

Do children perform and behave better at school when taught by same-gender teachers?



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ABSTRACT

An increase in the educational achievement of girls at the same time that the number of female teachers in primary school education is rising has led to the discussion whether boys are disadvantaged by the lack of male teachers. The Netherlands Twin Register identified a unique sample of 100 12-year-old monozygotic twin pairs discordant and 396 boy–girl twin pairs concordant for teachers' gender. School performance, as rated by the teacher, an educational achievement test score and teacher-rated ADHD behavior were similar for students with male or female teachers. In spite of the increase in the number of female teachers, boys still outperformed girls in arithmetic, while girls scored higher on language and reading. Boys demonstrated more ADHD behavior, but this was independent of teachers' gender. Therefore, increasing the number of male teachers in primary education may not be as effective to close a possible gender gap as suggested by some.

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1. Introduction

In many Western countries the share of female teachers in the educational system is greater than ever. In the Netherlands, for example, the percentage of female teachers in primary education is over 80%, ranging from 40% in last grade to over 90% in first grade (OCW, 2010). The share of female teachers in primary school will probably continue to rise since over 90% of teaching graduates is female (CBS Statistics Nederland, 2011). The majority of male and female teachers considers the feminization of primary education a problem for children (Sikkes, 2004). Female teachers are suggested to perceive the behavior of boys as more problematic and harm their social and emotional development and motivation to learn. Educational achievement of girls is increasing compared to boys at the same time that the share of women in primary education is rising. Reading and arithmetic levels are equal for 5-year old boys and girls attending kindergarten (Rathbun, West, & Germino Hausen, 2004). From primary school onwards, girls receive higher grades for reading and language, and boys for mathematics and science (OECD, 2010). Furthermore, boys have to repeat a grade more often and more boys attend specialized education (OCW, 2010). In college, the number of female students exceeds the number of males enrolled,

except in the more technical fields (CBS Statistics Nederland, 2011). In many Western countries some people blame the feminization of primary education for the supposed gap in educational achievement between boys and girls as same-gender teachers are said to enhance educational achievement (Ailwood, 2003; Ammermüller & Dolton, 2006; Helbig, 2010). Policies to increase the number of male teachers and to promote single-gender education have both been proposed.

The suggestion that boys need male teachers to achieve their true learning potential has been around for some time. Yet, empirical findings of studies investigating the influence of the gender of the teacher on educational achievement are inconclusive. Some studies did not observe an influence of teacher's gender on educational achievement in primary or secondary school (Ehrenberg, Goldhaber, & Brewer, 1995; Holmlund & Sund, 2008; Neugebauer, Helbig, & Landmann, 2011; Sokal, Katz, Chaszewski, & Wojcik, 2007). On the other hand, a number of studies from the United States and other countries reported an enhancing influence of a same-gender teacher on school achievements (Klein, 2004) in mathematics (Ammermüller & Dolton, 2006; Dee, 2007; Helbig, 2010) and reading (Dee, 2007; Helbig, 2010). Sometimes students were rewarded higher grades (Ehrenberg et al., 1995) and more positive evaluations with regard to their educational achievement (Hopf & Hatzichristou, 1999) by a teacher of their own gender. The age of the children included in these studies varies widely and some assess children in primary school while others report on secondary school students. A number of studies compared grades while others used results on standardized tests. Confounding influences of student traits,

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amongst others, socio-economic status, ethnicity, intelligence, and existing behavioral problems, could also be an explanation for the inconsistent results in the literature so far. Nonrandom placement with a male or female teacher with regard to these factors might confound results.

The enhancing influence of a same-gender teacher may be due to the fact that students identify more with a same-gender teacher and therefore work harder and behave better (Carrington, Tymms, & Merrell, 2008). Alternatively, teachers may prefer or feel more competent with students whose gender they share, and encourage them more (Powell & Downey, 1997). Also, negative gender stereotypes can influence the way teachers perceive and interact with their students, and have a detrimental effect on student motivation (Steele, 1997). Some of these explanations suggest that female teachers have a negative effect on the behavior of the boys in their classroom leading to underperformance (Carrington et al., 2008). Studies testing this hypothesis are rather scarce. One study in Dutch primary school students concluded that female teachers reported slightly more externalizing problem behavior for boys, not girls, compared to male teachers. However, parents of those twins did not rate the behavior of the children with a male and female teacher differently (Rietveld, van Beijsterveldt, & Boomsma, 2010). A study from Greece reported that female teachers evaluated the behavior of their students more positively compared to male teachers (Hopf & Hatzichristou, 1999).

