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DISCUSSION PAPER SERIES

IZA DP No. 11913

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ABSTRACT

Academic Achievement and the Gender Composition of Preschool Staff

This paper uses register based data covering the entire population of Danish children enrolled in preschool in 2006-2007 to investigate whether the gender composition of preschool staff members affects the timing of school start and subsequent academic performance. To estimate effects of the share of male staff member in preschools, we exploit within-preschool differences in teacher gender composition across time. We find that the share of male staff improves child outcomes and that gains are larger for boys who did not have access to male teachers previously and among children with less readily access to male role models.

JEL Classification: J13

Keywords: preschool, teacher gender, redshirting, child development

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1. Introduction

Female teachers and care providers dominate children's early lives and school; in 2012 87% of US primary school teachers and 94% of pre-primary school teachers were female according to the World Bank (2012). At the same time, boys are underperforming in schools in a range of subjects, and particularly in reading, while girls lag behind in math in the early years of schooling. This is true both in the US and elsewhere, see for example Bertrand and Pan (2013) and Fryer and Levitt (2010). We also document these patterns in our data. To the best of our knowledge, our paper is among the very first to investigate effects on child academic outcomes of the gender composition of preschool teachers, a group within which female staff members are particularly dominant.

We study the implications of preschool teacher gender on school starting age and, more importantly, also on subsequent achievement. Recently, delayed school start, also known as academic redshirting, has been rising in many countries; see e.g. Deming and Dynarski (2008) and Bassok and Reardon (2013). In Denmark, the setting of our study, the recommended school starting age (in grade 0, or kindergarten) is six. In 2007, however, about 21 % of six-year-old Danish boys and 11 % of six-year-old girls had not yet started school.[1] Delaying school start is potentially costly to society as it implies an extra year in preschool, which requires more resources per child compared to the costs of primary school, but effects on individual outcomes are less clear; see Black et al. (2011), Fredriksson and Öckert (2014), Dee and Sievertsen (2018) and Landersø et al. (2017). School achievement has been shown to correlate positively with a range of important later-life outcomes; see for example Heckman and Kruger (2006).

[1] Until 2009, kindergarten class (grade 0) was voluntary, but taken up by the vast majority. In 2009, kindergarten class became mandatory, and the general rule that children should start school the year they turn six became more binding. See section 3.1.

We contribute to a small literature that looks into the effects of male staff in childcare on child outcomes. Bauchmüller et al. (2014), using Danish data, study a range of quality measures while relying on a conditional-on-observables strategy. They find a very small but positive and significant association between a higher share of males and test results in 9th grade of elementary school. Drange and Rønning (2017) similarly analyze a variety of quality measures in institutions in Oslo, exploiting oversubscription of children to daycare.[2] They find that children first assigned to (but not necessarily attending) centers with a higher share of male staff perform better on language and math tests taken in the early school years. Cornelissen et al. (forthcoming) study effects of attending preschool on child outcomes while relying on staggered expansion of child care. Their paper also suggests that access to male staff members increases effects of preschool enrollment on school readiness (assessed by a pediatrician before school entry), motor skills for boys and reduction of BMI and overweight for both boys and girls.

Our paper relates not only to the literature on the effects of teacher gender per se (e.g. Nixon and Robinson 1999; Bettinger and Long, 2005; Dee 2007; Antecol et al. 2015), but also to the literature on the effects of quality parameters of preschools more generally. A large literature is concerned with the quality of schools (e.g. Rivkin et al. 2005 and Chetty et al. 2011), whereas much less is known about the quality of daycare and daycare staff (Blau 1993, 1997, 1999; Blau and Hagy 1998; Blau and Mocan 2002; Bauchmüller et al. 2014). Recent research shows that preschool is beneficial in terms of child performance relative to alternative means of care (see for example Datta Gupta and Simonsen 2010, Havnes and Mogstad 2011, Walters 2015, Felfe and Lalive forthcoming, and Cornelissen et al. forthcoming), but exactly what makes a preschool of high quality is less clear.

[2] See also Drange and Havnes (forthcoming) who use the same lottery to investigate effects of age at enrollment on child outcomes.

The key challenge to studying consequences of teacher gender is that it is merely one of many potential quality inputs into the production of child human capital. Thus even with random assignment to institutions, a version of which is exploited in Drange and Rønning (2017), it is still difficult to distinguish the effect of one contemporaneous input factor from another. If certain types of management are more likely to hire males, for instance, this will obscure a causal interpretation of estimated effects associated with teacher gender.

For this reason, we instead employ a strategy that combines quasi-random allocation into daycares in Denmark with within-preschool differences in the share of male teachers across time; a teacher switching quasi-experiment in the language of Chetty et al. (2014a, 2014b). Given that the (unobserved) quality of a preschool remains constant during a short period of time, the time variation in teacher gender composition enables us to distinguish between effects of male teacher share and other inputs. Moreover, our strategy allows for correlation between the quality of preschools – one example being their management – and the presence of male teachers. In the same way, it allows for parental and teacher selection into certain preschools. Overall, we actually find little parental selection of preschools with access to a larger share of male teachers based on observable characteristics such as child gender or parental socio-economic background.

We apply our empirical strategy to register-based data covering the entire population of Danish children enrolled in publicly provided preschool during the years 2006-2007. These data are merged with administrative data on school enrolment and compulsory IT-based national tests performed in 2^{nd} (reading), 3^{rd} (math) and 4^{th} (reading) grade in addition to extensive information about child, parent, and preschool characteristics. Importantly, these data allow us to characterize preschool teachers in terms of their background characteristics.

Overall, our findings indicate that an increase in the share of male preschool teachers has a positive effect on test scores. In terms of 2nd grade reading test performance, for example, our preferred estimate for boys indicates that a 10 percentage point increase in the share of males translates into an increase in test scores of 3.5 percentage points of a standard deviation. The corresponding number for girls is 2.6 percentage points of a standard deviation. These estimates reflect an intent-to-treat effect because we observe teacher inputs at preschool level rather than group level. Moreover, we find that gains are larger for boys if they did not have access to male teachers previously, whereas the opposite result is actually found for girls. Finally, we find larger benefits of male teachers among children with less readily access to male role models at home and overall larger effects for children born later in the calendar year.

We structure the remainder of the paper as follows: Section 2 discusses existing findings and hypotheses concerning the link between teacher gender and child outcomes, while Section 3 provides institutional background for the analysis and offers a description of the data. Section 4 presents our empirical framework, Section 5 shows our results, and Section 6 concludes.

2. The link between teacher gender and child outcomes

The existing literature on teacher gender has primarily focused on teacher gender effects in primary and secondary schools or college. The results are mixed (see for example Nixon and Robinson 1999, Dee 2007, Holmlund and Sund 2008, and Neugebauer et al. 2011), although papers exploiting within-student and -subject variations tend to find positive effects. Interestingly, Antecol et al. (2015) find, in a randomized experiment, that female students in disadvantaged neighborhoods who had been assigned to a female teacher did not obtain significantly different math test scores at the end of the academic year compared to similar female students having been assigned to a male teacher. Yet, while female students having had a female teacher without a strong math background suffered, the negative

effect disappeared and became (marginally) positive for female students who were assigned to a female teacher with a strong math background. In the literature on college education, the focus has been on the fact that male professors are more common in disciplines where female students typically do not perform well. At college level, the effects of same-sex teachers seem to be positive for women (Bettinger and Long 2005; Hoffmann and Oreopoulos 2009; Carrell et al. 2010).

It is possible, however, that gender effects are present much earlier – just as other characteristics of the learning environment have been documented to be more important early in life (e.g. Cunha et al. 2006). Preschool teachers, for example, may affect children's outcomes directly through the learning environment and through stimulation of non-cognitive skills such as child maturity, confidence, and independence. Preschool teachers may also play a role in advising parents about child school readiness, just as the quality of the relationship between the child and its preschool teachers may play a role for the parents' decision concerning the timing of school start.

Teacher gender, more specifically, is hypothesized to affect children directly through several channels. First, teacher gender is hypothesized to affect student engagement via role-model effects. Secondly, depending on their own gender, teachers may also communicate differential expectations to boys and girls in their classrooms; see Dee (2007). Third, as suggested by the child development literature, there may be differences between male and female staff members in preschools in the way they interact with children and the way children perceive the teachers (e.g. Sandberg and Pramling-Samuelsson 2005 and Sumsion 2005). While female teachers to a higher extent value calm play and social development, male teachers are found to be more playful and focus on physical development. Interestingly, some papers indicate a positive link between physical activity and academic performance, concentration, memory, and classroom behavior; see Strong et al. (2005) for an

overview. Yet, it is unknown whether these differences between male and female teachers are present on a larger scale and affect subsequent child achievement.

All channels suggest that boys as well as girls could be affected by the presence of male teachers. Yet, in the aggregate, it is theoretically unclear which gender will benefit more: even if male teachers primarily serve as role-models for boys – and even if they actually spend more time with boys – both boys and girls could benefit if it leads to a less disruptive overall environment[3] and more scope for scholastic activities. More generally, boys *as well as* girls could learn from a more playful environment and physical activities. Moreover, because preschool children are most often supervised by several teachers at a time (see below for details on organization), teacher gender may play a different role in preschools compared to schools simply because there is more room for specialization across teacher and child cognitive and non-cognitive skills.

The gender composition of staff members may also impact children's outcomes through effects on the working environment. Some work shows, for example, that gender balance correlates with job satisfaction (Fields and Blum, 1997) and lower turnover (Bygren, 2010) and that demographic diversity, including gender diversity, even correlates positively with firm productivity (Parrotta et al, 2014).

Viewing access to male teachers as an input into the production of child human capital and assuming positive (but diminishing) marginal returns, we hypothesize that the benefit increases in the share of male teachers, or more generally in the intensity of treatment. Hence, we conjecture that children with less readily access to male role models at home benefit more from exposure to a male teacher. Cobb-Clark and Tekin (2014), for example, find that more boys engage in delinquent behavior when there

[3] Kristoffersen et al (2015), for instance, find that the presence of potentially disruptive children in school significantly reduces test scores. It is possible that disruptive children will affect learning already in preschool.

is no father figure present, and that this is not solely explained by the lack of paternal involvement. We also hypothesize that gains are larger if children did not have access to male teachers previously, though this could depend on whether male teachers hired into such particular institutions (are asked to) specialize in one gender. Assuming further that returns to investments are larger, the younger the children (Cunha and Heckman, 2007), we expect that younger children benefit relatively more.

