Dyslexia in English as a Second Language

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This study focused on English as L2 in a group of Norwegian dyslexic 12 year olds, compared to an age and gender matched control group. Norwegian school children learn English from the first grades on. The subjects were assessed with a test battery of verbal and written tasks. First, they were given a comprehension task; second, a model sentence task; third, two pragmatic tasks, and fourth, three tasks of literacy. The verbal tasks were scored according to comprehension, morphology, syntax and semantics, while the literacy tasks were scored by spelling, translation and reading skills. It was hypothesized that the results of the control group and the dyslexia group would differ on all tasks, but that subgrouping the dyslexia group by comprehension skills would show heterogeneity within the dyslexia group. The data analyses confirmed these hypotheses. Significant differences were seen between the dyslexia group and the control group. However, the subgrouping revealed minor differences between the control group and the subgroup with good comprehension skills, and major differences between the control group and the subgroup with poor comprehension skills. Especially morphology and spelling were difficult for the dyslexia group. The results were tentatively discussed within the framework of biological and cognitive models of how to interpret L2 performance in dyslexia, underlining the importance of further research in L2 acquisition in dyslexia.

Keywords: dyslexia; L2 acquisition; L2 testing; comprehension; verbal skills; literacy skills

INTRODUCTION

Cross-cultural communication is increasingly important. Especially it is important in minor languages to be able to communicate in one or two of the major languages of the world, as English, French, German, Spanish

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Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/dys.286

or Chinese. However, dyslexics have *per se* a particular handicap in accessing this field of globalization. This study focused on English as a second language (L2) in a group of Norwegian dyslexic 6th and 7th graders, compared to an age and gender matched control group. A test battery constructed for the purpose was used to assess the pupils' verbal receptive and expressive skills and their skills in reading and writing.

Studies of brain activation in adopted children, in bi- and multilingualism, and in L2 learning are diverse and inconclusive. Age of acquisition and methods of learning seem to play important roles (Fabbro, 1999; Robertson, 2000). This is reflected in two central hypotheses on L2 learning. According to the crystallization hypothesis, the later L2 is learned, the more its cortical representation will differ from the first language (L1). The hypothesis of interference, on the other hand, holds that representations and maintenance of cortical areas of L1 interferes with and to some degree distorts the acquisition of L2 (Pallier *et al*., 2003).

Functional brain imaging studies show that dyslexia has a biological basis, but translate in accordance with the orthography (Paulesu *et al*., 2001) or the typology (Smythe & Evarett, 2000) of each language. Dyslexia is defined as a linguistic impairment (The Orton Dyslexia Society, 1994; Vellutino, 1979) related to phoneme awareness (Snowling, 2000; Snowling & Nation, 1997), short term and working memory (Baddeley, 1986; Torgeson & Wagner, 1998), or perception of short or rapid varying sounds (Tallal, 1984). Also problems with vision or scanning eye movement (Stein & Walsh, 1997), and problems with movement and balance, caused by defects in the cerebellum (Nicolson & Fawcett, 1999), are associated with dyslexia. In L2 acquisition in dyslexia, the typical deficits associated with dyslexia in L1 have to be accounted for. In typical language development cross-linguistic differences do not seem hard to overcome, but any of the above mentioned theories imply that the transitions from L1 to L2 should be especially challenging for dyslexic subjects.

A five-points model of cognitive factors to count for in dyslexia assessment cross-cultures is proposed by Smythe and Evarett (2000). These factors are phonological processing, auditory system, visual system, speed of processing, and semantic lexicon. Whereas phonological processing is the dominant factor in English-speaking dyslexic subjects, phonological processing, auditory and visual systems form the main areas of deficits in this model. This indicates that in L2 learning in dyslexia, one should be aware of the areas in which each individual dyslexic is likely to show deficits, and how these deficits meet with L2 typology.

Norwegian and English both stem from Old Norse, but have developed in different ways. Using the International Phonetic Alphabet (IPA) Norwegian has 40 *phonemes*, while English has 44 phonemes. Phonemes that are not found in Norwegian are e.g. [θ], [ð], [ʒ], and [w]. Also, there are more diphthongs in English than in Norwegian. As to *morphology*, Norwegian has developed from the synthetic Old Norse into a modern Norwegian with less morphology. Nouns are inflected by suffixes in singular and plural in congruence with the three grammatical genders, which also demand conjugation of adjectives and pronouns. The subject marks grammatical person, with no effect on the verb. As in English, verbs are conjugated according to tense, but contain several classes of both regular and irregular verbs. *Syntactically* Norwegian is quite similar to English, except for in interrogative and negative sentences, where there is no use

of the auxiliary 'to do'. Rather, interrogation is marked by inversion (verb before subject) and a tonal rise to mark the end of the sentence. Inversion is always seen in sentences starting with an adverbial phrase. The Norwegian passive voice is similar to English, and is considered to be a more difficult construction than other syntactical constructions. As to *semantics* English has a far richer vocabulary than Norwegian. Typical 'Norwagisms' in English as L2 are lack of 3rd person singular 's' in verbs and plural 's' in nouns, erratic conjugation of 'to be' and other irregular verbs, and use of inversion. Overcompensation is seen in too frequent use of the present continuous form, which does not exist in Norwegian.

