

University of Groningen

The impact of dyslexia in higher education

Rouweler, Liset

DOI:
[10.33612/diss.190485392](https://doi.org/10.33612/diss.190485392)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):
Rouweler, L. (2021). *The impact of dyslexia in higher education*. University of Groningen.
<https://doi.org/10.33612/diss.190485392>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

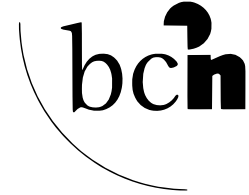
Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

The impact of dyslexia in higher education

Liset Rouweler

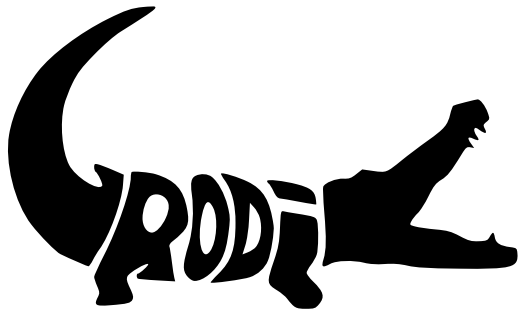


rijksuniversiteit
 groningen



The work reported in this dissertation has been carried out under the auspices of the Center for Language and Cognition Groningen (CLCG) and the School for Behavioral and Cognitive Neurosciences (BCN) of the University Medical Center Groningen.

Publication of this thesis was financially supported by the Graduate School of Humanities (GSH) and the Research School of Behavioral and Cognitive Neuroscience (BCN).



Cover design: Ann-Katrin Ohlerth & Fransien 'Furensi' Boswijk

Printing: Ipskamp Printing

Copyright ©2021 Liset Rouweler. All rights reserved. No parts of this publication may be reproduced or transmitted without permission in writing from the author.



**rijksuniversiteit
groningen**

The impact of dyslexia in higher education

Proefschrift

ter verkrijging van de graad van doctor aan de
Rijksuniversiteit Groningen
op gezag van de
rector magnificus prof. dr. C. Wijmenga
en volgens besluit van het College van Promoties.

De openbare verdediging zal plaatsvinden op
donderdag 18 november 2021 om 16.15 uur

door

Liset Louise Maria Rouweler

geboren op 01 November 1991
te Deventer

Promotor

Prof. dr. B. A. M. Maassen

Copromotores

Dr. W. Tops

Dr. B. J. A. de Groot

Beoordelingscommissie

Prof. dr. E. H. de Bree

Prof. dr. P. Ghesquière

Prof. dr. M. C. J. Keijzer

*To learn to read is to light a fire;
every syllable that is spelled out is a spark.*

VICTOR HUGO

Acknowledgements

Wow, this is it! My PhD adventure has come to an end, and that it was, an adventure, both personally and academically. Most people would argue that doing a PhD is a job for a lone wolf. I would argue the contrary, as it takes so many people to successfully complete a PhD – and also at least the same number - or even more - to keep you sane, especially if you're writing a big part of your thesis during a global pandemic.

My interest for the topic dyslexia already started way before I started thinking about higher education and science. Dyslexia runs in my family and at some point, I started wondering about why the number of people diagnosed with dyslexia, relatively speaking of course, was so high in my family. Thinking about future studies I accidentally stumbled upon linguistics in Groningen and I noticed that in this study there was a big focus on neurolinguistics and also dyslexia. In the first year of my bachelors, during the intro course about dyslexia, I already met my promotor, Ben Maassen, who since then played a large role during my studies and PhD. Starting as a first-year bachelor student, you taught me the first steps in the world of dyslexia and over the past ten years, you made sure that dyslexia also became more and more my field of expertise. I would like to thank you for your expertise and guidance throughout my studies and PhD, and furthermore for inspiring me to always think one step ahead.

