

Academic achievements among adolescent school children. Effects of gender and season of birth

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We have investigated gender differences in academic achievements in two age cohorts of students from the Lower Secondary School in Norway (2000, 2005; 15-16 year olds). In the 2000 and 2005 cohorts the female students outperformed male students in twelve out of thirteen academic disciplines, including mathematics and nature-science. Physical education was the only discipline where the male students had higher grade points than the female students. In both cohorts the results showed a significant effect of season of birth: Students who were born in the Nordic winter-spring season had slightly higher grade points than students born in the summer-autumn season. There was no significant interaction between gender and season of birth.

Keywords: Academic achievements, gender, adolescents, season of birth.

Logros académicos entre adolescentes escolares. Diferencias de género y de la estación del año en que nacieron. Hemos investigado las diferencias de género en los logros académicos en dos cohortes de edad de estudiantes de la Escuela media en Noruega (2000, 2005; de 15-16 años de edad). En los cohortes de 2000 y 2005 las estudiantes sobresalieron en rendimiento en comparación con sus compañeros varones en 12 de 13 disciplinas académicas, incluyendo matemática y ciencias naturales. Educación física fue la única disciplina donde los varones obtuvieron mayores puntuaciones que sus compañeras de estudios. En ambos cohortes los resultados también muestran un significativo efecto de la estación del año en que han nacido los estudiantes: aquellos nacidos en el invierno-primavera nórdica presentan mayores puntuaciones que aquellos nacidos en el verano-otoño, no habiendo interacciones significativas entre género y la estación del año de nacimiento.

Palabras clave: Logros académicos, género, adolescentes, estación del año de nacimiento.

Gender differences in learning and academic achievement is a matter of considerable political and public interest, but has also been a hot topic in educational research over the years (Bakken, Borg, Hegna and Backe-Hansen, 2008; Halpern, 2006; Kurdek and Sinclair, 1988; Skaalvik, 1990). Marks (2008) investigated gender gaps in reading and mathematics using OECD's 2000 PISA project (Programme for International Student Assessment). Results from 31 countries showed a consistent gender gap in reading (girls better) and mathematics (boys better). However, there were large national differences, especially in mathematics. In countries who had implemented politics to promote educational outcomes for girls, the differences in mathematics were very small. In Norway interest has increased considerably after publishing results from the European PISA project (Kjærnsli, Lie, Olsen and Roe, 2007). The Norwegian students showed reduced academic achievements compared to other European students. The gender gap was considerable, and seemed to have increased in the last years. Gender differences in academic achievements were also confirmed in other large-scale national studies (Hægeland, 2007; Hægeland and Kirkebøen, 2007; Nordahl, 2008). Several explanations for the observed gender gap for Norwegian students have been discussed and one hypothesis is linked to introduction of The New National Curriculum for the 10 Year Compulsory School in 1997 (L97 in Norwegian). L97 was accompanied by considerable changes in learning goals, teaching and learning methods, curriculum, organisation of classes etc. These changes might favour girls before boys, especially due to their emphasis on group and process activities (Haug, 2004). As shown in the PISA project (Kjærnsli *et al.*, 2007), however, the gender gap in academic achievement is also observed in nations which have not introduced educational reforms like the Norwegian L97. This suggests that a number of factors might be involved. These factors could be of a developmental, cognitive, biopsychological, social, cultural, technological, academic or social nature. For instance, Nilsson *et al.* (2011) reported gender differences in academic self-concept (ASC), where girls had higher scores than boys. Marsh and Martin (2011) found that increases in ASC was correlated with better academic achievements. Investigating gender differences in math and reading using K-8 national longitudinal data Robinson and Theule Lubienski (2011) reported no gender differences in kindergarten, but girls seemed to lose ground in elementary school and regain some in middle school. In reading girls achieved slightly better, and especially among low-achieving students. Nevertheless, teachers consistently rated girls higher than boys both in mathematics and reading. Small class rooms also seem to have a positive effect on reading, mathematics, listening and word recognition from kindergarten to third grade, but the effects diminished in second grade, but did not disappear (Shin and Raudenbush, 2011).