Our study adopts a unique design which makes it possible to minimize random error resulting from differences between children while also controlling for possible confounding by genetic influences. We employed two genetically sensitive designs, a discordant monozygotic (MZ) twin and a concordant dizygotic of opposite sex (DOS) design. In the MZ sample, twin pairs, who share nearly all their genes and always have the same gender, attended separate classes (or different schools). One twin had a male teacher and the co-twin was taught by a female teacher. In the DOS sample, twin pairs were included, who were both taught by the same or a different male or female teacher. Differences within the twin pairs may be ascribed to the influence of the gender of the teacher, since (part of their) genotype, family background, socio-economic status and multiple other characteristics of the twins are similar and controlled for.

2. Methods and materials

2.1. Participants

The Netherlands Twin Register (NTR), established around 1987 by the Department of Biological Psychology at the VU University Amsterdam, registers approximately 40% of all multiple births in the Netherlands (Boomsma et al., 2006; van Beijsterveldt et al., 2013). Parents of the twins gave permission to approach their primary school teachers. From birth cohort 1989 onwards teachers of the 12-year old twins were asked to report their own gender and since then data collection has yielded surveys on 6643 children. Data were excluded if a child had a disease or handicap that interfered severely with daily functioning ($N = 96$), if the child attended education for children with special needs ($N = 231$), if the survey was filled out by someone other than the regular teacher ($N = 60$), if teacher familiarity with the student was below average ($N = 40$) and if no information on the gender of the teacher was available ($N = 163$), resulting in data for 6053 children from 2593 complete (data on both twins) and 867 incomplete twin pairs.

For the MZ sample, MZ twin pairs for whom a male teacher had filled out the survey of one of the twins and a female teacher had filled out the survey of the co-twin were selected. This smaller sample included 129 discordant MZ twin pairs. A short survey was sent to the parents of these MZ twin pairs to obtain additional information and check discordance at the time of the teacher survey. Parents were asked to report, for all grades, whether the twins attended the same or separate classes and the gender of the teacher(s) of their children. When parents did not

return the survey they were contacted by phone. The information obtained from the parents revealed that some twin pairs, at the time of the teacher survey, were not in separate classes or one or both were taught by a male as well as a female teacher. For some twin pairs data could not be checked as parents were no longer willing to participate or a phone number was disconnected. Therefore, the final sample included 100 MZ twin pairs (39 male pairs; 61 female pairs) who were discordant for teacher's gender at the time of the teacher survey. In general, the decision to separate the twins was made by the parents in agreement with the school. None of the parents reported that a deliberate decision was made to place one of the children with the male and the other with the female teacher. Twin pairs included in this study were in separate classes during most of their primary school years. The total number of male teachers during primary school education was, on average, around two for the children who were taught by a male teacher at the time of the survey compared to one for the children with a female teacher. Zygosity status was based on DNA polymorphisms ($N = 26$) or on a parental questionnaire with 10 items about resemblance in appearance ($N = 74$). With this last method correct zygosity classification of MZ twins is estimated to be around 97% (Rietveld et al., 2000).

For the DOS sample, twin pairs for whom both surveys were filled out by either a male teacher or a female teacher were selected. The total sample included data from 1862 children belonging to a DOS twin pair. Surveys were excluded if a teacher had indicated that he or she did not teach a child at least 4 days per week and not all educational domains ($N = 659$). These exclusion criteria were applied to ensure that a child was not taught by both a male and a female teacher. This left surveys for 1203 children from 446 complete and 311 incomplete twin pairs. Surveys from twin pairs discordant for gender of their teacher were excluded, resulting in data from 396 complete DOS twin pairs concordant for gender of their teacher, sharing either the same ($N = 167$) or a different ($N = 38$) male or the same ($N = 158$) or a different ($N = 33$) female teacher. Table 1 gives the background characteristics of the parents of the MZ and DOS twin pairs.

