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Study strategies of first-year undergraduates with and without dyslexia and the effect of gender

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ABSTRACT

For students to be successful in higher education, they need not only have motivation and sufficient intellectual ability, but also a wide range of study skills as well as the metacognitive ability to determine when a change in strategy is needed. We examined whether first-year undergraduates with dyslexia (N = 100) differ from peers without learning disabilities (N = 100) in the use of study strategies. The Learning and Study Strategies Inventory was used and potential gender differences were investigated. Matched for age, gender and field of study, fluid intelligence scores were comparable between groups. The self-reports showed that knowledge of test taking strategies was more limited in the dyslexic group. Also, 'fear of failure' was higher in the dyslexic students. Further analyses revealed group × gender interactions for motivation, time management and fear of failure, with female undergraduates outperforming their male counterparts. Implications for secondary education and university, as well as college student support services are discussed.

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Adult dyslexia; study strategies; metacognition; LASSI; gender differences

Introduction

Any successful performance requires task-related skills and motivation. This certainly applies to studying in higher education with the aim to obtain a degree in a scientific discipline. Yet skills and motivation alone do not explain why some students succeed while others do not. To have the ability to switch between skills (in case they prove ineffective) and use them accordingly is another necessity for becoming successful in one's studies. In this paper we examine which study strategies are applied in higher education by students with and without dyslexia and the differences between them.

The DSM-5 (American Psychiatric Association 2013) defines dyslexia as a specific learning disorder characterised by problems with spelling, decoding, and accurate and/or fluent word recognition. It is distinct from reading and/or spelling difficulties caused by inadequate instruction or an impoverished home environment (Snowling 2000; Stanovich 1988). In individuals with dyslexia, reading/writing is at a significantly lower level given the age and educational level. Impairments are resistant to remedial teaching – that is to say, the requirements of the 'response to instruction' model (Vaughn and Fuchs 2003) are

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met. In addition, any reading and writing deficit cannot be attributed to external and/or individual factors such as socio-economic status (SES), cultural background, or intelligence.

An important factor related to study skills is metacognition, which has been defined by Flavell (1976), Flavell (1979)) as 'cognition about cognition'. Metacognition refers to an intrinsic ability to distinguish between cognitive skills as they are not equally appropriate in every situation, which involves both the monitoring and regulation of underlying cognitive processes. Metacognition is crucial in higher education as proper use of study strategies affects academic achievements in the long term (Metcalfe 2009). Pinto, Iliceto, and Melogno (2012) demonstrated that students are fairly proficient at calling upon metacognitive skills, as evidenced by their ability to explain how they arrived at the correct solution. The authors also observed clear gender and study-related differences in that male students and students in the hard sciences outperformed female students non-verbally, whereas female students and students in humanities outperformed their male peers in all metalinguistic abilities tested.

Studies suggest that metacognitive skills are not as sophisticated in dyslexic students as in non-dyslexics (Borkowski and Thorpe 1994; Geary 1993; Job and Klassen 2012; Mason and Mason 2005; Wong 1996). Job and Klassen (2012) found that adolescents (aged 12–13 years) with dyslexia were less accurate in predicting their performance than controls. They over-estimated their ability in a spelling and ball-throwing task, with the accuracy of their performance predictions decreasing with increasing difficulty levels. The authors called this 'optimistic miscalibration.' Comparing 16 to 18-year-old college students with and without dyslexia, Mason and Mason (2005) reported that dyslexic students showed deficits in their metacognitive skills, resulting in problems with selecting and using effective cognitive strategies such as note taking and organising academic tasks. Sideridis et al. (2006) found some evidence of metacognitive knowledge predicting learning disabilities. Generally, they observed that the knowledge dyslexic students aged 9–12 years had about how they could monitor and control their learning was one of the best predictors of their performance. Similarly, Trainin and Swanson (2005) argued that successful college students with dyslexia (mean age = 31,40; SD = 13,56) compensate for their cognitive difficulties and processing deficits by relying on metacognition (e.g. learning tricks and strategies to cope with a problem and seeking help in time). It is clear that, based on practice and experience, metacognitive knowledge makes students aware of (potential) problems, prompting control processes that can help them reach the goal pursued.