Other factors, such as season of birth might also affect academic achievement. English summer-born children seem to have more learning difficulties than other

children (Sharp, 1995). The effect was linked to age differences at introductory school tests. Also a few Scandinavian studies have reported comparable results by showing that kids born in the Nordic summer-autumn season (July-September- December) had more learning problems and psychosocial problems than kids born in the winter-spring season (Flagestad, 2001; Watten *et al.*, 2002; Ystrøm, 1994). Since public Norwegian schools start the schooling year in the middle of August, the main explanation has been differences in relative age; i.e. that kids born late in the year, are considerably younger at school entrance than children born in the beginning of the year. Consequently, they will be less mature in terms of cognitive, psychological, and social development than children born at the start of the year. Thus, relative age is a factor to consider.

The cited studies investigated children in primary school, however, and data on possible effects beyond this level is limited. It is possible, therefore, that birth-related differences disappear during the last years of the compulsory school (10 years in Norway), due to the educational and socialising effects of the school system. To check this possibility, the current study investigates differences in academic achievements related to gender and season of birth in secondary school. The design of the study also allows us to test the combined effects of gender and season of birth. Furthermore, the multinational PISA project was limited to studying student performance in mathematics, reading and science. In the current study, however, a number of other academic disciplines is added, e.g., domestic and foreign language, religion, and sports. To our knowledge, this widened approach to academic achievement has not been common in this field of research.

METHOD

Participants

We registered gender, academic achievements and season of birth for the complete population of pupils in the lower secondary school in an inland county of Norway in 2000 and 2005. This county is a mixture of urban and rural areas. There are totally 43 lower secondary schools in the county, and each school reported the individual final grade points for thirteen academic disciplines for the two student cohorts to the official register of the county's Department of Upper Secondary Education (see below). Thus limited to management data, we had no access to potentially interesting background variables – such as socioeconomic factors or family structure.

The two age cohorts consisted of 2.021 students in 2000 (N females = 991 and N males = 1.030) and 2.299 in 2005 (N females = 1.128 and N males = 1.171). When leaving lower secondary school after 2 years the students are normally 15-16 years old.

Assessment of academic achievements

At the end of lower secondary school the students were evaluated on the following academic subjects. 1) Norwegian-Oral, 2) Norwegian-Written, 3) Norwegian Extra, 4) English-Oral, 5) English-Written, 6) Mathematics, 7) Science-Nature, 8) Physical Education, 9) Social Studies, 10) Religion, 11) Home Economics, 12) Arts-Craft, and 13) Music. The academic evaluations employed a numeric 6-point scale (6= highest, 1= lowest).

Season of birth

Pupils' registered birth dates were re-grouped into two main classes: 1) January-June, i.e. the Nordic winter and spring season, and 2) July-December; i.e. the Nordic summer and autumn season. Since the Norwegian public school starts in the middle of August, children born e.g. in January will have an eight month advantage in age compared to children born in August when entering school. There were no significant gender differences in season of birth.

Statistical analyses

Gender differences in academic achievements and seasonal differences in time of birth were analysed in a factorial analyses of variance design (MANOVA), using academic performance as dependent variable and gender and season of birth as fixed and random factors, respectively. In addition to testing the main effects of gender and season of birth this design also allows testing the interaction between gender and season of birth. Since the samples are fairly large, testing gender differences in terms of effect size (*d*) and variance ratio (*VR*) could be an option. However, the possibility of testing interactions between variables would then be lost, so we decided to use conventional ANOVA.

RESULTS

Table 1 shows the mean grade point results across all the academic disciplines for male and female students and mean grade points for season of birth for the two student cohorts.

Table 1. Mean grade points across all the 13 academic disciplines for gender and season of birth for the two age cohorts

