

*Mild Developmental Dyslexia in University Students
Diagnosis and Performance Features in L1, L2, and L3*

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Signe-Anita Lindgrén



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Abstract

Developmental dyslexia, or specific reading and writing difficulties, is a condition persisting into adulthood. In university students, dyslexic problems are generally mild, and research shows that up to half of those who experience dyslexic difficulties in higher education have no official diagnosis upon entering the university. With the high reading and writing demands in university studies, even mild and compensated dyslexia can considerably impede academic performances. The first step in providing dyslexic students with adequate support and specific accommodations is to diagnose their problems. To date, however, no standardized and normed dyslexia tests are available for high-performing students with Finland-Swedish language background. The present thesis addresses this shortage through adaptation, design, testing, and norming of diagnostic instruments for dyslexia in high-performing Finland-Swedish young adults. The basic theoretical assumption adopted in this work is the widely accepted view that weak phonological processing constitutes the core functional deficit in developmental dyslexia.

Previous research has shown that certain language-specific features such as the degree of orthographic transparency influence dyslexia manifestations. This adds to the challenge of diagnosing dyslexia in multilingual speakers. To address this issue, the present work explores signs of dyslexia in reading and writing performances of multilingual Finland-Swedish university students in three structurally different languages: English, Swedish, and Finnish.

The thesis consists of three studies. In the first study, a Sweden-Swedish dyslexia group screening test (DUVAN™; Lundberg & Wolff, 2003) was adapted to Finland-Swedish (FS-DUVAN). Normative data and relevant background information were collected among a randomly selected sample of Finland-Swedish university freshmen ($n = 129$) together with data from a group of dyslexic university students ($n = 14$). The internal reliability of the FS-DUVAN was comparable to that of the original test. Further, a low performance on the FS-DUVAN, indicating poor phonological and orthographic skills, was associated with a positive self-report on familial dyslexia and with a history of special education in school. Due to language background effects on the test performance, separate cut-off values were suggested for monolingual Swedish speakers and early simultaneous Swedish-Finnish bilinguals.

For those performing poorly in a screening, further testing is required to specify the deficit. In the second study, an extensive individual test battery was therefore compiled. This test battery was administered to 20 dyslexic Finland-Swedish university students and 20 chronological age-matched and education-matched controls with close to identical language backgrounds. The test battery encompassed reading and writing tasks, cognitive tasks relevant for dyslexia diagnosis, and questionnaires on background information. In this study, the following measures

showed to be sensitive to dyslexia: complex speeded naming; multiple phoneme manipulation; error detection in written text; accuracy in reading text aloud, single word writing to dictation, free writing; and speeded segmentation of written input. This study thus reveals several test variables on which high-performing dyslexic university students show impairment when compared to their non-dyslexic peers.

In the third study, the reading and the writing performances of the participants in Study II were examined further in their domestic languages Swedish and Finnish, as well as in the foreign language English through both within-group and between-group comparisons. In addition to overall speed and accuracy measures, detailed error analyses were conducted, which focused on features expected to reflect phonological weaknesses. The results demonstrated poorer performances in the dyslexia group in all three languages, in particular in reading and writing accuracy. Furthermore, the dyslexia group exhibited significantly higher proportions of phoneme-to-grapheme errors in writing, especially in English. In addition marginal differences in inflectional errors were observed in the dyslexia group in the morphologically least rich language, English. Hence, the dyslexic problems surfaced most clearly in the less proficient foreign language that was the orthographically most opaque and morphologically poorest language. These results show that language proficiency and orthographic depth affect the appearance of high-performing multilinguals' dyslexic problems in reading and writing.

Taken together, the results are in line with the phonological deficit hypothesis of dyslexia and confirm the existence of pervasive underlying defects in compensated dyslexia through adulthood. The findings demonstrate that dyslexic university students perform differently from their non-dyslexic peers on a number of test measures. The data reveal difficulties in reading and writing performances of dyslexic university students as disclosed in their self-reports. As compared to normal performances, multilinguals' dyslexic problems in reading and writing tasks were most clearly observed in accuracy, and in particular in English, which was the least well mastered language and also the orthographically most opaque one.

The thesis addressed the lack of diagnostic instruments for dyslexia in high-performing Finland-Swedish university students and demonstrated the necessity to carefully modify test materials when borrowing tasks from one language variety and culture to another. The three studies contribute to the development of more sensitive procedures for dyslexia testing in high-performing individuals. In addition to use in Finland-Swedish higher education, the FS-DUVAN should be a valuable dyslexia screening tool in Finland-Swedish secondary education and vocational education. The results highlight the need to take into account the language background of a multilingual individual, as well as the structure of the language(s) involved when testing for signs of dyslexia.

List of Original Publications

The present thesis is based on the following publications, which will be referred to in the text by their Roman numerals:

- I: Lindgrén, S.-A., & Laine, M. (2007). The adaptation of an adult group screening test for dyslexia into Finland-Swedish: Normative data for university students and the effects of language background on test performance. *Scandinavian Journal of Psychology*, 48, 419–432.
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- II: Lindgrén, S.-A., & Laine, M. (2011). Cognitive-linguistic performances of multilingual university students suspected of dyslexia. *Dyslexia*, 17, 184–200.
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- III: Lindgrén, S.-A., & Laine, M. (2011). Multilingual dyslexia in university students: Reading and writing patterns in three languages. *Clinical Linguistics & Phonetics*, 25, 753–766.
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Author's Contribution

The first author adapted, designed and pilot tested the tasks in the three studies, and contacted the DUVAN™ constructors; recruited and contacted the participants, arranged the testings, assembled the input data, and did the archive searches for the background data. She collected the data for Study I and, together with the second author, supervised the testings for Study II and III. She fed the data into SPSS and performed the statistical analyses. She wrote and edited the manuscripts. The authors jointly discussed the design, the results and the implications, as well as read and approved the final manuscripts of the three articles.

1 Introduction

Developmental dyslexia, or specific reading and writing difficulties, is considered the most common handicap in the Western world (von Euler, 1996, p. 214). The prevalence estimates given for the general population in different countries with alphabetic languages vary between 5 and 15 percent (e.g., Brunswick, 2010, p. 140). For university students, the dyslexia prevalence is estimated to be around 2% (e.g., Stampoltzis & Polychronopoulou, 2008; Wolff & Lundberg, 2002). Reports from Finland, England, and Sweden show that 25% to 60% of student contacts with coordinators for students with disabilities in higher education were attributable to developmental dyslexia (Mortimore & Crozier, 2006; Pietilä, 2008; Svalfors, 2011). While both research and practical and clinical work on developmental dyslexia (henceforth dyslexia) have focused mainly on school-aged children (cf. e.g., Goulandris, 2005b; Hjelmquist & von Euler, 2002; Smythe, Everatt, & Salter, 2004; Snowling & Stackhouse, 2006), dyslexia clearly constitutes a challenge also to adults (e.g., Gilroy & Miles, 2001; Reid & Kirk, 2001; Vogel, Vogel, Sharoni, & Dahan, 2003). Research has confirmed that dyslexia is a condition that persists into adulthood (e.g., Elbro, Nielsen, & Petersen, 1994; Olofsson, 2002; Vellutino, Fletcher, Snowling, & Scanlon, 2004), also in compensated dyslexics in higher education (e.g., Bruck, 1990; Wolff, 2009). Early diagnosis and intervention of dyslexia is extremely important, but mild deficits may not always surface until later when reading and writing demands increase markedly, as is the case with university studies (e.g., Hanley, 1997; Mortimore, 2003, pp. 75–78; Mortimore & Crozier, 2006). Even mild and compensated dyslexia has thus been found to impede university studies considerably (e.g., Gilroy & Miles, 2001; Mortimore & Crozier, 2006; Wolff, 2006). The present research examines the occurrence and performance features of developmental dyslexia at the highest educational level, that is, among university students.

Several studies show that not all students whose performance is affected by dyslexia are identified prior to entering higher education (cf. Hanley, 1997; Parrila, Georgiou, & Corkett, 2007; see also e.g., Löwe & Schulte-Körne, 2004). This may be due to several factors such as the appearance of compensatory and avoidance strategies in milder forms of dyslexia, or to the lack of appropriate assessment instruments (cf. Frith, 1999; Niemi, 1998). Particular stumbling blocks seem to be foreign language classes (e.g., Downey, Snyder, & Hill, 2000; Ganschow & Sparks, 2000; Niemi, 1998), thesis writing, and, for Finland, also the university maturity test linked to the B.A. thesis or the M.A. thesis (e.g., Taskinen, 2008). Diagnosing dyslexia in a foreign language learner and a multilingual student is, however, not straightforward.¹ It is challenged, for instance, by variations in proficiency levels, by the difficulty in distinguishing between performance features that emerge from

¹ For a discussion on *multilingualism* and *bilingualism*, see e.g., Bialystok (2001, pp. 1–20). For a comprehensive description of the language situation in Finland, see e.g., Ringbom (1987, pp. 5–23).

the normal foreign language learning process and natural language use from those due to dyslexia, and by the linguistic demands posed by different orthographies (e.g., Everatt et al., 2010; Oren & Breznitz, 2005). For example, in case studies with multilinguals, manifest dyslexic difficulties have been observed in one language but not in another (cf. e.g., Meara, Coltheart, & Masterson, 1985; Wydell & Kondo, 2003; see also Everatt et al., 2010). Such observations have highlighted the importance of taking into account multilingualism and the structural features of the languages involved when diagnosing dyslexia.

In general, more dyslexia studies have focused on reading than on spelling and writing. Interviews and self-report studies of dyslexic university students show, however, that these students experience difficulties in writing as well (e.g., Gilroy & Miles, 2001; Mortimore & Crozier, 2006; Wolff, 2006). In fact, it has been noted that reading ability in dyslexics may improve over time whereas writing skills often remain poor (Høien & Lundberg, 2000, pp. 8, 63). Besides, in many languages such as in English and Swedish, writing poses higher demands on phonological skills than reading does (cf. e.g., Caravolas, 2007, p. 338; Goulandris, 2005a, p. 12; Høien & Lundberg, 2000, p. 63). This thesis therefore explores both reading and writing performances.

The present research had three aims. The first aim was to devise a diagnostic test instrument for multilingual Finland-Swedish university students for clinical use. To date, no standardized and normed test instruments for dyslexia have been available for the present target population, young Finland-Swedish adults. The second aim was to identify linguistic and cognitive measures that differentiate high-performing Finland-Swedish dyslexic university students from matched non-dyslexic peers. The identification of such measures is crucial for diagnostic purposes. The third aim was to examine the manifestations of dyslexia in reading and writing performances of multilingual Finland-Swedish dyslexic and non-dyslexic university students in three languages that differ in terms of structural features such as orthographic depth and morphological complexity, as well as in the proficiency levels exhibited by the participants. The languages included were the domestic languages Swedish (L1/L2) and Finnish (L1/L2), and one foreign language, English (L3)

2 Dyslexia

In this thesis, *dyslexia* refers to *developmental dyslexia*, which is differentiated from *acquired dyslexia* where normally developed reading skills become impaired due to brain injury or neurological disease. In accordance with common practice, developmental dyslexia is here taken to entail not only reading difficulties but also *dysgraphia*, that is, disorders of writing skills (cf. e.g., Høien & Lundberg, 2000, pp. 8, 63). In the following, the multifaceted nature of dyslexia is considered first.

The basic assumption adopted in many dyslexia studies, including the present one, is that at the cognitive level, the essential problem that leads to dyslexia is a phonological deficit (cf. e.g., Høien & Lundberg, 2000, pp. 8–9; Lyon, Shaywitz, & Shaywitz, 2003). This discussion is then followed by a short review of common test methods used to diagnose dyslexia, and the manifestations of dyslexia in different orthographies.

2.1 The Multifaceted Nature of Dyslexia

The multifaceted nature of dyslexia is illustrated clearly in the influential three-level framework presented by Morton and Frith (e.g., Frith, 1997, 1999; cf. also Lundberg, 1999). This framework captures dyslexia from the biological, the cognitive, and the manifest (behavioral) perspectives. The three levels are in interaction with individual, societal, and cultural factors such as print exposure, family support, education, and language background, to name a few (Frith, 1997, 1999; cf. Lundberg, 1999; see also Svensson, 2003, p. 32; cf. further e.g., Ramus, 2004).

Although dyslexics show considerable individual variation across all the levels, research focusing on the biological level has revealed systematic differences in the brain structure between dyslexics and non-dyslexics, as well as in functional neural measures, when subjects perform linguistic tasks (e.g., Paulesu, Brunswick, & Paganelli, 2010; Lishman, 2006). Findings from studies like these extend across cultures and orthographies, suggesting a universally shared neurocognitive basis for dyslexia (Paulesu et al., 2001; Paulesu et al., 2010). Moreover, genetic studies and research into hereditary dispositions show that children born into dyslexic families run an increased risk of becoming dyslexic (e.g., Puolakanaho et al., 2007; see also e.g., Galaburda, LoTurco, Ramus, Fitch, & Rosen, 2006; Pennington & Olson, 2007; Schulte-Körne, 2007; Vellutino et al., 2004).

Regarding the cognitive level, research has revealed a number of domains where dyslexics differ from their non-dyslexic peers (for a review, see e.g., Reid & Fawcett, 2004, pp. 3–8; see also Vellutino et al., 2004). Of particular interest here are studies that have shown impairments in encoding, decoding, manipulating and retaining of phonological information (e.g., Hatcher, Snowling, & Griffiths, 2002; Leinonen et al., 2001; Olofsson, 2002; Parrila et al., 2007; Reid, Szczerbinski, Iskierka-Kasperek, & Hansen, 2007; Snowling, Nation, Moxham, Gallagher, & Frith, 1997; Wilson & Lesaux, 2001; Wolff, 2009). Findings like these have led to the assumption that a phonological deficit lies at the core of most cases of dyslexia (cf. e.g., Frith, 1997, 1999; Høien & Lundberg, 2000; Lundberg, 1999; Lyon et al., 2003; Stanovich, 1988; Vellutino et al., 2004; see also e.g., Ramus, 2001b; 2004). In brief, according to this hypothesis, impaired processing of the sounds of words leads to inaccurate phonological representations, which in turn cause difficulties in phonological-orthographic-phonological mappings. A phonological deficit would also have a

negative impact on the ability to retain and manipulate auditory-phonological information in working memory (cf. Ramus, 2004).