2.2. Measurements

School performance was assessed by teacher ratings of several educational domains, arithmetic, language and reading, with two versions of the teacher's survey. In the first version of the survey (birth cohorts 1989–1993), teachers could choose up to six domains and rate the proficiency of the students in these domains on a five-point scale from 1 (insufficient) to 5 (very good). In the second version (birth cohorts 1994–2000), teachers rated the proficiency of the students in four predefined educational domains, i.e. arithmetic, language, reading, and physical education, on the same five-point scale. Due to the free choice of educational domains in the first version of the survey, the number of available teacher ratings differs across the educational domains.

Educational achievement was assessed by a score on a national test of educational achievement which is administered at the end of the school term to grade 6 students (ages 11 to 13) at approximately 80% of all primary schools in the Netherlands (Cito, 2002). This test consists of multiple choice items in four different domains, namely arithmetic, language, study skills, and science and social studies. Together the performance scales of the national educational achievement test can be combined into a total score. Since administration of the science and social studies scale is not required, the science and social studies items are not used in the calculation of this standardized measure.

Behavioral problems were assessed with the ADHD Index scale of the short version of the Conners' Teacher Rating Scales–Revised (CTRS-R). The CTRS-R consists of 28 items scored on a 4 point scale from 0 (not true at all) to 3 (completely true) and includes 4 scales describing Oppositional Behavior, Inattention/Cognitive Problems, Hyperactivity and ADHD Index (Conners, Sitarenios, Parker, & Epstein, 1998; Goyette, Conners, & Ulrich, 1978). A sum score for the ADHD Index was only computed when a subject had two or less missing items on

Table 1
Parental characteristics for the monozygotic (MZ) and dizygotic of opposite-sex (DOS) twin pairs.

| | MZ Twin pairs | | DOS Twin pairs | |
|---------------------------------------|------------------|------|-------------------|------|
| | N | % | N | % |
| Socio-economic status | | | | |
| Lower profession | 11 | 11.0 | 61 | 15.4 |
| Secondary profession | 40 | 40.0 | 168 | 42.4 |
| Higher profession | 30 | 40.0 | 82 | 20.7 |
| Scientific profession | 18 | 18.0 | 57 | 14.4 |
| Missing | 1 | 1.0 | 28 | 7.1 |
| Maternal age at birth | | | | |
| ≤24 years | 6 | 6.0 | 13 | 3.3 |
| 25–29 years | 40 | 40.0 | 108 | 27.3 |
| 30–34 year | 40 | 40.0 | 194 | 49.0 |
| ≥35 years | 14 | 14.0 | 78 | 19.7 |
| Missing | 0 | 0.0 | 3 | 0.8 |
| Paternal age at birth | | | | |
| ≤24 years | 3 | 3.0 | 3 | 0.8 |
| 25–29 years | 23 | 23.0 | 66 | 16.7 |
| 30–34 year | 43 | 43.0 | 156 | 39.4 |
| ≥35 years | 29 | 29.0 | 162 | 40.9 |
| Missing | 2 | 2.0 | 9 | 2.3 |
| Education of the mother | | | | |
| Lower education | 2 | 2.0 | 17 | 4.3 |
| Lower middle education | 23 | 23.0 | 104 | 26.3 |
| Higher middle education | 33 | 33.0 | 151 | 38.1 |
| Higher education | 41 | 41.0 | 95 | 24.0 |
| Missing | 1 | 1.0 | 29 | 7.3 |
| Education of the father | | | | |
| Lower education | 5 | 5.0 | 27 | 6.8 |
| Lower middle education | 26 | 26.0 | 86 | 21.7 |
| Higher middle education | 27 | 27.0 | 129 | 32.6 |
| Higher education | 40 | 40.0 | 126 | 31.8 |
| Missing | 2 | 2.0 | 28 | 7.1 |
| Country of birth of the mother | | | | |
| The Netherlands | 97 | 97.0 | 373 | 94.2 |
| other Western country | 0 | 0.0 | 11 | 2.8 |
| non Western country | 2 | 2.0 | 3 | 0.8 |
| Missing | 1 | 1.0 | 9 | 2.3 |
| Country of birth of the father | | | | |
| The Netherlands | 90 | 90.0 | 372 | 93.9 |
| other Western Country | 4 | 4.0 | 9 | 2.3 |
| non Western Country | 4 | 4.0 | 4 | 1.0 |
| Missing | 2 | 2.0 | 11 | 2.8 |