Kirby et al. (2008) looked at relationships between the learning strategies of university and college students with dyslexia (n = 36; mean age = 22,60; SD = 5,22) and without dyslexia (n = 66) and their reading skills using different reading tasks and the Learning and Study Strategies Inventory (LASSI) (Weinstein and Palmer 2002). The ten subscales of the latter test measure different types of metacognitive knowledge. The authors found that, compared to the controls, the students with dyslexia attained significantly lower scores on the LASSI 'selecting main ideas' and 'test taking strategies' subscales but had significantly higher scores on the 'time management strategies' and 'study techniques' subscales. The authors, moreover, found correlations between reading ability and the 'selecting main ideas' and 'test taking strategies' subscales. Based on the results of self-report questionnaires, Kirby et al. (2008) concluded that the study strategies of dyslexic students were determined both by their weak reading skills and their compensatory techniques. According to the authors, slow and/or inaccurate reading also negatively effects the reading comprehension skills of students with dyslexia. Some students are able to compensate for this by the use of study aids and efficient time management, while other students fall back on weak learning and test taking strategies. Whether poor reading comprehension is the result of the degrading integration quality of information processing or rather a matter of fundamental lack of time due to an effortful and time-consuming reading process, is yet to be explored. More research is needed to identify factors tapping into these differences (Kirby et al. 2008).

Tops et al. (2014) did not observe any significant difference in metacognitive skills between dyslexic and non-dyslexic students (mean age = 19 years). They asked 100 students with and 100 students without dyslexia to rate their confidence in a word spelling and proofreading task, and found that the two groups performed equally well in their estimations. Students with dyslexia were aware of how they performed and had good insight in which word spellings they knew and which they knew not.

Previous studies also suggest the role of gender in academic performance (Pinto, Iliceto, and Melogno 2012; Abada and Tenkorang 2009; Jacob 2002; Sheppard 2009). Sheppard (2009) found that girls with dyslexia performed significantly better than boys with dyslexia on standardised school performance tests like SATs, CAT verbal and GCSE. Although the gender difference was present in typically developing peers as well, it failed to reach significance.

The aforementioned studies notwithstanding, effects of gender and dyslexia on school performance are still understudied. In the present study, we followed Kirby et al. (2008) and used a Dutch translation of the LASSI to compare the metacognitive abilities of first-year undergraduates with dyslexia and peers without learning deficits. We replicated and validated the results of Kirby et al. (2008) using a sample of non-native English students in higher education, because most studies on study strategies and academic success were conducted in English-speaking countries while their education system is rather different from the Belgian system. For this reason, one cannot generalise and Callens, Tops, and Brysbaert (2012) put forward several arguments to prevent that. Additionally, we looked for potential gender differences, as gender was not included in the Kirby study, whereas research has shown it to be important in the study of learning strategies. Based on the literature, we hypothesise that the knowledge of and beliefs about learning strategies and study goals of students with dyslexia are not as developed as that of matched controls, with female students achieving higher scores than males.

Method

This study was approved by the ethical committee of Ghent University. Prior to their participation, all students agreed to the study terms by way of signing a written consent. The students were paid for their participation and informed that they could stop the experiment at any time without having to state a reason and without consequence.

Participants

Participants were 200 undergraduates who had recently embarked on their first year of higher education in the surroundings of Ghent (one of the main cities in the Dutch-speaking half of Belgium). Half of them had been diagnosed with dyslexia at primary or secondary school. The 100 students in the control group had no such diagnosis or any other known neurological impairment (e.g. autism spectrum disorder, specific language impairment). All participants had normal or corrected-to-normal vision and were native speakers of Dutch. The study and control groups were matched in terms of age, gender and field of study (see Callens, Tops, and Brysbaert 2012 for more details). All students attended either a research university or a university for applied sciences. Since admission criteria in Belgium are relatively low, we expect both student groups to be homogeneous and not yield significant differences between them, as was previously showed in the study of Callens, Tops, and Brysbaert (2012).

All candidates for the dyslexia group were invited on the basis of them having applied for special facilities (e.g. extended examination time); this information was provided by the institutes' student services. Eligible candidates were examined by trained diagnosticians to verify whether they met the three criteria for dyslexia as defined by the Dutch Dyslexia Foundation (Kleijnen et al. (2008). To obtain a sufficiently large sample, we originally recruited 120 dyslexic students. Of these, a small number declined participation once the study had been explained to them, while some did not attend all scheduled sessions. All 100 students completing the study met the dyslexia criteria in that (i) their reading and/or writing skills were significantly poorer than expected given their age and educational level, (ii) the 'resistance to instruction' criterion was met, implying that they had followed remedial programmes and received individual tutoring in primary or secondary school for a minimum period of six months, (iii) their reading and/or writing impairment could not be attributed to individual or external factors such as intelligence, cultural background or SES.