The specification of what constitutes *phonological ability* varies somewhat between studies. Phonological ability has been construed, for instance, through the three following concepts: *phonological awareness*, *phonological representation*, and *phonological working memory*, all of which have evidenced impairment in dyslexia (e.g., Lundberg & Wolff, 2003; see also e.g., Everatt et al., 2010; Ramus, 2001a; 2004). Phonological awareness represents the ability to identify and distinguish the sequence of sounds and letters in a word, to discriminate and exchange specific sounds in a word, or to decode unfamiliar words or pseudowords (cf. Lundberg & Wolff, 2003, p. 20). Phonological representation entails a mental representation of a spoken unit or word, enabling one to distinguish, for instance, between phonologically similar words like *execution* and *excursion* (cf. Lundberg & Wolff, 2003, p. 20; see also Elbro, 1996, on the hypothesis about the distinctness of phonological representations; cf. Elbro, 1998). Phonological working memory, specifically the phonological loop, is a capacity-limited, temporary short-term storage, which is essential for receiving, initially analyzing, and processing sounds (cf. Lundberg & Wolff, 2003, pp. 20, 21; see also Baddeley, 2003; Baddeley, Gathercole, & Papagno, 1998). The phonological loop is challenged in situations, for instance, where one tries to memorize a set of numbers such as a telephone number, and simultaneously answer a question (cf. Lundberg & Wolff, 2003, pp. 20–21). There is a discussion about the relationship between *orthographic skill* and phonological skill concerning the independence of the former (cf. e.g., Bekebrede, van der Leij, & Share, 2009; Burt, 2006). Nevertheless, tasks tapping orthographic skill are usually included in dyslexia testing (e.g., Lundberg & Wolff, 2003). Orthographic skill refers to the ability to form, store and access orthographic representations (cf. e.g., Burt, 2006), and is needed, for instance, for distinguishing between visually presented correctly and incorrectly spelled words like *doctor* vs. *doktor* (cf. e.g., Lundberg & Wolff, 2003). Further, tasks assessing *phonological recoding in lexical access*, or *lexical retrieval*, like naming and fluency, are also standard elements of much dyslexia testing (e.g., Ramus, 2004; Wilson & Lesaux, 2001; for a review of the double-deficit hypothesis, which separates naming-speed deficits from phonological deficits, see e.g., Vukovic & Siegel, 2006). Concerning the present target population, problems related to the above abilities have been observed in previous studies of dyslexic university students, albeit the measures, tasks, samples, and L1 backgrounds vary (e.g., Hatcher et al., 2002; Laasonen, Service, & Virsu, 2001; Olofsson, 2002; Parrila et al., 2007; Reid et al., 2007; Snowling et al., 1997; Wilson & Lesaux, 2001; Wolff, 2009; Wolff & Lundberg, 2002).

At the manifest level, dyslexia problems surface as various difficulties in reading and writing tasks (e.g., Gilroy & Miles, 2001; Mortimore & Crozier, 2006; Wolff, 2006). Research has demonstrated contrasting performances in reading and writing quality and quantity between dyslexic and non-dyslexic university students and

high-performing adults (e.g., Coleman, Gregg, McLain, & Bellair, 2009; Connelly, Campbell, MacLean, & Barnes, 2006; Leinonen et al., 2001; Pennington et al., 1986; Sterling, Farmer, Riddick, Morgan, & Matthews, 1998; Wengelin & Strömquist, 2000). Furthermore, manifestations have also been found to vary across languages differing in orthographic depth (e.g., Brunswick, McDougall, & de Mornay Davies, 2010). These issues are discussed further in sections 2.2 and 2.3 below.

In addition to the three levels, the issue of dyslexia is complicated further by the fact that its severity is best represented as a continuum that ranges from *mild* to *severe* deficits (cf. e.g., Frith, 1999; see also Frith, 2001). Generally, dyslexia in high-performers positions more towards the mild end of the dyslexia continuum, which in turn poses demands on the sensitivity of dyslexia test instruments. Furthermore, dyslexia symptoms may change over time reflecting both a general cognitive development and an increased use of compensatory strategies (e.g., Frith, 1999; Goulandris, 2005a). The three studies in this thesis addressed dyslexia testing and manifestations of dyslexia at the cognitive level (primarily Studies I and II) and at the manifest level (primarily Studies II and III).

2.2 Testing for Dyslexia

Given the prominent position of the phonological deficit hypothesis in dyslexia research, tasks tapping phonological processing play a central role in diagnostic instruments for dyslexia. Typical phonological tests include identification and manipulation of phonemes as, for instance, in discrimination between phonologically confusing items, pseudoword decoding, and spoonerisms (e.g., Hatcher et al., 2002; Høien & Lundberg, 2000; Ramus, 2001a; Snowling et al., 1997; Wilson & Lesaux, 2001). Naturally enough, dyslexia tests also tap various aspects of reading and writing performances like speed, accuracy, and reading comprehension (e.g., Hatcher et al., 2002; Høien & Lundberg, 2000; Ramus, 2001a; Snowling et al., 1997; Wilson & Lesaux, 2001). Other commonly included cognitive tasks are tests on working memory, visual confrontation, lexical retrieval, naming, and rapid automatized naming (e.g., Frith, 1999; Hatcher et al., 2002; Høien & Lundberg, 2000; Ramus, 2001a; Snowling et al., 1997; Snowling, 2000; see also e.g., Fawcett, 2003; Holopainen, Kairaluoma, Nevala, Ahonen, & Aro, 2004; Nevala, Kairaluoma, Ahonen, Aro, & Holopainen, 2006). Furthermore, measures of attention and executive function may also be included, as these can intervene with reading and writing (e.g., Hagin, 2003; Høien & Lundberg, 2000, pp. 11, 167).

An example of a dyslexia test based on the phonological deficit hypothesis is the DUVANTM test, a Sweden-Swedish dyslexia group screening test for adults and young adults (Lundberg & Wolff, 2003). The test taps phonological awareness, the quality of phonological representations, as well as phonological working memory function, and orthographic skill (Lundberg & Wolff, 2003). It also includes a self-report questionnaire on dyslexic symptoms and reading interests and habits

(Lundberg & Wolff, 2003). In the present research, this test was adapted to Finland-Swedish (Study I) and is described further in 4.2.1 below.

Self-reports have proven to be an important source of information when probing for dyslexia in adults (e.g., Lefly & Pennington, 2000; Parrila et al., 2007; Schulte-Körne, Deimel, & Remschmidt, 1997). Firstly, they can reveal dyslexic high-performers, who may not have a previous diagnosis but nevertheless exhibit subjective symptoms implying dyslexia. Secondly, self-reports may be the only option in substantiating a diagnosis in circumstances where no standardized and normed test instruments are available for the specific target group. Also in the present research, the self-report played an important role in assigning the participants into the study groups.

Some dyslexia investigations have focused on reading and writing errors to single out specific aspects of dyslexia (e.g., Moats, 1996; Wengelin, 2002).² These examinations are relevant both for developing further measures sensitive to dyslexia in high-performers (cf. Coleman et al., 2009) and for remediation and accommodations (cf. Coleman et al., 2009; Wengelin & Strömquist, 2000; Wilson & Lesaux, 2001). Research on the writing process has, for instance, revealed that dyslexic adults are preoccupied by word-level issues like spelling and spelling errors to a much greater extent than non-dyslexic writers, and that this has an unfavorable influence on higher-level aspects of the writing process like structuring information (Wengelin, 2002; Wengelin & Strömquist, 2000³). Certain errors and error patterns can thus reflect lower-level deficits that, in turn, might affect higher-level writing processes (cf. e.g., Connelly et al., 2006; Sterling et al., 1998). An in-depth analysis of specific spelling errors is particularly relevant in investigating dyslexia in high-performers where the linguistic deviations at the surface of a text may be very subtle, yet indicating dyslexic difficulties. For dyslexia research and diagnostics, Moats (1993, 1996) emphasized the relevance of error types that could be related more directly to the hypothesized underlying phonological processing deficit of dyslexia, also including errors on morphology (for a review on morphology and dyslexia, see e.g., Deacon, Parrila, & Kirby, 2008; cf. also e.g., Coleman et al., 2009; Fischer, Shankweiler, & Liberman, 1985; Pennington et al., 1986; Sterling et al., 1998). In the present research, the line of analysis presented by Moats was followed. However, the thesis extended the analyses to include controls and high-performing university students, and it explored performances not only in one language but in three languages, which, moreover, differ in both orthographic depth and morphological richness.

² For *errors* and *error analysis*, see e.g., Ellis (2008, pp. 47–66).

³ Wengelin (2002) and Wengelin and Strömquist (2000) based their observations on ScriptLog data. ScriptLog is a computer program that records keyboard presses and their latencies when writing on a computer. Thereby temporal patterns, pauses, and editing operations relevant for text production processes can be investigated (Wengelin, 2002, pp. 107–108).

2.3 Manifestations of Dyslexia in Different Orthographies

Although some studies have found that dyslexia shares the same core features at the biological level and the cognitive level irrespective of language and culture (e.g., Paulesu et al., 2010), its prevalence estimates vary between countries and languages (e.g., Brunswick, 2010; Paulesu et al., 2010). This variation has been ascribed to differences in definitional criteria and to variations due to the depth of orthography⁴ (e.g., Brunswick, 2010; Paulesu et al., 2010; cf. the orthographic depth and the script dependent hypotheses, e.g., in Oren & Breznitz, 2005). Higher estimates of the dyslexia prevalence have been reported for writing systems with relatively inconsistent sound-letter correspondences than for writing systems with more consistent mappings. For instance, a dyslexia prevalence estimate of 10% has been given for English, a deep orthography (Brunswick, 2010, p. 141), 2–8% for Swedish, an intermediate orthography (Jacobson, 2006), and 6–7% for Finnish, a shallow orthography (Taskinen, 2008; cf. Seymour, Aro, & Erskine, 2003).

Orthographic depth has been found to influence reading speed as well as reading and writing accuracy in both beginning readers (e.g., Brunswick et al., 2010; Everatt & Elbeheri, 2008; Seymour et al., 2003) and advanced dyslexic and non-dyslexic readers (e.g., Brunswick et al., 2010; Paulesu et al., 2010). Cross-language studies have indicated that inaccurate decoding and slow reading are typical manifestations of dyslexia in deeper orthographies where the phoneme-grapheme mappings are more challenging (cf. English); in more transparent orthographies, dyslexia has been characterized by slow and effortful reading, rather than poor accuracy (cf. Finnish; e.g., Brunswick, 2010; Goulandris, 2005b; Paulesu et al., 2010). In moderately transparent orthographies, difficulties manifest in both impaired accuracy and reduced reading speed, although to a lesser extent than in more opaque orthographies (cf. Swedish; e.g., Brunswick et al., 2010; Goulandris, 2005b). This implies that the Finnish orthography, which has a more or less one-to-one mapping between phonemes and graphemes, may in this respect be less demanding for dyslexics than English or Swedish (cf. Paulesu et al., 2010). However, Finnish utilizes other features that may challenge an impaired phonological system. One such feature is phoneme duration, which carries a semantically discriminating function in Finnish (cf. e.g., Lyytinen, Leinonen, Nikula, Aro, & Leiwo, 1995). Another feature is the overall high Finnish word length, which may challenge phonological working memory capacities (cf. Brunswick, 2010; Everatt et al., 2010). Finnish word length often reflects the complex morphological structure of the language (cf. Karlsson, 1983, e.g., pp. 356–357).

⁴ *Orthographic depth* refers to the continuum of predictable, one-to-one correspondences between sound and letter and complex mappings of, for instance, one-to-many (cf. e.g., Brunswick, 2010, pp. 131ff.). In accordance with Goulandris (2005a, p. 1), the present research uses orthographic depth and *level of transparency* interchangeably.

Recently, the effect of orthographic depth on dyslexia has also been documented in multilingual individuals and foreign language learners (e.g., Brunswick et al., 2010; Goulandris, 2005b). In analogy to monolingual cross-language research (e.g., Goulandris, 2005b), studies have, for instance, shown that multilingual dyslexics encounter more difficulties in deeper orthographies than in more shallow ones (e.g., Oren & Breznitz, 2005; Wydell & Kondo, 2003). The multilingual picture is complicated further by difficulties in distinguishing between errors due to dyslexia from those related to lower levels of proficiency or to the normal language learning process (e.g., Ganschow & Sparks, 2000). In a similar way, a dyslexic individual can be challenged in foreign language learning (e.g., Meara et al., 1985; but see also Miller-Guron & Lundberg, 2000⁵). Ganschow, Sparks and colleagues have repeatedly shown that problems that dyslexic students experience with foreign languages can be traced back to difficulties in native language abilities (for a summary, see e.g., Ganschow & Sparks, 2001; see also e.g., Sparks, Patton, Ganschow, Humbach, & Javorsky, 2006; for the linguistic coding differences hypothesis, LCDH, see Sparks, 1995; see also the interdependence hypothesis and the central deficit hypothesis, e.g., Oren & Breznitz, 2005). Much L1 experience and training, as well as an efficient use of compensatory strategies can, however, disguise underlying dyslexic deficits in the L1 particularly in high-performing university students. Yet in foreign language learning and usage, these individuals may fall short and underachieve due to both dyslexic deficits and to the lack of appropriate compensatory strategies. It is thus not uncommon that dyslexic difficulties in university students are recognized for the first time when the learner encounters difficulties in university foreign language classes or when they try to fulfill university foreign language requirements (cf. e.g., Downey et al., 2000; Ganschow & Sparks, 2000; Niemi, 1998). In the present research, which deals with multilingual dyslexic university students, specific performance features in the L1, L2 and L3 are explored. The three languages studied differ in orthographic depth, morphological richness and in terms of the participants' language proficiency levels.⁶

⁵ The Miller-Guron and Lundberg (2000) study is remarkable for identifying a small group of dyslexic L1 Swedish speakers who preferred reading in English (deep orthography) to reading in their L1 (shallower orthography) and who outperformed dyslexic L1 Swedish speakers preferring L1 reading on English literacy tasks. The authors tentatively attributed this to the use of different reading strategies and to effects of positive early reading experiences, among other factors. However, Miller-Guron and Lundberg (2000) did not attempt to estimate how common this phenomenon is amongst dyslexic speakers.

⁶ For a brief description of Swedish and Finnish, see e.g., Ringbom (2007, pp. 37–38), for Sweden-Swedish and Finland-Swedish pronunciation, Kuronen and Leinonen (2010).

3 Aims

The aims of the present thesis are as follows:

- (i) To adapt a Sweden-Swedish dyslexia group screening test for use among Finland-Swedish young adults and adults, and secondly to collect normative data from Finland-Swedish university students, a high-performing population (Study I).
- (ii) To identify linguistic and cognitive measures sensitive to dyslexia that differentiate a group of high-performing multilingual Finland-Swedish dyslexic university students from matched non-dyslexic peers (Studies II and III).
- (iii) To explore language-specific behavioral manifestations of dyslexia in a group of Finland-Swedish university students in reading and writing tasks that cover the participants' domestic languages Swedish and Finnish, and the foreign language English (Studies II and III).

4 Methods

4.1 Participants

The participants were all university students. Study I prompted the use of a random selection procedure for the main sample of the study, as normative data were collected. Studies II and III employed a natural groups design to compare performances of high-performing dyslexics with those of age-matched and education-matched normal controls. All participation was voluntary and each participant signed a written consent form for the data to be used for research purposes. The participants were recruited among Finland-Swedish students at Åbo Akademi University. As parts of the testing materials were being developed for the studies, a number of university students and colleagues participated in pilot tests. In the following sections, the participants of the three studies are briefly presented; for details, see Studies I–III. The participants in Studies II and III are the same.

4.1.1 Study I

The participants in Study I consisted of two groups: a randomly selected sample of full-time university freshmen registered with Swedish or Finnish as their mother tongue (L1) and a sample of dyslexic university students, see Table 1.

Table 1. Background Characteristics for the Participants in Study I

	Randomly selected sample	Dyslexia sample
Total <i>n</i> of the tested individuals	129	14
Gender, female/male	93/36	11/3
Registered mother tongue, Swedish/Finnish	108/21	14/ –
Age, <i>M</i> (<i>SD</i> , range)	20.6 (3.5, 18–45)	26.5 (5.9, 20–44)
Matriculation Examination ^a , <i>M</i> (<i>SD</i> , range)	4.9 (0.8, 3.0–6.7)	4.7 (1.2, 3.0–7.0)

^aThe grades are 1–7 (1 = fail, 7 = pass with distinction). All of the dyslexics and 125 of the randomly selected sample had taken the Matriculation Examination. (The Matriculation Examination is taken at the end of upper secondary school and includes several different subjects and subexaminations.)