the scale. A missing item on a scale was imputed by the averaged item score of the scale of child.

2.3. Analyses

Data were analyzed using the Statistical Package for the Social Sciences 20.0 (IBM, 2011). The main effects of teachers' gender, students' gender and the effect of their interaction on educational achievement, school performance and behavioral problems were examined with repeated measures general linear models. For the discordant MZ twin pairs the gender of the teacher was the within subjects factor and the gender of the student the between subjects factor while for the concordant DOS twin pairs the gender of the teacher was the between subjects factor and the gender of the student the within subjects factor. To correct for multiple testing a p -value of .01 (0.5/5 (total number of outcome measures)) was considered significant.

3. Results

The estimates of means and standard errors for teacher-rated school performance, for the national educational achievement test, and for ADHD related behavior are given in Table 2 and displayed in Fig. 1 for the 100 discordant MZ twin pairs and the 396 concordant DOS twin pairs. A summary of the results of the general linear model analyses is shown in Table 3. There were no significant main effects of teacher gender. In the MZ twin pairs sample, there was a main effect of student gender on ADHD ($p < .001$). Boys demonstrated more ADHD-related behavior than girls. In the DOS twin pairs sample, there was a main effect of student gender on teacher-rated school performance in arithmetic ($p < .001$), language ($p < .001$), and reading ($p < .001$), and on ADHD related behavior ($p < .001$). Boys received higher ratings for arithmetic and displayed more ADHD related behavior. Girls received higher grades for language and reading. There were no significant interactions between student and teacher gender for teacher ratings for arithmetic, language and reading, nor for the educational achievement test and ADHD behavior.

4. Discussion

Our study supplies some unique empirical data and sheds light on the debate concerning the feminization of primary school education

Table 2
Estimated means and standard errors from the general linear model analyses for the discordant monozygotic (MZ) and concordant dizygotic of opposite-sex (DOS) twin pairs.

| | N | Boys | | | | | | Girls | | | | | |
|-------------------------------------|-----|--------------|-------|------|----------------|-------|------|--------------|-------|------|----------------|-------|------|
| | | Male teacher | | | Female teacher | | | Male teacher | | | Female teacher | | |
| | | N | Mean | SE | N | Mean | SE | N | Mean | SE | N | Mean | SE |
| MZ twin pairs | | | | | | | | | | | | | |
| School performance | | | | | | | | | | | | | |
| Arithmetic | 81 | 33 | 4.24 | .179 | 33 | 4.12 | .176 | 48 | 3.96 | .149 | 48 | 4.13 | .146 |
| Language | 77 | 30 | 3.97 | .156 | 30 | 3.77 | .184 | 47 | 4.09 | .124 | 47 | 4.23 | .147 |
| Reading | 60 | 24 | 3.88 | .175 | 24 | 3.79 | .214 | 36 | 4.22 | .143 | 36 | 4.19 | .175 |
| Educational achievement test | | | | | | | | | | | | | |
| Total score | 67 | 26 | 539.7 | 1.70 | 26 | 537.7 | 1.73 | 41 | 538.0 | 1.36 | 41 | 537.7 | 1.37 |
| Behavioral problems | | | | | | | | | | | | | |
| ADHD | 98 | 39 | 5.12 | .772 | 39 | 6.28 | .967 | 59 | 2.11 | .628 | 59 | 2.61 | .786 |
| DOS twin pairs | | | | | | | | | | | | | |
| School performance | | | | | | | | | | | | | |
| Arithmetic | 374 | 193 | 4.07 | .075 | 193 | 4.16 | .078 | 181 | 3.71 | .084 | 181 | 3.73 | .087 |
| Language | 350 | 179 | 3.68 | .083 | 179 | 3.73 | .085 | 171 | 4.03 | .072 | 171 | 4.01 | .074 |
| Reading | 284 | 146 | 3.80 | .092 | 146 | 3.88 | .094 | 138 | 4.19 | .074 | 138 | 4.23 | .076 |
| Educational achievement test | | | | | | | | | | | | | |
| Total score | 246 | 127 | 539.6 | .74 | 127 | 539.4 | .77 | 119 | 538.4 | .77 | 119 | 538.7 | .79 |
| Behavioral problems | | | | | | | | | | | | | |
| ADHD | 391 | 201 | 5.27 | .479 | 201 | 5.34 | .493 | 190 | 2.39 | .271 | 190 | 1.93 | .279 |