I am also very grateful to my daily supervisor, Wim Tops, who played the most substantial role during my masters and PhD. Together we came up with the idea for this project and I would like to thank you for helping me writing the proposal for this thesis. This project would definitely not have existed without you. Thank you for your support, both personally and academically, and for believing that I could actually pursue a PhD. I would also like to thank Wim for his everlasting enthusiasm about dyslexia, his feedback and honesty – even though it was tough sometimes.

I am also very thankful to Barry de Groot, who joined my supervisory team in the last year of my project, but whose extensive feedback has been extremely valuable in creating the final version of this thesis. Thank you for sharing your knowledge about dyslexia, your advice and in particular your help with the statistical analyses.

Furthermore, I would like to express my gratitude to my assessment committee: Elise de Bree, Pol Ghesquière and Merel Keijzer. Thank you for taking the time to read and evaluate my work and for your valuable comments and suggestions. It definitely improved the final version of my thesis.

ACKNOWLEDGEMENTS

I would also like to thank Marc Brysbaert and Heleen vander Beken for their expertise and for sharing the reading comprehension materials with me. It most certainly made my thesis better. Furthermore, I would like to thank Marc Brysbaert for his help with the construction of the first paper, his input on the Flamingo Test and for always sending me new interesting articles. Regarding the materials, I would also like to thank Claroread for sharing their software with me. You made it possible that I could evaluate the use of software within this thesis.

During my PhD, I was lucky enough to be a part of the Research School on Behavioral and Cognitive Neuroscience (BCN) and Graduate School of Humanities (GSH). I am thankful for all the interesting courses and events I got to attend through GSH and BCN. In particular I would like to thank Marijke (GSH), Nadja (GSH), Christina (CLCG) and Diana (BCN) for their help whenever needed.

I am most grateful to those without whom my project simply would not have existed: my 120 participants. Thank you all for your time – 3 hours is a lot –, your enthusiasm, your curiosity and questions and for simply for helping me out. I also had the privilege to work with a few fantastic students who helped me out with testing during times I was not around. Thank you Nelleke, Tineke and Judith for helping me out during one of the busiest times of my PhD. Nelleke and Judith, thank you for also deciding to write your MA thesis with me as your supervisor. It was a great pleasure.

The life of a PhD student would be pretty uninspiring without fellow PhD students and without a research group. At the university, I had the pleasure to be part of the best research community. I am very thankful to all the members of the Neurolinguistics group: Adrià, Aida, Annie, Atila, Camila, Cheyenne, Dörte, Effy, Ellie, Frank, Irene, Jakolien, Jidde, Juliana, Kaimook, Nat, Nermina, Nienke, Pauline, Roel, Roelien, Sana, Seçkin, Srdjan, Silvia, Solveig, Suzan, Teja, Toivo, Vânia, Weng, and Yulia. Thank you for your feedback, support and talks together, both online and offline.

Some people of the Neurolinguistics group deserve a special mention in my acknowledgements. First, I would like to thank you Dörte for your feedback and for always helping me out when needed. You always made me feel very welcome and it never felt that I bothered you with my thoughts or questions even though you were very busy. You also helped me in getting a temporary teaching position for after the PhD, so once more, thank you very much. I also consider myself a lucky girl to have had a PhD colleague who was also working on adults with dyslexia and who also became a very good friend. Thank you, Aida for all our discussions on dyslexia - and our pets -, your help with the recruitment of the participants, for proofreading some of my chapters, for being the most awesome conference buddy, for your delicious zucchini pesto and most importantly your friendship. The next special mention is reserved for Annie and Frank, two of my dearest colleagues – who also became my very close friends during the pandemic. Feeling lost in the pandemic and quarantine times we decided to meet each other online every single working day from 9 till 12. It is because of the both of you that I was able to finish my PhD in time. You kept me motivated and it was such a joy to be working with the both of you and to talk to you almost every day, not only about PhD related stuff but also about our personal lives. And Annie, thank you for capturing my ideas for the cover in an amazing design, also together with Fransien, it is even better than imagined. Also, a special mention to Franks son, Timmy/Tippy, who always cheered us up!