Norwegian orthography is characterized as semi-transparent, with 29 letters and approximately 36 graphemes representing the 40 Norwegian phonemes. Contrary, English orthography, with its 26 letters, is considered deep. Dewey (1971) reported of 41 phonemes (44 phonemes according to IPA) that could be written in 561 different ways. On a continuum from 1 to 5, where Finnish was categorized as highly regular (score 5) and English as highly irregular (score 1), Norwegian scored 3, together with German, Dutch, Swedish, Icelandic and Greek orthographies (Elley, 1992). Danish and French scored 2 and Spanish and Hungarian 4. Norwegian, in other words, has a fairly regular orthography implying that in most cases the reader may access the script through a phonematic approach, but with some important exceptions.

In the Norwegian school system the children receive formal literacy L1 training from 2nd grade on, when they are 7 years old. As a rule they start learning the letters, gradually synthesising them into short, transparent words. This approach is usually supplemented by elements of whole language learning, much left to the taste of the teacher. Norwegian preschools are not especially encouraged to teach literacy, but rather to leave it for school. This points to a contrast to Anglo/American teaching, emphasising the correspondence between written words and pictures/objects early in preschool.

English as L2 is taught orally from the first grades on in Norwegian schools. By the 8th grade, the pupils' skills in oral and written English are evaluated by exams and grades. As for dyslexic children, this often coincides with a peak experience of L1 failure. Besides being taught in school, Norwegian pupils encounter the English language daily by TV and computer programmes, with or without Norwegian subtitles, and very rarely dubbed into Norwegian speech. Thus English is conveyed both explicitly and implicitly to Norwegian school children, meaning that Norwegian students, and students from other minor languages, should have an advantage to students from major languages, like French, Italian and German, where English as L2 is taught mainly by explicit approaches in school. This may be one explanation why Norwegian pupils gained top scores on an international ability tests of English as L2 (Alabau *et al*., 2002).

German-speaking reading impaired children have been documented to read non-words accurately, although slowly (Landerl, 2003), in contrast to English-speaking poor readers, who typically showed severe problems in reading non-words (Wimmer & Goswami, 1994). In more general terms dyslexic children in deep orthographies seem to fall behind at an alphabetic phase, while dyslexic children in more transparent orthographies fall behind at an orthographic phase, when greater automation of reading is needed (Hagtvet, Helland, & Lyster, in press; Hagtvet & Lyster, 2003). International literature is still sparse on L2 learning in dyslexia, but the interest in the topic seems to be growing (Peer &

Reid, 2000). The present study is the first one to focus on how Norwegian dyslexics learn English as a second language.

In Norway, dyslexia is usually assessed by speech and language therapists or trained special educators. The referred subjects are assessed by reading tasks (single word and non-word reading, context oral reading, silent reading measuring reading speed and comprehension) and spelling tasks (single word dictation, sentence dictation, free writing), and selected cognitive tasks (phonological awareness, auditory and visual processing, language comprehension). Commonly used tests are 'Norsk rettskrivings- og leseprøver'/Norwegian spelling and reading tests (Carlsten, 1982), 'Kartlegging av ordavkodingsstrategier'/Assessing word decoding strategies (Høien & Lundberg, 1998) and 'Aston Index', Norwegian version (Sivertsen, 1992). In a school situation, the tester will interview the parents, the L1 teacher and the pupil him/herself on language and literacy development and on academic and intellectual functioning. IQ-testing is not required for a dyslexia diagnosis, but is required in suspicion of any syndrome, mental retardation, or significant neurological deficit. Depending on age and grade, dyslexia will be suspected if either reading and/or spelling skills are substantially below what should be expected. In middle and secondary school, a reading or writing score equal to or below two school years is usually required for a dyslexia diagnosis.

Typical signs of dyslexia will in oral reading be reversals of letters/graphemes, abbreviations of long words, misreading or exclusion of inflectional suffixes; in silent reading low speed (i.e. 80 words/min or below in 12 year olds) and/or impaired text comprehension. In writing tasks oblique words are typically spelled phonologically, rules of single vs double consonants are violated, and compound words are split up. In sentence dictations the text may be shortened or altered, function words/closed classes may be left out, punctuation may be incomplete, and the dictated sentences often have to be reread by the tester. For more detailed descriptions of dyslexia in Norwegian, see Gjessing (1977) and Høien and Lundberg (1991).

As to cognition, the links between language development, language comprehension, specific language impairment (SLI) and dyslexia in L1 needs some special comments. Language comprehension in preschool is seen as a valid predictor of dyslexia (Korkman & Häkkinen-Rihu, 1994). Also, a history of SLI has been reported in up to 50% of dyslexic samples (Helland, 2002a; Snowling & Nation, 1997). If mixed receptive–expressive language disorders (DSM-IV, 1994) was diagnosed in preschool, this should always be re-assessed in school age as being resolved or persistent, in connection with dyslexia assessment. In the first author's previous studies of dyslexia, language comprehension was used as a subgrouping criteria, showing different cognitive and literacy profiles in the subgroups (Asbjørnsen, Helland, Boliek, & Obrzut, 2004; Helland, 2002b; Helland & Asbjørnsen, 2000, 2001, 2003, 2004). The subgroup with language comprehension impairments scored lower on tasks of short-term memory, working memory, rapid naming, reading and spelling, compared to the subgroup with no comprehension impairment. It was concluded that taking both a developmental and a functional perspective on L1 comprehension skills, was essential not only to the understanding of variations within dyslexia, but also to intervention.