3. Background and Data

3.1 Early Childhood Education in Denmark

The majority of Danish childcare institutions are organized and operated by the municipalities. Municipalities provide formal childcare at nursery centers for the 0-3-year-olds and preschools for children aged 3-6. Some childcare institutions combine nursery care and preschool into so-called age-integrated institutions (for the 0-6-year-olds) with separate nursery and preschool compartments. In addition, municipalities organize family day care where young children (usually 0-3-year-olds) are cared for by a child-minder, usually in her or his private home. This study focuses on preschools, i.e. daycare arrangements for the 3-6 year-olds.

Municipalities coordinate the allocation into all publicly subsidized childcare institutions. Although there is some variation across municipalities in how they manage allocation procedures, allocation into childcare is generally governed by waiting lists determined almost solely by birth date of the child. Apart from the birthdate-determined allocation of slots, municipalities can weigh in some social considerations, e.g. if the parents need support with attending to the child. Municipalities ask parents to submit a prioritized list of preferred childcare institutions as well as their preferred start date shortly after childbirth. There is variation in these procedures across municipalities; some municipalities ask parents to provide two priorities, others may ask for up to five prioritized institutions. Moreover,

municipalities have different rules as to whether parents may reject an offer and wait for a better one while staying on the waiting list, and whether parents are allowed to move their child to another institution once given a slot. Parents can obtain information about the length of the waiting lists at different institutions, implying that institutions that are put on the prioritized list may not always reflect the parents true priorities (due to strategic behavior). A recent study based on a survey from Copenhagen showed that around 17% of the parents showed strategic behavior in their submitted priorities regarding nursery care institutions for the 0-3 year-olds (Gørtz and Kennes 2016). Municipalities use the parental preferences combined with the child's birthdate and hence position on the waiting list to make the final allocation.

Generally, there has over the last decades been excess demand for daycare, implying that most municipalities had difficulties providing the number of slots needed for the youngest children when parents were to return to work after parental leave. However, for the 3-6-year-olds, demand for daycare is to a large extent met by the municipalities, although parents cannot expect a spot in their preferred daycare institution. From age four, most children are enrolled in preschool (more than 90 percent of the 3-6-year-olds attend formal childcare, cf. OECD (2009, 2012)).

Childcare institutions are regulated by general law and subject to municipal supervision. Publicly provided childcare is heavily subsidized; parents usually pay 20-30% of the actual cost of a preschool slot depending on income. Parental payment is equal across childcare institutions within a municipality, but varies across municipalities. The average preschool has around 60 children[4] and employs roughly seven preschool teachers with a degree in early childhood education (a bachelor

[4] Children are often organized in smaller groups of around 20. We do not observe these groups in our data.

degree in pedagogics) plus a number of assistants.[5] Around 11% of all staff members in our data are male.

Preschools are child-centered and focus on socialization and learning through play rather than a basic skills curriculum. As of 2004, Danish childcare institutions have been expected to develop independent pedagogical learning plans, establishing how the preschool intends to work pedagogically with its goals. To get further insights into staffing decisions and daily organization, especially related to the use of male staff, we performed semi-structured interviews with managers from three preschools.[6] Generally, these interviews confirmed the findings in the literature that male daycare teachers contribute to the pedagogical environment with activities associated with playfulness, outdoor activities such as gardening, sports etc. Daycare institutions are generally responsible for hiring their own staff and have some autonomy in choosing their own balance between staff with a degree in early childhood education (pedagogy). In principle, institutions are not allowed to let teacher gender affect their decision on whom to hire. However, our interviews indicate that institutions can signal that they are looking for specific skills, such as course completion in nature activities or experience with establishing e.g. a woodwork workshop. Moreover, when faced with two applicants of equal qualifications, they may be inclined to hire male teachers to achieve a better gender balance. In fact, in line with the literature discussed above, preschool managers report that the presence of males improves the working environment and that they serve as role-models for the children.

The preschools organize children in smaller groups in the middle of the day with specific staff members assigned. When staffing the groups, institutions aim at having a mix of trained pedagogues

[5] Previously, pedagogical assistants were often unskilled workers, who over time would receive some additional training. In recent years, a vocational education as pedagogical assistant has been initiated. The education takes 3-4 years with enrolment immediately after lower secondary school.
[6] Conducted April 11th, April 16th and May 1st for two different municipalities in Western and Eastern Denmark.

and assistants in each group. Pedagogical qualifications have more weight than teacher gender when staffing groups, so there is not necessarily a male staff member in each group. However, children play together across groups and staff members on the playground, preschools organize projects, activities and events that go across child groups, and there is flexibility in the staffing across groups in the early and late hours of the day (usually before 9 am and after 3 pm). All children will therefore be aware of a male preschool teacher, although some may interact more with him than others.

Children are expected to start school in the calendar year they turn six. Primary school consists of 0-9th grade (and a voluntary 10th grade), so kindergarten class (grade 0) is an integrated part of the primary schools and is thus free of charge. Kindergarten class was voluntary until 2009 (meaning that a child could start directly in 1st grade at age 7), but almost all children (98%) started primary school through kindergarten around the time of our cohorts' school start. Redshirting was common in 2007, about 21% of the boys and 11% of the girls experienced delayed school start. Children who delay school entry, i.e. are redshirted, stay one extra year in preschool and then start in kindergarten/grade 0 a year later. The decision whether to enroll the child in school is taken by the parents, often taking advice from preschool teachers. After kindergarten class, children move on to first grade.

In 2009, kindergarten class became mandatory. Since 2009, delayed school entry has been decreasing, and in 2016, 9% of all boys and 4% of girls experienced delayed school entry (Ministry of Education 2017). School authorities achieved this by making it more difficult for parents to obtain a permission to let their child delay school entry.

3.2 Data

Our analyses consider the population of Danish children enrolled in preschools in 2006-2007. Our main data stem from the Danish Day Care Register from Statistics Denmark, which is a unique longitudinal dataset. Statistics Denmark has successfully matched preschools from the childcare register to workplaces from the Integrated Database of the Labor Market (IDA) based on the preschools' unique identifier, thus linking children and staff in preschools (Gørtz & Andersson, 2014; Gørtz, 2012).[7] This link directly provides us with information about number of staff members and number of children, which we use to calculate the staff-to-child ratio.

Via unique personal identifiers, the information from the Danish Day Care Register is merged with registers containing rich socio-economic background variables for the children enrolled and their parents but also about their preschool teachers. Hence, we are able to characterize the composition of preschool teachers at each institution in terms of variables such as gender, education, age, experience, sickness absence etc.

School starting age is available from the Danish School Register, and academic achievement is measured via compulsory IT-based national tests performed in reading in the 2nd and 4th grade and math in the 3rd grade. An advantage of using these tests is that teachers are not involved in scoring the tests; the computer program does this automatically. Scores are measured on a logit scale. The national test scores correlate highly with 9th grade exit exam scores; in fact they explain 48-51% of the variation in the 9th grade Danish and math examination marks. See Beuchert and Nandrup (2018) for a thorough description of the Danish national tests.

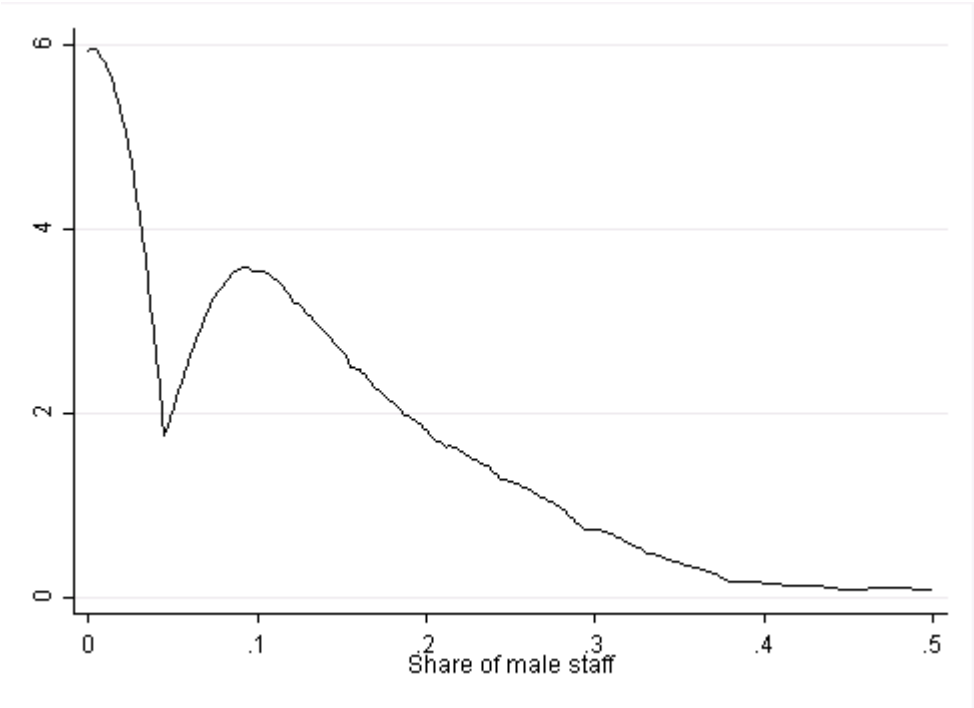
[7] In practice, we delete from our sample preschools with a child-to-staff ratio above 20 children per staff member corresponding to less than 0.5% of the sample.

We now outline the variables used in our empirical analysis and describe our sample in terms of observed background characteristics, exposure to male preschool teachers, and outcomes.

3.3 Definition of Sample, Key Variables, and Descriptive Statistics

Our analysis considers the effects of preschool teacher gender composition for subsequent child outcomes. Our main analyses consider the share of male teachers in the preschool a child is enrolled in in the year prior to expected school start. During the period under consideration, children were expected to enroll in kindergarten class in August in the year they turn six. We therefore select as our main estimation sample children who were enrolled in preschool in the calendar year in which they turned five. Figure 1 shows the distribution of male teacher shares. There is substantial mass at zero but also considerable variation above zero but below 0.5.