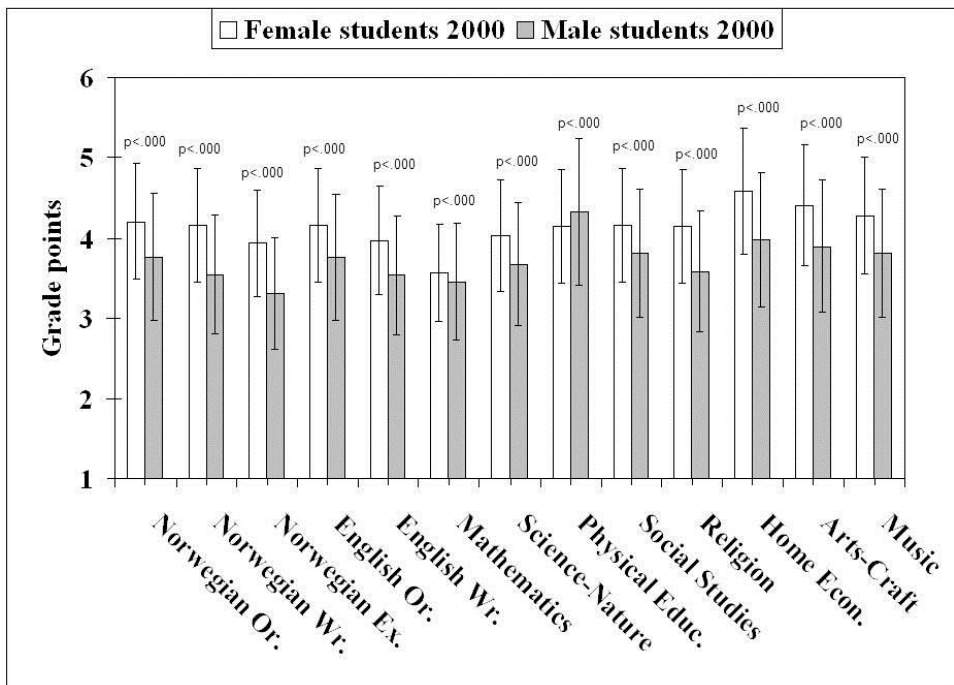
	Females		Males		Sig.	Winter		Autumn		Sig.
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
2000	4.13	0.8	3.73	0.8	***	3.96	0.8	3.89	0.8	**
2005	4.24	0.7	3.77	0.7	***	4.06	0.8	3.95	0.8	**

*** = $p < .000$, ** = $p < .01$.

Female students both in the year 2000 and 2005 had significantly higher average grade points than male students ($F=324.5$, $df=1$, $p<.000$), Students born in the winter-spring season had higher grade points than students born in the summer-autumn season ($F=12.6$, $df=1$, $p<.01$). There were also significantly higher average grade points for the 2005 cohort compared to the 2000 cohort ($F=9.5$, $df=1$, $p<.01$). There were no significant interactions between gender and age cohorts ($F=2.1$, $df=1$, $p=.14$), season of birth and age cohorts ($F=0.5$, $df=1$, $p=.46$), or gender and season of birth ($F=0.08$, $df=1$, $p=.77$). There were no significant three-way interaction between age cohorts, season of birth and gender ($F=2.3$, $df=1$, $p=.12$).

Figure 1 and 2 depict the distribution of the academic achievements for male and female students in 2000 and 2005 for the 13 academic disciplines.

Figure 1. Academic achievements for male and female students in lower secondary school in 2000. N female students in 2000 = 991, N male students in 2000 = 1030



For both age cohorts the teenage girls show significantly better results in 12 of the 13 academic categories. Physical education was the only academic discipline where the male students had significantly higher grade points than female students. Table 2 shows the results of the MANOVA analysis.

Figure 2. Academic achievements for male and female students in lower secondary school in 2005. N female students in 2005 = 1128, N male students in 2005 = 1171

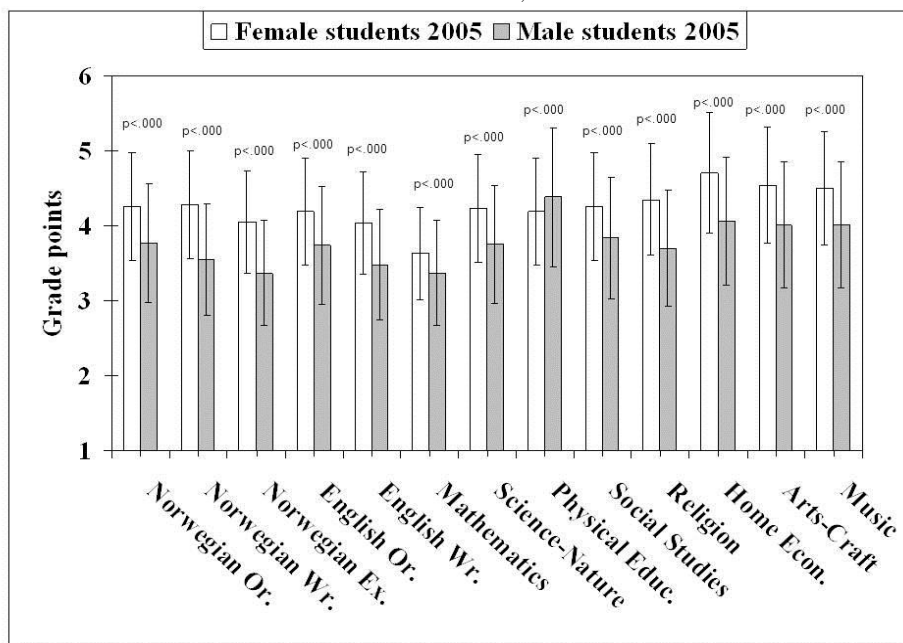


Table 2. MANOVA results for the 13 academic disciplines. Test of between-subjects main effects and interaction effects for gender, student cohort and season of birth