ACKNOWLEDGEMENTS

The last few years I have lived in three different places, first the Netherlands, then Brussels and nowadays in Vilnius. Living in different countries gives you the opportunity to meet a lot of great people, both inside and outside academia. Spending so much time on your PhD it makes it easy to forget that there is a life outside science and your dearest PhD baby. So much people deserve credit for not making me forget about this other part of life.

My first big and very special thank you is reserved for the best two paranymphs in town, Marita and Vincent. Of course, the both of you are officially my colleagues, but you are so much more than that. You are the best friends that I could wish for. You were always there to help me out, both personally and academically. If I think about the two of you and about the past four years it instantly puts a smile on my face. Thanks for all the talks about Nintendo (real fanboys), board games, Harry Potter, Eurovision (the list is way longer) and for visiting me in Brussels and Vilnius. You made my PhD very unforgettable. Also, a thank you to your other halves, René and Joël, for the ‘gezelligheid’ and our shared love for board games. Thank you, Joël for sharing the last steps in our PhD together, it made finishing up much nicer. And thank you Marita and René for hosting me every time I needed a place to stay.

There are more friends that deserve a ‘giant’ thank you. A very big shoutout to Natascha and Iris for being the group on whatsapp with the most messages and the ugliest pictures, and for just simply always being one phone call away. You mean so much to me. Thank you Bob, for your friendship and support for the past fifteen years. I’m very happy that you helped me through economics in high school, so that I could drop it quickly after and pursue something that I really enjoyed. I am also very lucky that I can call you my best man for the upcoming wedding. Davina and Caroline, thanks for sharing the love for the topic dyslexia, your everlasting faith in me and all the nice dinner dates we had at the pastafabriek. Also, thank you Caroline and Tim for hosting me whenever it was necessary. Sjors and Daan, thank you for always putting a smile on my face - your texts and gifjes can be just the weirdest - it was just always such a pleasure to see the both of you, with or without some ‘kraanwater’. My dear Mara, thank you you for sharing the same sense of humor, our love for sarcasm, for the occasional ‘schop onder de kont’ when making an important decision, and also for your very important friendship. Thank you, Vass for the sweetest post cards that I got every time you were travelling, for the awesome Harry Potter notebook and for all the enjoyable breaks together. Also a big thank you to the Mika fan club and my former house mates, Pieter, Romy and Ingrid. The three of you made living in Groningen as a student much more enjoyable, and Pieter, those pranks you pulled never got old. Kelly, Gamida and Lisa, thank you for already being my close friends for such a long time. We really grew up together and primary school, high school and university were so much more fun with the three of you in it. Many thanks to Jidde, Amélie and Iris of the rirarema group. It was such a pleasure that we met during our bachelors or research master and that we all landed a PhD after that. Soon our group will be called didadoctor (credits to Iris for the name). Fransien and Korlieke, thank you for all the nerdy talks and all our pet related pictures and discussions the past two years. And thank you Fransien for designing the cover for me together with Annie, I love it so much. Also, a giant thank you to all of our friends from PM+1! Wout, Dieuwke, Roderik, Corine, Vincent, Miranda, Vincent, Laura, Matthijs, Amber, Jesse, Elvira, Thomas, Anne Marijke, Jorick and Valeria, you always made me feel very welcome when I was in Groningen and it was great that you visited us in Brussels and Vilnius. Those days and evenings together are

always the best - I will never forget ‘Wie is de haas’ - and I know that we all are always there for one and other. A special mention is reserved for Jorick and Vincent and Miranda. Jorick, it was a blast to have lived in the same city for two years and thank you for also being such a willing victim to play board games with us - I still veto Munchkin. Miranda and Vincent, thank you for always offering me a place to sleep, your hospitality is enormous.

