybior	9	7	To	Nei	Nei	Ja	Ja
Ciady	5	5	Ciaby	5	5	To	Nei	Nei	Ja	Nei
Zobar	5	5	Zober	5	5	To	Ja	Nei	Nei	Nei
Czory	5	4	Czery	5	4	To	Nei	Nei	Ja	Ja
Szczony	7	5	Szczorny	8	6	To	Nei	Nei	Ja	Ja
Skmady	6	6	Skmaby	6	6	To	Ja	Nei	Nei	Ja
Piermić	7	7	Piemić	6	6	To	Ja	Nei	Nei	Ja/Nei
Pawwoz	6	6	Pawoz	5	5	To	Nei	Ja/Nei	Nei	Ja/Nei
	5,25	4,95		5,25	4,95					
Nes	3	3	Nus	3	3	En	Ja	Nei	Nei	Nei
Let	3	3	Letn	4	4	En	Ja	Nei	Nei	Nei/Ja
Akm	3	3	Akn	3	3	En	Ja	Nei	Nei	Ja
Pes	3	3	Pos	3	3	En	Ja	Nei	Nei	Nei
Buzy	4	4	Bulzy	5	5	To	Ja	Nei	Nei	Nei/Ja
Wiaszak	7	6	Wiarszak	8	7	To	Nei	Nei	Ja	Ja
Robab	5	5	Robaw	5	5	To	Nei	Nei	Nei	Nei
Słoska	6	6	Soska	5	5	To	Ja	Nei	Nei	Ja
Stramy	6	6	Strammy	7	7	To	Ja	Nei/Ja	Nei	Ja
Mienna	6	6	Miemma	6	6	To	Ja	Ja	Nei	Ja
Slote	5	5	Blote	5	5	To	Ja	Nei	Nei	Ja
Trafma	6	6	Trama	5	5	To	Ja	Nei	Nei	Ja
Kofa	4	4	Kefa	4	4	To	Ja	Nei	Nei	Nei
Wiegny	6	6	Wiepny	6	6	To	Ja	Nei	Nei	Ja
Slana	5	5	Salna	5	5	To	Ja	Nei	Nei	Ja
Rumme	6	5	Rume	4	4	To	Ja	Ja/Nei	Nei	Ja/Nei
Tącza	5	4	Tecza	5	4	To	Nei	Nei	Ja	Ja
Czkacka	7	6	Czkapka	7	6	To	Nei	Nei	Ja	Ja
Krafka	6	6	Kracka	6	6	To	Ja	Nei	Nei	Ja
Kyci	4	5	Kyści	5	5	To	Nei	Nei	Ja	Nei/Ja
	5	4,85		5,05	4,9					

14.8.4 Pseudoword reading Somali

Ord 1	Bkstv 1	Fon 1	Stav	Feil/match	Bkstv 2	Fon 2	Stav	Dob-vokal	D- kons	Kons-opph
Macrib	6	5	To	Marib	5	5	To	Nei	Nei	Ja / nei
Dheke	5	4	To	Dhike	5	4	To	Nei	Nei	Ja
Haybir	6	5	To	Hayir	5	4	To	Nei	nei	Ja / nei
Narr	4	3	En	Nar	4	3	En	Nei	Ja / nei	Nei
Moorta	6	5	To	Morta	5	5	To	Ja	Nei	Ja
Aarrey	6	5	To	Aarray	6	5	To	Ja	Ja	Nei
Shab	4	3	En	Shad	4	3	En	Nei	Nei	Ja
Tuqool	6	5	To	Tukool	6	5	To	Ja	Nei	Nei
Qeek	4	3	En	Qek	3	3	En	Ja / Nei	Nei	Nei
Licloo	6	4	To	Liloo	5	4	To	Ja	Nei	Ja / nei
Shemmi	6	4	To	Shemi	5	4	To	Nei	Ja / nei	Ja
Irmi	4	4	To	Imi	3	3	To	Nei	Nei	Ja / nei
Juul	4	3	En	Jool	4	3	En	Ja	Ja	Nei
Sheem	5	3	En	Shees	5	3	En	Ja	Nei	Ja
Fibin	5	5	To	Fibi	4	4	To	Nei	Nei	ja / nei
Wabbik	6	5	To	Wibbak	6	5	To	Nei	Ja	Nei
Dassar	6	5	To	Dammar	6	5	To	Nei	Ja	Nei
Cayad	5	3	To	Ciyad	5	3	To	Nei	Nei	Nei
Suullo	6	4	To	Soollu	6	4	To	Ja	Ja	Nei
Koosa	5	4	To	Soosa	5	4	To	Ja	Nei	Nei
	5,25	4,1			4,85	3,95				
Sokh	4	3	En	Sok	3	3	En	Nei	Nei	Ja / nei
Meeta	5	4	To	Meta	4	4	To	Ja / Nei	Nei	Nei
Dhecsaa	7	4	To	Dhesaa	6	4	To	Ja	Nei	Ja
Rayl	4	4	To	Qayl	4	3	To	Nei	Nei	Nei
Loodh	5	3	En	Lood	4	3	En	Ja	Nei	ja / nei
Heebbi	6	4	To	Haabbi	6	4	To	Ja	Ja	Nei
Widdo	5	4	To	Wido	4	4	To	Nei	Ja / Nei	Nei
Gemar	5	5	To	Gegar	5	5	To	Nei	Nei	Nei
Kem	3	3	En	Kim	3	3	En	Nei	Ja	Nei
Lay	3	2	En	Ley	3	2	En	Nei	Nei	Nei
Nisaal	6	5	To	Nisaar	6	5	To	Ja	Nei	Nei
Jollu	5	4	To	Jullo	5	4	To	Nei	Ja	Nei
Fobba	5	4	To	Foba	4	4	To	Nei	Ja / Nei	Nei
Lalkiis	7	6	To	Lakiis	6	5	To	Ja	Nei	Ja / nei
Xuuka	5	4	To	Xuka	4	4	To	Ja / Nei	Nei	Nei
Aatiya	6	4	To	Aateya	6	4	To	Ja	Nei	Nei
Qib	3	3	En	Qin	3	3	En	Nei	Nei	Nei
Ebbil	5	4	To	Ibbel	5	4	To	Nei	Ja	Nei
Xiika	5	4	To	Xiila	5	4	To	Ja	Nei	Nei
Gucmmu	6	4	To	Gummu	5	4	To	Nei	Ja	Ja / nei
	5	3,9			4,55	3,8				