The majority of controls registered via an online application form that the school made public or via the guidance counsellors working at the school. Some controls, however, were suggested by the dyslexic students who had asked their fellow students to join, in which case we selected several candidates at random.

The general characteristics of the two groups can be found in Table 1 (mean age, gender, college or university). The groups did not differ with regard to SES as based on parental educational level (mother: $\chi^2(3) = 4.855$, $p = .183$; father: $\chi^2(3) = 2.634$, $p = .452$), with the parent's education varying between lower secondary school, higher secondary school and post-secondary education (university or college). Table 1 also lists the results of two reading tests (Brus and Voeten 1991; van den Bos et al. 1999 and a word spelling test (Depessemier and Andries 2009) taken by the two groups. The control students achieved scores within the normal range on all three tasks, while the average score of the students with dyslexia was more than 1.5 standard deviation below this level (see Table 1 for effect sizes).

The students completed the *Kaufman Adolescent and Adult Intelligence Test, Dutch version* (Dekker, Dekker, and Mulder 2004) to assess the groups' mean fluid IQs. The results showed a non-significant difference ($F(1, 198) = 0.84$; $p = .36$): 107 ($SD = 10.8$) for the controls and 105 ($SD = 11.0$) for the students with dyslexia.

Instruments

One of the most widely used methods to assess metacognition (Desoete 2008) is by self-reports in which respondents evaluate their metacognitive knowledge about their thinking processes, problem-solving skills and work strategies. We opted for the Learning and

Table 1. General information about the student groups with and without dyslexia.

		Students without dyslexia N M (*SD*)	Students with dyslexia N M (*SD*)	Effect size Cohen's *d*
Gender	Male	46	46	
	Female	54	54	
Studies	University	66	66	
	College for higher education	34	34	
Age		19.40 *(1.00)*	19.11 *(0.70)*	NA
Fluid IQ		106.80 *(10.80)*	105.40 *(11.00)*	0.13
Word reading		100.40 *(10.60)*	77.00 *(14.20)*	1.97
Pseudoword reading		59.70 *(13.10)*	40.90 *(10.50)*	1.59
Word spelling		24.60 *(2.80)*	17.50 *(4.00)*	2.05

Fluid IQ = KAIT; Dekker, Dekker, and Mulder (2004); Word reading = Dutch word reading, number of words read correctly in 1 minute time (EMT; Brus and Voeten 1991); Pseudoword reading = number of pseudowords read correctly in 1 minute time (de Klepel; van den Bos et al. 1999); word spelling = number of words spelled correctly in a word dictation task (GL&SCHR; Depessemier and Andries 2009). Effect sizes calculated according to Cohen's *d* (positive d-values represent better performance of the controls and negative values better performance of the students with dyslexia).

Study Strategies Inventory (LASSI) (Weinstein and Palmer 2002) and asked our students to complete the validated Dutch version published by Lacante and Lens (2005), who reported alpha reliabilities ranging from .68 to .86 for the different subscales. In Table 2 we reported the reliabilities for the dyslexia and control group separately to exclude error variance modelling for our particular samples. Reliabilities range from 0.70 to 0.78 for the students with dyslexia and from 0.71 to 0.79 for the student without dyslexia. All reliabilities are 0.70 or higher and fall within the range of the validation sample; therefore, our test results are to be considered reliable.

The LASSI provides a profile of students' strengths and weaknesses in three metacognitive domains as assessed with ten different 8-item scales, except for the 'selecting main ideas' scale, which has five items. Lacante and Lens (2005) argued that the ten scales can be grouped under three knowledge domains:

(1) The first domain assesses self-knowledge in terms of how students deal with various situations and consists of three scales: The first scale is the attitude scale which measures the respondent's mindset towards education *(e.g. 'I don't care whether I finish my education or not, meeting the right partner is more important*

Table 2. Reliability measures for the control and dyslexia group.

	Dyslexia	
	without (N = 100)	with (N = 99)
LASSI measure	Alpha	Alpha
Attitude	0.72	0.75
Concentration	0.71	0.71
Anxiety for failure*	0.78	0.79
Selecting main ideas	0.75	0.75
Information elaboration	0.75	0.76
Motivation	0.70	0.74
Study techniques	0.74	0.78
Test taking strategies	0.72	0.73
Time management	0.72	0.72
Self-testing	0.73	0.77

Note. Alpha = Cronbach's alpha reliability measure.

for me now'). The second scale is the motivation scale, which evaluates the level of determination (effort, persistence) to complete one's studies *(e.g. 'I manage to hold on, even if I have to do things that don't interest me')*. The last scale is the fear of failure scale. It examines the extent to which the respondent experiences performance anxiety during tasks.