Living abroad can be difficult but also has a lot of perks, as you meet amazing people. It was great to have you, Jolanta and Michael, as our ‘kaimynai’ in two different countries. I bet that not many people can say that, and also many thanks for all your help the past few years! Ačiū labai, Mindaugas for offering me a spot in your co-working space in Vilnius and for making sure that we had a kick start in the city. A big thank you to Una and David, members of the Bruce fanclub - we all know which Bruce - for all the fun evenings we had and shared together. Many more to come, especially at Le Travi. Thank you Una for proofreading some parts of my thesis and David for dog sitting Mika whenever necessary. Ačiū labai to Aukse and Mantas for always giving me the option to distract myself from my PhD by offering walks together with our dog babies, Mika and Rumi. Also, ačiū Emilija for the nice lunch breaks and your never ending support.

Pursuing a PhD would never have been possible without the support of my family: my parents, my parents-in-law, my sisters and their boyfriends, and my grandparents. Mam en pap, ik ben jullie enorm dankbaar, meer dan woorden wellicht kunnen uitdrukken. Zonder jullie liefde en steun zou ik niet staan waar ik nu sta. Jullie vertrouwen in mij is enorm en ik kan altijd op jullie rekenen, zelfs na verhuizing nummer zes of zeven stonden jullie weer voor me klaar. En mama, dank je wel dat je me al vroeg de kunst van de spoonerisms hebt aangeleerd, zonder jou was mijn fonologisch bewustzijn nooit zo goed geweest. En Jolijn, jij bent eigenlijk de reden dat ik een PhD op het gebied van dyslexie ben gaan doen, jouw diagnose heeft ervoor gezorgd dat ik altijd net dat ene stapje extra wilde nemen. Dit proefschrift is dus eigenlijk een beetje voor jou (geen zorgen, ik verwacht niet dat je dit proefschrift helemaal gaat lezen, enkel de samenvatting). Benthe en Bjorn, en Jolijn en Bram, dank jullie wel voor de gezelligheid de afgelopen jaren, jullie hielden me met beide benen op de grond. Janny en Gerard, ik kan me geen betere schoonouders wensen. Bedankt voor jullie steun en hulp de afgelopen jaren, op welk gebied dan ook, zoals oppassen op Mika, het verhuizen en klussen en voor het feit dat we een dikke maand bij jullie mochten zijn na Peters beenbreuk, niets is jullie teveel. Opa en oma, jullie ook bedankt voor alle liefde en steun. Hoe vaak jullie me ook al niet geholpen hebben met verhuizen. Altijd als ik in Nederland ben, moet ik gewoon even naar jullie toe, jullie zijn fantastisch.

And now, the last one, but definitely not the least, my partner (in crime), my true love and best friend, and now also fiancé, Peter. I am not sure if I can capture how much I value you and how much you supported me in words, but at least I can give it a try. Looking back at the past five years it was a hell of a ride, moving two times within Europe, travelling to Latin America, experiencing a global pandemic in a foreign country and always being by each other’s sides, getting our – first monster, now angel – dog, Mika, you breaking your leg and our very recent engagement. Something that was never ending was our everlasting optimism in every single situation and I do not think that there is a situation that we cannot handle together. You and Mika mean the world to me and I am looking forward to all the adventures that await us. Dank je wel, merci and ačiū labai schatje, ik hou van je!

Table of Contents

Acknowledgements	vii
Table of Contents	xi
List of Abbreviations	xvi
List of Figures	xvii
List of Tables	xix
1 Introduction	1
1.1 Dyslexia in more detail	2
1.2 Characteristics of higher education students with dyslexia	5
1.3 Reading comprehension in higher education	7
1.4 Writing in Higher Education	10
1.5 The role of English in Dutch Higher Education	13
1.6 The Current Dissertation	15
1.7 Outline of the Thesis	15
1.8 References	16
2 The Flamingo Test: a new diagnostic instrument for dyslexia in Dutch higher education students	27
2.1 Introduction	28
2.1.1 Screening for reading problems at university level	28
2.1.2 Text reading as a diagnostic instrument	29
2.1.3 Present study	30
2.2 Experiment 1	30
2.2.1 Methods	30
2.2.2 Results	32