14.9 Phonological Working Memory

14.9.1 54 Syllables and times they appear

Number	Syllable	Quantity	Number	Syllable	Quantity
1	dib	1	28	ju:f	2
2	fif	3	29	jub	1
3	fu:b	1	30	jud	2
4	fub	1	31	juf	1
5	gɑ:n	1	32	kɑ:d	1
6	gi:b	2	33	li:l	1
7	gi:n	1	34	mɑ:f	1
8	gib	2	35	mɑb	2
9	gin	2	36	mi:b	2
10	gu:g	2	37	mib	3
11	gug	1	38	mu:b	1
12	i:b	2	39	mub	2
13	i:g	2	40	ni:g	1
14	ib	1	41	ni:n	1
15	ig	2	42	nig	1
16	jɑ:b	2	43	nu:f	1
17	jɑ:f	1	44	nuf	1
18	jɑ:l	1	45	sɑ:f	3
19	ja:s	1	46	si:f	1
20	jab	1	47	sif	2
21	jɑf	1	48	suf	1
22	jɑl	4	49	tɑ:b	3
23	ji:d	3	50	tɑb	1
24	ji:n	2	51	ti:b	3
25	jib	1	52	tib	1
26	ju:b	2	53	u:b	2
27	ju:d	1	54	ub	2

14.8.2 Language-independent phonological working memory

Phon1	Phon2	Syllables	COND	Condition_name	SwitchPos
/ju:b mi:b gu:g jal /	/mi:b ju:b gu:g jal /	4	2	Different	first
/tɑ:b ji:n fif ub/	/tɑ:b ji:n fif ub/	4	1	Same	N/A
/tab i:b ja:b suf ji:d /	/tab i:b suf ja:b ji:d /	5	2	Different	3
/jab ti:b ju:f jib sif/	/jab ti:b ju:f sif jib/	5	2	Different	last
/gu:g mab jaf ib nu:f/	/gu:g mab jaf ib nu:f/	5	1	Same	N/A
/si:f gug mu:b ja:s i:g /	/si:f mu:b gug ja:s i:g /	5	2	Different	2
/nig ju:b ti:b jal mib /	/nig ju:b ti:b jal mib /	5	1	Same	N/A
/jub ji:d ju:f li:l gin /	/jub ji:d li:l ju:f gin /	5	2	Different	3
/gi:b sa:f u:b jal mub/	/gi:b sa:f u:b jal mub/	5	1	Same	N/A
/jɑ:b ni:g gib tɑ:b sif i:b /	/jɑ:b ni:g gib tɑ:b sif i:b /	6	1	Same	N/A
/mab i:g jud nuf jɑ:l ti:b /	/mab i:g jud jɑ:l nuf ti:b /	6	2	Different	4
/kɑ:d fub gi:n juf gib mib /	/kɑ:d fub gi:n juf gib mib /	6	1	Same	N/A
/ni:n ji:d mib ig jud gin /	/ ji:d ni:n mib ig jud gin /	6	2	Different	first
/u:b jal fif gi:b sɑ:f mub/	/u:b jal gi:b fif sɑ:f mub/	6	2	Different	3
/sɑ:f jɑ:f fu:b gɑ:n tib ju:d ig/	/sɑ:f jɑ:f fu:b gɑ:n tib ju:d ig/	7	1	Same	N/A
/fif ub dib tɑ:b ji:n mɑ:f mi:b/	/fif ub dib tɑ:b mɑ:f ji:n mi:b/	7	2	Different	5

14.10 Processing speed

Picture of the shapes used in this task.

14.11 Test Protocol for test instructors

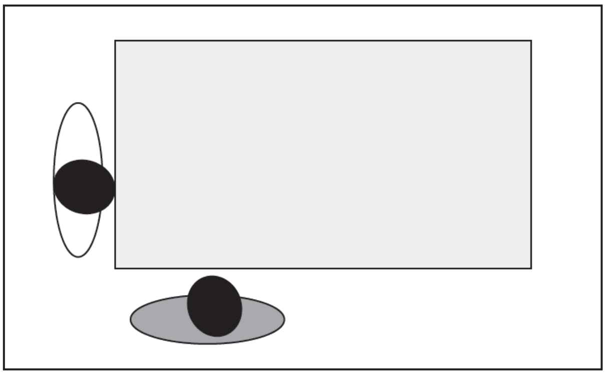
Protokoll for gjennomføring av kartlegging:

«Dysleksi eller bare flerspråklig?»

Helene Berntsens Ph.d.-prosjekt

Testbatteri:
I denne kartleggingen skal man ***først*** gjennomføre kartleggingen med DOT – dynamisk kartleggingstest på papir. Deretter gjennomføres kartleggingen på PC-en.
HUSK at testpersonens identifikasjonsnummer må være det samme på resultatarkene fra DOT og på testen på PC.

Gjennomføring av DOT:
Det er viktig at du gjør testpersonen oppmerksom på at du kommer til å *vise* hvordan en oppgave skal gjøres, i stedet for å *si* det. Du kan også opplyse om at ordene i denne testen ikke betyr noe.
Plasseringen er også viktig. Det anbefales at testleder og testperson sitter ved hjørnet av et bord. Se på bildet under. Testpersonen er hvit. Testleder er grå.



Bruk et brettet papir, pennal eller noe liknende for å skjerme arket hvor du skriver ned testpersonens resultater.
Forslag til instruksjon:
«Denne oppgaven er litt annerledes enn vanlige oppgaver. Jeg kommer til å ***vise*** *deg hvordan du skal gjøre oppgavene i stedet for å si det. Jeg kommer til å peke. Alle ordene vi skal bruke er tulleord. De betyr ingenting på norsk.»*

Skåring av resultat:

Testleder skårer resultatene på resultatarket underveis i kartleggingen. Tallet «**1**» noteres når svaret fra testpersonen er OK. Tallet «**0**» skrives når svaret er feil. Hvis testpersonen uttaler en lyd eller et ord feil, skal du ALLTID korrigere uttalen.

Hvis testpersonen uoppfordret retter på seg selv, markeres dette som riktig. Det er kun tillatt å korrigere seg selv en gang per bokstav.

I en runde er det flere oppgaver. Du skal først skåre resultatene for det enkelte nonordet i en runde. Deretter skårer du resultatene for en runde sammenlagt.

Sånn ser det første resultatarket ut:

Dynamisk Afkodningstest:
Scoreark til deltest 1. Indlæring af et nyt alfabet

Runde	**Bogstav**	**Lyd**	**Score for det enkelte bogstav** (OK = 1, fejl = 0)	**Score for runden** (alle bogstaver OK = 1, én el. flere fejl = 0)
1	╔	[s]		
	◇	[m]		
	◘	[ɑ]		
2	◘	[ɑ]		
	╔	[s]		
	◇	[m]		

Deltest 1 – Innlæring av et nytt alfabet:

Før du starter kartleggingen må du sørge for at du har:

- 1 øve-ark til eleven
- 10 test-ark
- 1 resultatark til å skrive resultatet
- Penn eller blyant
- Pennal eller liknende som gjør det mulig å skjule resultatarket

Formålet med deltest 1 er å introdusere tre nye bokstaver og deres tilhørende lyder «m», «a» (som i far) og «s». Vi skal teste hvor lett testpersonen lærer bokstav- lyd-forbindelsen. Resultatene skåres etter hvor mange riktige bokstav-lyd-oppgaver testpersonen klarer.