Figure 1. Distribution of share of males



Note. One observation is one preschool in one year. The graph is cut at 50% share of males due to too few observations above this point.

We focus on two main types of outcomes: (1) Redshirting, i.e. an indicator for enrolling in kindergarten class later than in the calendar year in which the child turns six, and (2) test scores in reading and math. We standardize test scores to have mean zero and a standard deviation of one for each cohort of all test takers. We expect these outcomes to represent very different margins; one outcome measure is concerned with school readiness before school enrollment, while the other speaks of performance given school enrolment. As the results for 4th grade are more likely to reflect whether there are effects in the medium run, we consider (reading) test scores both in the 2nd and 4th grade.

Preschool staff members are defined as employees hired to interact with the children. Hence, this excludes personnel types such as cleaning staff, kitchen staff, janitors and administrative workers.

Table 1. Descriptive statistics, selected variables by quartiles of male teacher share

	Q1		Q2		Q3		Q4	
Panel A: Preschool variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Share of male staff	-		0.07	(0.01)	0.13	(0.02)	0.26	(0.09)
Any male (0/1)	-		1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Children per staff member	5.36	(2.00)	4.02	(1.19)	4.54	(1.54)	4.50	(1.88)
Avg. children per preschool	49.49	(20.14)	69.39	(24.36)	59.97	(26.26)	57.55	(29.32)
Share, any sick leave	0.16	(0.16)	0.18	(0.13)	0.15	(0.14)	0.10	(0.13)
Share, trained staff	0.57	(0.18)	0.50	(0.13)	0.51	(0.15)	0.49	(0.15)
New manager (0/1)	0.15	(0.35)	0.18	(0.38)	0.18	(0.38)	0.20	(0.40)
Share of girls	0.48	(0.08)	0.48	(0.07)	0.48	(0.07)	0.48	(0.08)
Share of ethnic minority	0.09	(0.13)	0.10	(0.14)	0.10	(0.15)	0.11	(0.18)
Avg. Age of mothers	32.15	(1.39)	32.40	(1.40)	32.36	(1.50)	32.60	(1.62)
Share, mothers long educ.	0.34	(0.15)	0.39	(0.16)	0.38	(0.17)	0.41	(0.18)
Share, nuclear family	0.84	(0.10)	0.85	(0.09)	0.84	(0.10)	0.81	(0.11)
Avg. Log(household inc.)	13.05	(0.37)	13.12	(0.33)	13.07	(0.38)	13.00	(0.44)
Share, low birth weight	0.05	(0.04)	0.05	(0.03)	0.05	(0.04)	0.05	(0.04)
# preschools by year	2159		951		1647		1477	

Panel B: Child and parent background variables								
Girl (0/1)	0.49	(0.50)	0.49	(0.50)	0.48	(0.50)	0.48	(0.50)
log(Gross Inc.), household	12.98	(1.48)	13.03	(1.39)	13.00	(1.46)	12.95	(1.57)
Mother's age	31.93	(5.06)	32.07	(5.05)	32.14	(5.05)	32.39	(5.15)
Nuclear family (0/1)	0.81	(0.39)	0.82	(0.39)	0.81	(0.39)	0.80	(0.40)
Child from ethnic minority (0/1)	0.08	(0.28)	0.09	(0.29)	0.09	(0.29)	0.11	(0.31)
Mother above 12 years of educ. (0/1)	0.32	(0.47)	0.35	(0.48)	0.36	(0.48)	0.39	(0.49)
Low birth weight (0/1)	0.05	(0.22)	0.05	(0.22)	0.05	(0.22)	0.05	(0.22)
Panel C: Child outcomes								
Reading, 2nd grade	-0.02	(0.98)	0.02	(1.00)	0.02	(0.99)	0.02	(1.03)
Reading, 4th grade	-0.02	(0.99)	0.01	(0.99)	0.02	(0.99)	0.05	(1.00)
Math test score	-0.02	(1.00)	0.00	(0.99)	0.02	(0.99)	0.03	(1.01)
Redshirting (0/1)	0.15	(0.36)	0.16	(0.36)	0.15	(0.36)	0.15	(0.36)
# children	30409		16465		25852		20873	

Note: Preschool variables are measured in the year the child turns five. Parent background variables measured in the year in which the child turns two except for the indicator for non-nuclear family, which is measured in the year the child turns five. Quartiles are split at the following points: 0% men, 0.09% men and 0.17% men. Numbers for share of male staff and dummy for any men in Q1 are not shown due to Statistics Denmark's discretion policies as there are very few men in this group. These are marked with "-".

Our total sample consists of 93,599 observations at the child level, of which 45,409 are girls and 48,190 are boys. These 93,599 children were distributed across 6,234 observations of preschools by year. Table 1 shows selected descriptive statistics across preschools with varying shares of male teachers.

Child and parent background variables are generally measured in the calendar year in which the children turned two, except for the indicator for non-nuclear family that is measured at age five to capture current vulnerability. In our main analysis and in these descriptive statistics, preschool level characteristics are all measured in the year the child turns five. We make this choice because we are then certain that institutions all exist at this point in time and because it best represents the current preschool environment.[8] There is a positive but surely not perfect correlation between preschool characteristics measured at age 3 and age 5 (between 0.03 and 0.7), as shown in Table A1. This implies not only that preschools are unlikely to change character completely over the course of two years, but also that hiring decisions of males are unlikely to hinge fully on characteristics of the preschools at the time when the child is aged three. We discuss this further in section 5.5 on Robustness.

Preschools with a low share of male teachers (in the lowest quartile) tend to have more children but a lower child-per-staff ratio. Overall, however, neither of the relationships are monotonic in male teacher share.

Information on outcomes is shown in panel C of Table 1. Information on test scores in reading and math is only available for around 80% of the sample as some (private) schools opted out of the test, and as some children may have been absent on the day of the test.

[8] Mobility after first enrollment is low: 9% change institution between the age of three and four; 7% change between ages four and five.

To get a better sense of what exposure to male staff members entails, and hence to secure appropriate interpretation of estimated parameters, Table 2 shows characteristics for the samples of male and female staff members. We see that male staff members are significantly younger; in fact as many as 30% of the male staff members are aged 23 or younger. In comparison, only 10% of female staff members are aged 23 or younger. Males are less likely to be trained pedagogues, take less sick leave, and have less experience. They are, on the other hand, on average slightly more likely to be managers. Conditional on being a trained pedagogue, the difference is striking: in this group, 10% of females and 25% of males are managers. Appendix Figure A1 indicates no differences in the distributions of high school GPA for male and female staff members.[9]

Table 2. Descriptive statistics, staff members by gender

	Full sample				
	Female staff			Male staff	
	Mean	SD		Mean	SD
Experience	16.95	(10.48)	***	11.06	(11.48)
Trained (0/1)	0.53	(0.50)	***	0.29	(0.46)
Age	40.20	(11.60)	***	33.30	(12.27)
Any sick leave (0/1)	0.15	(0.36)	***	0.07	(0.26)
Manager (0/1)	0.06	(0.25)	***	0.09	(0.29)

Note: * p<0.1, ** p<0.05, *** p<0.01.

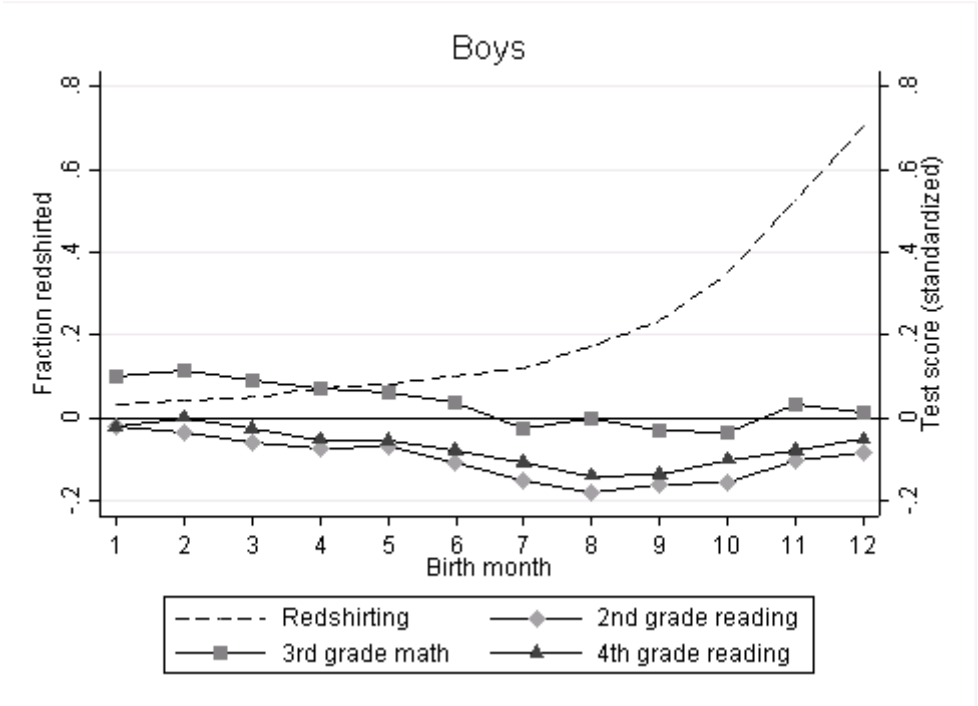
Test scores vary considerably with birth month, illustrating the age-at-test effect (Black et al., 2011). Thus test scores are the highest among children born early in the calendar year but decrease with birth month. The test score curve flattens towards the end of the calendar year, reflecting a considerable share of children being redshirted. About 15% of the children in our sample are redshirted but, as

[9] We detect no differences in the tendency to obtain a high school degree among male and female preschool teachers born after 1977. Among older cohorts, slightly more males than females had a degree.