	Gender		Cohort		Season		Gender X Co		Gender X Sea		Cohort X Sea	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Norwegian Oral	249.4	***	0.95	ns	11.7	**	0.6	ns	0.1	ns	0.2	ns
Norwegian Written	526.7	***	4.0	*	10.6	**	3.9	*	0.1	ns	0.3	ns
Norwegian Extra	495.9	***	8.8	**	9.4	*	0.8	ns	0.2	ns	0.3	ns
English Oral	201.8	***	0.0	ns	4.4	*	0.9	ns	0.8	ns	0.0	ns
English Written	236.9	***	0.0	ns	7.1	**	3.6	ns	0.2	ns	0.1	ns
Mathematics	26.9	***	0.2	ns	8.8	**	4.5	*	0.1	ns	0.7	ns
Nature-Science	143.8	***	14.5	***	8.0	**	3.5	ns	0.1	ns	0.9	ns
Physical Education	37.6	***	2.5	ns	5.7	*	0.1	ns	0.0	ns	0.2	ns
Social Studies	122.0	***	2.7	ns	8.1	**	1.6	ns	0.2	ns	0.7	ns
Religion	323.5	***	21.2	***	6.1	*	1.9	ns	0.9	ns	0.1	ns
Home Economics	667.7	***	16.2	***	21.1	***	0.6	ns	0.3	ns	1.1	ns
Arts and Craft	412.2	***	23.2	***	6.0	*	0.2	ns	0.4	ns	0.3	ns
Music	254.2	***	47.3	***	5.3	*	0.2	ns	0.1	ns	1.3	ns

Student cohort: Co = Cohort, Sea = Season of birth, *** = p<.000, ** = p<.01, * = p<.05, ns = no significant differences

The level of academic achievements has been rather stable from 2000 to 2005, but in five domains the results were slightly better for both genders across this 5-year

period: Home economics, religion, arts-craft, music, science environment, and Norwegian Extra. In addition we observed a significant interaction with gender for Norwegian Written ($p < .05$) and mathematics ($p < .05$). See table 2 for more statistical information.

Figure 3 and 4 show the results for academic achievements in 2000 and 2005 related to the students' season of birth.

Figure 3. Academic achievements and season of birth for the student cohort 2000.
N winter-spring season 2000: 1054, N summer-autumn 2000: 967

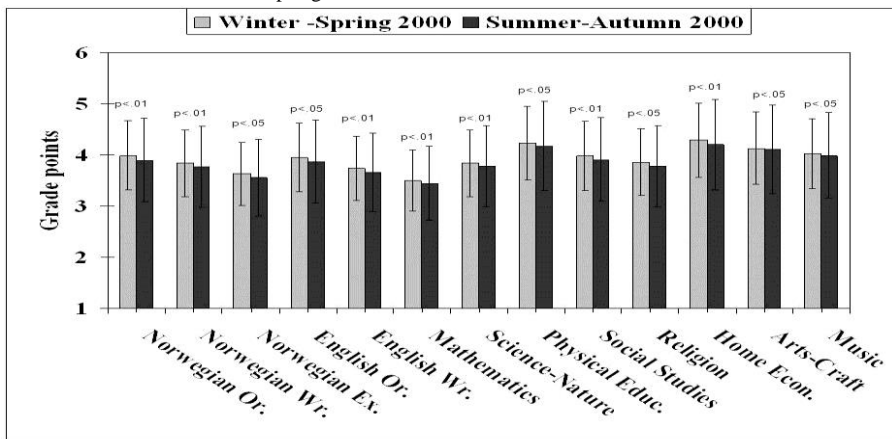
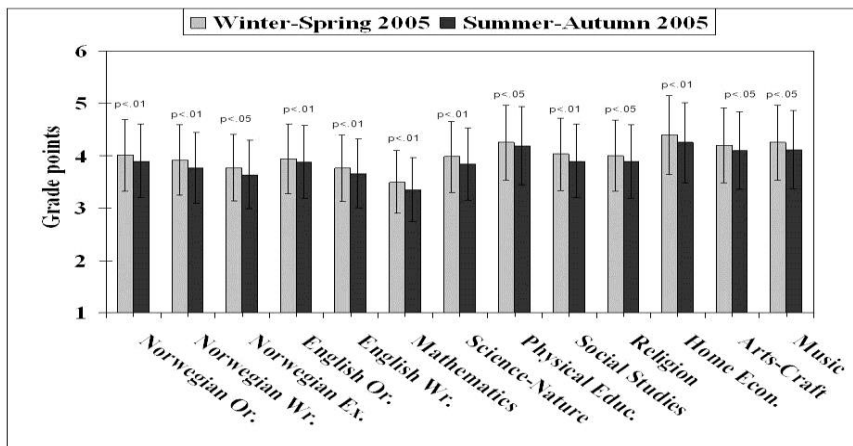