(2) The second domain gauges metacognitive knowledge with regard to time management, concentration, self-testing, and the use of study techniques. It includes the time management scale, which evaluates how respondents manage, self-regulate and monitor their learning process, and explores the efficiency of planning and organisation strategies *(e.g. 'I only study when I feel the pressure of an exam')*. The second and third contributing scales are the concentration scale, which assesses the ability to direct and maintain attention when studying *(e.g.'I fully pay attention when studying')*, and the self-testing scale, which questions the ways in which students prepare for academic tests (how to make revisions, rehearse material or prepare for exams, use new information in a new situation and apply principles and methods). Finally, the second domain also includes the study techniques scale, which tests the ability to make use of organisation strategies *(e.g. 'I take the material and use my own words to understand it')*.

(3) The third domain examines respondents' metacognitive knowledge of strategies for various tasks and contexts by means of three scales. First, the information elaboration scale assesses how well students are able to process new information by making use of reasoning skills, imagery and verbal elaborations. Second, the selecting main ideas scale examines students' ability to recognise the key topics and themes in a text *(e.g. 'It is hard for me to decide what is important enough it requires studying by heart')*. Finally, the test taking strategies scale evaluates whether students know which strategy to use when preparing for an exam.

Procedure

The LASSI was part of a larger protocol (Callens, Tops, and Brysbaert 2012; Tops et al. (2014); Tops et al. (2012); Tops et al. (2013) which also involved an intelligence test, various reading and spelling tests, a personality inventory, as well as a semi-structured interview about socio-emotional and academic functioning. The students completed all tests individually in a quiet room with one of three test administrators seated at the opposite side of the table. The tests were administered in two 3-hour standardised sessions, in which the order of the tests was counterbalanced in such a way that two similar tests were distributed across the two sessions. The students with dyslexia started either with part one or part two according to an AB-design, with the matched control taking the tests in the same order. Each participant was allowed a break halfway each session but additional breaks were allowed if needed. Participants could end their participation at any point without consequences. All sessions were videotaped. The test administrators were the first two authors and a test psychologist. After having agreed on the protocol and test guidelines, they reviewed the recordings of each other's first ten sessions. Any deviations from the protocol were discussed to obtain consistency in testing procedures.

Statistical analyses

We used mixed-effects regression modelling (Baayen 2008; Baayen, Davidson, and Bates 2008; Baayen and Milin 2010) to analyse the effects of group and gender on the LASSI scores. Predictors in mixed-effects models can both be factors with a small number of levels (such as gender) and continuous variables (e.g. age), in addition to the random effects. In the present study, per-item responses were not available and we used aggregate scores per subtest per subject.

The linear mixed-effects model was implemented using the lmer function of the lme4 package (R Core Team 2017) in R (Bates et al. 2015). All continuous measures entered into the final model were centred and *z*-transformed. We predicted individual LASSI scores and included data from all subtests in one model. The model was built stepwise by adding one variable at a time to define the measures that improved the model fit (as indicated by AIC and R^2). After establishing all significant main effects, we tested for possible interactions. For the random effects structure, we added random intercepts per subject, and also tested whether random slopes were necessary, which was not the case.

Model fit can be evaluated by the squared correlation between the fitted and observed values (R^2). In the case of mixed-effects models, this method only estimates the residual variance and ignores the random effects present in the model. Following the suggestion by Nakagawa and Schielzeth (2013), we also calculated a marginal and conditional R^2, the former being an estimation of the fixed-effects structure alone, while the latter incorporates both fixed and random effects.

Effect sizes were calculated using Cohen's *d*. Because the model was fit to *z*-transformed scores, each estimated model coefficient β is identical to Cohen's *d*. For post-hoc pairwise comparisons of the model predictions, we used the lsmeans package (Lenth and Hervé 2015), which calculates least square means, performing a Kenward-Roger estimation for the degrees of freedom of the model, as well as a TukeyHSD *p*-value adjustment for the comparison of groups of estimates.

Results

Table 2 presents the average LASSI scores for the two student groups as well as for the male and female students separately. It also includes effect sizes measured in Cohen's *d*. As a rule of thumb, we can consider an effect size of d = .4 or more as practically relevant. This agrees with a correlation of r = .2, which is a medium effect size in the literature of individual differences (Gignac and Szodorai 2016). As can be seen in Table 3, most effect sizes between groups were below the threshold. However, there was an effect size of *d* = 0.63 between students with and without dyslexia for test taking strategies, with students with dyslexia performing worse than students without dyslexia. Gender differences were observed for anxiety for failure (*d* = 0.45), motivation (*d* = 0.43), and time management (*d* = 0.45). Female students reported more fear of failure (the variable is defined in such a way that lower scores point to more problematic study-related behaviour), more motivation and better time management than males.