Her er oversikten over de tre nye bokstavene og lydene:

◊	[m]
◘	[ɑ]
╓	[s]

Disse bokstavene vil også gå igjen i deltest 2 og 3.

<u>Gjennomføring deltest 1:</u>

Øvingsarket:

1. Legg øve-arket med de tre nye bokstavene foran testpersonen
2. Pek på den første bokstaven (den lengst til venstre). Pek på deg selv mens du uttaler lyden. Sørg for at testpersonen ser på deg når du uttaler den.
3. Pek på bokstaven igjen. Oppfordre testpersonen til å si lyden. Du kan gjerne gestikulere. Rekk en flat hånd med håndflaten vendt oppover som om du tilbyr testpersonen noe.
4. Om nødvendig; gjenta inntil testpersonen sier den første lyden riktig. Når testpersonen sier den riktige lyden, signaliserer du at det er korrekt ved å nikke (eller et annet tydelig tegn).
5. Gå videre til neste bokstav og gjenta prosedyren.
6. Når dere har vært gjennom alle de tre lydene på øvingsarket, blar du om og testen begynner på ordentlig.

10 test-ark:

1. Ha resultatarket ved siden av deg sånn at du kan notere testpersonens respons etter hvert.
2. Nå skal du <u>**ikke**</u> <u>**si lydene**</u> – du peker på lyden og oppfordrer testpersonen til å si dem (ikke pek på testpersonen, bruk en vennlig gest). Når alle lydene på et testark er gjennomført, går du videre til neste ark.
3. Dersom testpersonen har svart riktig, skriver du «1» på resultatarket. Har testpersonen svart feil, skriver du «0» på det samme arket.

4. Hvis testpersonen glemmer lyden eller har feil uttale – gir du korrigerende feedback ved å uttale lyden og oppfordre testpersonen til å gjenta etter deg. Dette skårer du som «0» på resultatarket.
5. Dersom testpersonen har **alt riktig på tre test-ark etter hverandre, avslutter du deltesten** og gir full skår på de gjenværende testene.

Se neste side for deltest 2.

Deltest 2. Leseinnlæring med et nytt alfabet:

Før du starter kartleggingen må du sørge for at du har:

- Brikker med de tre bokstavene
- Resultatarket
- Penn eller blyant
- Pennal eller liknende som gjør det mulig å skjule resultatarket

Målet med denne deltesten er å teste personens potensiale for å lære å lese med det nye alfabetet. Testpersonen skal trekke lydene sammen.

Gjennomføring deltest 2:

Merk: du finner bokstavkombinasjonene du skal bruke i denne oppgaven, ved å se på Resultat-ark 2 (Scoreark til deltest 2).

Startposisjon:

1. Legg to bokstavbrikker foran testpersonen med en avstand på ca. 25 cm mellom brikkene ◊ ◘ (m og a)
2. Pek på hver brikke (start med den til venstre), mens du uttaler lyden (m og a) med ca. 1 sekund mellom lydene.
3. Pek på brikkene og oppfordre testpersonen til å si de tilsvarende lydene. Du kan gjerne gestikulere.

Mellomposisjon:

4. Flytt brikkene nærmere hverandre – ca. 5 cm mellomrom. Pek på den venstre brikken mens du sier lyden. Denne gangen har du en kortere pause mellom lydene enn hva du hadde første gang (0,5 sek) ◊ ◘ (m og a)
5. Oppfordre testpersonen til å gjenta hvis hen ikke gjør det av seg selv.

Sisteposisjon (syntese)

6. Flytt brikkene helt inntil hverandre og les ordet høyt. Gjør dette samtidig som du understreker leseretningen ved å bruke pekefingeren din. ◊◘ (ma)
7. Oppfordre testpersonen til å gjøre det samme.
8. Hvis det er nødvendig, gjentar du lydene i nonordet helt til testpersonen sider det selv.
9. Du fortsetter til alle de fire ordene er gjennomført – i fem forskjellige runder. Dersom testpersonen har **svart korrekt på alle de fire ordene i to runder etter hverandre**, **avsluttes deltesten** og du skårer de resterende rundende som korrekt.
10. *Dersom testpersonen **IKKE klarer** å svare korrekt på alle de fire nonordene i to runder etter hverandre, **avsluttes** DOT på dette tidspunktet.*

Merk 1: Det er meningen at testpersonen selv skal flytte brikkene fra startposisjon, til mellomposisjon og til sisteposisjon. Men hvis testpersonen ikke gjør det, kan du som testperson flytte brikkene. Når testpersonen har overtatt kontrollen over brikkene, trenger du ikke å vise leseretningen lengre.

Merk 2: Det er ikke strengt nødvendig at testpersonen går innom Mellomposisjonen. Det er to posisjoner som er viktige: 1. At bokstavene uttales som lyder. 2. At bokstavene leses som et ord/stavelser når de står inntil hverandre.

Deltest 3. Videre lesing med nytt alfabet

Før du starter kartleggingen må du sørge for at du har:

- Brikker med de tre bokstavene (de samme som i deltest 2)
- Resultatarket
- Penn eller blyant
- Pennal eller et brettet ark som gjør det mulig å skjule resultatarket

Målet med deltests 3 er å avdekke hvor godt testpersonen kan utnytte det nye alfabetet. Derfor skal det lese nye og lengre nonord. Resultatet på denne deltesten er antall korrekt leste nonord. I deltest 3 gis det bare begrenset korrigerende feedback. ╔ = /s/ ◊ = /m/ ◘ = /ɑ/

NB! Deltest 3 gjennomføres KUN hvis testpersonen ha klart å lese alle de fire nonorden riktig i to påfølgende runder, i deltest 2.

Gjennomføring av deltest 3:

Merk: du finner bokstavkombinasjonene du skal bruke i denne oppgaven ved å se på Resultat-ark 3 (Scoreark til deltest 3).

1. Legg kombinasjonen «╔◘◊◘» etter hverandre – uten mellomrom.
2. Les «sama» høyt mens du understreker leseretningen.
3. Oppfordre testpersonen til å gjenta dersom hen ikke gjentar automatisk.
4. Dersom det er nødvendig; gjenta helt til testpersonen sier det riktig.
5. Ha resultatarket ved siden av deg, sånn at du kan se den neste kombinasjonen av bokstavene. Legg denne kombinasjonen av brikker foran testpersonen.
6. Oppfordre testpersonen til å lese ordet.
7. Hvis testpersonen leser feil, leser du ordet høyt. **Legg merke til**: *I deltest 3 skal du ikke oppfordre testpersonen til å gjenta etter at du har lest ordet korrekt*.
8. Hvis testpersonen har **lest feil tre ganger etter hverandre, avsluttes testen**. Ellers fortsetter du til alle de 12 ordene er lest.

Nå er du ferdig med DOT-testen og du kan starte kartleggingen på PC. Sørg for at alle resultatarkene er merket med testpersonens identifikasjonsnummer. Du må også sørge for at alle resultatarkene blir levert til Helene Berntsen.