In sum, dyslexia in Norwegian is seen as constitutional impairment compatible with the definitions of The Orton Dyslexia Society (1994) and/or The British

Dyslexia Association (1998) affecting both verbal and written language processing. This should mean that reading and writing development in dyslexia is not only delayed, but is also qualitatively different from typical literacy development.

Dyslexia should be diagnosed in L1. In Norwegian clinical reports, English as L2 is sometimes mentioned as especially difficult for the dyslexic pupil, but is rarely systematically assessed. This is due to several factors: usually the tester has no formal competence in L2 teaching, there are no formal tests of L2 assessment, and the main focus is traditionally on L1- functioning in school. But L2 assessment may add valuable information to the diagnosis, especially in dyslexic individuals with relatively good L1 functions. The distinction between L2 and bi/multilingualism is complex. One way of distinguishing is how the language is acquired. Usually L2 is learned explicitly in an academic manner, taking time and effort to get automatised, while bi/multilingualism is merely a result of implicit learning, and not an outcome of academic training (see Cummins, 1984, for a further discussion). L2 as a function of explicit learning puts demands on the memory functions that are typically impaired in dyslexia.

It has not been possible for us to find any assessment tool for L2 skills in dyslexia. Therefore, for the present study a specific test battery was constructed (Kaasa, 2001; Kaasa, Sanne, & Helland, 2004). A test like this has to integrate demands from several fields, based on specific principles. First, it has to target differences between L1 and L2 as to typology, phonology, morphology, syntax, semantics, pragmatics and orthography. Second, it has to integrate knowledge of typical symptoms of dyslexia in L1. Third, it has to target, from a theoretical and clinical viewpoint, the typical symptoms of dyslexia in the transition from L1 to L2. Fourth, it should be based on essential components of a language test. Fifth, it should be based on essential components of a dyslexia test. Finally, all these components should be adjusted to school curriculum and age expectancies, need a minimum of testing time, and have a face value. The last point on face value is important, since quite a few dyslexic pupils will describe L2 learning as especially difficult or as something they dislike. A valid assessment is therefore dependent on a test battery that is motivating and encouraging.

To match school curricula the test should be divided into two main parts: one for verbal and one for written communication. The verbal part should focus on language comprehension and production across a multiple of linguistic aspects. The written part should focus on skills in writing, reading and text comprehension. Since the discrepancy in English phoneme/grapheme correspondence is significant, the written part of the test battery should be balanced, evaluating both where the correspondence is close, and where it is distant. Due to memory problems in dyslexia, tasks and task instructions should be short, and with a vocabulary well know from school curricula and mass media.

Based on these principles, an assessment test of English as L2 in Norwegian dyslexics should reveal differences between a control group and a dyslexia group, both as to verbal and literacy skills. Greatest differences should be seen where the contrast between the two languages co-occur with typical difficult L1 areas of dyslexia. This would be within spelling, where the Norwegian dyslexic is trained to attend to regular grapheme/phoneme correspondence and to sequencing of phonemes. The irregularity in English orthography should therefore be especially challenging to Norwegian dyslexics. Further, since

dyslexia by definition is a constitutional, mainly language based impairment, one should expect difficulties within verbal skills where the contrasts between the two languages are most obvious. These difficulties should be more prominent in a dyslexic subgroup with comprehension impairments compared to a subgroup with no comprehension impairments.

METHOD

Participants

Forty pupils from six different schools surrounding a major city of Norway were recruited with the regular consents required for such studies in Norway. It should be noted that the school system in Norway is mainly public and is based on a philosophy of integration. Legal rights of adjusted teaching are given to students with special educational needs. Subjects with sight and hearing impairments, any syndrome, mental retardation (IQ < 70, DSM-IV, 1994), significant neurological deficit, and/or Norwegian as second language, were not included in the study. Descriptive data are shown in Table 1.

The Dyslexia group consisted of 20 subjects, mean age 12.08 (range 11.25–12.83). They were all diagnosed as dyslexics by skilled speech and language therapists, in accordance with standard assessment of dyslexia in Norwayr. All subjects were within normal range of IQ, and participated in regular classes with some support due to their dyslexia. To assess variation in dyslexia, the Dyslexia group was split by the Median score on the L2 Comprehension test into two subgroups of 10 subjects, see the paragraph on 'subgrouping' below. The Control group consisted of 20 subjects, mean age 12.06 (range 11.17–13.00), matching the Dyslexia group also by gender and school class affiliation. According to their class teachers and the school administrations, none of these subjects had been in need for any special education, and their reading and writing performances were normal.

L1 Comprehension

To assess L1 comprehension the Receptive Language Test (Maul, 1989) was administered. The test is not standardized, but has proven to be clinically valid, differencing statistically between dyslexics in other samples (Asbjørnsen *et al*., 2004; Helland, 2002a; Helland & Asbjørnsen, 2000, 2001, 2003, 2004). Maximum score was 24 points.

The L2 Test Battery

A specific test battery was constructed for the purpose (Helland, 2003; Kaasa, 2001; Kaasa *et al*., 2004) aiming at fulfilling the criteria listed in the introductory section. An important principle was that the test should not be diagnostic, since the diagnosis was set in advance, but should reflect how dyslexic Norwegian pupils perform in English as L2.