There were 341 randomly selected students invited to the study, of which 129 participated (37.8%). Analyses of the subject loss did not reveal any major bias in the selection. The criterion for inclusion in the dyslexia sample was a self-report given by the participants that they had been identified as dyslexic by a psychologist or a teacher. In addition to these students ($n = 14$), another 12 participants from the randomly selected and tested individuals fulfilled the same criterion for inclusion in the suspected dyslexia group through their self-report in the test (dyslexics total $n = 26$; non-dyslexics $n = 117$). The data were also analyzed with respect to the participants' language background. For a monolingual vs. bilingual categorization, all participants who had been raised in an environment where the L1 of both parents and of daycare was either Swedish or Finnish only, and where the parents and the child had used only this language in their communication until school-starting age were assigned to the monolingual Swedish language group or to the monolingual Finnish language group (57 Swedish-speaking non-dyslexics, 13 Swedish-speaking dyslexics, 16 Finnish-speaking non-dyslexic, no Finnish-speaking dyslexics). The bilingual group included early simultaneous bilinguals who had grown up with each parent speaking their own L1 (Swedish/Finnish) to the child. The child may have used either Swedish or Finnish or both with their parents, as well as have attended either a Swedish- or a Finnish-language kindergarten/day care (21 bilingual non-dyslexics, 9 bilingual dyslexics).

4.1.2 Studies II and III

The participants in Studies II and III comprised a group of Åbo Akademi University students with previously established dyslexia ($n = 20$) and a control group of non-dyslexic peers ($n = 20$) matched on age, gender, faculty, and language background (Table 2). The inclusion criteria for the dyslexia group were either poor performance

on the FS-DUVAN dyslexia screening test when compared to norms and/or a self-report of a previous dyslexia diagnosis as identified by a teacher or a psychologist.

Table 2. Background Data for the Participants in Studies II and III

	Dyslexia group		Control group		
Total <i>n</i>	20		20		
Gender, female/male	13/7		13/7		
Registered mother tongue, Swedish/Finnish	17/3		17/3		
	<i>M (SD)</i>	Range	<i>M (SD)</i>	Range	<i>p</i> -value ^a
Age	24.2 (2.8)	19–30	24.5 (3.0)	19–29	n.s.
The FS-DUVAN	161.4 (26.6)	127–221	214.2 (28.0)	149–265	<0.001
<i>Self-assessment of language skills</i>					
L1 Swedish/Finnish	21.8 (2.9)	13–24	22.8 (2.0)	18–24	n.s.
L2 Finnish/Swedish	18.6 (4.3)	8–24	19.2 (4.6)	10–24	n.s.
Swedish	20.7 (3.7)	13–24	22.2 (2.6)	16–24	n.s.
Finnish	19.6 (4.2)	8–24	19.8 (4.7)	10–24	n.s.
English (<i>n</i> = 20/19)	18.2 (4.7)	9–24	19.8 (3.4)	14–24	n.s.
<i>Matriculation Examination (n = 19/19)</i>					
Mother Tongue Test	3.8 (1.2)	2–6	5.2 (1.3)	3–7	0.004
Second Domestic Language Test	4.4 (1.6)	2–7	4.6 (1.8)	2–7	n.s.
First Foreign Language Test (English)	4.8 (0.9)	3–7	5.6 (1.2)	3–7	0.015
General Studies Test	4.4 (1.2)	2–7	4.8 (1.3)	2–6	n.s.

Note. The *n* is given separately for those tests where the number of participants per group differs from 20. n.s., not statistically significant.

^aMann-Whitney.

The language skills of the participants were estimated using both subjective and objective measures (Table 2). No statistically significant group differences occurred with regard to self-assessed current language skills. The controls but not the dyslexics estimated their Swedish skills significantly higher than their Finnish skills, and both groups ranked their Swedish skills significantly higher than their English skills. Both groups also assessed their English skills as similar to their Finnish skills. In the objective assessment, the National Matriculation Examination, the grades showed that the dyslexia group had performed significantly less well in the Mother Tongue Test and in the First Foreign Language Test (here English) than the controls (Table 2).

4.2 Materials

In Study I, the focus was on adapting an existing Sweden-Swedish group screening test to Finland-Swedish, and on collecting normative data from young Finland-Swedish high-performing adults. Below brief descriptions are given of the screening test, its adaptation, and the supplementary background questionnaire used. Studies II and III aimed at exploring cognitive performances and linguistic performances in high-performing multilingual Finland-Swedish dyslexics in an attempt to find sensitive diagnostic tests for this group and to explore their language performances in different languages. For these purposes, an extensive individual test battery was compiled. The test battery is briefly presented below.

4.2.1 The Dyslexia Group Screening Test, the FS-DUVAN (Study I)

The Finland-Swedish DUVAN (FS-DUVAN) was adapted from the Sweden-Swedish group screening test for adults and young adults (DUVAN™) developed by Ulrika Wolff and Ingvar Lundberg (Lundberg & Wolff, 2003; Wolff & Lundberg, 2003). The test battery is based on the phonological deficit hypothesis of dyslexia. It consists of a self-report and five subtests that tap cognitive functions relevant for reading and writing: phonological awareness, phonological representation, phonological working memory, and orthographic skill (Lundberg & Wolff, 2003). Figure 1 relates the subtests to the cognitive functions that they are expected to tap (Lundberg & Wolff, 2003; see further section 2.1 page 16 above). A description of each subtest is given in Table 3. The screening test has an administration time of approximately 40 minutes and all tasks are completed with pencil and paper in a test booklet.

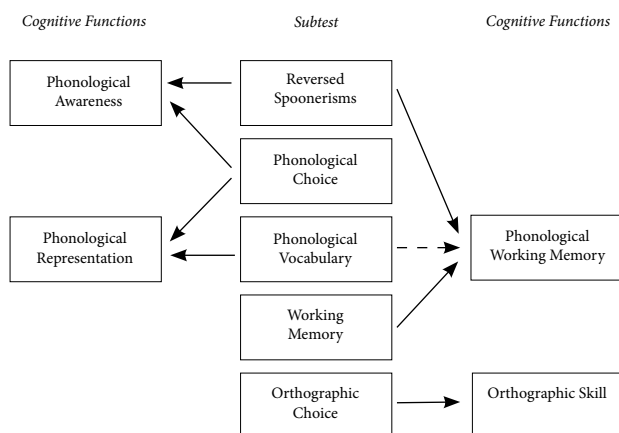


Figure 1. Cognitive Functions Tapped by the FS-DUVAN Subtests (cf. Lundberg & Wolff, 2003, pp. 20–22)

Table 3. Contents of the FS-DUVAN Group Screening Test

Subtest	Description	Points
A. Self-report	6 statements on reading interest and habits	24
	15 statements related to dyslexia in L1	60
	4 statements related to dyslexia in L2	16
	4 statements related to dyslexia in FL	16
	1–4 Likert item response	
B. Working Memory	6 tasks increasing in difficulty. Listen to and remember a letter, listen to a sentence, answer a question by showing a yes or no sign, listen to and retain a new letter etc. After 2-3-4 such series, write down the retained letters. Each series is presented once, from a CD. Time restricted.	36
C. Phonological Vocabulary	14 items in a multiple choice format with one target word and two phonologically confusing alternatives. Mark the synonym of each item.	14
D. Reversed Spoonerisms	24 reversed spoonerisms. Listen to two pseudowords once from a CD. Silently exchange the initial sounds and mark the picture of three that corresponds to the new word/word pair. Time restricted.	24
E. Phonological Choice	Three orthographic pseudowords per row. Mark the one that sounds like a real Swedish word. Mark as many as possible in 2 min.	60
F. Orthographic Choice	One lexical word per row, once correctly spelled in Swedish, twice misspelled, i.e. three items. Mark the one correctly spelled per row. Mark as many as possible in 2 min.	99
Summative score	Including A L1, B, C, D, E, F	293

Note. L1, mother tongue; L2, second domestic language; FL, foreign language; cf. Lundberg and Wolff (2003, pp. 10, 24–27).

In the adaptation of the DUVAN™ to Finland-Swedish, the aim was to make as few changes to the original as possible, yet make it valid and reliable for use in Finland-Swedish. To ensure a full understanding of the background of the test and of the compatibility between the test versions, the test adaptation was conducted in collaboration with the authors of the original test. The changes involved several details related to cultural, linguistic, and technical aspects. A small number of improvements were also made in linguistic and technical matters, and questions concerning strategy use were added. All changes were based on detailed analyses of each subtest and extensive piloting with Finland-Swedish individuals; for further details on the adaptation, see Study I.

4.2.2 Background Information (Study I)

A questionnaire of background information was compiled. It covered personal details, details on language background, language studies, a subjective evaluation of one's language proficiency (cf. Portin & Laine, 2001), and questions on dyslexia in the family and on one's history of special education in school. The administration time was 15 minutes.

Grades from the Matriculation Examination and the Final School Record from upper secondary school were obtained from the university database and archives. Due to varying entrance requirements and fields of study, not all records were available for all participants.

4.2.3 The Individual Test Battery (Studies II and III)

The test battery used for Studies II and III was aimed at measuring four different aspects relevant for dyslexia diagnosis: (i) background information retrieved through self-reports, (ii) indices of dyslexia in reading and writing tasks, (iii) cognitive functions related to reading and writing, and (iv) other cognitive functions that are important in determining the specificity of reading and writing problems. The FS-DUVAN was also administered to those participants that had not participated in Study I.

The tasks of the individual test battery consisted of both well-known, established test tasks used in dyslexia research, some of which were translated and adapted into Swedish and Finnish, as well as of tasks constructed specifically for the present research. The testing time was approximately five hours.

4.2.3.1 Self-Reports

The self-reports covered personal details, questions on dyslexia, reading and writing, study habits, and handedness (Table 4), and provided additional information to what was gathered in connection with the FS-DUVAN testing in Study I. Except for Vinegard's (1994) check list for dyslexia in adults and the handedness questionnaire (Oldfield, 1971), which were translated into Swedish, all material was designed for the present thesis.

4.2.3.2 Reading and Writing Tasks

A number of reading and writing tasks were included to measure decoding accuracy of words and pseudowords in isolation and in context, oral reading speed, and error detection skills (see Table 5). Syntactic and semantic skills were also tapped in the proofreading task and in the sentence chains of the Reading Chain Test (Jacobson, 2001). A reading comprehension task was designed to measure comprehension skills and speed. To measure coding accuracy, single word dictation tests and free writing tasks were included. In free writing, production was measured. The dictation tasks were digitally recorded with female native speakers

of English, Finland-Swedish and Finnish, who all used a standard pronunciation. Except for the Reading Chain test in Swedish (Jacobson, 2001), all materials were developed for the present thesis.

4.2.3.3 Tests Tapping Dyslexia-Related Cognitive Functions

In addition to reading and writing tests, the test battery included cognitive tasks that were considered sensitive to an underlying phonological impairment in dyslexia (cf. e.g., Hatcher et al., 2002; Høien & Lundberg, 2000; Ramus, 2001a). The tasks tapped word retrieval skills and word fluency, verbal working memory, as well as phoneme manipulation. The tests are presented in Table 6; for further details, see in particular Study II.

For rapid automatized naming (RAN), Ahonen, Tuovinen, and Leppäsaari (2003) was used. The Swedish version and the English version of the BNT visual confrontation naming task were a translation of the Finnish BNT (Boston Naming Test; Laine, Koivuselkä-Sallinen, Hänninen, & Niemi, 1997). Similarly the Swedish version of the Digit Span test was a translation of the Finnish test (Wechsler, 1996). The phoneme segmentation and deletion task was adapted from German (Gregg & Romonath, 2003) and digitally recorded with a Finland-Swedish female native speaker, who used standard Finland-Swedish pronunciation.

Table 4. Contents of the Individual Test Battery: The Self-Reports

Tasks	Description
Extended self-report questionnaire	
Personal details	E.g., age, language background.
General dyslexia section	E.g., previous testing, accommodations, current situation.
Reading and writing	E.g., acquisition, past and present experiences in education, habits.
Current study strategies	E.g., course selection, the use of speech recognition programs, voice recorders.
The Revised Adult Dyslexia Check List	12 yes-no questions adapted to Swedish.
The Edinburgh Handedness Inventory	12 questions on which hand/hands are used for specific manual tasks.

Table 5. *Contents of the Individual Test Battery: The Reading and the Writing Tasks*

Tasks	Description	Scoring
Pseudoword reading	Read a list of 10 items aloud. Different lists for English, and Swedish/Finnish.	Accuracy/second
Text reading	Read passages aloud with a correct, normal pronunciation and intonation, preferably at good speed, yet at your own pace. Different texts for each language, i.e. English, Swedish, and Finnish.	Accuracy, error scoring, speed
The Reading Chain test	2 min time for each part. Different chains for each language.	
Word chains	Separate 64 chains of each four concatenated words with a pencil. E.g., <i>plane pig umbrella wash</i>	64 points
Sentence chains	Separate with a pencil 20 chains of four concatenated sentences each.	80 points
Error detection in running text	Find and mark as many of the inserted errors (51) as possible in 2 min. Different text contents for Swedish and Finnish but within the same field of topic.	Errors found, error scoring
Reading comprehension	Different narrative texts for English, Swedish and Finnish. Varying types of questions, minimized writing.	Accuracy, speed
Writing to dictation	20 words in each language administered from a CD. Heard first once in a sentence context, then once in isolation. Ample writing time.	Words correct, accuracy, error scoring
Free writing	Running text production based on a picture and given context, different for each language. To be written in legible handwriting with varied vocabulary and constructions. 1 min planning time, 7 min writing. A signal given to finish 5 min into the writing.	No of words, sentences, syllables; accuracy; error scoring

Table 6. *Contents of the Individual Test Battery: Tests Tapping Dyslexia-Related Cognitive Functions*

Tests	Description	Scoring
RAN	Name as quickly as possible 50 objects; 50 digits, letters; 50 color patches, digits, letters. Each set was presented on a separate paper sheet.	Speed, accuracy
BNT	English, BNT pictures 1–23 Swedish, BNT pictures 38–60 Finnish, BNT pictures 38–60 Interruption after four consecutive errors or omissions.	23 points 23 points 23 points
Semantic word fluency	List 10 animals as quickly as possible. Practice trial: fruits. Compounds, repetitions and proper names gave no points. Performed separately in Swedish and in Finnish.	Speed
Phonemic word fluency	List 10 words beginning with ‘t’ as quickly as possible. Practice trial: ‘a’. Compounds, repetitions and proper names gave no points. Performed separately in Swedish and in Finnish.	Speed
Word Span	Orally presented with 2 sets of 3–8 items to be repeated back to the test leader. Separate tests with Swedish words, Finnish words, and Swedish-Finnish pseudowords. Interruption after two faulty recalls within a given sequence length.	12 points
Digit Span Forward Backward	Orally presented with 2 sets of 3–8 items in each task to be repeated back to the test leader. Interruption after two faulty recalls within a given sequence length.	12 + 12 points
Segmentation and deletion	24 items. Repeat a pseudoword heard once from a CD. Repeat again excluding an orally specified phoneme (12 single phonemes, 12 multiple phonemes).	12 + 12 points

Note. RAN, Rapid automatized naming; BNT, Boston Naming Test.