2.2.3	Discussion	36
2.3	Experiment 2	37
2.3.1	Methods	37
2.3.2	Results	38
2.3.3	Discussion	41
2.4	General Discussion	42
2.5	References	43
3	Test type has an effect on the outcome on L1 and L2 reading comprehension performance of higher education students with dyslexia	47
3.1	Introduction	48
3.1.1	Models of reading comprehension	48
3.1.2	Dyslexia and reading comprehension	49
3.1.3	L2 learning and higher education	50
3.1.4	Present study	51
3.2	Methods	52
3.2.1	Participants	52
3.2.2	Reading comprehension materials	52
3.2.3	Cognitive tests and questionnaire	54
3.2.4	Procedure	56
3.2.5	Statistical analyses	56
3.3	Results	57
3.3.1	Assessing the participants' L1 and L2 proficiency level	57
3.3.2	Determining the participants' WM and Fluid IQ scores	58
3.3.3	Performance on reading and reading comprehension	59
3.3.4	Influence of predictors on total TF and FR scores	63
3.4	Discussion	63
3.4.1	Performance on the TF tests	63
3.4.2	Performance on the FR tests	64
3.4.3	Conclusions	65
3.5	References	66
4	Determining factors in academic reading comprehension performance for higher education students with and without dyslexia	71
4.1	Introduction	72
4.1.1	Reading comprehension and dyslexia	72
4.1.2	Text-to-speech software	73
4.1.3	Present study	74
4.2	Methods	75
4.2.1	Participants	75
4.2.2	Reading and reading comprehension materials	76
4.2.3	Assessment of language proficiency and print exposure	77
4.2.4	Statistical analyses	78
4.3	Results	78

4.3.1	Control variables: word reading, language proficiency and print exposure	78
4.3.2	L1 Reading comprehension	79
4.3.3	L2 Reading comprehension	80
4.3.4	Differences between L1 and L2	82
4.3.5	Correlations per group	83
4.4	Discussion	84
4.4.1	L1 reading comprehension performance	85
4.4.2	L2 reading comprehension performance	86
4.4.3	The effect of text-to-speech software	86
4.4.4	Limitations and suggestions for future research	88
4.4.5	Conclusions	88
4.5	References	89
5	The L1 and L2 spelling and writing skills of Dutch higher education students with dyslexia	95
5.1	Introduction	96
5.1.1	Spelling	96
5.1.2	Writing	97
5.1.3	Present study	98
5.2	Methods	99
5.2.1	Participants	99
5.2.2	Spelling and writing materials	99
5.2.3	Cognitive tests and print exposure	100
5.2.4	Procedure	101
5.2.5	Statistical analyses	101
5.3	Results	102
5.3.1	PA and WM	103
5.3.2	Questionnaire responses	103
5.3.3	Spelling	104
5.3.4	Summary writing	106
5.4	Discussion	110
5.4.1	Spelling	110
5.4.2	Writing	111
5.4.3	Limitations and suggestions for future research	112
5.4.4	Conclusions	112
5.5	References	113
6	General Discussion and Conclusions	117
6.1	Understanding dyslexia in higher education	118
6.1.1	Word reading and text reading	118
6.1.2	Word spelling	119
6.1.3	Reading comprehension	119
6.1.4	Writing	124
6.2	Implications for research and education	125

6.3	Limitations and future directions	126
6.3.1	Limitations	126
6.3.2	Suggestions for future research	128
6.4	General conclusions	129
6.5	References	130
English Summary		135
Nederlandse Samenvatting		139
Appendices		143
A.	The Flamingo Test	144
B.	Reading comprehension materials (Chapter 3 and 5)	145
C.	Reading comprehension materials (Chapter 4)	151
Groningen Dissertations in Linguistics (GRODIL)		155