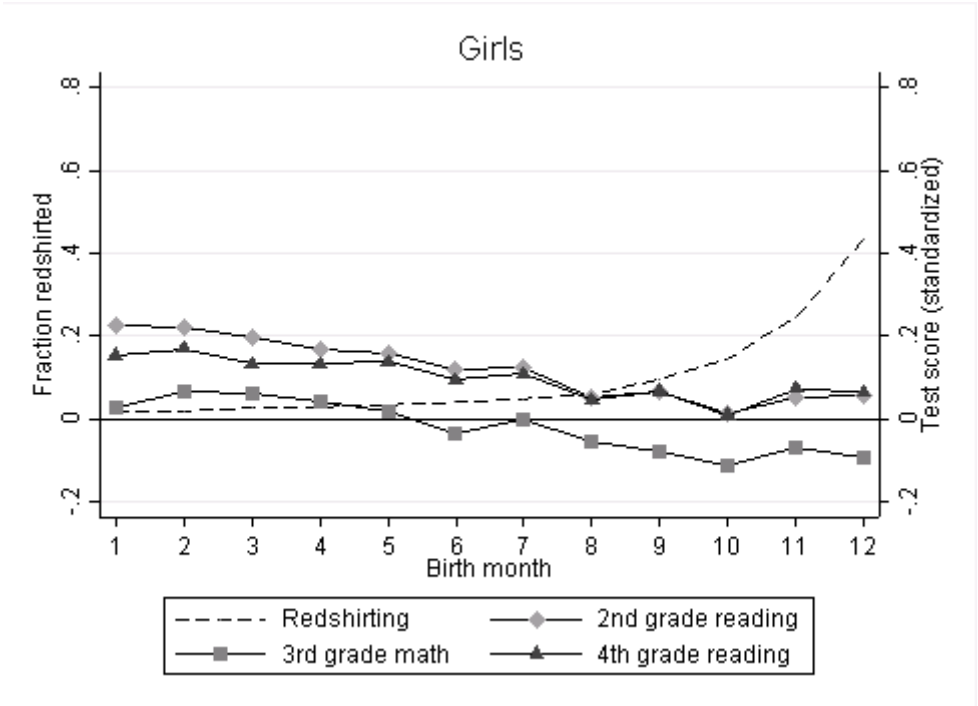
seen in Figure 1, this varies substantially with birth month: redshirting is much more common for children born late in the year. As discussed above, we will pay further attention to the role of birth month in our empirical analyses. While boys outperform girls in math, girls' reading test scores exceed those of boys. Graphs for 2nd and 4th grade reading results are very similar.

Figure 1. Standardized test scores and redshirting, by birth month

Panel A. Boys



Panel B. Girls



4. Estimation Strategy and Interpretation of Parameter of Interest

We first investigate the effect of share of male preschool teachers in the year prior to potential school start for children's school readiness as measured by their propensity to redshirt.[10] As explained in section 3.1, for the years we consider, children were expected to enroll in kindergarten class in the year they turn six. We classify children as 'redshirters' if they enroll later than this. The next step in our analysis is to estimate effects on academic achievement tests. For both types of outcomes, we rely on the following linear model:

$$(1) \qquad y_{ij} = x_i\beta + T\alpha + z_j\gamma + sh\_male_j\delta + e_j + u_{ij}$$

where *i* indicates child and *j* preschool. We exploit preschool enrolment data from five-year-old children in 2006 and 2007. *y* represents the outcome (an indicator for academic redshirting; standardized test scores), *x* is a set of child characteristics (whether parents divorced before the child turned five, whether the child belongs to an ethnic minority, mother's age, whether the mother has more than 12 years of education, whether the child had a low birth weight, birth month, and regional dummies). *z* is a set of characteristics of the preschool in the previous period (share of trained staff, share of staff with any sick leave, share of staff employed as managers, share of preschool teachers, share of assistants, whether the preschool had a new manager, the average age of staff members, the average experience of staff members, whether the preschool had less than 12 employees, number of children, share of girls, share of children from divorced families at age five, share of children from ethnic minorities, average age of mothers, share of mothers with more than 12 years of education, average household log income, and share of children who had a birth weight below 2,500 gram). *T* is

[10] To the extent that the preschools that children enroll in at age 5 are of higher overall quality than previous preschools, this will affect the external validity of our results. Still, as noted in Section 3.3, year-to-year mobility is low.

a 2007 indicator, *sh_male* measures the share of male preschool teachers, *e* is a preschool fixed effect, and *u* is the idiosyncratic error term. δ is our parameter of interest.

We suspect that the presence of male staff as well as preschool quality characteristics are potentially endogenous. Our main identification strategy incorporates preschool fixed effects and thus exploits within-preschool differences in the share of male preschool teachers across the two years. The strength of such a strategy is that it allows both parents and teachers to select into types of preschools of a particular quality or to be exposed to a certain peer group (*e*) that is constant over time and unobserved by the researcher. It also allows for correlation between quality and the ability to hire male teachers. Preschools without variation in the share of male teachers identify time trends and aid identification of parameters associated with child, parent, and other preschool characteristics. In this way, they comprise a clean control group in what bears resemblance to a difference-in-difference set-up (with preschool fixed effects).

The experiment we have in mind is one where the share of male teachers increase because male staff members are hired from the population of male applicants, holding fixed the other preschool characteristics. Staff turnover is generally high in Danish preschools, implying that hiring is not a rare event (Bauchmüller et al. 2014). Interestingly, they find no correlation between staff stability and child outcomes. Given the insights from Section 3.3, the appropriate interpretation of the estimated parameter will be the effect of employing more of relatively young, less experienced staff members who are more likely assistants and not trained teachers.[11] If more experienced and trained staff are superior to less experienced assistants, our parameter of interest will be less positive for child outcomes compared to a situation where male staff members had exactly the same distribution of characteristics as female staff members. To more directly address differences in observable

[11] We did also see that they are slightly more likely to be a manager.

characteristics, we also perform analyses that allow effects of male staff members to vary with characteristics of the males (Table A3).

Threats to this strategy arise if other features of the preschool that correlate with the employment of male staff members and child outcomes change over time. This could wrongfully lead us to ascribe their effects to that of employing males. It might, for example, be the case that the composition or behaviors of the staff members could induce preschool managers to hire males, or it could be that preschools hire males to address the needs of the children already enrolled. For instance, if a preschool experiences that the fraction of boys is increasing, the manager may be more likely to hire males. To the extent that boys are more prone to be held back a year, our estimation strategy will ascribe these higher redshirting rates to the presence of males. This may generate negative bias in models of redshirting for boys – when it is actually just due to the composition of children enrolled. Alternatively, a preschool that increasingly faces disciplinary problems may look for a more experienced teacher – and such a teacher is simply more likely female. This would lead us to overestimate the positive effects of access to male teachers.

Parental choice might also be a concern if certain types of parents select into (or out of) preschools because of the hiring of male preschool teachers or because of unobserved characteristics that are correlated with the changes in the stock of male employees. One could worry, for example, if children and parents with particularly advantageous characteristics are overrepresented in preschools that choose to hire male staff members, possibly because they are more aware of staff characteristics. This would lead us to overestimate the effects of access to male teachers.

Luckily our data allows us to characterize the relationship between access to male teachers and a wide range of child, parent, and preschool characteristics measured in an extended period back in time. As

explained, we also adjust for prior characteristics in our estimations and show that their inclusion does not change our conclusions.

5. Results

This section presents our results. We start out by characterizing preschools that employ male teachers relative to other preschools. We then present our main estimates and a set of heterogeneity analyses.

5.1 Characterizing identifying preschools: Sorting and mechanisms

To address the potential selection problem that it may be a select group of parents that sort their children into preschools that have relatively many male teachers, we regress the share of male teachers on child, parent and preschool characteristics, while adding a preschool fixed effect and a time dummy. Results shown in Table 3 do not indicate sorting on observable characteristics; all estimated coefficients are very small and only two (mother's age and dummy for low birthweight) are significant (at the 5% and 10% level, respectively). Given that we estimate a large number of coefficients per model, it is not surprising to detect some significant coefficients.[12] Another way to perform this type of test is to regress child, parent, and preschool characteristics one-by-one on the share of male teachers, while again controlling for the preschool fixed effect and a time dummy. Results of this exercise are shown in Appendix Table A2. The conclusion remains the same.

Appendix Figure A2 shows graphs of selected preschool characteristics (share of girls; number of children enrolled; share of trained staff; average age of mothers; share of mothers with more than 12 years of education) since 2000 by measures of their variation in male staff members. We would worry

[12] Bonferroni corrections render all coefficients insignificant at the 5% level.

if preschools that employ males experienced different trends compared to other preschools. However, we find no such evidence. The complete set of graphs is available upon request.

Table 3. Probability of being in preschool with male teachers

	Outcome: Share of male staff	
	Girls	Boys
Child and parent variables		
Log(household income)	0.0002	-0.0001
	(0.0002)	(0.0002)
Mother's age	-0.0001**	-0.0001**
	(0.0000)	(0.0000)
Mother above 12 years of education (0/1)	-0.0004	0.0008*
	(0.0005)	(0.0004)
Nuclear family (0/1)	0.0001	0.0005
	(0.0006)	(0.0005)
Ethnic minority (0/1)	0.0004	-0.0010
	(0.0007)	(0.0007)
Low birth weight (0/1)	-0.0017*	0.0018*
	(0.0010)	(0.0010)
Previous period staff characteristics		
Share of staff with training	0.0158	0.0105
	(0.0118)	(0.0109)
Share of staff with sick leave	0.0021	-0.0004
	(0.0083)	(0.0078)
Share of managers	-0.0089	0.0247
	(0.0282)	(0.0273)
Share of preschool teachers	-0.0055	0.0227
	(0.0200)	(0.0198)
Share of assistants	-0.0091	0.0156
	(0.0208)	(0.0193)
New manager (0/1)	0.0036	0.0033
	(0.0025)	(0.0025)
Average age of staff	0.0003	0.0003
	(0.0004)	(0.0004)
Average experience of staff	0.0005	0.0004
	(0.0005)	(0.0004)
Less than 12 employees (0/1)	-0.0007	-0.0012
	(0.0026)	(0.0024)

Previous period preschool characteristics		
# children	-0.0000	0.0000
	(0.0000)	(0.0000)
Share of girls in preschool	-0.0044	0.0013
	(0.0156)	(0.0139)
Share of children from ethnic minorities	0.0078	0.0009
	(0.0082)	(0.0077)
Average age of mothers	-0.0010	-0.0014
	(0.0011)	(0.0011)
Share of mothers with above 12 years of educ.	0.0028	0.0124
	(0.0109)	(0.0101)
Share of children from nuclear families	-0.0006	-0.0018
	(0.0148)	(0.0145)
Average log(household income)	0.0048	0.0016
	(0.0050)	(0.0047)
Share of children with low birthweight	-0.0015	-0.0031
	(0.0307)	(0.0272)
# observations	45,409	48,190
	93,599	
F-test for joint significance	1.368	1.419
P-value for joint significance	0.113	0.0887

Note: Preschool fixed effects regression of share of male staff in preschool on year 2007 dummy, student and parent controls and preschool staff, parent, and children controls. In addition, the regressions include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.