4.2.3.4 Tests Tapping Other Cognitive Functions

Other cognitive domains relevant for reading and writing were also assessed to rule out more widespread impairments. These tasks tapped verbal learning and visual learning, visuoconstructive ability, visuomotor function, abstract reasoning, and inhibition ability (see e.g., Hagin, 2003; Hatcher et al., 2002; Høien & Lundberg, 2000). The tasks are briefly presented in Table 7; see also in particular Study II. Standard test procedures and scoring were applied.

Table 7. Description of the Individual Test Battery: Tests Measuring Other Cognitive Functions

Tests	Description	Scoring
WMS-R Verbal Learning	Eight word pairs presented altogether 6 times for learning and immediate recall (the first word of a pair as a prompt), out of which the first 3 recall trials are scored. This is followed by delayed recall c. 30 min later.	24 + 8 points
WMS-R Visual Learning	Same procedure as with verbal learning but the to-be-learned items are pairs of nonsense pictures and colors.	24 + 8 points
WAIS-R Block Design	Arrange 4–9 blocks according to visually presented patterns. 9 patterns.	Accuracy, speed 51 points
WAIS-R Digit Symbol Coding	Recode numbers 1–9 with a pencil into given symbols as fast as possible (four rows, 93 numbers). 90 seconds.	Accuracy, speed 93 points
Symbol Chains ^a	Separate upper-case letter sets, lower-case letter sets and number sets with a vertical pencil line. 2 min. Four sets per chain, 64 chains, 1 point per correct chain.	64 points
WAIS-R Similarities	Orally describe how two auditorily presented words are alike or the same. Interruption after four consecutive errors. 14 items.	28 points
Stroop ^b	Name the ink color of 50 X-items printed in a five-column format, and those of 50 items with mismatching color names (four colors).	Stroop effect ^c

Note. WMS-R, Wechsler Memory Scale-Revised (Wechsler, 1996); WAIS-R, Wechsler Adult Intelligence Scale-Revised (Wechsler, 1999).

^aJacobson (2001). ^bE.g., MacLeod & MacDonald (2000). ^cTime difference between conditions.

4.2.4 Test Procedures, Scoring, and Statistical Analyses

Study I was conducted with group testings and started with the questionnaire of background information and the consent form succeeded by the FS-DUVAN. The administration and the scoring of the FS-DUVAN followed Lundberg and Wolff (2003). Each test session of the individual test battery started with the self-reports and an informed consent form. These were followed by the verbal and the visual learning tasks for which delayed recall was probed about 30 minutes into the testing. All the other tasks were presented to the participants in random order. The reading aloud of the pseudoword lists and of the running texts, as well as the fluency tasks were digitally recorded. All other test performances were recorded by pen and paper either by the participants themselves or by the test leaders. The participants were given the choice of performing the RAN test, Digit Span, Verbal Learning, Visual Learning, Stroop, and the handedness questionnaire in either Swedish or

Finnish. Generally instructions were given in Swedish, but the participants could ask for instructions in Finnish.

Prior to the scoring and the analyses, the protocols from the digitally recorded tests were checked against the recordings for accuracy. The handwritten running text productions were typed into the computer and any identification in the form of names of the participants was removed. The typed corpus was controlled against the originals by an external, independent examiner. All independent native speakers assisting in the development of the reading and the writing tasks and in the inter-rater reliability assessments had a background in linguistics or in psychology.

In Study III, the specific reading and writing errors were scored according to two main categories. The first category consisted of four types of grapheme-phoneme-grapheme errors. The second category comprised morphological errors on inflections. For further details, see Study III.

As for the statistic procedures, the following measures were used in Study I: Cronbach's alpha and mean inter-item correlations, the Chi-square test, the Mann-Whitney *U*-test, the Kruskal-Wallis test, the two-way between-subjects ANOVA, the independent samples *t*-test, and receiver operating characteristic (ROC) curves. In Studies II and III, the Chi-square test, the Mann-Whitney *U*-test, the Wilcoxon signed ranks test, and Rosenthal's effect size measure were applied. For further details on the procedures and the scoring, see the individual studies.

5 Results

Study I presented a Finland-Swedish adaptation of the DUVAN™ group screening test for dyslexia for adults and young adults (Lundberg & Wolff, 2003) and provided normative data from Finland-Swedish high-performers. The internal reliability values of the adapted test proved to be comparable to those of the original version. Low summative scores on the FS-DUVAN were found to correlate with a positive self-report on familial dyslexia and with a history of special education in school. An examination of the language background of the normal (non-dyslexic) participants revealed significant performance differences between monolingual Swedish-speaking and monolingual Finnish-speaking university students, and early simultaneous bilingual Swedish-Finnish speaking university students. One of the differences concerned the summative score, which is the key score in the assessment (Lundberg & Wolff, 2003, p. 42). As regards the dyslexic students, both the monolingual Swedish-speaking group and the bilingual Swedish-Finnish speaking group performed significantly less well on the test than their non-dyslexic language-peers as measured in the critical summative score. Separate cut-off scores and sensitivity and specificity measures were introduced

for monolingual Swedish-speaking university students and for bilingual Swedish-Finnish university students.

Study II presented results on an extensive individual test battery administered to Finland-Swedish dyslexic and non-dyslexic university students. The analyses showed significant differences between the two groups in the self-reports. On tests measuring dyslexia-related cognitive functions, the dyslexia group performed significantly less well than the controls in advanced tasks measuring word retrieval skills and word fluency (RAN with mixed color patches, digits, letters; Swedish phonemic word fluency), and in complex phoneme manipulation (oral multiple phoneme deletion). No significant differences emerged in the additional tests tapping further cognitive functions that may influence reading and writing. The manifest performances of reading and writing in Swedish and Finnish were investigated further in Study III together with performances in English.

Taken together, Studies II and III showed poorer dyslexia group performances concerning reading and writing in all three languages in oral text reading accuracy, in writing accuracy in dictation and in free writing, on speeded written word and sentence segmentation, as well as in proofreading, which was measured in Swedish and Finnish. Additionally the dyslexia group exhibited significantly higher proportions of phoneme-to-grapheme errors especially in the writing tasks, and particularly in English. In addition a tendency towards higher proportions of inflectional errors in oral text reading in English was observed in the dyslexia group. Moreover the dyslexia group displayed poorer performance in the BNT in English. The groups did not, however, differ on the reading comprehension tests or on free writing length.

6 Discussion

High-performing adults with compensated dyslexia pose particular challenges to dyslexia diagnostics. The situation is even more complicated regarding multilingual individuals, as dyslexic difficulties may be less noticeable in one language than in another (cf. e.g., Meara et al., 1985). The purpose of the present research was to develop and test diagnostic tasks that would be applicable to multilingual Finland-Swedish high-performers. A further purpose was to study cognitive and manifest performance differences between Finland-Swedish multilingual high-performing dyslexic and non-dyslexic university students. The participants were probed in their three main languages Swedish, Finnish, and English, which differ in terms of regularity in phoneme-grapheme-phoneme mappings and in morphological richness. English is the orthographically most complex of these languages, Finnish the morphologically richest one, and Swedish is positioned between in both respects (cf. Seymour et al., 2003). It was expected that these features, as well as the participants' proficiency in the languages would be reflected in dyslexia

manifestations at the behavioral level (e.g., Paulesu et al., 2010). With high-performing multilingual young Finland-Swedish adults (university students) as the target group, the thesis thus aimed at (i) designing and norming a Finland-Swedish version of the Sweden-Swedish dyslexia group screening test DUVAN™ (Lundberg & Wolff, 2003), (ii) identifying linguistic and cognitive measures sensitive to dyslexia, and (iii) exploring language-specific behavioral manifestations of dyslexia in English, Swedish and Finnish.

In the three studies of the thesis, the group comparisons of the dyslexic and the non-dyslexic Finland-Swedish university students clearly demonstrated that the dyslexics performed significantly less well than their non-dyslexic peers on several test measures assessing features at both the cognitive level and the manifest level. Although these results were not as such unexpected (cf. e.g., Hatcher et al., 2002; Olofsson, 2002; Parrila et al., 2007; Reid et al., 2007; Wilson & Lesaux, 2001), the extent and robustness of the differences constitute an important finding. After all, the present dyslexic participants were highly educated young university students, who had completed general upper secondary education successfully, passed the university entrance examination, and were pursuing their studies in programs that set high demands on reading and writing skills both in Swedish and in English, and yet they found reading and writing troublesome. In line with previous studies (e.g., Bruck, 1990; Elbro et al., 1994; Olofsson, 2002; see also Vellutino et al., 2004), the present research confirmed the persistence of dyslexic difficulties into adulthood, and the fact that mild developmental dyslexia can also have negative effects on the performances of well compensated high-achievers (e.g., Gilroy & Miles, 2001; Mortimore & Crozier, 2006; Wolff, 2006). Along with the self-reports, weaker performances by the dyslexia group were seen in reading and writing especially in accuracy in all three languages, in specific fluency tasks, and in phonological processing and orthographic skills in more complex tasks.

6.1 The Test Adaptation

A prerequisite for successful testing for dyslexia is a valid and reliable test instrument. Study I of the present thesis utilized a Sweden-Swedish dyslexia group screening test (DUVAN™; Lundberg & Wolff, 2003). The Swedish spoken in Sweden and that spoken in Finland are distinguished in particular by certain prosody differences and inevitable variations in vocabulary. Generally, however, the two languages are mutually understandable. Still, initial analyses of the Sweden-Swedish test items and piloting with Finland-Swedes disclosed cross-linguistic differences that would have negative effects on the test performances of Finland-Swedes (cf. e.g., Garlén, 1988; Kuronen & Leinonen, 1999, 2010; Niemi, 1982). These observations, as well as a few other more general cultural and linguistic concerns prompted an adaptation of the DUVAN™ to Finland-Swedish (FS-DUVAN) prior to collecting normative data for the screening test from the present target population (cf. *Standards*, 1999).

Based on the data collected, the internal reliability of the FS-DUVAN proved to be comparable to that of the original test (Lundberg & Wolff, 2003). The average test results were markedly higher in the present research than for Lundberg and Wolff's (2003) sample. This underlines the importance of providing cut-off scores based on specific target populations (cf. *Standards*, 1999). The new, Finland-Swedish version of the screening test presented in this thesis should be a valuable screening tool for dyslexia in Finland-Swedish adults and young adults in higher education. It should also be a usable test instrument at other educational levels, once it has been supplemented with corresponding normative data. The need for assessment batteries to conform to linguistic, cultural, age-level and educational-level requirements that previous studies have called for were thus accounted for in the present test adaptation (e.g., Everatt & Elbeheri, 2008; Everatt et al., 2010; *Standards*, 1999).

6.2 Diagnostic Testing for Dyslexia in Multilinguals

In the thesis, normative data were collected for the dyslexia group screening test, the FS-DUVAN, among Finland-Swedish university students. A closer analysis of the non-dyslexic (normal) participants' test performances revealed significant differences in the summative score between early monolingual Swedish speakers vs. early monolingual Finnish speakers, and early simultaneous bilingual Swedish-Finnish speakers. This probably reflected differences in the level of Swedish proficiency of the subgroups (cf. Service, Simola, Mäntänheimo, & Maury, 2002). Another contributing factor may relate to the differences in the orthographic depth of the mother tongues that sets demands on reading-related processes, which, in turn, may have affected processing accuracy and speed (cf. e.g., Paulesu et al., 2010). The findings resemble those reported on in Everatt et al. (2010) of non-dyslexic bilingual tertiary education students whose test performance in some tasks rather echoed those of dyslexic monolingual peers than those of non-dyslexic monolingual peers. Together, the subgroup differences underlined the need for separate cut-off scores for the language groups.

The group screening test aimed at testing underlying cognitive functions that are relevant for reading and writing (Lundberg & Wolff, 2003), whereas the extensive individual test battery included tasks tapping both underlying cognitive functions and performance features at the manifest level. In the individual test battery, the following cognitive measures were singled out as sensitive to dyslexia in high-performing adults with Finland-Swedish language background: rapid automatized naming with mixed categories, phonemic word fluency in Swedish, and multiple phoneme segmentation and deletion. The language tasks that were most sensitive to the presence of dyslexia were as follows: the error detection tasks, accuracy in reading text aloud, the timed Reading Chain tests (cf. Jacobson, 2001), and accuracy in single word dictation and in 7-minute free writing. Further, dyslexic difficulties

were most clearly reflected in reading and writing accuracy in the foreign language (English). These findings call for the inclusion of not only domestic languages, but also of foreign languages in diagnostic testing for dyslexia in multilingual individuals (cf. e.g., Meara et al., 1985; Wydell & Kondo, 2003).

6.3 Features of Dyslexia in High-Performing Multilinguals

The present studies focused on exploring features of dyslexia at the cognitive level and the manifest level within the three-level framework of dyslexia (e.g., Frith, 1997, 1999; cf. Lundberg, 1999) in accordance with the phonological deficit hypothesis (e.g., Høien & Lundberg, 2000; Lyon et al., 2003; Vellutino et al., 2004). Dyslexic impairments were expected to surface in tasks such as phoneme manipulation, pseudoword reading, word retrieval, verbal working memory, and phonemic word fluency (cf. e.g., Frith, 1999; Hatcher et al., 2002; Høien & Lundberg, 2000; Ramus, 2001a). Secondary effects might be seen in poor vocabulary and reading comprehension (cf. e.g., Høien & Lundberg, 2000, pp. 5, 9, 102–103; Lyon et al., 2003). On the whole, the test performances corresponded to these expectations. However, in the individual test battery, this specific group of high-performing dyslexics did not differ significantly from their non-dyslexic peers in some of the traditional tasks considered to be sensitive dyslexia indicators. Some examples are given below.

Concerning tests that failed to show the expected group differences, the phoneme repetition, segmentation and deletion task challenges memory, segmentation and sound manipulation skills. Yet no group differences were observed in the repetition part or in the single phoneme segmentation and deletion part between the dyslexia group and the non-dyslexia group. This is concomitant to Olofsson (2002), who found that the dyslexic university students performed better than the non-university dyslexic participants in his study. These results are contrary to those of, for instance, Parrila, Georgiou and Corkett (2007). The difference between the studies may be due to differing item numbers. Moreover a difference may hide in lower task demands regarding repetition and single phoneme manipulations, because in the most complex part with multiple phoneme segmentation and deletion, differences emerged in the present research. The multiple phoneme segmentation and deletion task is comparable to the FS-DUVAN Reversed Spoonerisms, but no statistically significant differences emerged in the latter test between the groups.

Further, the groups did not differ significantly on the pseudoword reading tasks, whereas a group difference was obtained on the FS-DUVAN Phonological Choice test, another type of pseudoword reading. In contrast to the former task, the latter test was a time-limited one. Also the items in the former task may have been less complex and shorter than the ones used in other studies where differences between dyslexic and non-dyslexic university students have been reported in pseudoword

reading (e.g., Snowling et al., 1997; Wilson & Lesaux, 2001). The first Swedish text of the oral reading task in Study II resembled Hatcher, Snowling and Griffiths' (2002) test, where pseudoword items were embedded in running text. In both studies, these tasks evidenced performance differences between the tested dyslexic and non-dyslexic university students (cf. Gross-Glenn, Jallard, Novo, Helgren-Lempesis, & Lubs, 1990). The present results highlight the need for employing more complex and cognitively demanding tasks when diagnosing dyslexia in university students.