Behandling av resultatarene i DOT:

Sørg for at alle resultatarkene er tydelig merket med testpersonens identifikasjonsnummer.

Hvis du har anledning, scann resultatarkene og send dem på e-post til helenebergtsen@uia.no

Hvis dette ikke er mulig, må kan du oppbevare dem på et trygt sted og sørge for at Helene Berntsen får det fysiske arket.

Det kan også sendes i posten til: Helene Berntsen
Ravnedalsveien 13
4616 Kristiansand s

Gjennomføring av kartlegging på PC:
Alt du trenger av programvare ligger på minnepinnen.
Nummeret fra spørreskjemaet skal følge nummeret på både DOT og det man skriver inn på PC-en. Alle testpersoner skal ha et nummer med fire tall. Det er samarbeidspartnerne som oppbevarer listene med navn og nummer.
0 (null) er nummeret vi bruker i situasjoner hvor vi øver/viser frem programmet.

Overordnet informasjon om hvordan du kan manøvrere inni testen:

- → Etter at testinstruksjonen er lest, må du trykke «**Q**» for å starte selve testen
- → Mens testinstruksjonen leses, kan du trykke «**Q**»- for Quit – da hopper man over testinstruksjonen, og du kommer rett til oppgaven. Dette vil være mest aktuelt når du holder på å lære deg testen.
- → Trykk «**S**» – for Skip – da hopper du over hele oppgaven.
- → Trykk «**R**» – for Repeat – da repeteres instruksjonen.
- → Dersom testen har hengt seg opp eller du trenger å forlate testen, trykk «**ESC**». Da får du et spørsmål om du ønsker å avslutte testen. Trykk på «**Q**» for å avslutte.
- → Det er «**Enter**» som er tasten som setter i gang en oppgave eller stanser tidtakingen.
- → Nummertastene fra «**0 til 9**», markerer hvor mange feil testpersonen gjorde i en deltest.
- → Hvis du ikke kommer videre i testen, så kan det være fordi du har trykket utenfor testvinduet og dette vinduet er derfor ikke «aktivert». Ta markøren fra musa og venstreklikk et sted inne på det hvite området i testvinduet.
- → Dersom du f.eks. ikke ser ordene «Samme» og «forskjellig» nederst på skjermen din, kan det være fordi skjermen din har en høyere innstilling enn 100 %. Gå da til skjerminnstillinger – skala og oppsett – og sett verdien til 100 %.

Som testleder må du finne ut om testpersonene er høyre- eller venstrehendt. Dette er viktig for gjennomføringen av testen. Hva som registreres som «**samme**» eller «**forskjellig**» i testen, endrer seg etter hva som er testpersonens dominante hånd. I kartleggingssituasjonen vil det alltid være informasjon på skjermen som forteller testpersonen hvilken tast som er «**samme**» og «**forskjellig**».

I testen vil både tidsbruk og korrekthet bli registrert. Derfor er det viktig at det poengteres at personen skal svare så raskt den har mulighet til å svare (gjelder alle deltestene), og at du som testleder trykker raskt på «**Enter**» (gjelder Fonemisk bevissthet og RAN).
Testpersonene blir først testet på morsmålet. Deretter møter de tilsvarende tester på norsk. Det er viktig at de får ca. 15 min pause mellom testingen på morsmålet og testingen på norsk. Dette fordi hjernen trenger å «kalibrere» seg mellom bruk av første- og andrespråk.
Alle instruksjonene blir spilt av på en lydfil samtidig som de kan leses på skjermen.
Testinstruksjonene på morsmålet kan være litt lengre og ha et litt mer komplisert språk, enn hva de norske testinstruksjonene har. Dette er gjort fordi de norske instruksjonene skal leses på testpersonenes andrespråk og utvalget vil ha ulik grad av norskferdigheter. I tillegg vil testpersonene ha gjennomført testen på morsmålet, før de testes på norsk – noe som gjør at vi antar at de trenger mindre forklaringer for å forstå hva de skal gjøre.

Testrekkefølgen er:

- Fonemisk bevissthet på morsmål
- RAN på morsmål
- Ordlesing på morsmål
- Nonordslesing på morsmål
- Fonologisk arbeidsminne - språknøytral
    - Pause ca. 15 min
- Fonemisk bevissthet på norsk
- Ordlesing på norsk
- Nonordslesing på norsk
- RAN på norsk
- Prosesseringshastighet – språknøytral (men instruksjonene gis på morsmålet)

For å gjennomføre testen trenger du:

- En PC- hvor testen er installert
- Et numerisk tastatur
- Headset med mikrofon til testpersonen

- Høyttalere og innstilling av lydenheter sånn at lyden kommer både i head-setet, og ut i rommet
- Fasiten for oppgavene knyttet til Fonemisk bevissthet – både for morsmål og norsk.

Starte kartleggingen:

1. Skru på PC-en. Åpne filutforskeren og trykk på **OSDisk (C:)** eller **HELENE_TEST_C**. Dette kan variere litt fra PC til PC. Dobbeltrykk på «**RUN_TESTS**». Det skal komme opp to vinduer. Det kan ta litt tid før det andre vinduet dukker opp. Vær tålmodig. Det er det andre vinduet du skal forholde deg til.

2. I det andre vinduet som dukker opp, skriver du inn deltakernes nummer og trykk på «**Enter**».

3. Du får opp en liste med språk. Du skal velge testpersonens språk.

«**e**» for engelsk
«**p**» for polsk
«**s**» for somalisk
«**n**» for norsk
Velg riktig språk og trykk på «**Enter**».

4. Testleder må finne ut om testpersonen er høyre eller venstrehendt?

Trykk «**1**» for høyrehendt
Trykk «**2**» for venstrehendt
Trykk på «**Enter**». (Etter at du har trykket «**Enter**», vil lydfil og testinstruksjon for neste oppgave starte med en gang).

<u>Fonemisk bevissthet på morsmålet: (Testpersonen skal avgi alle svar på morsmålet sitt)</u>

I denne oppgaven skal testpersonen lytte til en instruksjon og si høyt et nonord. Deretter får de beskjed om å ta bort en lyd, for så å si høyt det nonordet som blir igjen etter at lyden er tatt bort.