5.2 Main results

Next, we investigate the link between share of male teachers and the propensity to redshirt and then continue to analyze the effects on student achievement. Table 4 shows the results by child gender. Panel A shows the results for boys and Panel B shows the results for girls. As discussed previously, the estimations for redshirting are carried out for the entire sample of 48,190 boys and 45,409 girls, while estimations for test scores are done on a slightly smaller sub-sample of the entire sample. We first present simple OLS results that only condition on time, and then gradually increase the conditioning set by first including preschool fixed effects, next adding child and parent characteristics, and finally preschool variables. The latter specification shown in column (4) is our

preferred model. Generally, precision is reduced once preschool fixed effects are included, although we also observe increased precision for girls' reading in 2nd grade. Subsequently adding student, parent, and preschool controls only cause minor changes that do not change our conclusions.

Consider first effects on redshirting. Strictly speaking, we cannot distinguish whether children's school readiness improves from being exposed to male teachers or whether male staff members are more likely to view children as being ready for school. Given that male staff members are most often untrained caretakers (or pedagogical assistants), they are, however, less likely to be involved in advising parents on the child's school readiness than the trained preschool teachers. Our preferred specification in column (4), which exploits time variation within preschools, shows small and insignificant effects on redshirting for both boys and girls of share of male staff members.

In terms of 2nd grade reading test performance, effects are positive and statistically significant, though only at a 10% level for girls. Our preferred estimate for boys indicates that a 10 percentage point increase in the share of males translates into an increase in test scores of 3.5 percentage points of a standard deviation; the corresponding number for girls is 2.6 percentage points of a standard deviation. Figure 1, Panel A indicates that being one month older is associated with a 2.5 percentage point increase in the standardized 2nd grade reading test score, at least for children born during the first part of the calendar year where redshirting is less common. Hence, loosely speaking, an effect of 3.5% of a standard deviation corresponds to being roughly 1.4 months older. The effect is slightly smaller for girls but still substantial in size. To put our results into perspective, Dee (2007), for example, finds that assigning girls a female instead of a male teacher in middle school has no significant effect on girl's test scores (estimate of 1.8% of standard deviation); assigning boys to a female teacher, on the other hand, significantly decreases test scores with 4% of a standard deviation.

Effects on math test performance are positive too but only significant for boys – and only at a 10% significance level. We see no significant effects on 4th grade reading.[13]

[13] Our estimates reflect an intent-to-treat effect because staff members are primarily assigned to groups. One way of arriving at a direct effect of share of male teachers is simply by scaling the estimates with the average number of groups in a preschool. In an institution with 60 children and three groups, effects for those exposed may be three times as large.

Table 4. Effect of share of male staff in preschool in year the child turns five

	(1)	(2)	(3)	(4)
Panel A: Boys				
Redshirt (0/1)	-0.0085	0.0205	-0.0150	-0.0163
	(0.0236)	(0.0520)	(0.0463)	(0.0463)
# observations: 48,190				
Reading, 2nd grade	0.1538**	0.4028***	0.3629***	0.3453**
	(0.0696)	(0.1393)	(0.1371)	(0.1370)
# observations: 38,039				
Math	0.1982***	0.2780**	0.2252*	0.2142*
	(0.0698)	(0.1262)	(0.1242)	(0.1254)
# observations: 39,652				
Reading, 4th grade	0.3387***	0.1458	0.0836	0.0734
	(0.0665)	(0.1286)	(0.1261)	(0.1260)
# observations: 39,366				
Panel B: Girls				
Redshirt (0/1)	-0.0252	0.0295	0.0386	0.0388
	(0.0167)	(0.0372)	(0.0358)	(0.0357)
# observations: 45,409				
Reading, 2nd grade	0.1119	0.2464*	0.2747**	0.2645*
	(0.0705)	(0.1412)	(0.1349)	(0.1349)
# observations: 36,449				
Math	0.1261*	0.1362	0.1680	0.1656
	(0.0686)	(0.1312)	(0.1271)	(0.1276)
# observations: 38,035				
Reading, 4th grade	0.2149***	-0.0679	-0.0214	-0.0327
	(0.0632)	(0.1266)	(0.1231)	(0.1231)
# observations: 37,801				
Preschool fixed effects	NO	YES	YES	YES
Dummy for 2007	YES	YES	YES	YES
Child and parent characteristics	NO	NO	YES	YES
Preschool characteristics	NO	NO	NO	YES

Note: Each cell is associated with a different regression. The reported coefficient is on share of male staff. Child and parent controls include household income, whether parents divorced before child turned five, whether child belongs to ethnic minority, mother's age, whether the mother has above 12 years of education, a dummy for low birth weight, birth month, and regional dummies. Preschool controls refer to preschool characteristics the child attended in the previous year, such as share of staff with training, sick leave, managers, teachers, assistants, a new manager, average age and experience, number of children, whether the preschool had less than 12 employees, share of girls, children from ethnic minorities, mothers with above 12 years of education, children from nuclear families and children with low birthweight as well as average log(household income) and age of mothers. In addition, the regressions include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.

Table 5. Treatment intensity: previous exposure to male staff members; dummies for number of male staff members

	(1) No male before: Effect of share of male staff	(2) Effect of at least one male teacher vs. none	(3) Effect of at least two male teachers vs. one or none
Panel A. Boys			
Redshirt	-0.0684	-0.0100	0.0070
	(0.1963)	(0.0091)	(0.0080)
# observations	7,817	48,190	48,190
Reading, 2nd grade	1.1307**	0.0399	0.0520**
	(0.5253)	(0.0244)	(0.0249)
# observations	6,249	38,039	38,039
Math	1.1157**	0.0191	0.0483*
	(0.5205)	(0.0237)	(0.0254)
# observations	6,433	39,652	39,652
Reading, 4th grade	1.4309***	0.0237	-0.0003
	(0.4919)	(0.0235)	(0.0235)
# observations	6,377	39,366	39,366
Panel B. Girls			
Redshirt	-0.0488	0.0091	-0.0085
	(0.1040)	(0.0076)	(0.0067)
# observations	7,440	45,409	45,409
Reading, 2nd grade	-0.6615	0.0295	0.0684***
	(0.5248)	(0.0241)	(0.0252)
# observations	6,085	36,449	36,449
Math	-0.9988*	0.0071	0.0156
	(0.5384)	(0.0240)	(0.0230)
# observations	6,302	38,035	38,035
Reading, 4th grade	-0.7803	0.0019	-0.0233
	(0.5773)	(0.0230)	(0.0217)
# observations	6,247	37,801	37,801

Note: Each cell is associated with a separate regression. Preschool fixed effects regression with control for year 2007 dummy, household income, whether parents divorced before the child turned five, whether child belongs to ethnic minority, mother's age, whether the mother has above 12 years of education, a dummy for low birth weight, birth month, regional dummies, share of staff with training, sick leave, managers, teachers, assistants, a new manager, average age and experience, number of children, whether the preschool had less than 12 employees, share of girls, children from ethnic minorities, mothers with above 12 years of education, children from nuclear families and children with low birthweight as well as average log(household income) and age of mothers. All preschool characteristics are measured for the preschool the child attended in the previous year. Regressions include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.

Table 5 further explores treatment intensity. We do this in two ways: we first analyze whether effects vary if children have not previously been exposed to male staff members; results are shown in columns (1). We next redefine our treatment variable to be indicators for exposure to at least one male compared to none (column (2)) and at least two males compared to one or none (column (3)).

The first part of this exercise is motivated by our initial hypothesis that gains will be larger for children who did not have access to male teachers before. For around 75% of the sample, we have information about the preschool attended at ages three and four. 30% of the children in the subsample did not have access to a male preschool teacher in neither of the two previous years. For this group, we estimate the effects of share of male preschool teachers and detect large gains for boys. For girls, the effects on test scores are insignificant except for a negative effect on math performance that is significant at a 10% level. These results are consistent with male teachers primarily serving as role-models for boys in cases where the preschool did not employ any males for a longer period. Of course, conditioning on no previous exposure to a male teacher forces us to rely on variation from preschools that employ male teachers for the first time in 2007 and is therefore a somewhat specific case. Accordingly, the sample size is heavily reduced. The second part of Table 5 shows, maybe not surprisingly, that results on test scores are primarily driven by children in preschools with two or more males.[14]

[14] Alternatively, one could think of intensity in terms of size of the preschool. However, large preschools may be different from small preschools for a number of reasons. Skills of their management, for example, may differ (see e.g. Drange and Rønning (2017) who find that parents prefer larger preschools). Large preschools are also more likely to employ higher shares of men in both 2006 and 2007, simply because they have more staff members. For these reasons, it is not obvious that effects of access to males should be larger in small preschools – and this is indeed not what we find either. Results are available upon request.

5.3 Heterogeneity by child characteristics

As we hypothesize in section 2, children with less access to male role models may benefit more from having a male teacher, simply because the treatment is more substantial. To test this hypothesis, we consider whether effects vary in a subsample of children living in non-nuclear families.

Moreover, we conjecture that returns to investments are larger, the younger the children. Figure 1, in fact, shows stark differences in the tendency to redshirt and in test scores for children born early and late in the calendar year. Consequently, we consider heterogeneity in the effects depending on birth month. Specifically, we consider the subsample of births on or after July 1.