As regards word retrieval, the present study groups differed in RAN with the mixed color-digit-letter series, but not with single categories. This is again contrary to some other studies on university students (e.g., Hatcher et al., 2002; Reid et al., 2007). Further in the present data, a marked difference emerged in the BNT task in the foreign language (FL) English, whereas it did not distinguish between the two groups in the domestic languages Swedish and Finnish. The performances in English are interesting in that more frequent items were used to accommodate for lower FL-proficiency, but the group performances still differed significantly. As no phonological cueing was employed in the present research, it is hard to say whether the poorer spontaneous recall in the dyslexia group reflects more limited FL vocabulary and/or retrieval problems with FL items. Regarding Swedish, the two groups differed on the FS-DUVAN Vocabulary test. However, in addition to "vocabulary proper", this test also heavily taps phonological skills (Lundberg & Wolff, 2003).

With regard to working memory, the groups did not differ on Word Span and Digit Span, which concurs with Snowling, Nation, Moxham, Gallagher and Frith (1997), but is contradictory to the digit span results of Hatcher et al. (2002) and Wilson and Lesaux (2001). In the FS-DUVAN Working Memory subtest, however, differences emerged. The latter task can be considered more demanding than the span tasks, as it calls for more manipulation of working memory contents.

Some previous studies of university students have reported reading comprehension difficulties in dyslexics (e.g., Gilroy & Miles, 2001; Laasonen et al., 2001; Mortimore & Crozier, 2006; Simmons & Singleton, 2000; Wolff, 2006; but see Jackson & Doellinger, 2002). The reading comprehension tasks used in the present research did not distinguish the groups significantly in any of the three languages.⁷ However, in the Reading Chains (Jacobson, 2001), in which one subtest calls for sentence segmentation skills coupled with sentence comprehension and decoding fluency, the dyslexia group performed significantly weaker than the non-dyslexia group. It is thus likely that there are underlying deficits in the present dyslexia group that interfere with their reading comprehension, as depicted in their self-reports, even if the present reading comprehension tasks did not reveal any group differences.

⁷ The individual test battery also included a reading comprehension task in English, but this is not reported in the published articles.

In sum, in the present research focusing on high-performing young adults, several expected features of dyslexia were observed in tasks measuring phoneme manipulation, pseudoword reading, word retrieval, verbal working memory, phonemic word fluency, and vocabulary. As compared to previous literature, some inconsistencies were found as well (cf. e.g., Hatcher et al., 2002; Jackson & Doellinger, 2002; Parrila et al., 2007; Reid et al., 2007; Snowling et al., 1997; Wilson & Lesaux, 2001). A closer look at the impaired vs. non-impaired test performances in the present dyslexia group showed that group differences emerged primarily in tasks that were more complex and, in particular, in those that employed time restrictions. When devising tasks for dyslexia assessment, it is thus pivotal to consider factors such as task length, task types, time restrictions, and the cognitive level of the target population (cf. e.g., Everatt & Elbeheri, 2008; Parrila et al., 2007; *Standards*, 1999).

6.4 Effects of Language Structure and Language Proficiency on the Manifestations of Dyslexia in High-Performing Multilinguals

Given the multilingual language background of the participants, a specific issue explored in the present research was the manifest reading and writing performances in three structurally different languages in the dyslexia group and the non-dyslexia group. In the three languages studied, the scripts differ with regard to their orthographic depth, and the languages vary in morphological richness (Swedish: an intermediate orthography and morphology; Finnish: a shallow orthography, richest in morphology; English: a deep orthography, morphologically most limited). Overall, within-group analyses across the three languages showed the same performance patterns in the two groups with regard to the accuracy and fluency measures. As one would expect, both groups performed best in the domestic languages Swedish and Finnish, and most poorly in the foreign language English.

More importantly, the between-group results imply that the language structure influences the emergence of group differences in reading and writing. For instance, the comparisons of oral text reading speed and accuracy showed the expected group differences in English and Swedish, that is, in the deeper orthographies. The dyslexia group performances were inferior to those of the non-dyslexics. This was also seen in the Oren and Breznitz study (2005) on reading in Hebrew and English by a group of dyslexic and non-dyslexic university students. However, contrary to some previous results on reading in shallow orthographies among both children and high-performing multilingual young adults (cf. Goulandris, 2005b; Oren & Breznitz, 2005), the present dyslexia group did not read slower in the shallow orthography of Finnish than the non-dyslexics. Here accuracy differences rather than speed differences emerged. It may be that the present results reflect a speed-accuracy trade-off where the participants read fast at the cost of making more

errors. As the study groups were university students, who are used to reading under time pressure, this would seem plausible. The performance pattern would concur with the results found for “Hasty Dyslexic Readers” or “Mildly Dyslexic Readers” as described in Leinonen et al. (2001; cf. Laasonen, Service, Lipsanen, & Virsu, 2010) and the hasty bilingual dyslexic reader in Wydell and Kondo (2003).

The dyslexia group evidenced higher proportions of grapheme-phoneme-grapheme errors in the more opaque orthographies, particularly in English. This conforms to expectations that a foreign language, here English, would most readily elicit problems in dyslexics when compared to the controls (cf. e.g., Niemi, 1998; Taskinen, 2008). Furthermore, English also has the most opaque orthography of the investigated languages, which in this respect should make it the most error-prone language (cf. e.g., Brunswick, 2010; Paulesu et al., 2010). Furthermore, these group differences were more prominent in writing than in reading, which followed expectations, as phoneme-to-grapheme mappings needed for writing are less predictable than grapheme-to-phoneme mappings needed for reading (cf. e.g., Caravolas, 2007, p. 338; Goulandris, 2005a, p. 12; Høien & Lundberg, 2000, p. 63). Moreover, this is in line with the claim that the reading performances of dyslexics should improve more than writing over time (Høien & Lundberg, 2000, pp. 8, 63). However, in concordance with Hatcher et al. (2002), the observed reading problems implied that the present dyslexic university students were not fully compensated fluent readers.

Problems with phonemic duration errors, which has been pinpointed as one of the most persistent features characterizing reading difficulties in Finnish (e.g., Lyytinen et al., 1995), did not emerge as a distinguishing feature between the two study groups in the present research. The proportion of this error type was indeed somewhat higher in text reading in the dyslexia group but the difference failed to reach statistical significance. The finding may in part reflect the fact that the strongest language of both groups was Swedish and not Finnish, making this feature demanding also for the controls (cf. Vihanta, 1990).

As for the morphological structure of the languages, interestingly enough the dyslexics tended to produce higher proportions of inflectional errors in the least morphologically rich language, that is, in English. No significant group differences were observed in this respect regarding Swedish or Finnish, which are both morphologically richer languages. This suggests again that the level of language proficiency plays a dominant role here.

In sum, the findings suggest an effect of proficiency level and/or orthographic transparency as the driving force for the group differences observed in the language tasks, featuring English as the most troublesome language for the present target dyslexia group. In addition, however, impairments were also distinguishable in the domestic languages. Together with the general speed and accuracy results, the findings from the specific error type analyses provide further evidence of weaker

performances in English, Swedish and Finnish reading and writing performances among advanced multilingual dyslexics. In line with, for instance, Oren and Breznitz (2005; see also Paulesu et al., 2010), the present research thus lends support to the following theoretical claims: FL skills fall back on L1 skills and vice versa (e.g., the LCDH, Sparks, 1995; Sparks et al., 2006; the interdependence hypothesis and the central deficit hypothesis, cf. e.g., Oren & Breznitz, 2005), dyslexic deficits at the cognitive level are universal and persistent (Frith, 1997, 1999), and that specific characteristics of the languages and scripts involved affect the emergence of dyslexic symptoms (e.g., orthographic depth and script dependent hypotheses, cf. e.g., Everatt et al., 2010; Oren & Breznitz, 2005).

7 Methodological Considerations and Suggestions for Further Research

Empirical studies are affected by factors such as sampling methods and selection criteria, sample sizes, subject loss, loss of data, and methods of analysis. This is also true for the present studies. Similarly, participant characteristics, like differences in language proficiency levels (e.g., Parrila et al., 2007; Wolff, 2009), can be expected to influence the results. In the end, the setup and the methodological choices have to be a compromise. To mitigate some of the limitations of the present data, nonparametric tests were applied for the smaller group comparisons. However, this approach did not allow for analyses of interaction effects. Moreover the small sample sizes, the use of nonparametric tests together with the strict group selection criteria, and the strict error type criteria may have led to type II errors; that is, there may be further differences in the data that were not detected in the analyses. Nevertheless, the observed effects should be more robust.

One fundamental issue affecting the present research is the criteria used for assigning the participants to the dyslexia groups vs. the non-dyslexia groups. To a large degree, these criteria build on self-selection and a dyslexia diagnosis of a teacher or psychologist as reported by the participants in the self-reports. This could be discussed, although the reliability of dyslexia self-reports has been substantiated in previous research (e.g., Lefly & Pennington, 2000; Parrila et al., 2007; Schulte-Körne et al., 1997). Nevertheless, it is encouraging that the results showed poorer performance in the examined dyslexia screening test by individuals with dyslexia in the family and by those who have received special education in school, which in previous studies have been common features amongst individuals with dyslexia (cf. e.g., Lefly & Pennington, 2000; Mortimore & Crozier, 2006). Moreover, the findings confirm poorer performances by non-dyslexic individuals who reported familial dyslexia. These observations are thus in line with previous studies (e.g., Lefly & Pennington, 2000; Mortimore & Crozier, 2006).

In Studies II and III, the inclusion of participants with both Swedish and Finnish mother tongue backgrounds can be criticized. To accommodate for possible differences, the groups were carefully matched on language background, and subjective and objective assessments of the language skills were analyzed in detail. A larger study with subgroups by early language background should, however, be conducted to obtain cut-off measures by language background for the tasks of the individual test battery.

The thesis focused on dyslexia as defined by the phonological core deficit hypothesis (e.g., Høien & Lundberg, 2000; Lyon et al., 2003; Vellutino et al., 2004). Although phonological weaknesses are observed in most individuals with specific reading and writing difficulties (e.g., Ramus, 2004; Reid et al., 2007), previous research also points to other deficits (e.g., Reid & Fawcett, 2004). The present data invite explorations, for instance, of those participants suspected of dyslexia who performed above cut-off in the FS-DUVAN and yet reported reading and writing difficulties in their self-reports and/or presented an official diagnosis, and of those not suspected of dyslexia who performed poorly. Such a study would provide important complementary information to these results.

The data invite further detailed examinations of qualitative features of text production and reading strategies. For instance, the analyses had no means of keeping apart *errors of knowledge* (e.g., phonological, orthographic, and technical errors) from *errors of performance* (e.g., slips of the tongue/pen; Høien & Lundberg, 2000, p. 60). This could be investigated through think-aloud protocols and on-line writing (cf. e.g., Wengelin & Strömqvist, 2000). Further, in an on-line writing task, Wengelin (2002; cf. Wengelin & Strömqvist, 2000) unveiled differences in pause patterns between dyslexic and non-dyslexic adult writers. She interpreted these as a sign of the dyslexia group spending more time and effort on spelling, that is, on lower-level processes, to the extent that higher-level processing was also affected. This was reflected in poorer text planning than that of the controls (Wengelin, 2002; but see e.g., Connelly et al., 2006). It follows that the present findings on error rates could be indicative of lower-level processing deficits (cf. e.g., Gregg, Coleman, Davis, & Chalk, 2007). In analogy to Wengelin (2002), this raises the issues whether the present dyslexia and non-dyslexia groups stumbled on the same features in the read-aloud text tasks, and whether specific higher-level problems could be discerned even in the relatively short free writings of the present high-performing multilingual dyslexic university participants. An analysis of the rates and positions of hesitation and repetition errors in the oral text reading tasks and a more comprehensive analysis of the writing performances could contribute with information on reading and writing strategies and provide useful information for teaching. Further, more studies on multilingual high-performing dyslexics with different language combinations are called for, for example, to disentangle the proficiency and orthographic depth effects.

8 Practical Implications

An important goal of the present research was to attend to the need for more sensitive diagnostic procedures for high-performing Finland-Swedish dyslexic individuals. Both the group screening test for dyslexia, which was adapted to Finland-Swedish (the FS-DUVAN), as well as selected tasks of the individual test battery should be valuable dyslexia testing tools for adult and young adult dyslexics in Finland-Swedish higher education, in secondary education, and in vocational education. The results showed that it is possible to detect even mild dyslexic difficulties through clinically applicable cognitive and linguistic tasks in high-performing university students. The findings also indicated the need to take into account the language background of multilinguals when testing for dyslexia in linguistic performances. Moreover, the testing should preferably tap all languages of the advanced multilingual individual, as difficulties may be disguised in one language and be more overt in another.

The participant samples in the three studies demonstrated that the proportion of those who had received remedial education in school was markedly higher in the dyslexia groups than among the non-dyslexics. This shows that they have experienced problems in school that have been recognized at some point during their education, but also that they do not exhibit fully compensated dyslexia. In spite of remedial education, many of the dyslexia group participants in Studies II and III did not have an official diagnosis. Furthermore, the present research showed that not all high-performers may be aware of the fact that their performances may be affected by dyslexia. It follows that, although self-reports serve an important function in dyslexia diagnostics in adults, screening test data of the present research also provided evidence of undiagnosed dyslexia at this high educational level. In other words, dyslexia testing and accommodations seem highly warranted also for high-performers.

It is evident that a diagnosis may serve various purposes for the affected university student. For example, in the self-reports, one dyslexic participant wrote that “I can’t pass the fourth language [requirement of my university degree] and therefore I cannot graduate” (Lindgrén, 2004–2005, I–7, own translation⁸). This student would thus need accommodations or an exemption, for which an official diagnosis is required (Intyg, 2011; Tillgänglighet, 2011). A diagnosis may also fill important personal needs, which another dyslexic participant expressed like this: “To have it finally in writing that it really has been hard for me—a kind of confirmation/redress for all the years one had to hear that one was lazy/unfocused/used the wrong study technique and so on” (Lindgrén, 2004–2005, I–2, own translation⁹).

⁸ ”Jag klarar inte av det fjärde språket och kan därför inte bli färdig.”

⁹ ”Få svart på vitt att jag faktiskt har haft svårt—ett [*sic*] sorts bekräftelse/upprättelse av de år man fått höra att man varit lat/ofokuserad/använt fel studieteknik osv.”

For the particular interest of the English foreign language (EFL) learner and teacher and those developing software, the present findings point towards the need for more support and an extra effort in specific aspects of EFL, such as the mastery of inflections and basic spelling patterns. Finally, the research showed that the use of learning aids and directed strategy use were rather infrequent, and that very few of the dyslexic university students had discussed their situation with someone at university, although they all reported experiencing difficulties or a need for support in their academic studies. Such findings also have practical implications and stress the importance of diagnostic services, individual support, and an increased general awareness of dyslexic difficulties in the university context.