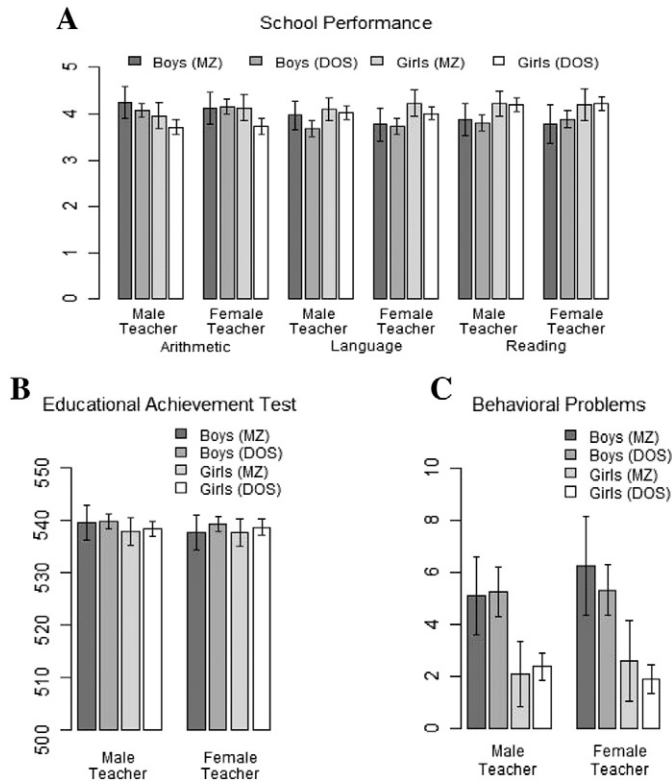


Fig. 1. Estimated means (95% CIs) of school performance assessed by teacher ratings (A), educational achievement assessed with the national Dutch educational achievement test (B), and the assessment of ADHD behavior with the CTRS-R (C) for the monozygotic (MZ) and dizygotic of opposite-sex (DOS) twin pairs, by male and female teachers.

and its influence on the educational achievement of children. It has been proposed that same-gender teachers enhance educational achievement and lessen behavioral problems. Male and female teachers do not rate the proficiency of their students in arithmetic, language and reading differently. They do not give higher ratings to children with whom they shared their gender. Looking at the score on a national educational achievement test, not rated by the teacher, there were also no differences between children with a male and a female teacher. Traditional gender differences were observed with boys outperforming girls on the numeracy domains while girls did better on the literacy domains and boys showed more ADHD-related behavior in the classroom.

Teachers all throughout primary school contribute to a student's educational achievement and this study did not control for the gender of the teachers in the earlier grades. This means that we are mainly considering the short term effects, namely one school year, of a same-gender teacher. It could be that having a same-gender teacher all throughout primary school may have an effect on educational achievement and behavior.

A possible positive effect of a same-gender teacher may be due to female teachers negatively affecting the behavior of boys, leading to lower educational performance. This hypothesis is not supported by the findings from this study since there was no indication that male and female teachers rated the behavior of their students differently. Our findings are in line with those from a Dutch longitudinal study among primary school children, which demonstrated that neither having a male teacher in the last grade of primary education nor the total number of male teachers affected educational achievement or social-emotional development of the students (Driessen, 2007).