Table 6 shows the results from these additional exercises. Male preschool staff members are beneficial for both boys and girls from non-nuclear families in terms of reading in the 2nd grade, though estimates are only significant for girls. Boys from non-nuclear families also tend to benefit significantly in terms of math performance. Interestingly, although there was no overall effect on redshirting, Table 6 shows that for girls born later in the year, there is a large and significantly *positive* effect on this outcome from the share of male teachers. This positive effect may be due to the observation that it is not straightforward whether higher preschool quality should have a positive or a negative effect on redshirting. Thus parents who find that the quality of their preschool is high may choose to redshirt children born late in the year in order for them to become more mature and ready for school. Finally, we also see improvements in 2nd grade reading and in math scores for both boys and girls born later in the year and some evidence of improvements in 2nd grade reading in the corresponding girl sample.[15]

[15] In addition, subsample analysis for children with a low birth weight indicates that a male preschool teacher has a negative effect on redshirting for boys with low birth weight. An interaction with mother's age show a tendency for larger gains among children born to younger mothers. Results are available upon request.

Table 6. Effect of share of male staff in preschool in year the child turns five, heterogeneity results

	Children from non-nuclear families	Birth month>6
Panel A. Boys		
Redshirt	-0.0614	-0.0362
	(0.1140)	(0.0766)
	9,171	24,248
Reading, 2nd grade	0.3779	0.3522*
	(0.4119)	(0.2033)
	7,086	19,257
Math	0.6745*	0.3881**
	(0.3860)	(0.1826)
	7,438	19,859
Reading, 4th grade	-0.0870	0.1603
	(0.3651)	(0.1941)
	7,398	19,728
Panel B. Girls		
Redshirt	0.1429	0.1062*
	(0.0992)	(0.0637)
	8,748	23,329
Reading, 2nd grade	0.7910**	0.5057***
	(0.3629)	(0.1853)
	7,042	18,731
Math	0.1792	0.3144*
	(0.3395)	(0.1845)
	7,318	19,452
Reading, 4th grade	0.2064	0.0946
	(0.3625)	(0.1715)
	7,319	19,339

Note: Each cell is associated with a separate regression. Preschool fixed effects regression with control for year 2007 dummy, household income, whether parents divorced before the child turned five, whether child belongs to ethnic minority, mother's age, whether the mother has above 12 years of education, a dummy for low birth weight, birth month, regional dummies, share of staff with training, sick leave, managers, teachers, assistants, a new manager, average age and experience, number of children, whether the preschool had less than 12 employees, share of girls, children from ethnic minorities, mothers with above 12 years of education, children from nuclear families and children with low birthweight as well as average log(household income) and age of mothers. All preschool characteristics are measured for the preschool the child attended in the previous year. In addition, the regressions include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01. Number of observations for each regression is shown below standard errors.

5.4 Heterogeneity by male teacher characteristics

In Appendix Table A3, we report results by male teacher characteristics. Overall, there are no strong indications that male managers or trained males are superior to other males. We find some indications that younger and less experienced males actually improve boys' math outcomes significantly more than older and more experienced males. To the extent that younger men, for example, serve as stronger role-models or are more playful and spend more time on physical activities, this might explain these results.

5.5 Robustness

A potential concern one might have relates to the timing of the measurement of preschool characteristics, including the share of male staff members. Table A4 shows results where we measure these variables at age 3 instead of 5. Generally, we find that our results are robust to measuring the share of male staff at age 3 instead of at age 5, except for the result on boys' 2nd grade reading scores. The effect of share of male staff at age 5 does not change much depending on whether we condition on staff characteristics at ages 3, 4 or 5. Thus in order to keep as many observations as possible in our regressions, we condition on staff characteristics at age 4.

Another concern relates to how we condition on the size of the preschool. Appendix Table A5 shows our results for various alternative specifications: we first condition on number of children and number of employees; next we instead control for the child-to-staff ratio; and third we control for number of children and quartile dummies for number of employees. The final specification is our preferred specification that controls for number of children and a dummy for being above the median in terms of number of employees. Findings only vary at the third decimal point.

6. Discussion and conclusion

This paper investigates the effects of the share of male preschool teachers for children's academic outcomes. We rely on population-wide Danish administrative data that allow us to link children and teachers in preschools. Our estimations exploit within preschool differences in teacher gender composition across time. Overall, we find that access to male teachers improves child outcomes. Gains are larger for boys who did not have access to male teachers previously whereas the opposite seems to hold for girls. We find larger benefits of access to male teachers among children with less readily access to male role models at home and show evidence that the effects of this type of investment are larger, the younger the children. The effects on test scores in fourth grade are smaller than the effects in second grade. This is consistent with Chetty et al. (2011) who show that effects on test scores seem to die out in the medium run but sometimes reappear in the longer run. Bauer and Schanzenbach (2016) similarly find persistent effects on non-cognitive outcomes of the Head Start Program. Despite the fact that male preschool teachers are largely pedagogical assistants with lower levels of experience, we find a substantial positive effect on achievement for subgroups with limited alternative access to male role models. It is possible, of course, that the current group of male preschool teachers is exceptionally motivated. Overall, our results suggest that there is scope for policy initiatives that increase the share of male employees in preschool somewhat above the current level.

The literature on the effects of a teacher's gender have suggested different mechanisms that we can draw on when explaining our results. Dee (2007) summarizes various mechanisms: First, male and female teachers might have a bias in their expectations (which might become self-fulfilling) as well as in their interactions with children (referred to as a teacher bias). Moreover, children may view teachers differently depending on their gender, causing role model effects. Furthermore, there might be a negative stereotype threat where children fear being viewed through a negative lens. It is, of

course, also possible that employing a male teacher in preschool influences the work environment and through this changes the performance of the female teachers.

In our setting, stereotype threats might be less of a concern as achievement is measured years after exposure to a male preschool teacher. On the other hand, role model effects and teacher biases are hard to separate. Sandberg and Pramling-Samuelsson (2005) find evidence of a teacher bias in the setting of preschools, where male teachers interact differently with children compared to female teachers. Through interviews with Swedish preschool teachers, male preschool teachers appear to contribute with more playfulness, and this is something that both female and male preschool teachers notice. While female preschool teachers tend to value calm play and emphasize the importance of social development, male preschool teachers accentuate the significance of physical development. This type of male play, possibly through an increased level of physical activity, may improve certain types of behavior and lead to improved achievement. Sumsion (2005) presents suggestive evidence that children in preschools to some degree also perceive a male and a female preschool teacher differently. This suggests that there could be role model effects.

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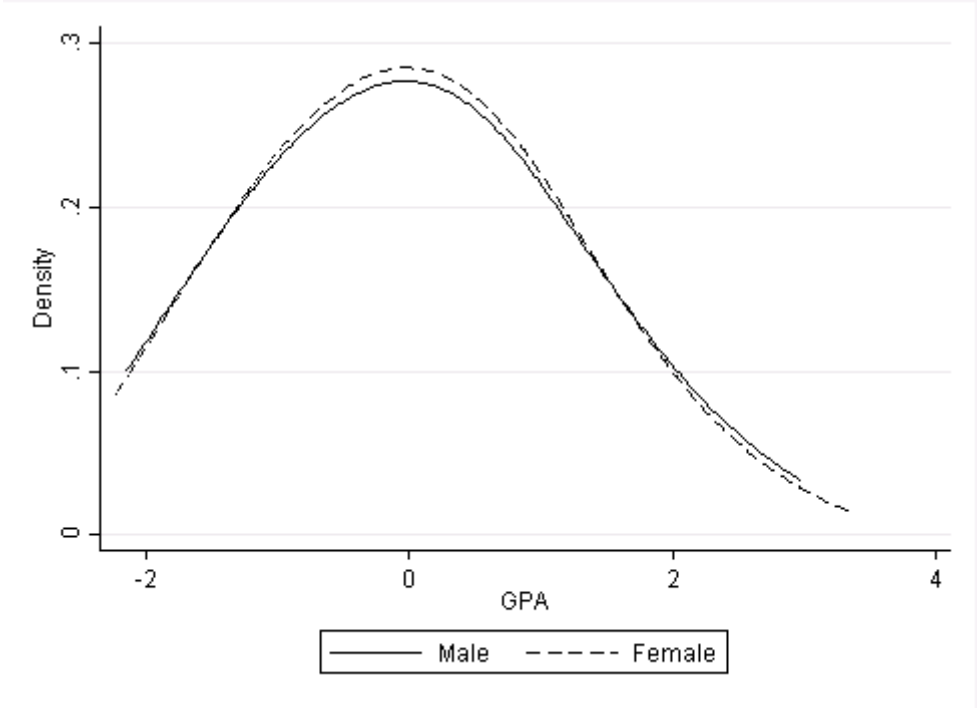
Appendix

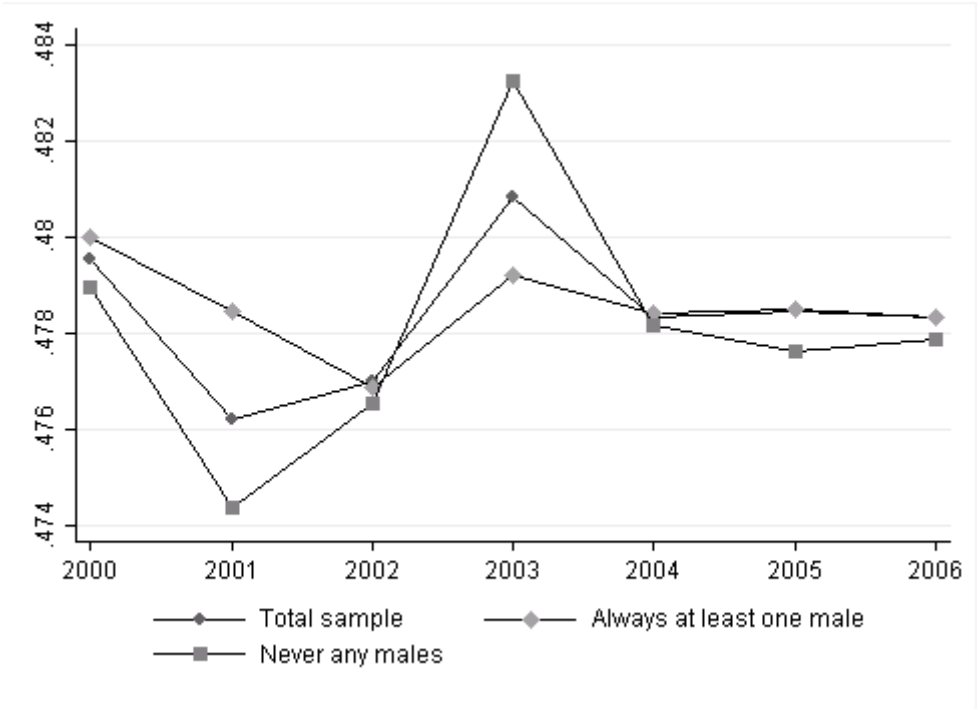
Figure A1. Distributions of high school GPA, corrected for birth year.