9 Conclusion

Developmental dyslexia is increasingly recognized as an important condition in higher education (e.g., ABC-projektet, 2006–2010; ESOK-projekti, 2006–2011; Gilroy & Miles, 2001; Mortimore & Crozier, 2006; Taskinen, 2008; Vogel et al., 2003). Yet less than half of the dyslexic university students participating in the individual testing of the present research had discussed their situation with someone at university, even though all reported experiencing difficulties or a need for support, particularly related to foreign languages. Many of the dyslexic participants did not have an official dyslexia diagnosis or statement either, which is a prerequisite for accommodations and further support (e.g., Intyg, 2011; Tillgänglighet, 2011). These observations concur with previous reports and studies from other universities (e.g., Hanley, 1997; Parrila et al., 2007; Pedersen, 2008; Wolff, 2006).

On the developmental dyslexia continuum, most university students with dyslexia are likely to position close to the end indicating mild dyslexic difficulties. This is one reason why their dyslexia may not have been identified earlier. The thesis confirms, however, the fact that even mild dyslexic difficulties can have unfavorable effects on the academic achievements in higher education. Further, it shows that it is possible to detect mild dyslexic difficulties in high-performing university students through sensitive testing. Subjective reading and writing problems, as expressed in the background questionnaires, were repeated in the reading and writing performances and confirmed in complex tasks tapping dyslexia-related functions. Moreover, the results implied that weaknesses are not necessarily revealed through all tasks expected to pertain, for instance, to phonological processing in advanced dyslexia groups. The findings thus comply with researchers underlining the importance of applying language-specific and level-appropriate measurements (cf. e.g., Everatt & Elbeheri, 2008; Everatt et al., 2010; Parrila et al., 2007; *Standards*, 1999).

The reading and writing performances of the tested university students are consistent with the argument of Høien and Lundberg (2000, p. 153) that dyslexics tend to make more spelling mistakes than non-dyslexics do. Further, the findings concerning the dyslexics are in line with their dyslexia definition stating, among other things, that “[e]ven though [dyslexics’] reading ability can eventually reach an acceptable performance level, poor writing skills most often remain” (Høien & Lundberg, 2000, p. 8, cf. p. 63; cf. Wolff, 2009). In fact, especially in written production, error manifestations thought to reflect phonological weaknesses were produced in higher proportions by the dyslexic participants than by their non-dyslexic peers. The surface features of dyslexia were modulated by the orthographic depth of each particular language as well as by the language proficiency level of the participants (cf. Lyytinen et al., 1995; Moats, 1996). The most challenging and error-prone language of the three languages probed proved to be the foreign language English, which was also the orthographically most opaque language investigated. This was

the case even when looking at the proportion of inflectional errors. However, also in the domestic languages, significant performance differences emerged, above all in accuracy and not only in writing performances but also still in reading.

The FS-DUVAN dyslexia group screening test fills the gap of a test tapping phonological skills for Finland-Swedes and is suitable for adults and young adults. It answers the call for age-appropriate, language-appropriate, culture-appropriate, and level-appropriate test instruments, as well as for target group norms (e.g., Everatt & Elbeheri, 2008; Everatt et al., 2010; Parrila et al., 2007; *Standards*, 1999). The findings from the extensive individual test battery singled out sensitive dyslexia test tasks and error patterns in L1, L2, and L3 that should be helpful in diagnosing dyslexia in multilingual Finland-Swedish high-performing university students.

All in all, the thesis confirms the presence of weakened phonological and orthographic skills in dyslexia in university students and highlights the pervasive nature of these defects through adulthood. The pattern of results fits the phonological deficit hypothesis of developmental dyslexia. The thesis contributes to the development of sensitive diagnostic procedures for high-performing multilingual dyslexic individuals, and the results underline the need to take into account the language background of multilingual individuals and the orthographic structure of the involved language(s), when testing for signs of dyslexia.

10 Svensk sammanfattning (Swedish Summary)

Doktorsavhandlingens titel motsvaras på svenska av ”Lindrig dyslexi hos universitetsstuderande – diagnostik och särdrag i prestandan i S1, S2 och S3”. S1 och S2 betecknar de två inhemska språken svenska och finska, och S3 engelska som främmande språk. *Dyslexi* innefattar här *utvecklingsdyslexi* åtskild från *förvärvad dyslexi*. Avhandlingen består av tre artiklar som har publicerats i vetenskapliga tidskrifter, samt kapp. Dess teoretiska ram utgörs av den fonologiska deficithypotesen, enligt vilken kärnsvårigheter hos dyslektiker kan hänföras till svagheter i det fonologiska systemet (t.ex. Høien & Lundberg, 2000; Lyon et al., 2003). Avhandlingen undersöker dyslexi på manifest nivå och på kognitiv nivå (Frith, 1997, 1999; jfr Lundberg, 1999; se även Svensson, 2003, s. 32) med beaktande av bl.a. språks ortografiska transparens (jfr t.ex. Brunswick et al., 2010) och flerspråkighet (t.ex. Brunswick et al., 2010; Meara et al., 1985; Wydell & Kondo, 2003).

Dyslexi, också *specifika läs- och skrivsvårigheter*, betecknas som det vanligaste handikappet i västvärlden (von Euler, 1996, s. 214). Tidigare forskning har visat att dyslektiska svårigheter kvarstår upp i vuxen ålder (t.ex. Bruck, 1990; Elbro et al., 1994; Olofsson, 2002; Vellutino et al., 2004; Wolff, 2009). Förekomsten av dyslexi bland universitetsstuderande har uppskattats till ungefär 2 % (t.ex. Stampoltzis & Polychronopoulou, 2008; Wolff & Lundberg, 2002). Inom projektet *Allomfattande högre utbildning* (ESOK-projekti, 2006–2011) framhålls att antalet högskolestuderande med dyslexi ökar snabbt både nationellt och internationellt (Taskinen, 2008; jfr Mortimore & Crozier, 2006; Pietilä, 2008; Svalfors, 2011).

Dyslektiska universitetsstuderandes prestationer påverkas sannolikt av en relativt sett lindrig typ av dyslexi, vilket tillsammans med välutvecklade kompenseringar strategier och brist på känsliga testinstrument förklarar ställvis avsaknad av tidigare diagnos (Frith, 1999; Hanley, 1997; Niemi, 1998; Parrila et al., 2007; se även Löwe & Schulte-Körne, 2004). Av samma orsaker kan det vara svårt för den enskilda studenten själv och för lärare att identifiera dyslektiska problem. Universitetsstudier utmanar däremot tidigare använda strategier (jfr Gilroy & Miles, 2001; Hanley, 1997; Mortimore, 2003, ss. 75–78; Mortimore & Crozier, 2006; Wolff, 2006). Flertalet studier och rapporter visar att universitetsstuderande med dyslexi upplever svårigheter i akademiska studier (t.ex. Gilroy & Miles, 2001; Wolff, 2006), samt att dyslexi tydligast påverkar framgången i främmande språk (t.ex. Downey et al., 2000; Ganschow & Sparks, 2000; Niemi, 1998; Taskinen, 2008). För att fastställa lämpliga studietekniker och för att utesluta eventuella andra orsaker till läs- och/eller skrivproblem behövs en detaljerad utredning som bygger på såväl språkliga som kognitiva undersökningar (t.ex. Høien & Lundberg, 2000). En officiell utredning eller diagnos är också ofta en förutsättning för beviljande av olika stödformer och specialarrangemang inom utbildningsväsendet (t.ex. Intyg, 2011; Tillgänglighet, 2011). Till dags dato saknas emellertid standardiserade

och normerade dyslexitest för vuxna och unga vuxna med finlandssvensk språkbakgrund. Den här doktorsavhandlingen bidrar till att fylla denna lucka.

Det antas allmänt att dyslektiska svårigheter i modersmålet leder till svårigheter även i främmande språk (Ganschow & Sparks, t.ex. 2000, 2001; Sparks, 1995). En del tidigare fallstudier har också visat att det finns dyslektiker vars prestationer i modersmålet har identifierats som påverkade av dyslexi först i samband med att individen har upplevt svårigheter i ett främmande språk (t.ex. Meara et al., 1985; men se också Miller-Guron & Lundberg, 2000). Andra fallstudier har rapporterat om manifesta dyslektiska svårigheter som har observerats i ett språk, men inte i ett annat, hos flerspråkiga dyslektiker (t.ex. Wydell & Kongo, 2003, se även Everatt et al., 2010). En utmaning inom dyslexiutredningar är att särskilja t.ex. stavfel som hör till den normala främmandespråksinläringen och normalt språkbruk, från sådana som har sin utgångspunkt i dyslexi. Ny forskning har visat att vissa lingvistiska särdrag inverkar på manifesteringen av dyslexi, såsom t.ex. ortografiers relation mellan ljudbild och skrift (transparens; t.ex. Paulesu et al., 2010). Dessa observationer påtalar tillsammans vikten av kartläggningar som omfattar prestationer både i modersmålet och i främmande språk. Doktorsavhandlingen tar fasta på detta och undersöker tecken på dyslexi hos flerspråkiga finlandssvenska universitetsstudenter i deras läs- och skrivprestationer i de strukturellt olika språken svenska, finska och engelska (engelskan ortografiskt mest komplex, finskan morfologiskt mest komplex och svenskan mittemellan i båda fallen).

Målen för den föreliggande avhandlingen var:

- (i) att bearbeta ett rikssvenskt gruppsscreeningtest för dyslexi för ungdomar och vuxna för finlandssvenskt bruk och att samla in normativa data från finlandssvenska universitetsstudenter (Studie I),
- (ii) att identifiera lingvistiska och kognitiva testuppgifter känsliga för dyslexi som åtskiljer en grupp högpresterande flerspråkiga finlandssvenska universitetsstudenter med dyslexi från matchade icke-dyslektiska medstudenter (Studierna II och III),
- (iii) att utforska språkspecifika särdrag av dyslexi hos en grupp högpresterande flerspråkiga finlandssvenska universitetsstudenter i läs- och skrivuppgifter på svenska och finska samt engelska som främmande språk (Studierna II och III).

I Studie I gjordes en gedigen bearbetning av DUVANTM, ett rikssvenskt gruppsscreeningtest för dyslexi hos vuxna och ungdomar (Lundberg & Wolff, 2003), för att anpassa testet till finlandssvenska förhållanden (jfr Everatt et al., 2010; *Standards*, 1999). Gallringstestet består av fem deltest som prövar fonologisk processering och ortografisk kompetens och av en självrapport (Lundberg & Wolff, 2003). Testet kompletterades med ett frågeformulär om bl.a. språkbakgrund, familjär dyslexi och stödundervisning. Den totala testtiden uppgick till ca

60 minuter. Efter förutprövningar av de bearbetade testuppgifterna och frågeformuläret genomfördes normeringen av den finlandssvenska testversionen, FS-DUVAN, med slumpmässigt utvalda förstaårsstuderande vid Åbo Akademi i Jakobstad, Vasa och Åbo ($n = 129$), samt en grupp något längre hunna studerande med dyslexi ($n = 14$). FS-DUVANs interna konsistens motsvarade i stort originaltestets värden. Resultaten visade att FS-DUVAN till en hög grad särskiljde mellan misstänkta dyslektiker och icke-dyslektiker, samt att en positiv självrapport angående familjär dyslexi och specialundervisning under skolgången var kopplad till svaga prestationer i FS-DUVAN (jfr Lefly & Pennington, 2000; Mortimore & Crozier, 2006). Ytterligare visade resultaten att språkbakgrunden under tidig uppväxt påverkade testprestationerna, varvid separata gränsvärden presenterades för enspråkigt (finlands-)svenska och tvåspråkigt svensk-finska universitetsstuderande.

För deltagare som presterar svagt i ett screeningtest behövs ytterligare kartläggning för att specificera den undersökta deficieten. I Studie II konstruerades ett omfattande individuellt testbatteri för att ta fram dylika testuppgifter för dyslexi. Det här testbatteriet omfattade läs- och skrivuppgifter, uppgifter som mäter kognitiva färdigheter relevanta för dyslexidiagnos, samt en mera detaljerad självrapport med frågor relaterade bl.a. till dyslexi, läsning, skrivning, skolgång och universitetsstudier (t.ex. Frith, 1999; Hatcher et al., 2002; Høien & Lundberg, 2000; Ramus, 2001a; Snowling et al., 1997; Wilson & Lesaux, 2001). Befintliga kognitiva test och språkliga test anpassades och översattes (svenska, finska, engelska). En del testuppgifter konstruerades specifikt för studierna II och III (t.ex. alla läs- och skrivuppgifter på de tre språken, med undantag av svenska Läskedjor™; Jacobson, 2001). Efter pilottestningarna utfördes den egentliga datainsamlingen med individuella testningar (ca 5 h per person). Deltagarna bestod av finlandssvenska flerspråkiga studerande vid Åbo Akademi med dyslexi ($n = 20$) och utan dyslexi ($n = 20$), matchade enligt kön, ålder, modersmål (svenska/finska) och fakultet. Resultaten visade, att även om finlandssvenska högpresterande dyslektiker inte presterade signifikant avvikande från kontrollgruppen i alla uppgifter som i en del tidigare forskning har visat sig känsliga för dyslexi hos universitetsstuderande (se t.ex. Hatcher et al., 2002; Reid et al., 2007; Snowling et al., 1997; Wilson & Lesaux, 2001), framkom markanta skillnader i bakgrundsfaktorer och i fonologisk processering på kognitiv och på manifest nivå. Följande uppgifter visade sig känsliga för dyslexi i den undersökta målgruppen: stora delar av självrapporten; snabb automatiserad benämning med färger, siffror och bokstäver; fonemiskt ordflöde på svenska; samt multipel fonemmanipulering.

Studie III undersökte manifesta läs- och skrivprestationer i svenska och finska, samt i engelska som främmande språk, mera ingående i samma undersökningsgrupper och med samma individuella testbatteri som i Studie II. Tillsammans med resultat ur Studie II framkom att dyslexigruppen presterade signifikant sämre i både läs- och skrivuppgifter: i högläsning av löpande text, diktamen och skrivning av kort

sammanhängande text vad gäller språkriktighet i svenska, finska och engelska; på ord- och meningssegmentering i skrift i alla tre språk; samt i felsökning i svensk och finsk text (undersöktes ej i engelska). Dyslexigruppen uppvisade också proportionellt signifikant fler stavfel relaterade till typer av fonem-till-grafemförhållanden som antas belasta den fonologiska processeringen mer än andra fonem-till-grafemkombinationer (jfr Moats, 1993, 1996). Skillnaderna var speciellt markanta i engelskan. En tendens till proportionellt fler morfologiska fel i engelsk högläsning noterades också i dyslexigruppen. Studien påvisade inflytande från nivån på deltagarnas språkfärdighet samt från stavningssystemens transparens på manifesta prestationer i läs- och skrivuppgifter hos dyslektiska finlandssvenska universitetsstudenter.

Avhandlingen behandlade således bristen på diagnostiska testinstrument för dyslexi bland högpresterande finlandssvenska ungdomar och vuxna. I likhet med tidigare studier framhävde den vikten av att testuppgifter bör anpassas till den specifika målgruppen, till språket (språken) i fråga och till målkulturen (jfr Everatt & Elbeheri, 2008; Everatt et al., 2010; *Standards*, 1999). Avhandlingen påvisade behovet av att beakta språkbakgrund och ortografiers transparens i dyslexiutredningar.