List of Abbreviations

Acc	Accuracy
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
APA	American Psychiatric Association
BDA	British Dyslexia Association
C-test	Cloze-test
DAP	Dyslexia Assessment Protocol
Dys	Dyslexia
EMT	Een Minuut Test
FIQ	Fluid IQ
FR	Free-recall
GL&SCHR	Test voor Gevorderd Lezen en Schrijven
IDA	International Dyslexia Association
IDAA	Interactive Dyslexia test Amsterdam-Antwerpen
IQ	Intelligence Quotient
L1	First language
L2	Second language
LCDH	Linguistic Coding Differences Hypothesis

LEMs	Leestest Een Minuut voor Studenten
LOP-effect	Levels of Processing effect
M	Mean
N	Number
NonDys	Non Dyslexia
NPV	Negative Predictive Value
OMT	One Minute Test
PA	Phonological Awareness
Pc	Percentile
PE	Print Exposure
PPV	Positive Predictive Value
RC	Reading Comprehension
RSF	Reading Systems Framework
RT	Reading Time
SD	Standard Deviation
SDN	Stichting Dyslexie Nederland (Dutch Dyslexia Association)
SON	Non-verbal Intelligence Test
SR	Self Reported
TF	True/false
WAIS	Wechsler Adult Intelligence Scale
WM	Working Memory
WRAT	Wide Range Achievement Test
WRpM	Words read per minute

List of Figures

1.1	Theoretical reading comprehension model of Faggella-Luby and Deshler (2008)	9
1.2	Writing model of Flower and Hayes (1981)	11
2.1	Correlations (and regression line with 95% confidence interval) across groups — between the reading efficiency scores of the Flamingo test and the LEMs and Klepel	40
3.1	Theoretical reading comprehension model of Faggella-Luby and Deshler (2008)	49
3.2	Interaction between Diagnosis and Test Type for reading comprehension outcome	61
3.3	Interaction between Diagnosis and Language for reading comprehension outcome	61
4.1	Reading comprehension score in English	81
4.2	Reading times in English	82
4.3	Reading comprehension score per language	83
4.4	Words read per minute per language	83
5.1	Interaction between Diagnosis and Language for summary writing content score	107
5.2	Interaction between Diagnosis and Language for summary writing errors	108

List of Tables

2.1	Accuracy, Time and Reading Efficiency scores on the Flamingo Test	32
2.2	Norm scores per measure based on the NonDys group	33
2.3	Error analysis of the Flamingo Test	34
2.4	Diagnostic accuracy of the Flamingo Test: correct and incorrect classifications	35
2.5	Sensitivity and specificity scores of the Flamingo Test	35
2.6	Accuracy, Time and Reading Efficiency of the Alouette test and Flamingo Test	36
2.7	LEMs, Klepel and Flamingo scores	39
2.8	Diagnostic accuracy of the Flamingo Test, LEMs and Klepel	39
2.9	Sensitivity and specificity scores of the Flamingo Test	41
3.1	Demographic overview of the participants	53
3.2	Language proficiency results	58
3.3	Working Memory and Fluid IQ results	58
3.4	Reading Times for both groups	59
3.5	Reading comprehension descriptive results	60
3.6	Regression analysis of predictors of true/false (TF) and free recall (FR) test . .	62
4.1	Word reading, language proficiency and questionnaire results	79
4.2	Reading comprehension descriptive statistics L1	80
4.3	Reading comprehension descriptive statistics L2	81
4.4	Correlations in Dys group	84
4.5	Correlations in NonDys group	84
5.1	Phonological awareness and working memory outcomes	103
5.2	Language proficiency and questionnaire results	104
5.3	Word spelling scores	105
5.4	Multiple regression outcomes spelling	106
5.5	Summary writing scores	106
5.6	Multiple regression outcomes summary writing	109