Table 1. Age, gender and L1 comprehension scores across groups

	Control		Dyslexia				C+		C−						
N	20		20				10		10						
M/F ratio	11/9		11/9				6/4		5/5						
	Mean	S.D.	Mean	S.D.	*t*-value	*p*	Mean	S.D.	Mean	S.D.	*F*-value	*p*	Con vs C+	Con vs C−	C+ vs C−
Age	12.06	0.48	12.08	0.553	0.019	n.s.	12.04	0.48	12.13	0.64	0.092	n.s.	n.s.	n.s.	n.s.
L1 comprehension	23.28	0.66	22.30	1.32	8.718	**	23.10	0.84	21.50	1.25	14.410	***	n.s.	***	***

Notes: L1 comprehension test (Maul, 1989), max. score 24 points. C+ (dyslexia subgroup): above Median on L2 comprehension test; C− (dyslexia subgroup): below Median on L2 comprehension test. *: $p = 0.05$: **: $p = 0.01$; ***: $p = 0.001$.

The test battery was divided into two main parts, each with three subtests: (1) verbal skills: receptive language, expressive language, and pragmatics, and (2) literacy skills: spelling, reading, and translation.

Verbal skills

L2 Comprehension test assessed receptive language. This subtest was made up of 15 sentences; three narrative, three interrogative, three negative, three with inversion in L1, and three with the passive voice, all of approximately equal length. The subject was presented with a series of six pictures from the Collaboration Story box SCHUBI 'Sir James' (SCHUBI, undated, with permission), and had to point to the correct picture for each sentence being read out by the test leader. Each correct response was given 1 point, wrong response was given 0 points, with a maximum score of 15 points.

Model sentences assessed expressive language. Also this subtest was made up of fifteen sentences; three narrative, three interrogative, three negative, three with inversion in L1, and three with the passive voice, all of approximately equal length, and also comparable with the sentences in the receptive task. The subtest started with three examples of trial. The subject was presented with a model sentence matching a picture drawn from Corel Gallery (1997). S/he was then to make an analogue sentence matching an analogue picture to the first one presented. The responses were type recorded, then transcribed. In addition to correct/not correct response, the responses were evaluated according to types of errors, being morphological, syntactic or semantic. Maximum score was 15 point for each item.

Two subtasks were given to assess pragmatic skills. The first one was Daily Conversation. The tester asked questions from a questioner about name, age, family members and hobbies. The conversation was tape-recorded and transcribed. The responses were evaluated in two ways. First, the response was evaluated as 'communicative' or 'not communicative'. Second, the utterances of the subject were timed, and an estimate of words per minute was calculated. The second pragmatic task was Picture Story, with pictures from the 'Sir James' series (SCUBI, undated). The subject was to look at a picture story made up from four pictures for half a minute. Then s/he was to tell the story, which was tape-recorded. As in the 'Daily conversation', the response was evaluated as 'communicative' or 'not communicative'. Then the story was transcribed, and an estimate of words/min was calculated.

The three tests assessing Literacy were Spelling, Reading and Translation. The subtests were built around 22 words, which were scored in each subtest (see Appendix A). They are high frequent words, used in all beginners and intermediate level textbooks. They contain words with different degrees of transparency, targeting familiar and unfamiliar phonemes and orthography relative to Norwegian. First the words were given as a single word dictation (Spelling). Second the subjects were asked to read nine simple sentences containing the same 22 words (Reading). The reading was type-recorded, and the pronunciation of the 22 words was coded as 'communicative' or 'not communicative'. Third, the subjects were to translate the nine sentences they had read (Translation), and the 22 words were scored as 'correct' or 'not correct'. Each correct or communicative response was given 1 point, and each incorrect or

not communicative response was given 0 points. Thus maximum score for each of the written language subtests were 22 points.

Measures of Reliability and Validity

Verbal tests

Split-half reliability of the L2 Comprehension test showed a reliability quotient of 0.87. Pearson product–moment correlations showed that the L2 Comprehension test correlated significantly with the sum score of Model Sentences ($r = 0.805$, $p < 0.000$), Daily Conversation ($r = 0.671$, $p < 0.000$), and Picture Story ($r = 0.726$, $p < 0.000$).

Literacy tests

Split-half reliability of the Spelling test showed a reliability quotient of 0.96 and of the Translation test a reliability quotient of 0.87. The Reading test had too many null variances for split-half reliability testing, but Pearson Product-Moment Correlations showed that the Reading test scores correlated significantly with the Spelling test scores ($r = 0.802$, $p < 0.000$) and the Translation test scores ($r = 0.883$, $p < 0.000$).

Five individual professionals evaluated the test battery in advance of the testing, and all found it valid for its purposes. Also, a small pilot study on 3 pupils showed that the test could be administered within 45 min, or a school lesson. The pilot subjects conveyed that they liked the test, which should indicate face validity. The subjects of the study confirmed this impression.

To postulate effect size, we had to calculate from similar studies within L1 acquisition, since we knew of no other comparable L2 study. We chose to use our earlier computed means of the means and S.D.s of different language and dyslexia studies of children between 5 and 12 years old. Using Cohen's d 2.058, effect size r is 0.717, pointing to an expected effect in the population: $\rho = 0.70$, with little effects to be seen in samples larger than $N = 7$ (Hugdahl, Helland, & Ofte, 2003).

Data Scoring

The data were scored as described above. Possible effect of gender was analysed jointly on the two groups, and on the Dyslexia group separately, but yielded no effect. The scores are shown in Tables 1, 2, 3 and Appendix A and B.