Arbetet har, trots vissa metodologiska begränsningar, flera praktiska tillämpningar. Den lägger fram ett gruppsscreeningstest för dyslexi för bruk bland finlandssvenska ungdomar och vuxna, FS-DUVAN, med normer och förslag till gränsvärden för finlandssvenska universitetsstudenter. Förutom inom universitet och högskolor, torde FS-DUVAN lämpa sig för dyslexiscreening också inom övrig vuxenutbildning i Svenskfinland, samt inom finlandssvenska yrkesskolor och gymnasier, efter nödvändig komplettering av normvärden för respektive grupp. Ur det individuella testbatteriet presenterades testuppgifter som påvisade känslighet för dyslexi vid testning av högpresterande finlandssvenska universitetsstudenter. Resultaten torde komma till användning inom finlandssvensk dyslexidiagnostisering. För normvärden bör materialinsamlingen utvidgas. Felanalyserna och resultaten i läs- och skrivprestationerna i svenska, finska och engelska kan appliceras både inom diagnostisering och inom undervisning, samt på tillämpningar inom IT. Vidare visade bakgrundsinformationen att långt ifrån alla universitetsstudenter, vars prestationer påverkas av dyslexi, har testats för dyslexi och kan uppvisa dyslexiintyg (jfr t.ex. Hanley, 1997; Parrila et al., 2007). Bland deltagarna i dyslexigruppen i Studie II och III påtalade alla att de upplevde svårigheter med sina akademiska studier och hade behov av stöd. Däremot hade få diskuterat sin situation med någon vid universitetet, och endast hälften hade dyslexiintyg. Deras användning av olika hjälpmedel i sina studier var begränsad. De här iakttagelserna lyfter fram behovet av dyslexiutredningar, individuellt stöd och en ökad allmän kunskap och medvetenhet om dyslexi och dyslektiska svårigheter på universitetsnivå.

Avhandlingen inbjuder till ytterligare undersökningar av högpresterande flerspråkiga dyslektikers läs- och skrivprestationer t.ex. i språk med olika ortografisk

transparens och i språk på olika färdighetsnivåer. Vidare kunde en jämförelse av pauspositioner och positioneringen av läsfel i dyslektikers och icke-dyslektikers prestationer i det befintliga högläsningmaterialet ge värdefull information om lässtrategier (jfr Wengelin, 2002). Därtill utgör de individuella prestationer som avvek från grupptypiska resultat både inom dyslexigrupperna och inom icke-dyslexigrupperna ett intressant material för fallstudier av prestationsprofiler.

Avslutningsvis kan konstateras att avhandlingen tydligt visade att grupperna med finlandssvenska dyslektiska universitetsstuderande presterade annorlunda än icke-dyslektiska medstudenter på en rad kognitiva och lingvistiska uppgifter. De kognitiva uppgifter som särskiljde grupperna kännetecknades av mer komplexitet och av att uppgifterna utfördes på tid. Skillnaderna i lingvistiska test var mest framträdande i skriftliga prestationer men syntes även i läsning. Av de tre språk, i vilka prestationer undersöktes, noterades skillnader speciellt i det främmande språket engelska, som också har en opak ortografi. Emellertid framkom också klara prestationsskillnader i de inhemska språken. Resultaten visade således att det är möjligt att upptäcka lindrig, kompenserad dyslexi hos högpresterare med tillräckligt känsliga testuppgifter. Resultaten ger vidare stöd åt studier som visar att dyslexi är bestående och åt den fonologiska deficityhypotesen. Avhandlingen visade att även lindrig utvecklingsdyslexi påverkade högpresterande dyslektikers akademiska prestationer, att språkbakgrund, prestationer i både modersmålet och i andra språk bör beaktas vid dyslexitestning, samt att språkspecifika lingvistiska särdrag påverkade manifesteringen av dyslexi.

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Signe-Anita Lindgrén

Afterword

A word of wisdom from a *Langnet* research seminar:

The End of the Process is the Beginning of Another One

The research process never ends with the resolution of the research problem; every answer is always a partial answer, just part of the truth. Research never ends, but it has to be ended by writing a report on the results, by putting a period at the end of it all. On the other hand, the answers you obtain in the research to certain questions will usually inspire new questions and theoretical problems. The end of one research, or the idea it has inspired, may be the beginning of a new project.

Alasuutari, P. (1995). *Researching culture: Qualitative method and cultural studies* (p. 175). London: Sage Publications.

References

- ABC-projektet. (2006–2010). [Finland-Swedish ABC reading and writing project]. Förbundet För De Utvecklingsstördas Vål [Association for the care of persons with intellectual disability] and Vasa Specialpedagogiska Center vid Åbo Akademi [Center for Special Education at Åbo Akademi University, Vasa]. Retrieved January 1, 2012, from <http://www.fduv.fi/Site/Widget/Editor/837/files/abc/ABCbroschyr.pdf>
http://www.fduv.fi/verksamhet/projekt_utveckling/slutforda_projekt/abc/
- Ahonen, T., Tuovinen, S., & Leppäsaari, T. (2003). Nopean sarjallisen nimeämisen testi [Rapid Serial Naming test] (2nd revised ed.). Lievestuore: Haukkarannan koulu, Niilo Mäki Instituutti.
- Baddeley, A. (2003). Working memory and language: An overview. *Journal of Communication Disorders*, 36, 189–208.
- Baddeley, A., Gathercole, S., & Papagno, C. (1998). The phonological loop as a language learning device. *Psychological Review*, 105, 158–173.
- Bekebrede, J., van der Leij, A., & Share, D. L. (2009). Dutch dyslexic adolescents: Phonological-core variable-orthographic differences. *Reading and Writing: An Interdisciplinary Journal*, 22, 133–165.
- Bialystok, E. (2001). *Bilingualism in development: Language, literacy, and cognition* (pp. 1–20). Cambridge: CUP.
- Bruck, M. (1990). Word-recognition skills of adults with childhood diagnoses of dyslexia. *Developmental Psychology*, 26, 439–454.
- Brunswick, N. (2010). Unimpaired reading development and dyslexia across different languages. In N. Brunswick, S. McDougall, & P. de Mornay Davies (Eds.), *Reading and dyslexia in different orthographies* (pp. 131–154). Hove: Psychology Press.
- Brunswick, N., McDougall, S., & de Mornay Davies, P. (Eds.). (2010). *Reading and dyslexia in different orthographies*. Hove: Psychology Press.
- Burt, J. S. (2006). What is orthographic processing skill and how does it relate to word identification in reading? *Journal of Research in Reading*, 29, 400–417.
- Caravolas, M. (2007). The nature and causes of dyslexia in different languages. In M. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 226–355). Malden, MA: Blackwell.
- Coleman, C., Gregg, N., McLain, L., & Bellair, L. W. (2009). A comparison of spelling performance across young adults with and without dyslexia. *Assessment for Effective Intervention*, 34, 94–105.
- Connelly, V., Campbell, S., MacLean, M., & Barnes, J. (2006). Contribution of lower order skills to the written composition of college students with and without dyslexia. *Developmental Neuropsychology*, 29, 175–196.

- Deacon, S. H., Parrila, R., & Kirby, J. R. (2008). A review of the evidence on morphological processing in dyslexics and poor readers: A strength or weakness? In G. Reid, A. J. Fawcett, F. Manis, & L. S. Siegel (Eds.), *The Sage handbook of dyslexia* (pp. 212–237). Los Angeles, CA: Sage.
- Downey, D. M., Snyder, L. E., & Hill, B. (2000). College students with dyslexia: Persistent linguistics deficits and foreign language learning. *Dyslexia*, 6, 101–111.
- Elbro, C. (1996). Early linguistic abilities and reading development: A review and a hypothesis. *Reading and Writing: An Interdisciplinary Journal*, 8, 453–485.
- Elbro, C. (1998). When *reading* is “readn” or somthn. Distinctness of phonological representations of lexical items in normal and disabled readers. *Scandinavian Journal of Psychology*, 39, 149–153.
- Elbro, C., Nielsen I., & Petersen, D. K. (1994). Dyslexia in adults: Evidence for deficits in non-word reading and in the phonological representation of lexical items. *Annals of Dyslexia*, 44, 205–226.
- Ellis, R. (2008). *The study of second language acquisition* (2nd ed., pp. 47–66). Oxford: OUP.
- ESOK-projekti. (2006–2011). Esteetön opiskelu korkea-asteen oppilaitoksissa [Inclusive Higher Education in Finland]. Retrieved January 1, 2012, from Jyväskylä University website: <http://esok.jyu.fi/>
- von Euler, C. (1996). Dyslexi – även kallat ordblindhet. Ett allvarligt och utbrett problem på biologisk grund [Dyslexia–also called wordblindness. A serious and widespread problem with a biological constitution]. In L. Widén (Ed.), *En bok om hjärnan* [A book about the brain] (pp. 213–229). Stockholm: Tiden/Rabén Prisma.
- Everatt, J., & Elbeheri, G. (2008). Dyslexia in different orthographies: Variability in transparency. In G. Reid, A. J. Fawcett, F. Manis, & L. S. Siegel (Eds.), *The Sage handbook of dyslexia* (pp. 427–438). Los Angeles, CA: Sage.
- Everatt, J., Ocampo, D., Veii, K., Nenopoulou, S., Smythe, I., al Mannai, H., & Elbeheri G. (2010). Dyslexia in biscriptal readers. In N. Brunswick, S. McDougall, & P. de Mornay Davies (Eds.), *Reading and dyslexia in different orthographies* (pp. 221–245). Hove: Psychology Press.
- Fawcett, A. J. (2003). Screening and support for dyslexia in adults in the United Kingdom. In S. A. Vogel, G. Vogel, V. Sharoni, & O. Dahan (Eds.), *Learning disabilities in higher education and beyond: International perspectives* (pp. 107–132). Baltimore, MD: York Press.
- Fischer, F. W., Shankweiler, D., Liberman, I. Y. (1985). Spelling proficiency and sensitivity to word structure. *Journal of Memory and Language*, 24, 423–441.
- Frith, U. (1997). Brain, mind and behaviour in dyslexia. In C. Hulme & M. Snowling (Eds.), *Dyslexia: Biology, cognition and intervention* (pp. 1–19). London: Whurr.

-
- Frith, U. (1999). Paradoxes in the definition of dyslexia. *Dyslexia*, 5, 192–214.
- Frith, U. (2001). What framework should we use for understanding developmental disorders? *Developmental Neuropsychology*, 20, 555–563.
- Galaburda, A. M., LoTurco, J., Ramus, F., Fitch, R. H., & Rosen, G. D. (2006). From genes to behavior in developmental dyslexia. *Nature Neuroscience*, 9, 1213–1217.
- Ganschow, L., & Sparks, R. (2000). Reflections on foreign language study for students with language learning problems: Research, issues and challenges. *Dyslexia*, 6, 87–100.
- Ganschow, L., & Sparks, R. (2001). Learning difficulties and foreign language learning: A review of research and instruction. *Language Teaching*, 34, 79–98.
- Garlén, C. (1988). *Svenskans fonologi* [Phonology of the Swedish language]. Lund: Studentlitteratur.
- Gilroy, D. E., & Miles, R. (2001). *Dyslexia at college* (2nd ed.). London: Routledge.
- Goulandris, N. (2005a). Introduction: Developmental dyslexia, language and orthographies. In N. Goulandris (Ed.), *Dyslexia in different languages: Cross-linguistic comparisons* (pp. 1–14). London: Whurr.
- Goulandris, N. (Ed.). (2005b). *Dyslexia in different languages: Cross-linguistic comparisons*. London: Whurr.
- Gregg, N., Coleman, C., Davis, M., & Chalk, J. C. (2007). Timed essay writing: Implications for high-stakes tests. *Journal of Learning Disabilities*, 40, 306–318.
- Gregg, N., & Romonath, R. (2003). Universität Georgia Testbatterie Phonologischer und Orthographischer Fähigkeiten (Deutsche Version): Phonologische Segmentierung [Georgia University Test Battery for Phonological and Orthographic Skills (German version): Phonological segmentation]. In Ministerium für Bildung, Wissenschaft und Kultur des Landes Mecklenburg-Vorpommern (Ed.), *Optimierung von Lese-Rechtschreibfähigkeiten bei Legasthenikern im Jugendalter. Abschlussbericht zum Forschungsprojekt (1999–2002)* [Optimization of Reading and Writing Skills Among Teenage Dyslexics. Final research project report (1999–2002)] (Appendix I, pp. 8–9). Greifswald: Panzig.
- Gross-Glenn, K., Jallard, B., Novo, L., Helgren-Lempesis, V., & Lubs, H. A. (1990). Nonsense passage reading as a diagnostic aid in the study of adult familial dyslexia. *Reading and Writing: An Interdisciplinary Journal*, 2, 161–173.
- Hagin, R. A. (2003). Diagnosing adults with learning disabilities: Essential components. In S. A. Vogel, G. Vogel, V. Sharoni, & O. Dahan (Eds.), *Learning disabilities in higher education and beyond: International perspectives* (pp. 83–91). Baltimore, MD: York Press.

- Hanley, J. R. (1997). Reading and spelling impairments in undergraduate students with developmental dyslexia. *Journal of Research in Reading*, 20, 22–30.
- Hatcher, J., Snowling, M. J., & Griffiths, Y. M. (2002). Cognitive assessment of dyslexic students in higher education. *British Journal of Psychology*, 72, 119–133.
- Hjelmquist, E., & von Euler, C. (Eds.). (2002). *Dyslexia and literacy*. London: Whurr.
- Høien, T., & Lundberg, I. (2000). *Dyslexia: From theory to intervention*. Dordrecht: Kluwer.
- Holopainen, L., Kairaluoma, L., Nevala, J., Ahonen, T., & Aro, M. (2004). *Lukivaikeuksien seulontamenetelmä nuorille ja aikuisille* [Reading Disability Screening test for adolescents and adults]. Jyväskylä: Mäki Niilo Institute.
- Intyg över funktionsnedsättning [Certificate of special needs]. (2011). Åbo Akademi University. Retrieved January 1, 2012, from Åbo Akademi University website:
<http://www.abo.fi/personal/Content/Document/document/24149>
(Last updated May 5, 2011)
- Jackson, N. E., & Doellinger H. L. (2002). Resilient readers? University students who are poor recoders but sometimes good text comprehenders. *Journal of Educational Psychology*, 94, 64–78.
- Jacobson, C. (2001). *Läskedjor™* [Reading Chains: User's manual]. Stockholm: Psykologiförlaget.
- Jacobson, C. (2006). Hur kan vi se på läs- och skrivsvårigheter? [How can we view reading- and writing difficulties?]. *Dyslexi – aktuellt om läs- och skrivsvårigheter*, 4. Retrieved January 1, 2012, from
http://dyslexiforeningen.se/egnafiler/jacobson_hemsidan.pdf
- Karlsson, F. (1983). *Suomen kielen äänne- ja muotorakenne* [Sound and form structure of the Finnish language] (pp. 356–357). Helsinki: WSOY.
- Kuronen, M., & Leinonen, K. (1999). Fonetiska skillnader mellan finlandssvenska och rikssvenska [Phonetic differences between Finland-Swedish and Sweden-Swedish]. Retrieved January 1, 2012, from,
http://www.ep.liu.se/ecp_article/index.en.aspx?issue=006;article=011
- Kuronen, M., & Leinonen, K. (2010). *Svenskt uttal för finskspråkiga* [Swedish pronunciation for Finnish speakers]. Tampere: Juvenes Print—Tampereen Yliopistopaino Oy.
- Laasonen, M., Service, E., Lipsanen, J., & Virsu, V. (2010). Adult developmental dyslexia in a shallow orthography: Are there subgroups? *Reading and Writing: An Interdisciplinary Journal*. Online First. DOI:10.1007/s11145-010-9248-9
- Laasonen, M., Service, E., & Virsu, V. (2001). Temporal order and processing acuity of visual, auditory, and tactile perception in developmentally dyslexic young adults. *Cognitive, Affective, & Behavioral Neuroscience*, 1, 394–410.