Testpersonen får høre testinstruksjonen opplest, samtidig som de kan lese den på skjermen. Instruksjonen er som følger:

«I denne oppgaven skal du gjenta et norsk tulleord. Etterpå må du ta bort en lyd fra tulleordet. Eksempel: «Si blart» - (du sier BLART). «Si blart uten r» - (du sier BLAT).
Du får ikke se noen av ordene. Du får bare høre dem. Det gjør ingenting om du svarer feil. Det viktigste er at du prøver.
Er du klar?»
De ulike språkene har ulike eksempler:
Engelsk: "Say **tonlip**" ……… you will say tonlip. "Say **tonlip** without **L**" ………. you will say **tonip**
Polsk: "Powiedz **krubi**"....... powiesz krubi. "Powiedz **krubi** bez **k**"....... powiesz **rubi.**
Somalisk: "Waxaad dhahdaa **baat**"....... waxaad dhahaysaa BAAT. "Waxaad dhahdaa **baat** aan lahayn **t**" **-** waxaad dhahaysaa **BAA**

Hvis testpersonen er klar, trykk på «**Q**». Hvis hen ikke har forstått oppgaven, kan du utdype forklaringen. <u>*Det er du som testleder som må vurdere om svarene er riktige eller feil*</u> – og det gjør du ved hjelp av Fasiten og numerisk tastatur. Trykk på «**Enter**» for å starte hver oppgave. Når testpersonen er ferdig, trykker du som testleder på tasten «**Enter**» for å stoppe tidtakingen og trykker inn «**0 til 9**» for antall feil personen hadde (i virkeligheten trykker du kun på 0 eller 1. 0 for null feil når alt er riktig. 1 for en feil når svaret ikke blir korrekt). Trykk «**Enter**» for å starte neste oppgave.
Her er fasit. I kartleggingssituasjonen kan du ha en egen utskrift av Fonemisk Bevissthet.

Engelsk	**Lyd blir tatt borty**	**Svaret**	**Riktig eller feil?**
Say "Klosp"	Say "Klosp" without "s"	Klop	
Say "Jilk"	Say "Jilk" without "l"	Jik	
Say "Thauk"	Say "Thauk" without "th"	auk	
Say "Tweln"	Say "Tweln" without "w"	teln	
Say "Liogs"	Say "Liogs" without "l"	iogs	
Say "Sploitel"	Say"Sploitel" without "p"	sloitel	
Say "Skrepus"	Say"Skrepus" without "r"	skepus	

Say "Plaitef"	Say "Plaitef" without "f"	plaite	
Say "Jaloom"	Say "Jaloom" without "m"	jaloo	
Say "Trasjoib"	Say "Trasjoib" without "s"	trajoib	
Say "Absumpt"	Say "Absumpt" without "m"	absupt	
Say"Zablet"	Say"Zablet" without "z"	ablet	
Say "Feekna"	Say "Feekna" without "n"	feeka	
Say "Biltrum"	Say "Biltrum" without "t"	bilrum	
Say "Lanspung"	Say "Lanspung" without "s"	lanpung	
Say "Pilpsoy"	Say "Pilpsoy" without "l"	pipsoy	
Say "Rempsluff"	Say "Rempsluff" without "m"	repsluff	
Say "Woftnup"	Say "Woftnup" without "t"	wofnup	

Polsk	**Lyd blir tatt borty**	**Svaret**	**Riktig eller feil?**
Powiedz "dke"	Powiedz"dke" bez "d"	ke	
Powiedz "brez"	Powiedz "brez" bez "b"	rez	
Powiedz "wajr"	Powiedz "wajr" bez "j"	war	
Powiedz "łówr"	Powiedz "łówr" bez "w"	łór	
Powiedz "walkon"	Powiedz "walkon" bez "l"	wakon	
Powiedz "casnek"	Powiedz "casnek" bez "s"	canek	
Powiedz "rumna"	Powiedz "rumna" bez "n"	ruma	
Powiedz "mługa"	Powiedz "mługa" bez "ł"	muga	
Powiedz "tarsa"	Powiedz "tarsa" bez "t"	arsa	
Powiedz "jomez"	Powiedz "jomez" bez "j"	omez	
Powiedz "ustra"	Powiedz "ustra" bez "s"	utra	
Powiedz "myrok"	Powiedz "myrok" bez "k"	myro	
Powiedz "wuzoń"	Powiedz "wuzoń" bez "ń"	wuzo	
Powiedz "nisor"	Powiedz "nisor" bez "r"	niso	
Powiedz "zopkra"	Powiedz "zopkra" bez "k"	zopra	
Powiedz "rumska"	Powiedz "rumska" bez "s"	rumka	
Powiedz "barmia"	Powiedz "barmia" bez "r"	bamia	
Powiedz "jawle"	Powiedz "jawle" bez "w"	jale	

Somalisk	Lyd blir tatt borty	Svaret	Riktig eller feil?
Si "meys"	Si "meys" uten "m"	eys	
Si "bosic"	Si "bosic" uten "b"	osic	
Si "liidh"	Si "liidh" uten "dh"	lii	
Si "qem"	Si "qem" uten "q"	em	
Si "tafuum"	Si "tafuum" uten "m"	tafuu	
Si "shaykoor"	Si "shaykoor" uten "sh"	aykoor	
Si "dhibrec"	Si "dhibrec" uten "dh"	ibrec	
Si "fol"	Si "fol" uten "l"	fo	
Si "kheysab"	Si "kheysab" uten "kh"	eysab	
Si "luugta"	Si "luugta" uten "t"	luuga	
Si "leysig"	Si "leysig" uten "g"	leysi	
Si "siqlid"	Si "siqlid" uten "q"	silid	
Si "kafdhaan"	Si "kafdhaan" uten "n"	kafdhaa	
Si "diilkash"	Si "diilkash" uten "l"	diikash	
Si "xaliig"	Si "xaliig" uten "x"	aliig	
Si "simlaq"	Si "simlaq" uten "s"	imlaq	
Si "baskuul"	Si "baskuul" uten "k"	basuul	
Si "gildeem"	Si "gildeem" uten "d"	gileem	

RAN på morsmålet: (Testpersonen skal avgi alle svar på morsmålet sitt)

I denne oppgaven skal testpersonen så raskt de kan, si navnet på tall i flere tallrekker. Instruksjonen er som følger:

«I denne oppgaven får du se mange tall på skjermen. Si på (morsmålet), navnet på tallene - så raskt du bare kan. Du må lese fra venstre til høyre. Ikke stopp før du har lest alle tallene. Ikke stopp hvis du lese et tall feil, bare fortsett å les. Oppgaven gjøres to ganger. Du får en liten pause mellom hver oppgave.»

Du som testleder starter testen ved å trykke på «**Q**». Når du har gjort det kommer spørsmålet «Er du klar?». Hvis testpersonen er klar, trykk på «**Enter**». Med en gang testpersonen er ferdig med å lese alle tallene, trykker du som testleder på tasten «**Enter**». Ved å trykke på denne tasten stopper du tidtakingen. Deretter trykker du på et tall fra «**0 til 9**» for å markere hvor mange feil personen hadde. Når du har trykket antall feil, kommer automatisk spørsmålet «Er du klar?»

Denne oppgaven gjøres to ganger.
Trykk på «**Enter**» for å starte oppgave nummer to. Når testpersonen er ferdig, trykker du som testleder på tasten «**Enter**» for å stoppe tidtakingen og trykker inn «**0 til 9**» for antall feil personen hadde.