As can be gleaned from Table 4, there were significant Pearson's product moment correlations among a number of LASSI scores. The *time management, concentration* and *motivation* subtests formed a triad with high pairwise correlations in the range of *r* = 0.59

Table 3. Average LASSI scores per subtest for females and males, as well as students with and without dyslexia.

LASSI	Dyslexia					Gender				
	without (N = 100)		with (N = 99)			female (N = 117)		male (N = 82)		
measure	M	*(SD)*	M	*(SD)*	*d*	M	*(SD)*	M	*(SD)*	*d*
Attitude	31.92	*(3.84)*	31.03	*(4.25)*	0.21	32.04	*(3.82)*	30.67	*(4.28)*	0.33
Concentration	24.64	*(4.97)*	24.85	*(4.83)*	0.00	25.13	*(4.93)*	24.20	*(4.79)*	0.24
Anxiety for failure*	26.08	*(5.46)*	24.81	*(5.06)*	0.29	24.41	*(5.07)*	26.80	*(5.33)*	0.45
Selecting main ideas	17.58	*(3.53)*	16.85	*(3.11)*	0.22	16.99	*(3.75)*	17.54	*(2.65)*	0.16
Information elaboration	27.94	*(4.61)*	29.10	*(4.45)*	0.25	28.26	*(4.40)*	28.89	*(4.78)*	0.13
Motivation	26.71	*(4.41)*	27.00	*(4.99)*	0.07	27.68	*(4.74)*	25.67	*(4.39)*	0.43
Study techniques	25.68	*(4.14)*	25.08	*(4.47)*	0.14	25.97	*(4.39)*	24.54	*(4.06)*	0.33
Test taking strategies	29.39	*(4.10)*	26.73	*(4.25)*	0.63	27.96	*(4.29)*	28.21	*(4.52)*	0.05
Time management	22.83	*(5.50)*	23.09	*(5.41)*	0.03	23.77	*(5.69)*	21.80	*(4.88)*	0.39
Self-testing	23.84	*(4.59)*	24.13	*(3.77)*	0.09	24.08	*(4.44)*	23.85	*(3.85)*	0.04

Note. * lower scores for anxiety for failure indicate more fear of failure, which makes it consistent with the other scales where lower scores correspond to more problematic study-related behaviour.

to r = 0.65. Similarly, the measure of *test taking strategies* showed moderate to high correlations with *concentration,* $r = 0.45$, *fear of failure,* $r = 0.46$ and *selecting main ideas,* $r = 0.53$. Considering these correlations, the scales or clusters in the LASSI differed from the three domains suggested by Lacante and Lens (2005) [39].

Mixed effects regression

The best model for predicting the individual LASSI scores included interactions for LASSI subtest × dyslexia group, LASSI subtest × gender, the type/level of the student's secondary education, paternal occupations, as well as random intercepts per subject. None of the IQ measures, nor the inclusion of the participant's age, handedness, or mother tongue improved the model fit any further. The resulting model for 195 participants (see Supplementary Information 1) was checked for normality of residuals and heteroscedasticity (model criticism, see [44]), and values causing residuals over 2.50 *SD* above or below the prediction were deleted. This affected 33 measures, which corresponds to less than 1.69% of the data. The final model was then fit again to the remaining data. Based on R^2, our final model described 36.89% of the variance in the data (*marginal* $R^2 = 0.09$; *conditional* $R^2 = 0.33$).

Effects of group

As is shown in Figure 1, the linear mixed-effects regression analysis generated significant main effects of group for *test taking strategies* ($\beta = d = -0.66$, $t(962) = -4.71$, $p < .001$) and *fear of failure* ($\beta = d = -0.35$, $t(995) = -2.47$, $p = .014$), with dyslexic students scoring lower than their non-dyslexic peers.

Effects of gender

There were main effects of gender on *attitude* ($\beta = d = -0.45$, $t(995) = -3.11$, $p = .002$), *motivation* ($\beta = d = -0.46$, $t(975) = -3.24$, $p = .001$), *time management* ($\beta = d = -0.43$, $t(975) = -3.00$, $p = .003$), and *study techniques* ($\beta = d = -0.37$, $t(984) = -2.62$, $p = .009$), with

Table 4. Pearson's product moment correlations between LASSI measures.