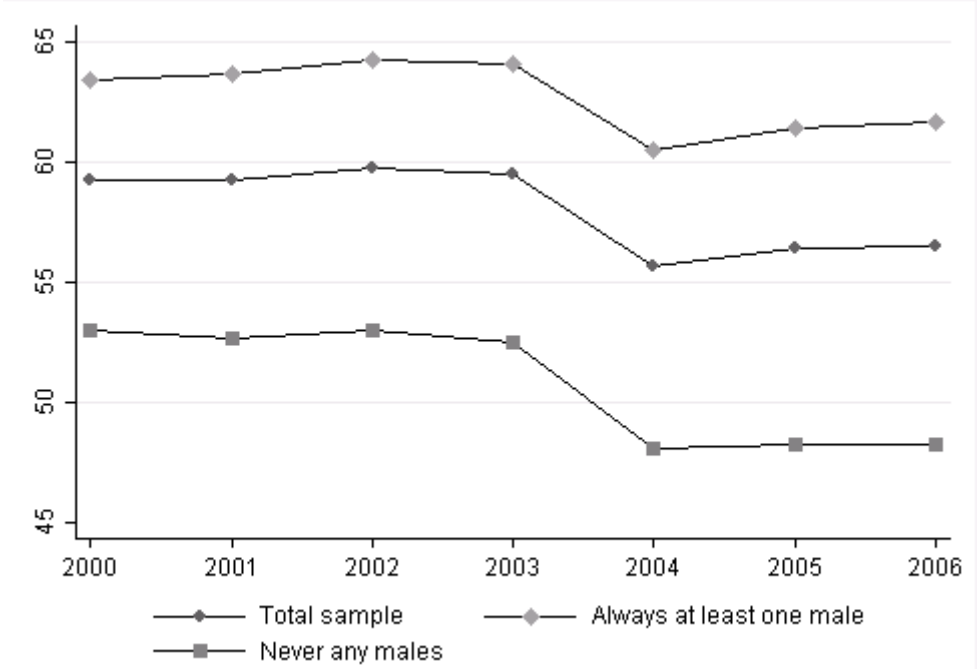
Note: Figure shows distributions of residuals from regression of standardized high school GPA (mean zero, standard deviation one) on birth year.

Figure A2. Trends in preschool characteristics

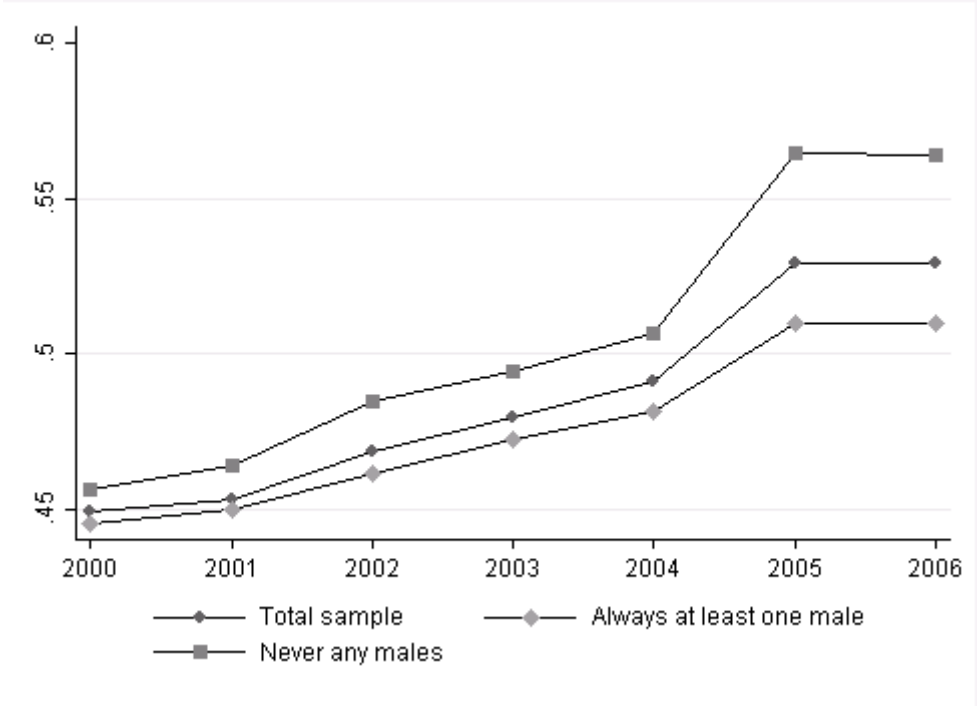
Panel A. Share of girls in preschool



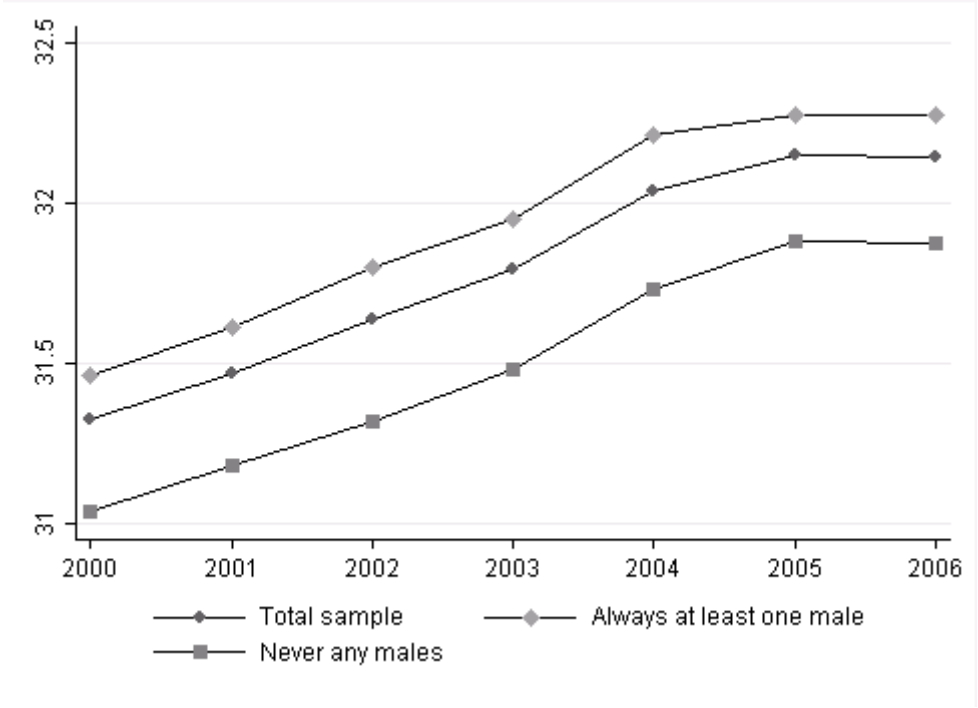
Panel B. Average number of children in preschool



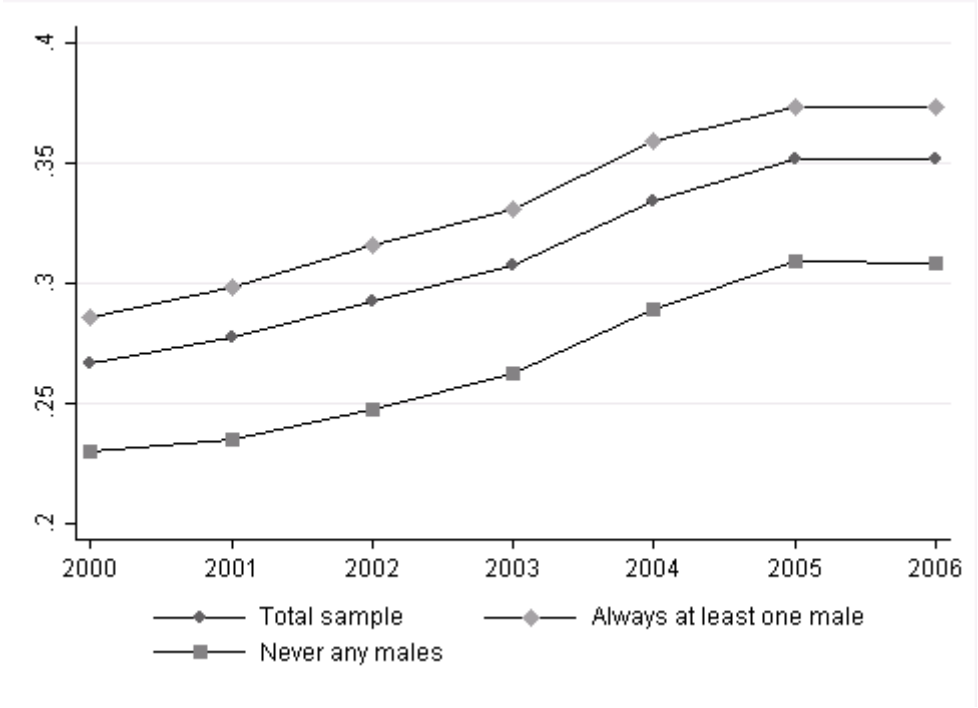
Panel C. Share of trained staff



Panel D. Average age of mother's in preschool



Panel E. Share of mother's with above 12 years of education in preschool



Note. An observation is a preschool. Not all preschools exist back to 2000. Total sample refer to all preschools in the sample, always at least one male refer to preschools that have at least one male employed in both 2006 and 2007 and never any males refer to preschools that do not have any males employed in either 2006 or 2007.