<u>Ordlesing på morsmålet:</u>
I denne oppgaven får testpersonen høre et ord på morsmålet sitt, samtidig som de ser et ord på skjermen. Testpersonen skal så raskt som mulig vurdere om det hen ser og hører er det samme ordet, eller om de er litt forskjellige. Under hele oppgaven skal testpersonen skal holde en finger på «**Z**» og en på «**M**». Tastene er markert med «samme» eller «forskjellig» ut fra hva som er testpersonens dominante hånd. Det er lagt inn pauser i oppgaven for at ikke testpersonen skal bli utslitt og miste konsentrasjonen.
Instruksjonen er som følger:
«This task involves reading (morsmål) words. You will hear an English word and at the same time you will see a word on the screen. You should decide if the words are the same or different.
If the words are the same press the key marked "same"
If the words are different press the key marked "different"
These are shown at the bottom of this screen.
Please respond as quickly and as accurately as you can. Don't worry if you make a mistake just get ready for the next word. It is important to keep your fingers on the response keys to help you respond quickly. Let's start with some practice words. Each trial will begin with a cross on the screen to show you where the word will appear.
Are you ready?»
Testen starter når du som testleder trykker på «**Enter**». De seks føres ordene er øvingsoppgaver. Etter disse kommer ordet «PAUSE» opp. Du kan forsikre deg om at testpersonen har forstått oppgaven. Minn dem på at de skal svare så raskt som mulig. Trykk «**Enter**» og deltesten fortsetter. Oppgaven har fire pauser etter at øvingsoppgaven er gjennomført. Din oppgave er å sette testen i gang igjen etter hver pause – bortsett fra det skal du forholde deg rolig.

Nonordlesing på morsmålet:

Denne testen gjennomføres på akkurat samme måte som ordlesingsoppgaven. Den eneste forskjellen er at de leser nonord i stedet for ord. Testpersonen får høre et nonord på morsmålet sitt, samtidig som de ser et nonord på skjermen. Testpersonen skal så raskt som mulig vurdere om det hen ser og hører er det samme nonordet, eller om de er litt forskjellige. Under hele oppgaven skal testpersonen skal holde en finger på «**Z**» og en på «**M**». Tastene er markert med «samme» eller «forskjellig» ut fra hva som er testpersonens dominante hånd. Det er lagt inn pauser i oppgaven for at ikke testpersonen skal bli utslitt og miste konsentrasjonen.

Instruksjonen er som følger:

«This task involves reading nonsense words. You will hear a nonsense word and at the same time you will see a nonsense word on the screen. You should decide if they are the same or different.

If the nonsense words are the same press the key marked "same"

If the nonsense words are different press the key marked "different"

These are shown at the bottom of this screen.

Please respond as quickly and as accurately as you can. Don't worry if you make a mistake just get ready for the next nonsense word. It is important to keep your fingers on the response keys to help you respond quickly. Let's start with some practice.

Are you ready?»

Testen starter når du som testleder trykker på «**Q**». De seks føres ordene er øvingsoppgaver. Etter disse kommer ordet «PAUSE» opp. Du kan forsikre deg om at testpersonen har forstått oppgaven. Minn dem på at de skal svare så raskt som mulig. Trykk «**Enter**» og deltesten fortsetter. Oppgaven har fire pauser etter at øvingsoppgaven er gjennomført. Din oppgave er å sette testen i gang igjen etter hver pause – bortsett fra det skal du forholde deg rolig.

Fonologisk arbeidsminne: (språknøytral test)

I denne oppgaven får testpersonen høre en *sammenhengende rekke* med stavelser som ikke gir mening (nonord-stavelser). På skjermen vil de se et 1-tall når den første rekken med stavelser høres, og et 2-tall når den andre rekken med stavelser

høres. Når begge tallrekkene er ferdige, vil det stå på skjermen «Samme eller forskjellige?»
Denne oppgaven er kun auditiv. Testpersonen *skal så raskt som mulig* vurdere om rekkefølgen på stavelsene er den samme, eller om rekkefølgen er blitt byttet om. Testpersonen holder en finger på «**Z**» og en på «**M**» og trykker på det som er merket som «samme» eller «forskjellig». Testpersonens dominante hånd avgjør hvilken tast som er hva.
Instruksjonen er som følger:
«I denne oppgaven skal du bestemme om flere tulleord er de samme eller forskjellige. Du får høre to lydklipp med flere tulleord. Har tulleordene samme rekkefølge eller er den litt forskjellig?
Hvis rekkefølgen er den samme; Trykk på tasten for «Samme»
Hvis rekkefølgen er litt forskjellig; Trykk på tasten for «Forskjellig»

Svar så raskt og riktig som du kan. Hold fingene på tastene hele tiden, sånn at du kan svare raskt.
Er du klar?»
Testen starter når du som testleder trykker på «**Q**». Den starter med to øvingsoppgaver. Trykk «**Enter**» etter disse. Oppgaven har en pause. Trykk «**Enter**» etter pausen.

PAUSE
Testpersonen får ca. 15 min pause. Dette er viktig for å gi testpersonens hode mulighet til å koble om fra morsmålet til norsk.

Oppstart etter pause

Fonemisk bevissthet på NORSK: (Testpersonen skal avgi alle svar på norsk)
I denne oppgaven skal testpersonen lytte til en instruksjon og si høyt et nonord. Deretter får de beskjed om å ta bort en lyd, for så å si høyt det nonordet som blir igjen etter at lyden er tatt bort. Oppgaven er auditiv, og testpersonen ser ingenting på skjermen underveis i oppgaven.
Testpersonen får høre testinstruksjonen opplest, samtidig som de kan lese den på skjermen. Instruksjonen er som følger:

«I denne oppgaven skal du gjenta et norsk tulleord. Etterpå må du ta bort en lyd fra tulleordet. Eksempel: «Si blart» - (du sier BLART). «Si blart uten r» - (du sier BLAT).
Du får ikke se noen av ordene. Du får bare høre dem. Det gjør ingenting om du svarer feil. Det viktigste er at du prøver.
Er du klar?»
Hvis testpersonen er klar, trykk på «**Q**». Hvis den ikke har forstått oppgaven, kan du utdype forklaringen. De har gjort samme oppgave på morsmålet tidligere. Det er du som testleder som må vurdere om svarene er riktige eller feil.
Trykk på «**Enter**» for å starte hver oppgave. Når testpersonen er ferdig, trykker du som testleder på tasten «**Enter**» for å stoppe tidtakingen og trykker inn «**0 til 9**» for antall feil personen hadde. Trykk «**Enter**» for å starte neste oppgave.

Her er fasit. I kartleggingssituasjonen kan du ha en egen utskrift av Fonemisk Bevissthet.