Subgrouping

To assess the variation in dyslexia, the Dyslexia group was split by Median score = 10.5 (range 4 – 15, Mean = 9.95. S.D. 3.03) on the L2 Comprehension test. The first subgroup, Comprehension Plus (C+), scored above the Median, and the second subgroup, Comprehension Minus (C−), scored below the Median. Median score of the Control group was 14.5 (range 8 – 15, Mean = 13.6, S.D. 2.09), indicating a ceiling effect in this group. One-way ANOVA showed that the scores of the Control group and the C+ subgroup were significantly higher than the

Table 2. L2 comprehension, production and literacy across groups

	Control $n = 20$		Dyslexia $n = 20$				$C+$ $n = 10$		$C-$ $n = 10$						
Test (max. score)	Mean	S.D.	Mean	S.D.	*t*-value	*p*	Mean	S.D.	Mean	S.D.	*F*-value	*p*	Con vs C+	Con vs C−	C+ vs C−
RECEPTIVE LANGUAGE:															
Comprehension Test (15)	13.60	2.09	9.95	3.03	4.43	***	12.40	1.27	7.50	2.12	34.028	0.000	ns	***	***
EXPRESSIVE LANGUAGE:															
Model sentences (15)	9.45	3.32	4.35	3.50	4.73	***	7.20	2.35	1.50	1.51	28.014	0.000	ns	***	***
(a) Morphology (15)	10.70	2.90	5.65	3.42	5.03	***	8.10	2.51	3.20	2.25	26.414	0.000	*	***	***
(b) Syntax (15)	14.20	1.51	10.60	4.15	3.65	**	13.70	1.83	7.50	3.41	33.483	0.000	ns	***	***
(c) Semantics (15)	13.15	1.76	8.90	4.10	4.26	***	12.00	2.21	5.80	3.05	37.052	0.000	ns	***	***
Daily conversation (words/min)	41.74	13.35	23.12	14.15	4.28	***	30.67	14.86	15.58	8.68	14.069	0.000	ns	***	*
Picture story (words/min)	63.19	20.20	37.25	20.77	4.00	***	49.06	18.27	25.44	16.33	13.381	0.000	ns	***	*
LITERACY:															
Spelling (22)	13.90	4.81	5.75	4.17	5.73	***	6.30	3.34	5.20	4.98	16.241	0.000	***	***	n.s.
Reading (22)	19.90	2.10	11.80	4.29	7.59	***	13.90	2.51	9.70	4.76	39.935	0.000	***	***	**
Translation (22)	19.16	2.61	12.25	4.71	5.62	***	15.30	2.45	9.20	4.49	32.711	0.000	**	***	***

Notes: C+ (dyslexia subgroup): above Median on L2 comprehension test; C− (dyslexia subgroup): below Median on L2 comprehension test. *: $p = 0.05$: **: $p = 0.01$; ***: $p = 0.001$.

Table 3. L2 Model sentences/syntax across groups

Mann–Whitney *U*-Test	Control	Dyslexia				Rank sum *p*-level	C+		C−		Rank sum *p*-level		
Test (no. of sentences/max. score)		Mean	S.D.	Mean	S.D.	Control vs. Dyslexia	Mean	S.D.	Mean	S.D.	Con vs C+	Con vs C−	C+ vs C−
L2 Comprehension Test (max. score = 15)	Narrative (3)	2.80	0.41	1.80	1.06	***	2.50	0.53	1.10	0.99	ns	***	**
	Interrogative (3)	2.90	0.31	2.50	0.69	ns	2.70	0.67	2.30	0.67	ns	*	n.s.
	Negative (3)	2.65	0.59	1.80	0.83	**	2.20	0.79	1.40	0.70	ns	***	***
	Inversion (3)	2.65	0.67	1.70	1.08	**	2.50	0.53	0.90	0.88	ns	***	*
	Passive (3)	2.60	0.60	2.15	0.88	ns	2.60	0.52	1.70	0.95	ns	**	*
Model Sentences (max. score = 15)													
	Narrative (3)	2.95	0.22	2.55	0.60		2.90	0.32	2.20	0.63	ns	**	*
	Interrogative (3)	3.00	0.00	2.35	0.93	ns	2.80	0.42	1.90	1.10	ns	**	n.s.
	Negative (3)	2.80	0.52	2.15	1.09	*	2.80	0.42	1.50	1.18	ns	**	*
	Inversion (3)	2.95	0.22	2.05	1.05	ns	2.80	0.42	1.30	0.95	ns	***	**
	Passive (3)	2.50	0.89	1.50	1.24	**	2.40	0.70	0.60	0.97	ns	***	**

Notes: C+ (dyslexia subgroup): above Median on L2 comprehension test; C− (dyslexia subgroup): below Median on L2 comprehension test. *: $p = 0.05$: **: $p = 0.01$; ***: $p = 0.001$. See Table 2 for sum scores on (b) ''Syntax''.

score of the C− subgroup, with no difference between the Control group and C+. See Table 2.

As is shown in Table 1, the subgroups differed significantly on the L1 Comprehension test, and in accordance with the scores on the L2 Comprehension test.

Statistical Analyses

The data were analysed in accordance with their properties by *T*-test for independent samples, one- and two-way ANOVAs, and Mann–Whitney *U*-test. An alpha level was set to 0.05. Significant effects of the ANOVAs were followed up by Tukey HSD test. The test scores are shown in Tables 2 and 3.

RESULTS

Initially, for an overview of the data, four two-way ANOVAs were executed with (a) a Group (2: Control, Dyslexia) by Task design, and (b) a Group (3: Control, C+, C−) by Task design.