Teaching quality varies and might have an effect on the educational achievement of students (Taylor, Roehrig, Soden Hensler, Connor, & Schatschneider, 2010). However, there appear to be no systematic differences in teaching methods between male and female teachers (Stone, 2010). Behaviors thought to be associated with masculinity as well as femininity are displayed by both male and female teachers (Skelton, 2003). Educational achievement could have been influenced by other factors, such as, classroom factors (e.g. classmates) and teacher characteristics (e.g. age), but only when they systematically differ between male and female teachers. For example, male teachers in primary school are, in general, older and therefore more experienced than their female colleagues which could perhaps influence the educational achievement of their students. The male teachers in our sample are in fact somewhat older than the female teachers, but additional analyses did not show an effect of age of the teacher on the different outcome measures.

The sample from which the MZ twin pairs were selected was rather large, but the number of MZ twin pairs discordant for teachers' gender was still small. As a consequence, the statistical power to detect the effects of interest was moderate in this group. The number of DOS twin pairs who were concordant for teachers' gender was larger, and thus had greater statistical power. A post-hoc power analysis in G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) revealed that, for the MZ twin pairs, the sample had enough power to detect an interaction between gender of the teacher and student of medium effect size (Cohen's $d = .5$) (Cohen, 1988). The power for a small effect size (Cohen's $d = .2$) was low, ranging from .17 to .38 for the various outcome measures. The

Table 3
Results of the general linear model analyses for the monozygotic (MZ) and dizygotic of opposite-sex (DOS) twin pairs.

| | | MZ twin pairs | | | DOS twin pairs | | |
|-------------------------------------|-------------------|------------------------|------------------|----------|------------------------|------------------|----------|
| | | <i>F</i> (<i>df</i>) | Partial η^2 | <i>p</i> | <i>F</i> (<i>df</i>) | Partial η^2 | <i>p</i> |
| <i>School performance</i> | | | | | | | |
| Arithmetic | Teacher | .033 (1,79) | .000 | .856 | .354 (1,372) | .001 | .552 |
| | Student | .520 (1,79) | .007 | .473 | 36.198 (1,372) | .089 | <.001 |
| | Teacher × Student | 1.331 (1,79) | .017 | .252 | .314 (1,372) | .001 | .576 |
| Language | Teacher | .052 (1,75) | .001 | .820 | .014 (1,348) | .000 | .906 |
| | Student | 2.454 (1,75) | .032 | .121 | 25.072 (1,348) | .067 | <.001 |
| | Teacher × Student | 2.432 (1,75) | .031 | .123 | .379 (1,348) | .001 | .538 |
| Reading | Teacher | .220 (1,58) | .004 | .641 | .352 (1,282) | .001 | .553 |
| | Student | 2.829 (1,58) | .047 | .098 | 28.754 (1,282) | .093 | <.001 |
| | Teacher × Student | .055 (1,58) | .001 | .815 | .127 (1,282) | .000 | .722 |
| <i>Educational achievement test</i> | | | | | | | |
| Total score | Teacher | 2.156 (1,65) | .032 | .147 | .000 (1,244) | .000 | .996 |
| | Student | .172 (1,65) | .003 | .680 | 4.224 (1,244) | .017 | .041 |
| | Teacher × Student | 1.108 (1,65) | .017 | .296 | .164 (1,244) | .001 | .686 |
| <i>Behavioral problems</i> | | | | | | | |
| ADHD | Teacher | 1.615 (1,96) | .017 | .207 | .210 (1,389) | .001 | .647 |
| | Student | 13.285 (1,96) | .122 | <.001 | 75.194 (1,389) | .162 | <.001 |
| | Teacher × Student | .253 (1,96) | .003 | .616 | .516 (1,389) | .001 | .473 |

power of the DOS twin pairs sample to find small effect sizes was larger and ranged from .63 to .79. Results in both groups showed no effect of a same-gender teacher. Therefore, increasing the number of male teachers in primary education or implementing single-gender education may not be as effective to close a possible gender gap between the educational achievement of boys and girls as suggested by some.

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