- Laine, M., Koivuselkä-Sallinen, P., Hänninen, R., & Niemi, J. (1997). *Bostonin nimentätesti suomenkielinen versio* [Boston Naming Test, Finnish version]. Helsinki: Psykologien Kustannus.
- Lefly, D. L., & Pennington, B. F. (2000). Reliability and validity of the Adult Reading History Questionnaire. *Journal of Learning Disabilities, 33*, 286–296.
- Leinonen, S., Müller, K., Leppänen, P. H. T., Aro, M., Ahonen, T., & Lyytinen, H. (2001). Heterogeneity in adult dyslexic readers: Relating processing skills to the speed and accuracy of oral text reading. *Reading and Writing: An Interdisciplinary Journal, 14*, 265–296.
- Lindgrén, S.-A. (2004–2005). (Individual test battery with 20 dyslexic and 20 non-dyslexic university students.) Unpublished data.
- Lishman, W. A. (2006). The dyslexic brain. In M. J. Snowling & J. Stackhouse (Eds.), *Dyslexia, speech and language: A practitioner's handbook* (2nd ed., pp. 36–53. London: Whurr.
- Löwe, C., & Schulte-Körne, G. (2004). Dyslexia in Germany. In I. Smythe, J. Everatt, & R. Salter (Eds.), *International book of dyslexia: A guide to practice and resources* (pp. 100–102). Chichester: Wiley.
- Lundberg, I. (1999). Towards a sharper definition of dyslexia. In I. Lundberg, F. E. Tønnessen, & I. Austad (Eds.), *Dyslexia: advances in theory and practice* (pp. 9–29). Dordrecht: Kluwer.
- Lundberg, I., & Wolff, U. (2003). *Dyslexiscreening för ungdomar och vuxna:Handledning* [DUVAN Dyslexia screening for young adults and adults: User's manual]. Stockholm: Psykologiförlaget.
- Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). A definition of dyslexia. *Annals of Dyslexia, 53*, 1–14.
- Lyytinen, H., Leinonen, S., Nikula, M., Aro, M., & Leiwo, M. (1995). In search of the core features of dyslexia: Observations concerning dyslexia in the highly orthographically regular Finnish language. In V. W. Berninger (Ed.), *The varieties of orthographic knowledge II: Relationships to phonology, reading and writing* (pp. 177–204). Dordrecht: Kluwer.
- MacLeod, C. M., & MacDonald, P. A. (2000). Interdimensional interference in the Stroop effect: Uncovering the cognitive and neural anatomy of attention. *Trends in Cognitive Sciences, 4*, 383–390.
- Meara, P., Coltheart, M., & Masterson, J. (1985). Hidden reading problems in ESL learners. *TESL Canada Journal, 3*, 29–36.
- Miller-Guron, L., & Lundberg, I. (2000). Dyslexia and second language reading: A second bite at the apple? *Reading and Writing: An Interdisciplinary Journal, 12*, 41–61.
- Moats, L. C. (1993). Spelling error interpretation: Beyond the phonetic/dysphonetic dichotomy. *Annals of Dyslexia, 43*, 174–85.

- Moats, L. C. (1996). Phonological spelling errors in the writing of dyslexic adolescents. *Reading and Writing: An Interdisciplinary Journal*, 8, 105–119.
- Mortimore, T. (2003). *Dyslexia and learning style: A practitioner's handbook*. London: Whurr.
- Mortimore, T., & Crozier, W. R. (2006). Dyslexia and difficulties with study skills in higher education. *Studies in Higher Education*, 31, 235–251.
- Nevala, J., Kairaluoma, L., Ahonen, T., Aro, M., & Holopainen, L. (2006). *Lukemis- ja kirjoittamistaitojen yksilötestistö nuorille ja aikuisille* [Individual Test Battery of Reading and Writing Skills for Adolescents and Adults]. Jyväskylä: Niilo Mäki Institute.
- Niemi, P. (1998). Svårigheter och lösningar [Difficulties and solutions]. In K. Strandén (Ed.), *Ingen dumbom bara annorlunda: En handbok om dyslexi* [Not a fool, just different: A handbook of dyslexia] (pp. 28–31). Helsinki: Stakes.
- Niemi, S. (1982). *Fonologisk ljudförändring och ordgestalt: Akustiska och strukturella iakttagelser över sverigesvenskans, finlandssvenskans och finskans ljud och stavelsestruktur samt ordgestalt* [Phonological sound change and the word form: Acoustic and structural observations of Sweden-Swedish, Finland-Swedish and Finnish sound and syllable structures and word form]. Unpublished licentiate thesis, Åbo Akademi University, Åbo, Finland.
- Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh Inventory. *Neuropsychologia*, 9, 97–113.
- Olofsson, Å. (2002). Twenty years of phonological deficits: Lundberg's sample revisited. In E. Hjelmquist & C. von Euler (Eds.), *Dyslexia and literacy* (pp. 151–162). London: Whurr.
- Oren, R., & Breznitz, Z. (2005). Reading processes in L1 and L2 among dyslexic as compared to regular bilingual readers: Behavioral and electrophysiological evidence. *Journal of Neurolinguistics*, 18, 127–151.
- Parrila, R., Georgiou, G., & Corkett, J. (2007). University students with a significant history of reading difficulties: What is and is not compensated? *Exceptionality Education Canada*, 17, 195–220.
- Paulesu, E., Brunswick, N., & Paganelli, F. (2010). Cross-cultural differences in unimpaired and dyslexic reading: Behavioural and functional anatomical observations in readers of regular and irregular orthographies. In N. Brunswick, S. McDougall, & P. de Mornay Davies (Eds.), *Reading and dyslexia in different orthographies* (pp. 249–271). Hove: Psychology Press.
- Paulesu, E., Démonet, J.-F., Fazio, F., McCrory, E., Chanoine, V., Brunswick, N., ... Frith, U. (2001). Dyslexia: Cultural diversity and biological unity. *Science*, 291, 2165–2167.

- Pedersen, A. L. (2008). *Educational reading and writing assistance for dyslexic students at the University of Aarhus, Denmark*. Retrieved January 1, 2012, from Aarhus Universitet, Århus, Rådgivnings og støttecentret, Publications website: <http://www.rsc.au.dk/downloads/educational-reading.pdf>
- Pennington, B. F., McCabe, L. L., Smith, S. D., Lefly, D. L., Bookman, M. O., Kimberling, W. J., & Lubs, H. A. (1986). Spelling errors in adults with a form of familial dyslexia. *Child Development*, *57*, 1001–1013.
- Pennington, B. F., & Olson, R. K. (2007). Genetics of dyslexia. In M. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 453–472). Malden, MA: Blackwell.
- Pietilä, P. (2008). Kohti esteettömämpää Turun yliopistoa. Vammaisasiamiehen loppuraportti (Rehtorinviraston julkaisusarja 1) [Towards a more accessible Turku University: Final report by the Advisor of Disability Issues; Rectorate's Publishing Series No. 1]. Turku University, Turku: Turun yliopisto.
- Portin, M., & Laine, M. (2001). Processing cost associated with inflectional morphology in bilingual speakers. *Bilingualism: Language and Cognition*, *4*, 55–62.
- Puolakanaho, A., Ahonen, T., Aro, M., Eklund, K., Leppänen P. T. H., Poikkeus, A.-M., ... Lyytinen, H. (2007). Very early phonological and language skills: Estimating individual risk of reading disability. *Journal of Child Psychology and Psychiatry*, *48*, 923–931.
- Ramus, F. (2001a). Outstanding questions about phonological processing in dyslexia. *Dyslexia*, *7*, 197–216.
- Ramus, F. (2001b). Talk of two theories. *Nature*, *412*, 393–395.
- Ramus, F. (2004). Neurobiology of dyslexia: A reinterpretation of the data. *Trends in Neurosciences*, *27*, 720–726.
- Reid, A. A., Szczerbinski, M., Iskierka-Kasperek, E., & Hansen, P. (2007). Cognitive profiles of adult developmental dyslexics: Theoretical implications. *Dyslexia*, *13*, 1–24.
- Reid, G., & Fawcett, A. (2004). An overview of developments in dyslexia. In G. Reid & A. Fawcett (Eds.), *Dyslexia in context: Research, policy and practice* (pp. 3–8). London: Whurr.
- Reid, G., & Kirk, J. (2001). *Dyslexia in adults: Education and employment*. Chichester: Wiley.
- Ringbom, H. (1987). *The role of the first language in foreign language learning* (pp. 5–23). Clevedon: Multilingual Matters.
- Ringbom, H. (2007). *Cross-linguistic similarity in foreign language learning* (pp. 24–40). Clevedon: Multilingual Matters.
- Schulte-Körne, G. (2007). Genetik der Lese- und Rechtschreibstörung [The genetics of dyslexia]. *Monatsschrift Kinderheilkunde*, *155*, 328–336.

- Schulte-Körne, G., Deimel, W., & Remschmidt, H. (1997). Can self-report data on deficits in reading and spelling predict spelling disability as defined by psychometric tests? *Reading and Writing: An Interdisciplinary Journal*, 9, 55–63.
- Service, E., Simola, M., Mäntänheimo, O., & Maury, S. (2002). Bilingual working memory span is affected by language skill. *The European Journal of Cognitive Psychology*, 14, 383–408.
- Seymour, P. H. K., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology*, 94, 143–174.
- Simmons, F., & Singleton, C. (2000). The reading comprehension abilities of dyslexic students in higher education. *Dyslexia*, 6, 178–192.
- Smythe, I., Everatt, J., & Salter, R. (Eds.). (2004). *International book of dyslexia: A guide to practice and resources*. Chichester: Wiley.
- Snowling, M. J. (2000). *Dyslexia* (2nd ed.). Oxford: Blackwell.
- Snowling, M. J., Nation, K., Moxham, P., Gallagher, A., & Frith, U. (1997). Phonological processing skills of dyslexic students in higher education: A preliminary report. *Journal of Research in Reading*, 20, 31–41.
- Snowling, M. J., & Stackhouse, J. (Eds.). (2006). *Dyslexia, speech and language: A practitioner's handbook* (2nd ed.). London: Whurr.
- Sparks, R. L. (1995). Examining the linguistic coding differences hypothesis to explain individual differences in foreign language learning. *Annals of Dyslexia*, 45, 187–214.
- Sparks, R. L., Patton J., Ganschow, L., Humbach, N., & Javorsky, J. (2006). Native language predictors of foreign language proficiency and foreign language aptitude. *Annals of Dyslexia*, 56, 129–160.
- Standards for educational and psychological testing*. (1999). Washington, DC: American Educational Research Association.
- Stanovich, K. E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The phonological-core variable-difference model. *Journal of Learning Disabilities*, 21, 590–605.
- Stampoltzis, A., & Polychronopoulou, S. (2008). Dyslexia in Greek higher education: A study of incidence, policy and provision. *Journal of Research in Special Educational Needs*, 8, 37–46.
- Sterling, C., Farmer, M., Riddick, B., Morgan, S., & Matthews, C. (1998). Adult dyslexic writing. *Dyslexia*, 4, 1–15.
- Svalfors, M. (2011, April 14). Studera med funktionshinder. Statistik 2010, 2009 [Studying with Disabilities. Statistics 2010, 2009]. Retrieved January 1, 2012, from Stockholm University website: <http://www.studeraedfunktionshinder.nu/statistik.htm>

- Svensson, I. (2003). *Phonological dyslexia: Cognitive, behavioural and hereditary aspects*. Göteborg: Department of Psychology, Göteborg University. Academic Dissertation.
- Taskinen, E. (2008). Korkeakouluopiskelijoiden lukivaikkeudet ja hyvät käytännöt opiskelun tukemiseksi [Dyslexia in students in higher education and good practices in study support]. Report ESOK 2006–2009. Turku: Turun yliopisto. Retrieved January 1, 2012, from Jyväskylä University website: <http://esok.jyu.fi/julkaisut/luki/>
- Tillgänglighet [Special needs students]. (2011). Åbo Akademi University. Retrieved January 1, 2012, from Åbo Akademi University website: <http://www.abo.fi/student/en/Content/Topic/topic/tillganglighet/?setlanguage=sv>
<http://www.abo.fi/student/Content/Topic/topic/tillganglighet/?setlanguage=en>
(Last updated, October 29, 2010 [Plan of action], August 17, 2011 [Reading and writing difficulties, dyslexia], August 25, 2011 [Special needs, Applicants and students with special needs.]
- Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, 45, 2–40.
- Vihanta, V. V. (1990). Suomi vieraana kielenä foneettiselta kannalta [Finnish as a foreign language from the phonetic perspective]. In J. Tuomola (Ed.), *AFinLA Yearbook: Vol. 48. Foreign language comprehension and production* (pp. 199–225). Turku: Suomen soveltavan kielitieteen yhdistys 1990.
- Vinegard, M. (1994). A Revised Adult Dyslexia Check List. *Educare*, 48, March.
- Vogel, S. A., Vogel, G., Sharoni, V., & Dahan, O. (Eds.). (2003). *Learning disabilities in higher education and beyond: International perspectives*. Baltimore, MD: York Press.
- Vukovic, R. K., & Siegel, L. S. (2006). The double-deficit hypothesis: A comprehensive analysis of the evidence. *Journal of Learning Disabilities*, 39, 25–47.
- Wechsler, D. (1996). *WMS-Revised* [Finnish manual]. Helsinki: Psykologien Kustannus.
- Wechsler, D. (1999). *WAIS-Revised* [Swedish manual] (2nd revised ed.). Stockholm: Psykologiförlaget.
- Wengelin, Å. (2002). *Text production in adults with reading and writing difficulties*. Gothenburg Monographs of Linguistics. Göteborg: Department of Linguistics, Göteborg University. Academic Dissertation.
- Wengelin, Å., & Strömqvist, S. (2000). Discourse level writing in dyslexics—methods, results and implications for diagnostics. *Logopedics Phoniatrics Vocology*, 25, 22–28.

- Wilson, A. M., & Lesaux, N. K. (2001). Persistence of phonological processing deficits in college students with dyslexia who have age-appropriate reading skills. *Journal of Learning Disabilities, 24*, 394–400.
- Wolff, U. (2006, January). *Att studera med dyslexi vid Göteborgs universitet* [Studying with dyslexia at Gothenburg University]. Retrieved January 1, 2012, from Gothenburg University, Jämlikhet, Rapporten [Equality, Reports] website: http://www.gu.se/digitalAssets/830/830801_Att_studera_med_dyslexi_2006_U_Wolff.pdf
- Wolff, U. (2009). Phonological and surface subtypes among university students with dyslexia. *International Journal of Disability, Development and Education, 56*, 73–91.
- Wolff, U., & Lundberg, I. (2002). The prevalence of dyslexia among art students. *Dyslexia, 8*, 34–42.
- Wolff, U., & Lundberg, I. (2003). A technique for group screening of dyslexia among adults. *Annals of Dyslexia, 53*, 324–339.
- Wydell, T. N., & Kondo, T. (2003). Phonological deficit and the reliance on orthographic approximation for reading: A follow-up study on an English-Japanese bilingual with monolingual dyslexia. *Journal of Research in Reading, 26*, 33–48.



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