LASSI measure	Attitude	Motivation	Time management	Anxiety for failure	Concentration	Information elaboration	Selecting main ideas	Study techniques	Self testing
Attitude	1	-	-	-	-	-	-	-	-
Motivation	.352*	1	-	-	-	-	-	-	-
Time management	.345*	<u>.645*</u>	1	-	-	-	-	-	-
Anxiety for failure	.157*	−.022	.027	1	-	-	-	-	-
Concentration	.259*	<u>.589*</u>	<u>.649*</u>	.228*	1	-	-	-	-
Information elaboration	.157*	.217*	.096	.088	.199*	1	-	-	-
Selecting main ideas	.157*	.063	.109	.306*	.221*	.286*	1	-	-
Study techniques	.101	.239*	.233*	−.101	.069	.224*	.188*	1	-
Self testing	.203*	.395*	.318*	−.196*	.256*	.323*	.070	.492*	1
Testing strategies	.369*	.258*	.314*	.460*	.454*	.201*	<u>.526*</u>	.107	−.011

High correlations are underlined. * $p < .05$.

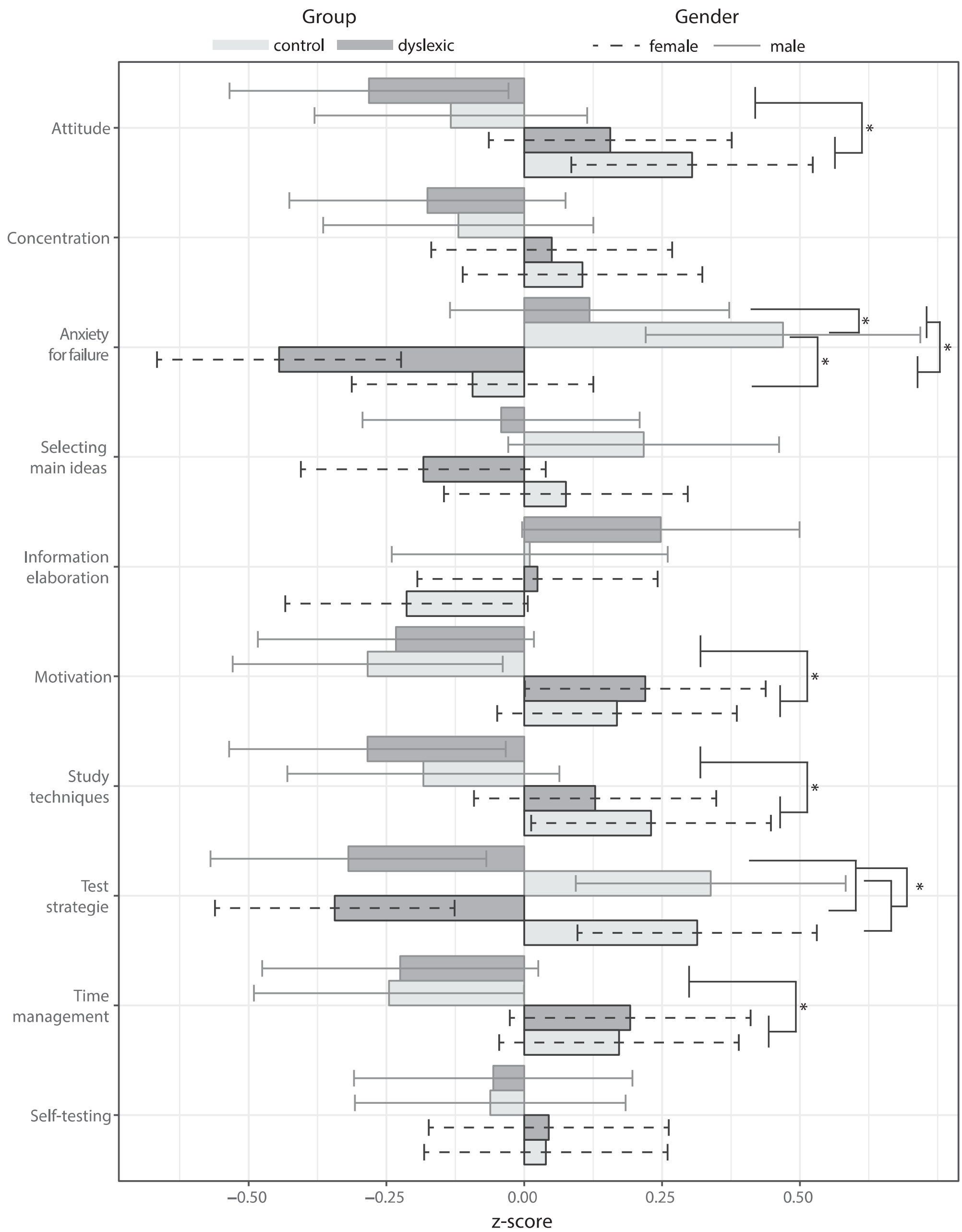

Figure 1. Representation of the fixed-effects structure of the linear mixed-effects model predicting LASSI scores for each combination of group and gender. Effects are averaged over parental and participant educational level. Error bars show 95% confidence intervals. Asterisks indicate significant differences after pairwise comparisons with TukeyHSD *p*-value adjustments. Low scores for anxiety for failure indicate high rates of fear of failure.

female students scoring better than male students on all these scales. The opposite was found for *fear of failure* ($\beta = d = 0.56$, $t(1005) = 3.87$, $p < .001$), where the male students reported less anxiety than the female students.

Interaction of gender and group for fear of failure

We found two significant interactions for *fear of failure* × gender, as well as *fear of failure* × group, which, unfortunately, are not very meaningful given that the 3-way LASSI subscale × gender × group interaction did not yield significant results. To follow up on a potential interaction restricted to this subtest, we ran a linear regression with identical specifications (albeit without the random effects structure) and found a marginally significant group × gender interaction ($\beta = d = -0.48$, $t(168) = -1.68$, $p = .09$). Pairwise comparisons with least square means and Tukey *p*-value adjustments (see Supplementary Information 2) revealed an effect of gender in the control population ($\beta = d = -0.73$, $t(168) = -3.56$, $p = .003$), but not in the dyslexia group ($\beta = d = -0.25$, $t(168) = -1.19$, $p = .633$), as well as an effect of group for the male students ($\beta = d = 0.61$, $t(168) = 2.74$, $p = .034$), but not for the female students ($\beta = d = 0.13$, $t(168) = 0.68$, $p = .907$).

The effect sizes for the differences described above ranged from small ($d = 0.13$) to large ($d = 0.73$).

Discussion

Inspired by the body of literature suggesting that an adequate degree of metacognition may help students with dyslexia to compensate for their reading and spelling difficulties (Sideridis et al. (2006), we investigated whether undergraduates with dyslexia attending the first year of university or college in the Dutch speaking part of Belgium would differ from their non-dyslexic peers in their study attitudes and metacognitive knowledge about study strategies. For this we used the Dutch version of the LASSI (Lacante and Lens (2005). Additionally we looked at gender differences.