Figure 4. Academic achievements and season of birth for the student cohort 2005.
N winter-spring season 2005: 1198; N summer-autumn 2005: 1101



We observed significant differences in achievements for the students born in the Nordic winter-spring season compared to students born in the summer-autumn

season for all academic disciplines (table 2). On average teenagers born in the Nordic winter-spring season had higher grade points than teenagers born in the summer-autumn season. There were no significant interaction with gender, i.e. season of birth affected both male and female students in the same way. There was no significant three-way statistical interaction with gender, season of birth and student cohort.

DISCUSSION

Both in 2000 and 2005 female students outperformed the male students in 12 out of 13 academic disciplines, including mathematics and nature-science. Physical education was the only discipline where the male students had higher grade points than female students. Although our results in most of the academic disciplines are in line with earlier and contemporary research, our findings for mathematics and science are against (Marks, 2008).

The marked increase in gender differences in academic results across the two cohorts is probably related to several factors. One explanation could be of structural nature, i.e. the changes in the educational system, teaching methods, curriculum etc. linked to the New National Curriculum for the 10 Year Compulsory School introduced in 1997 (Reform 97 in Norwegian) as mentioned in the introductory section. Several changes were made: School started at the age of six instead of seven, 10 years schooling (instead of 9 years) dividing the compulsory school into three stages (primary, intermediary and lower secondary stage), and, finally, a new curriculum referred to as L97 in Norwegian. Furthermore, all students were taught in mixed ability classes, permanent grouping within a class was not allowed. However, some flexibility was introduced since the schools were allowed to develop flexible groupings within a class in order to maximise the possibilities given by the new curriculum in individual and pedagogical terms (NDET, 2005). In addition to curriculum changes focussing more on theoretical disciplines than before, the role of the teacher changed from being a classical authority figure lecturing *Ex Cathedra* to being more of an advisor, supportive of the students' activities, a "background figure" leaving the classroom, student learning process activities more to the students themselves. The responsibility for learning goals and methods was to a higher degree now transferred to the students instead of the teachers (Nordahl, 2008). The new professional role of the teachers was a considerable personal and pedagogical challenge with variable outcomes in many schools (Haug, 2004). It was also a challenge for the students who now had to rely more on themselves and their own individual abilities, group processes and learning through student initiated projects. These changes could favour students who were more cognitive, emotionally and socially mature, were autonomous, and with developed social and verbal competence and abilities to cope with group processes and discussions. These factors are favouring female students. In this age group teenage girls are more mature biologically,

emotionally, and socially and show better verbal and psychomotor abilities than their male colleagues (Siegler, Deloache and Eisenberg, 2006). In addition, it is well established knowledge that females also have higher affiliation needs than males (Larsen and Buss, 2008). The increased responsibility placed on each student for his/her learning outcomes would favour female students for the same reasons. In addition, as a consequence of the curriculum related to theoretical knowledge and language, a number of more practical and activity-related disciplines which earlier were options which could be selected by the individual students were removed by the L97. This curriculum change might also favour the teenage girls more than teenage boys.