(1) L2 Comprehension Test vs Model Sentences

(a) Group (2: Control, Dyslexia) by Task: a significant effect of Group $F(2,38) = 24.842$, $p < 0.000$, and Task, $F(2,38) = 158.118$, $p < 0.000$. Tukey HSD test showed that the effect of Group was due to higher scores in Control vs Dyslexia ($p < 0.000$), and of Task to higher scores on the L2 Comprehension test than Model Sentences ($p < 0.000$);

(b) Group (3: Control, C+, C−) by Task showed a significant effect of Group, $F(2,37) = 40.30$, $p < 0.000$, and of Task, $F(1,37) = 155.58$, $p < 0.000$. Follow up test showed that the Group effect was due to C-having an over-all lower score vs Control and C+ ($p < 0.000$), with no difference between Control and C+. Task effect is cited in point (a).

(2) Model Sentences

Morphology vs Syntax vs Semantics, yielded an effect of:

(a) Group $F(2,38) = 21.541$, $p < 0.000$, and Task; $F(2,76) = 92.514$, $p < 0.000$. Follow up test showed that the effect of Group was due to higher scores in Control vs Dyslexia ($p < 0.000$), and of Task to due to Morphology scores being lower ($p < 0.000$) than the other two scores, and Semantics scores being lower than Syntax ($p < 0.000$);

(b) Group (3: Control, C+, C−) by Task: Group, $F(2,37) = 40.631$, $p < 0.000$, of Task, $F(1,37) = 93.810$, $p < 0.000$. Follow up test showed that the Group effect was due to C− having an over-all lower score vs Control and C+ ($p < 0.000$), with no difference between Control and C+. The task effect is cited above.

3. Daily Conversation vs Picture Story

It showed an effect of:

(a) Group $F(2,38) = 19.203$, $p < 0.000$, and Task, $F(2,38) = 68.627$, $P < 0.000$. Follow up test showed that the effect of Group was due to more words/min in Control vs Dyslexia ($p < 0.000$), and of Task due to more words/min on the Picture Story than on Daily Conversation ($p < 0.000$).

(b) Group (3: Control, C+, C−) by Task: Group, $F(2,37) = 15.916$, $p < 0.000$, and of Task (words per minute), $F(1,37) = 55.033$, $p < 0.000$. Follow up test showed that the effect of Group was due to a significant lower score in C− vs Control ($p < 0.000$) and vs C+ ($p = 0.02$). The task effect is cited above.

(4) Spelling vs Reading vs Translation

There was an effect of:

(a) Group $F(1,37) = 54.279$, $p < 0.000$, and Task, $F(2,74) = 70.305$, $p < 0.000$. Follow up test showed that the effect of Group was due to higher scores in Control ($p < 0.000$) than in Dyslexia, and of Task due to significantly lower Spelling scores than Reading and Translation scores ($p < 0.000$).

(b) Group (3: Control, C+, C−) by Task: There were significant effects of Group $F(2,37) = 31.78$, $p < 0.000$, of Task $F(2,74) = 75.70$, $p < 0.000$, and of Interaction $F(4,74) = 3.63$, $p < 0.01$. Follow up test showed that the effect of Group was due to higher scores in Control vs the two subgroups ($p < 0.001$), and higher scores in C+ vs C− ($p = 0.03$); The effect of Task was due to significantly more errors in Spelling than in Reading and Translation ($p < 0.000$). The effect of Interaction was due to Reading and Translation scores in Control being significantly higher than all other scores ($p < 0.000$), that all scores in C− were significantly lower than all scores in Control ($p < 0.000$) and the Reading and Translation scores in C+ ($p < 0.01$). Thus, there was no significant difference between the Spelling scores in C+ and C−. Within-group differences were seen in all three groups by Spelling being significantly lower ($p < 0.000$) than Reading and Translation. The significant higher Reading scores ($p = 0.005$) in C+ vs C−, in spite of their equally low score in Spelling, however, point to a higher L2 phoneme/grapheme awareness in C+ than in C−.

For further corroboration of the data all tasks were first analysed for between group differences by *t*-test (Control vs Dyslexia) and one-way ANOVA (Control vs C+ vs C−) (see Table 2), second, the Syntax structures were analysed by ranking level (see Table 3), third, the Daily Conversation and Picture Story were undertaken a more quantitative analyses by evaluating the subjects' communication as 'communicative' or 'not communicative'. Two of the performances in the Control group, and 12 of the performances in the Dyslexia group, were evaluated as 'not communicative' on both tasks. Two of these performances were seen in the C+ subgroup, while all performances in the C− subgroup got this evaluation. Also, as can be seen from the appendix, the spelling, reading and translation scores were registered for each of the 22 words. In addition, the spelling words were registered by graphemes.

As can be seen from Table 2, *T*-test yielded significantly higher scores in the Control group vs the Dyslexia group on all tasks. The sub-grouping

differentiated this picture. First, as shown in Table 2 also, there were no significant differences between the scores of the Control group and the C+ subgroup on six of the 10 analyses, while the C− subgroup scored significantly lower than the Control group on all analyses. Also, there were significant differences between the scores of C+ and C− on all analyses, except on the Spelling task, where the scores were equally low in both subgroups.