The results showed that self-reported fear of failure was higher in the students with dyslexia, while their knowledge of test taking strategies was less advanced than it was in matched non-dyslexics. Surprisingly, the responses to the other LASSI scales did not differ significantly between the two student groups. There were also gender-specific differences in that female students had higher scores on the motivation and attitude subscales than their male counterparts. This was true for both the dyslexic and the typically developing group. More than the male students, the female students reported that their university/college study programs were either relevant or important to them and that they had developed a sufficient understanding of how their training and academic performance related to their future life goals. Also, their knowledge of planning and monitoring was higher than that of their male counterparts, making them better at assuring the timely completion of academic tasks and avoiding procrastination while still being able to include non-academic activities in their schedules. The male students were, moreover, less able to apply different and/or efficient study techniques than the female students. At the same time, the female students reported more fear of failure.

The effects of dyslexia and gender were largely additive. Only for the fear of failure scale were there some indications for a marginally significant group x gender interaction effect, with highest scores for female students with dyslexia and lowest scores for typically developing males. As this is the outcome of a post-hoc analysis, it is better to see whether the pattern will replicate in future studies before attaching importance to it.

We thus observed few differences in the metacognitive abilities of undergraduates with dyslexia and matched controls, while gender variations within both groups were more pronounced. Our results are partly in line with the results of Kirby et al. (2008) and our previous study (Tops et al. 2014). Kirby et al. (2008) also tested study strategies in university and college students with and without dyslexia using the LASSI (Weinstein and Palmer 2002). They found lower scores on the LASSI 'test taking strategies' subscale – as we did – but also on the subscale 'selecting main ideas' for which we failed to find a significant difference. Kirby et al. (2008) not only found weaknesses in the profile of students with dyslexia, but also specific strengths such as significantly higher scores on the 'time management strategies' and 'study techniques' subscales which the authors interpreted as compensation strategies for the weak reading skills of dyslexic students. In our sample the group of students with dyslexia did not outperform the control group on any of the LASSI subscales. Kirby et al. (2008) claimed that many students with dyslexia in their sample suffered from a combination of both technical reading problems and problems with reading comprehension. In the sample we used for this study both groups performed equally well on reading comprehension (for more details, see Callens, Tops, and Brysbaert 2012). Although Kirby et al. (2008) argue to look into more factors playing a role in study strategies, they did not include such factors. In this study we looked into gender differences because previous research underlined the importance of gender in academic success, which was also confirmed by our results.