Another factor is related to the tremendous increase in the use of Information and Communication Technology (ICT) over the last 10 years; especially mobile phone and internet activities such as SMS, surfing, chatting, gaming and e-mail. Teenagers are high frequency users of ICT and gender differences are reported here; girls prefer relational activities such as SMS, chatting and email, while boys are more frequent users various games and electronic shopping (Hogg and Vaughan, 2008). ICT activities could be competitors to school work and Norwegian male students could use more time per day for ICT activities not linked to school work than female students - and especially various forms of gaming. However, since we only had access to administrative, educational data from the county's Municipality we had no information about ICT use or other relevant aspects of the students' life such as family structure, socioeconomic background information etc. This is a weakness of this study, but we are currently undertaking another study where these factors are included.

Another explanation of the gender gap in academic results could be gender differences in cognitive abilities, but data from two large scale studies data speaks against this suggestion. For instance, data from standardized exams taken by 15 million US students in the fourth, eighth and twelfth grades undertaken by the Educational Testing Service (ETS) of Princeton, New Jersey finding no gender differences in average performance (Goodwin, 1997). Comparing results over the past 30 years, they also concluded that the sexes are evenly matched in verbal reasoning, abstract reasoning and math computation. However, they reported that girls had a slight advantage compared to boys in perceptual speed, short-term memory, and language ability. The somewhat higher ranking of boys in mathematics and science was marginal and less than 30 years ago. The only subject where the boys had a clear advantage was in mechanical and electronic ability and knowledge of history and economics. These findings are also supported by a large study encompassing more than 320000 11-12 year olds in UK reporting small sex differences cognitive abilities (Strand, Deary and Smith, 2006). The authors used data from UK schools' Cognitive Ability Test battery (CAT3) providing assessment on verbal reasoning (verbal classification, sentence completion, verbal analogies), quantitative reasoning (number analogies, number series, equation building),

and non-verbal reasoning (figure classification, figure analogies, figure analysis) and found that girls had a 2.2 higher standard point verbal reasoning score than boys, a 0.3 point higher non-verbal score, while boys had 0.7 point higher score in quantitative reasoning. However, the boys showed a considerably higher variability in scores, they were represented both at the top and bottom extremes, a warning against stereotyping the boys as low achievers. Thus, observed gender differences in academic achievements probably have other explanations than differences in cognitive abilities.

We register that there are differences in academic results not only related to gender, but also to season of birth of the teenagers. Students born in the Nordic winter-summer season have generally better results than students born in the summer-autumn season. The season of birth effect was a separate effect and showed no interaction with gender or student cohort. Our findings are supporting previous studies in line with the relative age hypothesis (Sharp, 1995; Watten *et al.*, 2002), although these studies were carried out on younger children. We expected that the disadvantage of a lower relative age for children at the entrance of the school system would disappear as the pupils became older, but our findings suggest that this seems not to be the case. However, the causal mechanism might be more complex than a direct effect of immaturity. In a national sample comprising more than 10000 UK 5-15 year olds (Goodman, Ford and Gledhill, 2003) found that differences in relative age were related to increased child psychiatric disorders and behaviour problems. Biological factors related to amine turnover might also be involved (Chotai and Adolfsson, 2002). Nevertheless, since the birth-effect in our study is moderate, we are careful with causal suggestions. More detailed analyses on other comparable samples have to be conducted.

A final comment on some implications of the described gender differences should be added. In Norway, when the students are leaving the lower secondary school they are in an age period where important choices for the students' future education are made. Good academic results increase the probability for choosing the theoretical lines in the Upper Secondary School, which again lead to higher education such as college and university studies. Lowered results in the Lower Secondary School probably lead to shorter non-academic practical education and early entrance into the working life. Thus, the gender differences we observe for 15-16 year olds could be one of the factors behind the large and increasing preponderance of female students in a variety of university studies in Norway (medicine, psychology, economy, computer science, language, social sciences etc.), leading to an increasing female preponderance in a number of professions such as medicine, psychology, health and social science, education etc. For instance, 61.4% of the students applying for higher education in Norway in 2008 were women, compared to 60.9% in 2007 (NUCAS, 2008). Therefore, if the tendencies we have observed in the lower secondary school are continuing, the gender gap in higher

education will increase further and will have profound implications for the working life in general.

CONCLUSION

We find a considerable gender gap in academic achievements among students in 2000 and 2005 in favour of the female students. The girls outperformed the boys significantly in 12 out of 13 disciplines, including mathematics and nature-science. In physical education, however, the boys had better results. In both student cohorts, the results showed a slight effect of season of birth in favour of being born in the Nordic winter-spring season, probably supporting an effect of relative age at the entrance of the school system.

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