The obvious differences in Spelling were further exploited by grapheme scoring. A grapheme was defined by its phoneme. The graphemes of each word were given one point. This is shown in Appendices A and B. Although the mean C− score was lower than the mean C+ score, one-way ANOVA did not yield significance. A general error trait was that the subjects tended to write the words phonetically, and adjusted to Norwegian phonology. Examples of this are 'bjutiful', 'boi', 'haus', 'neim', 'cud'. Also, some interference of Anglican orthography was seen: 'byouthyfoool', 'whery', 'chud'. As the tests scores show, this was done to a larger extent in the Dyslexia group than in the Control group, and also, the dyslexic subjects gave up on more words.

Comprehension and production of the five different Syntax structures, each containing three sentences, were analysed. As can be seen in Table 3, Mann–Whitney *U*-tests showed that the Control group ranked significantly higher on Narrative, Negative and Inversion on the L2 Comprehension test, and on the Interrogative, Inversion and Passive on Model Sentences, compared to the Dyslexia group. However, analyses of Control vs C+ vs C−, showed no significant differences between the Control group and the C+ sub-group, but significant higher scores on all syntactic structures in the Control group vs the C− sub-group, and significant higher scores on all syntactic structures on C+ vs C−, except for the two interrogative structures.

SUMMARY

As to verbal tasks L2 comprehension was easier than producing model sentences. Within model sentences making correct syntax was easier than producing correct semantics and correct morphology, which was the most difficult grammatical area. Also, to tell a picture story seemed easier than responding in a daily conversation. On the literacy tasks, reading and translation showed to be easier than spelling.

As to between-group differences the Control group scored significantly higher than the Dyslexia group on all tasks. However, the subgrouping by L2 comprehension differentiated this picture. The subgroup with good comprehension, C+, did not differ significantly from the Control group on any of the verbal tasks except on morphology, whereas the subgroup with poor comprehension, C−, scored significantly lower than both groups on all verbal tasks.

On the literacy tasks the Control group scored significantly higher than the Dyslexia group, but also in this area the subgrouping differentiated the picture. As to spelling, the two subgroups scored equally low. Also, they both scored significantly lower than the Control group on the reading and translation tasks, but with C− significantly lower than C+.

DISCUSSION

As the subgroups were small, the statistical analyses should be looked upon as highly tentative, but with some support in size effect calculations. Nevertheless, the differences that emerged were rather dramatic, supporting the hypotheses that were set forward. First, there were highly significant differences between the Control group and the Dyslexia group as to skills within morphology, syntax, semantics and orthography. Second, comprehension skills in L1 and L2 differentiated these skills within the Dyslexia group. Third, the scores on the test battery indicated which areas in the transition from L1 to English as L2 were problematic to Norwegian pupils in general, and in dyslexic pupils in particular. Fourth, the findings may shed light on problems in the transition to English as L2 in languages comparable to Norwegian, as for instance German, Dutch, Swedish and Icelandic.

Taken the definitional aspects of dyslexia as a language impairment, the most unexpected results were the scores seen in the C+ sub-group, which were comparable to the scores of the Control group on all verbal tasks, except for the morphology scores. As to the summed Literacy scores of the test battery, the C+ sub-group scored significantly lower than the Control group, but significantly higher than the C− subgroup. Only on the spelling task the two subgroups scored equally low. Due to its good verbal skills, the C+ subgroup should be able to follow the regular English teaching in class, using computerized aids as spell check.

The C− sub-group diverged significantly from the Control group across all measures, and from the C+ subgroup on all measures except for the Spelling task. Also word processing was slow in this subgroup, indicating either limited vocabulary or processing impairment. This points to rather massive problems in English as a L2, but not in the sense that L2 should be given up. Pupils within this sub-group should need special education in L2, with teaching adjusted to their verbal and literacy skills.

Comments from many of the subjects in the Dyslexia group were that they had not spoken so much English before. This went for both sub-groups. Obviously the test had made them perform more English than what they usually did, which had been a positive experience for them. This may also be interpreted in another way; they may seldom have been in a position in class to show what they actually mastered, pointing to teaching strategies of English as L2 in Norwegian schools. Awareness of onsets and rimes is a strong predictor of reading and spelling development in English, but not in Norwegian (Goswami, 1999). Hence, teaching onset-/rime-awareness is much used in English, but not in Norwegian schools, but should be seriously considered as a strategy in English as L2 teaching, especially in dyslexia.

The present study indicated strongly that although L2 spelling was homogeneously impaired in the Dyslexia group, other linguistic skills varied substantially. Taken that the Anglo/American literature the past 20–30 years has concentrated on dyslexia mainly as an impairment within linguistic awareness, one should expect that in English as L2, morphology should be a specifically difficult area. Since also Norwegian poor readers typically show impaired morphology in L1 (Hagtvet & Lyster, 2003), one may speculate that the poor L2 morphological skills seen in this study, could be explained by an interference from poor L1 morphological skills. Further, that typical Norwegian, or semi-transparent, orthography was seen in the L2 spelling mistakes, mostly in the Dyslexia group, underscores the view that L1 and L2 interfere.

From these findings one may speculate that beginners' or poor L2 skills in dyslexia could be characterized by interference of L1 skills, to develop into good or automated skills in L2, not interfered by L1. This development may vary along a scale from easy to difficult task demands, as for instance moving from comprehension to morphology to spelling, as in the present study. This view may be compatible with both the hypothesis of crystallisation and the hypothesis of interference. One may speculate that the automated skills will activate different brain areas in L1 and L2, supporting the hypothesis of crystallization, while less automatized skills, will activate the same brain areas in L1 and L2, supporting the hypothesis of interference. Further investigations using brain-imaging techniques during automatized and not-automatized tasks should shed light on which areas of the brain these tasks would activate.