In Tops et al. (2014) we likewise did not find evidence for deficits in the metacognitive skills of dyslexic students based on a word spelling task and a proofreading task. Although dyslexic students presented with more fear of failure and had less knowledge about test taking strategies, we found no significant differences between students with dyslexia and typical students, despite that our groups were large enough to observe effect sizes of $d = .4$ with 80% power.

Whereas previously published studies reported less sophisticated metacognitive skills in students with dyslexia compared to typically developing controls (Borkowski and Thorpe 1994; Geary 1993; Job and Klassen 2012; Mason and Mason 2005; Wong 1996), we found no meaningful differences in the present or in the previous study (Tops et al. 2014), suggesting that students with dyslexia are similarly equipped for the early stages of higher education. Whether this will enable them to continue their studies equally successfully as their matched controls, is a matter of future study. Future studies will also have to explicate whether differences between the present study and older ones can be attributed to national differences in educational systems, or to the fact that underpowered studies producing significant results are more likely to be accepted for publication – as opposed to studies with null-effects (Fanelli 2011; Franco, Malhotra, and Simonovits 2014).

As for the limitations of the current study, we need to mention the sole use of the LASSI to gauge the students' metacognitive skills. We opted for this self-report questionnaire based on the dyslexia study by Kirby et al. (2008), so that we could directly compare our results with theirs. However, the LASSI only gives information about metacognitive abilities as perceived by the students themselves. It is possible that groups of students differ in abilities and still have the impression of doing equally well. In future research, it would be wise to add other, less subjective measures of metacognition (such as think-aloud protocols) to the test battery. Other studies (Engin-Demir 2009; Uy, Manalo, and Cabauatan 2015) also suggest that maternal and paternal educational levels explain more variance in their offspring's metacognitive skills than, for instance, their child's IQ, age, handedness, or language – although the fact that none of these factors reached significance might result from the studies' small subgroup sizes.

Also, our findings may not extend to other languages and/or educational systems even though there are similarities in the cognitive profiles of Dutch-speaking and English-speaking undergraduates (Callens, Tops, and Brysbaert 2012) and in personality profiles (Tops et al. 2013). Other factors that might have played a role in our results are the age and cognitive functioning of our participants. They were all high functioning college and university students (mean age = 19 years), yielding results partially in line with other studies conducted in the age range of high functioning post-secondary students (Kirby et al. 2008; Tops et al. 2012). The other studies we referred to used either younger (12 to 18 years) or older students (mean age = 31 years). Furthermore, we observed correlations between the LASSI scales in our sample that did not correspond with the three domains as suggested by Lacante and Lens (2005). Likewise, Cano (2006) found a three-factor model when exploring the latent structure of scores on the LASSI among 1000 college students that also differed from these domains. The discrepancies merit further investigation.

Despite these limitations, we think that our study uncovered important information in that, overall, the metacognitive abilities of first-year Dutch-speaking undergraduates with dyslexia are similar to those of typical peers, suggesting that, as far as metacognition is concerned, they can be as successful in their academic careers as students without the disorder. It also suggests that no extra practice in metacognition is needed for students with dyslexia. At the same time, we observed that students coming from less demanding high school curricula and from parents with less education scored lower. These are groups that may profit from extra practice in metacognition. However, this applies to students without dyslexia too.

Finally, in terms of academic support, our results indicate that major paradigm shifting changes need not be implemented by disability services as metacognitive abilities in students with dyslexia seem to be considerably intact. However, these students (females, in particular) could present with an increased anxiety to fail their studies as opposed to students without dyslexia. Likewise, dyslexic students (males, in particular) may lack motivation or have difficulty managing their time which could result from the daily struggles pertaining to student life. In this vein, a 'one size fits all' approach is not advised, for individual differences among students with dyslexia seem apparent. Better guidance (aimed at, for example, reducing the anxieties students perceive) could aid them in further accomplishing their studies. In metacognition research, more accurately identifying deficiencies in study skills and finding the optimal strategies to help individuals or specified groups of students, is the next step.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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