Norsk	**Lyd blir tatt borty**	**Svaret**	**Riktig eller feil?**
Si "kjamt"	Si "kjamt" uten "kj"	amt	
Si "plird"	Si "plird" uten "l"	pird	
Si "plusk"	Si "plusk" uten "s"	pluk	
Si "smeikt"	Si "smeikt" uten "k"	smeit	
Si "pransto"	Si "pransto" uten "n"	prasto	
Si "jarstett"	Si "jarstett" uten "s"	jartett	
Si "nombikk"	Si "nombikk" uten "m"	nobikk	
Si "skrauden"	Si "skrauden" uten "r"	skauden	
Si "lapri"	Si "lapri" uten "l"	apri	
Si "riplett"	Si "riplett" uten "r"	iplett	
Si "gratusk"	Si "gratusk" uten "g"	ratusk	
Si "kreifag"	Si "kreifag" uten "g"	kreifa	
Si "vemin"	Si "vemin" uten "n"	vemi	
Si "trapskait"	Si "trapskait" uten "p"	traskait	
Si "arbeskt"	Si "arbeskt" uten "s"	arbekt	
Si "skroble"	Si "skroble" uten "b"	skrole	
Si "hurnat"	Si "hurnat" uten "n"	hurat	
Si "kompkal"	Si "kompkal" uten "p"	komkal	

Ordlesing på NORSK:

I denne oppgaven får testpersonen høre et ord på norsk, samtidig som de ser et ord på skjermen. Testpersonen skal så raskt som mulig vurdere om det hen ser og hører er det samme ordet, eller om de er litt forskjellige. Under hele oppgaven skal testpersonen skal holde en finger på «**Z**» og en på «**M**». Tastene er markert med «samme» eller «forskjellig» ut fra hva som er testpersonens dominante hånd. Det er lagt inn pauser i oppgaven for at ikke testpersonen skal bli utslitt og miste konsentrasjonen.

Instruksjonen er som følger:

«Denne oppgaven handler om å lese ord på norsk. Du får høre et ord. Samtidig vil du se et ord på skjermen. Er ordene de samme eller litt forskjellige?
Hvis ordene er de samme; Trykk på tasten for «Samme»
Hvis ordene er litt forskjellige; Trykk på tasten for «Forskjellig»
Svar så raskt og riktig som du kan. Det er viktig at du holder fingrene på svartastene hele tiden, sånn at du kan svare raskt.
Er du klar?»

Testen starter når du som testleder trykker på «**Q**». De seks føres ordene er øvingsoppgaver. Etter disse kommer ordet «PAUSE» opp. Du kan forsikre deg om at testpersonen har forstått oppgaven. Minn dem på at de skal svare så raskt som mulig. Trykk «**Enter**» og oppgaven fortsetter. Oppgaven har fire pauser etter at øvingsoppgaven er gjennomført. Din oppgave er å sette testen i gang igjen etter hver pause – bortsett fra det skal du forholde deg rolig.

Nonordlesing på NORSK:

Denne testen gjennomføres på akkurat samme måte som ordlesingsoppgaven. Den eneste forskjellen er at de leser nonord i stedet for ord. Testpersonen får høre et nonord på norsk, samtidig som de ser et nonord på skjermen. Testpersonen skal så raskt som mulig vurdere om det hen ser og hører er det samme nonordet, eller om de er litt forskjellige. Under hele oppgaven skal testpersonen skal holde en finger på «**Z**» og en på «**M**». Tastene er markert med «samme» eller «forskjellig» ut fra hva som er testpersonens dominante hånd. Det er lagt inn pauser i oppgaven for at ikke testpersonen skal bli utslitt og miste konsentrasjonen. Testinstruksjonen går som følger:

«Denne oppgaven handler om å lese ord som ikke betyr noe. De kalles for tulleord. Du skal gjøre det samme som du gjorde i ordlesingsoppgaven, men alle

ordene er tulleord. Du får høre et tulleord. Samtidig vil du se et tulleord på skjermen. Er tulleordene de samme eller litt forskjellige?
Hvis tulleordene er de samme; Trykk på tasten for «Samme»
Hvis tulleordene er litt forskjellige; Trykk på tasten for «Forskjellig»
Svar så raskt og riktig som du kan. Det er viktig at du holder fingrene på tastene hele tiden, sånn at du kan svare raskt.
Er du klar?»
Testen starter når du som testleder trykker på «**Q**». De seks føres ordene er øvingsoppgaver. Etter disse kommer ordet «PAUSE» opp. Du kan forsikre deg om at testpersonen har forstått oppgaven. Minn dem på at de skal svare så raskt som mulig. Trykk «**Enter**» og oppgaven fortsetter. Oppgaven har fire pauser etter at øvingsoppgaven er gjennomført. Din oppgave er å sette testen i gang igjen etter hver pause – bortsett fra det skal du forholde deg rolig.

<u>RAN på NORSK:</u>
I denne oppgaven skal testpersonen så raskt de kan, si navnet på tall i flere tallrekker – <u>**på norsk**</u>. Instruksjonen er som følger:
«I denne oppgaven får du se mange tall på skjermen. Si på norsk, navnet på tallene - så raskt du bare kan. Du må lese fra venstre til høyre. Ikke stopp før du har lest alle tallene. Ikke stopp hvis du lese et tall feil, bare fortsett å les. Oppgaven gjøres to ganger. Du får en liten pause mellom hver oppgave.»
Du som testleder starter testen ved å trykke på «**Q**». Når du har gjort det kommer spørsmålet «Er du klar?». Hvis testpersonen er klar, trykk på «**Enter**». Med en gang testpersonen er ferdig med å lese alle tallene, trykker du som testleder på tasten «**Enter**». Ved å trykke på denne tasten stopper du tidtakingen. Deretter trykker du på et tall fra «**0 til 9**» for å markere hvor mange feil personen hadde. Når du har trykket antall feil, kommer automatisk spørsmålet «Er du klar?»
Denne oppgaven gjøres to ganger.
Trykk på «**Enter**» for å starte oppgave nummer to. Når testpersonen er ferdig, trykker du som testleder på tasten «**Enter**» for å stoppe tidtakingen og trykker inn «**0 til 9**» for antall feil personen hadde.

<u>Prosesseringshastighet: (språknøytral oppgave)</u>

Denne testen består av tre deler. Alle delene tester ulike ferdigheter knyttet til prosesseringshastighet. Det gjennomgående trekket ved alle oppgavene er at testpersonene skal svare så raskt de kan når de ser et stimuli på skjermen. Testinstruksjonen blir gitt på morsmålet til testpersonen.

Del 1:

Instruksjonen er som følger:

*«Du vil se en trekant på skjermen. Tykk på «**M**» med en gang du ser den. Trykk så raskt du kan. Trekanten vil bli synlig der du ser et kryss.*
Vi begynner med noen øvingsoppgaver.»

Trykk på «**Q**» og spørsmålet «Er du klar?» kommer frem. Hvis testpersonen er klar, trykk på «**Enter**». Oppgaven har noen øvingsoppgaver. Etter øvingsoppgavene kommer ordet «PAUSE» frem. Sjekk at testpersonen har forstått hva den skal gjøre. Trykk «**Enter**» for å fortsette.