However, taken that brain activation in dyslexia differs form typical brain activation during language tasks, the picture of L2 acquisition in dyslexia is particularly complex. In this aspect the five-point model proposed by Smythe and Evarett (2000) in cross-culture assessment of dyslexia should be useful. For instance, due to different effects of phonological processing and auditory systems, dyslexia in L2 typologies characterized by tones and/or short words may show patterns different from those described in both English-speaking and Norwegian-speaking samples. Further, in i.e. Chinese script as L1, the visual factor should be especially accounted for in the transition to any phonematic script in L2, as the Latin alphabet. In a neuro-cognitive perspective, if magnocellular impairment or cerebellar impairments were confirmed, also the visual factor should be especially accounted for.

Several authors have pointed to L2 acquisition as important to dyslexia research, but that the literature within this area is still sparse (Peer & Reid, 2000). The present study is the first one administered to Norwegian dyslexic subjects as to English as L2. At a more general level, the present study exemplifies eases and difficulties for dyslexic subjects in the transition between two languages of minor differences as to typology, but with major differences as to orthography, albeit within the same alphabetic system. This raises the question of the universality of the manifestations of dyslexia across languages, and how it meets with the specificities of different language typologies, in L1, L2 and bi- and multilingualism. Besides replication of the present study, other areas of investigation should be pursued. Tentatively these could be longitudinal studies of L2 development, starting at a low age level; analogue studies in other L1 languages with English as L2; comparison of different L2 teaching strategies, and as mentioned above, brain-imaging studies with varying L2 task demands. Greater knowledge within this area should contribute to the knowledge of how the brain works during language acquisition in dyslexia in general, and in L2 learning in dyslexia more specifically. Better knowledge in this field is needed to improve participation in cross-cultural communication for dyslexic subjects.

APPENDIX A

Scores on spelling, reading and translation tests across groups are given in Table A1.

Table A1

	Control			C+			C−		
	Spelling n=19	Reading n=20	Translation n=20	Spelling n=10	Reading n=10	Translation n=10	Spelling n=10	Reading n=10	Translation n=10
1. BOY	19	20	20	8	10	10	8	10	7
2. GIRL	18	20	19	8	8	10	6	5	7
3. SCHOOL	13	20	20	2	8	9	1	5	6
4. CHILD	11	15	18	3	1	8	3	0	3
5. CAT	18	20	20	8	10	10	6	10	9
6. NAME	18	20	17	6	9	5	3	7	5
7. VERY	14	20	17	5	10	9	1	5	5
8. SHOULD	5	14	18	0	0	5	0	0	1
9. NOSE	17	18	17	3	8	9	3	3	7
10. MOUTH	7	12	18	0	1	6	0	2	1
11. MUCH	4	20	15	0	8	4	0	2	1
12. WHEN	13	20	15	4	9	6	3	8	1
13. COULD	5	13	18	0	0	4	0	1	3
14. JUST	8	19	11	0	2	4	1	3	0
15. BEAUTIFUL	7	19	17	0	6	6	0	3	4
16. MANY	14	20	19	5	8	7	2	5	3
17. BOOKS	15	18	14	5	5	6	2	5	5
18. WHAT	11	19	18	4	7	10	2	6	6
19. HOUSE	17	20	20	5	10	9	2	7	7
20. LITTLE	14	20	19	0	9	10	3	7	7
21. THAN	7	16	13	0	5	3	0	2	1
22. HIGH	10	15	12	1	5	5	1	1	1

APPENDIX B

Spelling scored by graphemes are given in Table B1.

Table B1

										Con	C+	C−
	1	2	3	4	5	6	7	8	Max score	Mean	Mean	Mean
1. BOY	b	oy							2	2.00	1.80	1.80
2. GIRL	g	i	rl						3	2.95	2.80	2.40
3. SCHOOL	s	ch	oo	l					4	3.53	2.60	2.20
4. CHILD	ch	i	l	d					4	3.16	2.60	2.40
5. CAT	c	a	t						3	2.95	2.80	2.40
6. NAME	n	a	m(e)						3	2.89	2.50	2.10
7. VERY	v	e	r	y					4	3.74	3.50	2.70
8. SHOULD	sh	ou	ld						3	1.45	0.70	0.65
9. NOSE	n	o	s(e)						3	2.89	2.20	2.20
10. MOUTH	m	ou	th						3	2.00	1.00	1.00
11. MUCH	m	u	ch						3	1.74	1.10	1.00
12. WHEN	wh	e	n						3	2.58	2.20	2.10
13. COULD	c	ou	ld						3	1.55	0.75	0.75
14. JUST	j	u	s	t					4	2.58	2.50	1.70
15. BEAUTIFUL	b	j	eau	t	i	f	u	l	8	5.79	4.90	4.60
16. MANY	m	a	n	y					4	3.74	3.40	2.50
17. THEN	th	e	n						4	2.79	2.40	2.10
18. WHAT	wh	a	t						3	2.47	2.20	1.90
19. HOUSE	h	ou	s(e)						3	2.89	2.40	2.40
20. LITTLE	l	i	tt	l					4	3.58	2.60	3.00
21. THAN	th	a	n						3	2.16	1.20	1.20
22. HIGH	h	igh							2	1.53	1.10	0.90
									75	60.95	49.25	44.00
										(8.49)	(6.58)	(10.98)

Note: diphthongs are treated as one phoneme.

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