Del 2:

Instruksjonen er som følger:

*«Du vil se en trekant eller en sirkel. Hvis du ser en trekant; Tykk på «**M**». Hvis du ser en sirkel; Trykk på «**Z**»*
Svar så raskt og riktig som du kan. Vi begynner med noen øvingsoppgaver.»

Trykk på «**Q**» og spørsmålet «Er du klar?» kommer frem. Hvis testpersonen er klar, trykk på «**Enter**». Oppgaven har noen øvingsoppgaver. Etter dette kommer ordet «PAUSE» frem. Sjekk at testpersonen har forstått hva den skal gjøre. Trykk «**Enter**» for å fortsette.

Del 3:

Instruksjonen er som følger:

«I denne oppgaven vil du se to rekker med figurer på skjermen. Du skal bestemme om rekkene er de samme eller om de er litt forskjellig. Hvis rekkene er de samme; Trykk på tasten for «Samme». Hvis rekkene er litt forskjellige; Trykk på tasten for «Forskjellig». Svar så raskt du kan.
Oppgaven har to deler. Del 1 har tre figurer i rekkene. Del 2 har seks figurer i rekkene. Du får en pause mellom hver del. Hver del har 24 oppgaver.
Figurene kommer frem der det er et kryss på skjermen. Vi begynner med noen øvingsoppgaver.»

Trykk på «**Q**» og spørsmålet «Er du klar?» kommer frem. Hvis testpersonen er klar, trykk på «**Enter**». Oppgaven har noen øvingsoppgaver. Etter dette kommer ordet «PAUSE» frem. Sjekk at testpersonen har forstått hva den skal gjøre. Trykk «**Enter**» for å fortsette.

Avslutning:
Nå er kartleggingen ferdig.
Si tusen takk til deltakeren for at hen har bidratt til denne forskningen.
Pass på at alle ark tilhørende denne kartleggingen er merket med testpersonens nummer, og at du både får sendt papirene fra DOT og resultatene fra den digitale kartleggingen til Helene Berntsen.

Resultatene av kartleggingen:
Når du er ferdig med kartleggingen må alle resultater sendes til Helene Berntsen.
Epost: helene.berntsen@uia.no Mobil: 98020339

1. Åpne minnepinnens mappe
2. Trykk på «**Helene_Tests_dev**»
3. Trykk på «**SUBJ_RESULTS**»
4. **Høyreklikk** på aktuell fil – venstreklikk på «**Send til**» - venstreklikk på «**Epostmottaker**»
5. Filen vil nå legge seg som et vedlegg i en epost. Send eposten til meg: helene.berntsen@uia.no

Hvis noe går galt underveis i den digitale kartleggingen:
Hvis noe går galt – brannalarm, eller noe annet uforutsett som skjer, og du må avbryte midt i testingen - så lar testen deg starte opp på nytt. Ved å skrive inn deltakerens identifikasjonsnummer, kommer du til oppstartsmenyen.

Du må skrive inn språket (engelsk, polsk, somalisk eller norsk) og du må oppgi om personen er høyre eller venstrehendt. Med andre ord lar dette deg starte på nytt dersom det ble trykket feil på høyre/venstrehendt.
Deretter får du tre valg:

1. Fortsette der vi stoppet (de tre siste oppgavene gjentas)

Hvis du velger dette alternativet, kommer testen til å lese testinstruksjonen på nytt. Deretter går den tre oppgaver tilbake slik at testpersonen får noen øvelsesoppgaver for å hente seg inn igjen (testpersonen møter et par oppgaver den allerede har gjort).

2. Gjøre hele den siste testen på nytt

Hvis du velger denne, vil f.eks. hele ordlesingstesten gjentas – ikke bare de resterende oppgavene.

3. Avslutte testen

Velg denne hvis du f.eks. har tastet feil identifikasjonsnummer og du trenger å starte på nytt.

4. Overskrive det forrige resultatet

Velg denne hvis du skal starte helt på nytt.

Det er også mulig å gå inn i resultatfilen og rette opp i et tall som har blitt feil – men da bør vi være veldig sikre på hva vi gjør. (F.eks. hvis du som testleder trykket på feil tast under Fonemisk bevissthet og har behov for å korrigere sånn at oppgaven blir riktig skåret).

14.12 Table of multiple regressions including dummy variables

14.12.1 Table 31 L2 word reading including dummy variables

Table 31 including dummy variables

Linear Multiple Regression Predicting L2 word reading from L1 word reading and L2 spoken proficiency

L2 word reading	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model (R^2=.666, *adj.* R^2=.643)						
Constant	-.187	-.396	.022	.105		.08
1. L1 word reading	.786	.622	.950	.082	.807	<.001***
2. L2 spoken proficiency	.339	.203	.474	.068	.377	<.001***
3. Interaction L1 word and L2 spoken proficiency	.002	-.334	-.142	.146	-.323	.973
4. Dummy Somali language	.468	.045	.889	.211	.199	.08
5. Dummy Polish language	.284	-.003	.572	.144	.157	<.05*

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

14.12.2 Table 33 L2 phonemic awareness including dummy variables

Table 33 including dummy variables

Multiple Linear Regression Predicting L2 phonemic awareness from L1 phonemic awareness (PA) and L2 spoken proficiency

L2 phonemic awareness	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model (R^2=.707, *adj.* R^2=.687)						
Constant	.273	.061	.486	.107		.01**
1.L1 phonemic awareness	.837	.682	.992	.078	.837	<.001***
2.L2 spoken proficiency	-.002	-.138	.134	.068	-.002	.98
3.Interaction L1 PA and L2 spoken proficiency	.017	-.128	.163	.073	.015	.82
4. Dummy Somali language	-.635	-1.01	-.265	.186	-.243	<.001***
5. Dummy Polish language	-.391	-.717	-.064	.164	-.194	.02*

Note. Model = "Enter" method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.

14.12.3 Table 34 RAN including dummy variables

Table 34 including dummy variables

Multiple Linear Regression Predicting L2 RAN from L1 RAN and L2 spoken proficiency

L2 RAN	***B***	**95% Confidence Interval for B**		***SE B***	***β***	***p***
		LL	UL			
Model (R^2=.673, *adj.* R^2=.645)						
Constant	.267	-.028	.561	.148		.08
1.L1 RAN	.786	.563	1.01	.112	.568	<.001***
2.L2 spoken proficiency	-.555	-.690	-.419	.068	-.599	<.001***
3.Interaction L1 RAN and L2 spoken proficiency	-.102	-.297	.094	.098	-.071	.31
4. Dummy Somali language	-.373	-.790	.043	.209	-.154	.08
5. Dummy Polish language	-.470	-.761	-.179	.146	-.252	<.002**
6. Educational level	.047	-.240	.334	.144	.024	.746

Note. Model = “Enter” method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval: LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; *β* = standardized coefficient, R^2 = coefficient of determination. *$p < .05$. ** $p < .01$. *** $p < .001$.