Table A1. Correlations between staff characteristics at age 5 and age 3

	Age 5		Age 3		Correlation
	Mean	SD	Mean	SD	
Any male (0/1)	0.68	(0.47)	0.69	(0.46)	0.4457***
Share of male staff	0.10	(0.10)	0.11	(0.10)	0.5601***
Children per staff member	4.85	(1.73)	4.69	(1.94)	0.3291***
Avg. Children per preschool	64.55	(28.57)	63.26	(27.10)	0.7607***
Share, any sick leave	0.15	(0.14)	0.16	(0.14)	0.4173***
Share, trained staff	0.53	(0.15)	0.51	(0.15)	0.5296***
New manager (0/1)	0.17	(0.38)	0.18	(0.39)	0.0387***
# observations					69,268

Note. * p<0.1, ** p<0.5, ***p<0.01

Table A2. Regression of child, parent, and preschool characteristics on share of male staff

	Independent variable: Share of male staff	
	Girls	Boys
Child and parent variables		
Log(household income)	0.1705	0.1782
	(0.1941)	(0.1854)
Mother's age	-1.3534**	-0.9000
	(0.5906)	(0.5789)
Mother above 12 years of education (0/1)	-0.0491	0.0938*
	(0.0587)	(0.0566)
Nuclear family (0/1)	0.0413	0.0039
	(0.0485)	(0.0467)
Ethnic minority (0/1)	0.0124	-0.0439
	(0.0276)	(0.0278)
Low birth weight (0/1)	-0.0549*	0.0434
	(0.0305)	(0.0287)
Previous period staff characteristics		
Share of staff with training	0.0859**	0.0798**
	(0.0358)	(0.0337)
Share of staff with sick leave	0.0113	0.0041
	(0.0309)	(0.0302)
Share of managers	0.0094	0.0114
	(0.0118)	(0.0115)
Share of preschool teachers	0.0584	0.0631*
	(0.0359)	(0.0360)
Share of assistants	-0.0640**	-0.0542
	(0.0318)	(0.0331)
New manager (0/1)	0.1318	0.1318
	(0.1085)	(0.1071)
Average age of staff	2.1003	1.3816
	(1.3986)	(1.4125)
Average experience of staff	2.3161***	1.9212**
	(0.8789)	(0.9012)
Less than 12 employees (0/1)	0.0757	0.0443
	(0.0846)	(0.0830)

Previous period preschool characteristics		
# children	-3.7789	-0.3886
	(3.6287)	(4.0838)
Share of girls in preschool	-0.0034	-0.0069
	(0.0217)	(0.0185)
Share of children from ethnic minorities	0.0021	-0.0094
	(0.0094)	(0.0102)
Average age of mothers	-0.2361	-0.7530
	(1.0281)	(1.0008)
Share of mothers with above 12 years of educ.	-0.0073	0.0018
	(0.0172)	(0.0161)
Share of children from nuclear families	-0.0020	-0.0141
	(0.0298)	(0.0282)
Average log(household income)	-0.0114	-0.2349
	(0.4145)	(0.4052)
Share of children with low birthweight	-0.0003	-0.0020
	(0.0068)	(0.0062)
# observations	45,409	48,190
	93,599	

Note. Each cell is associated with a separate regression. Preschool fixed effects regression of row variable on share of male staff. All regressions include a dummy for year 2007. All preschool characteristics are measured for the preschool the child attended in the previous year. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.

Table A3. Types of male teachers, share of male staff

	Share of male staff	Share of male staff*male manager	Share of male staff	Share of male staff*any trained male	Share of male staff	Share of male staff*Avg. age of males	Share of male staff	Share of male staff*Avg. exp. of males
Panel A. Boys								
Redshirt	-0.0178	0.0071	-0.0375	0.0429	-0.0944	0.0026	-0.0140	-0.0004
	(0.0479)	(0.0573)	(0.0558)	(0.0539)	(0.1115)	(0.0034)	(0.0515)	(0.0039)
Danish 2nd grade	0.3328**	0.0587	0.3218*	0.0484	0.8509**	-0.0168	0.4796***	-0.0234
	(0.1409)	(0.1969)	(0.1674)	(0.1888)	(0.3794)	(0.0123)	(0.1508)	(0.0144)
Math	0.1837	0.1427	0.1724	0.0851	0.7525**	-0.0180*	0.4112***	-0.0347***
	(0.1306)	(0.1764)	(0.1482)	(0.1679)	(0.3345)	(0.0105)	(0.1417)	(0.0121)
Danish 4th grade	0.0571	0.0757	0.1072	-0.0678	0.1579	-0.0028	0.1575	-0.0148
	(0.1315)	(0.1822)	(0.1511)	(0.1684)	(0.3550)	(0.0114)	(0.1411)	(0.0133)
Panel B. Girls								
Redshirt	0.0358	0.0148	0.0346	0.0084	0.0694	-0.0010	0.0478	-0.0015
	(0.0367)	(0.0452)	(0.0407)	(0.0432)	(0.0892)	(0.0027)	(0.0406)	(0.0031)
Danish 2nd grade	0.3127**	-0.2380	0.3299**	-0.1323	0.2585	0.0002	0.2216	0.0073
	(0.1381)	(0.2087)	(0.1605)	(0.1819)	(0.3617)	(0.0113)	(0.1533)	(0.0127)
Math	0.1686	-0.0146	0.2537*	-0.1737	0.3208	-0.0052	0.2327	-0.0115
	(0.1338)	(0.1698)	(0.1495)	(0.1724)	(0.3295)	(0.0104)	(0.1432)	(0.0119)
Danish 4th grade	-0.0104	-0.1073	0.0835	-0.2289	0.1368	-0.0056	0.0164	-0.0084
	(0.1284)	(0.1626)	(0.1513)	(0.1611)	(0.3358)	(0.0101)	(0.1436)	(0.0117)

Note. The columns belong together two and two. Each cell is associated with a separate regression. Preschool fixed effects regression with control for year 2007 dummy, household income, whether parents divorced before the child turned five, whether child belongs to ethnic minority, mother's age, whether mother has above 12 years of education, dummy for low birth weight, birth month, regional dummies, share of staff with training, sick leave, managers, teachers, assistants, a new manager, average age and experience, number of children, whether preschool had less than 12 employees, share of girls, children from ethnic minorities, mothers with above 12 years of education, children from nuclear families and children with low birthweight,

average log(household income) and age of mothers. All preschool characteristics are measured for the preschool the child attended in the previous year. The regressions include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.

Table A4. Share of male staff at age 3

	Indep. var: share of male staff at age 5	Indep. var: share of male staff at age 5	Indep. var: share of male staff at age 3	Preferred model Indep. var: share of male staff at age 5
Panel A. Boys				
Redshirt	-0.0136	-0.0125	-0.0044	-0.0163
	(0.0461)	(0.0460)	(0.0329)	(0.0463)
# observations	48,190	48,190	35,725	48,190
Reading 2nd grade	0.3602***	0.3457**	0.0977	0.3453**
	(0.1371)	(0.1371)	(0.1130)	(0.1370)
# observations	38,039	38,039	28,304	38,039
Math 3rd grade	0.2205*	0.2107*	0.2067*	0.2142*
	(0.1244)	(0.1256)	(0.1110)	(0.1254)
# observations	39,652	39,652	29,506	39,652
Reading 4th grade	0.0747	0.0647	0.0895	0.0734
	(0.1263)	(0.1263)	(0.1088)	(0.1260)
# observations	39,366	39,366	29,270	39,366
Panel B. Girls				
Redshirt	0.0349	0.0360	-0.0324	0.0388
	(0.0358)	(0.0356)	(0.0280)	(0.0357)
# observations	45,409	45,409	33,543	45,409
Reading 2nd grade	0.2811**	0.2711**	0.1951*	0.2645*
	(0.1350)	(0.1350)	(0.1109)	(0.1349)
# observations	36,449	36,449	27,004	36,449
Math 3rd grade	0.1697	0.1673	0.1768*	0.1656
	(0.1272)	(0.1278)	(0.1033)	(0.1276)
# observations	38,035	38,035	28,137	38,035
Reading 4th grade	-0.0099	-0.0223	0.0563	-0.0327
	(0.1228)	(0.1228)	(0.1056)	(0.1231)
# observations	37,801	37,801	27,971	37,801
Preschool fixed effects	YES	YES	YES	YES
Year 2007 dummy	YES	YES	YES	YES
Child and family controls	YES	YES	YES	YES
Staff characteristics at age 3	YES	YES	YES	NO
Staff characteristics at age 4	NO	YES	NO	YES

Note: Each cell is associated with a different regression. The reported coefficient is on share of male staff at the age indicated. Child and parent controls include household income, whether parents divorced before child turned five, whether child belongs to ethnic minority, mother's age, whether the mother has above 12 years of education, a dummy for low birth weight, birth month, and regional dummies. Preschool controls refer to preschool characteristics the child attended at the age indicated, such as share of staff with training, sick leave, managers, teachers, assistants, a new manager, average age and experience, number of children, whether the preschool had less than 12 employees, share of girls, children from ethnic minorities, mothers with above 12 years of education, children from nuclear families and children with low birthweight as well as average log(household income) and age of mothers. In addition, the regressions

include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.

Table A5. Changing control for number of employees, share of male staff

Type of control for number of employees	# children + # employees	Child-to-staff ratio	# children + quartile dummies for number of emp.	Preferred model: # children + dummy for above median emp.
Panel A. Boys				
Redshirt	-0.0175	-0.0169	-0.0151	-0.0163
	(0.0463)	(0.0462)	(0.0463)	(0.0463)
Reading 2nd grade	0.3463**	0.3468**	0.3433**	0.3453**
	(0.1371)	(0.1371)	(0.1371)	(0.1370)
Math 3rd grade	0.2152*	0.2160*	0.2154*	0.2142*
	(0.1252)	(0.1252)	(0.1255)	(0.1254)
Reading 4th grade	0.0745	0.0727	0.0748	0.0734
	(0.1260)	(0.1261)	(0.1260)	(0.1260)
Panel B. Girls				
Redshirt	0.0384	0.0386	0.0389	0.0388
	(0.0357)	(0.0357)	(0.0357)	(0.0357)
Reading 2nd grade	0.2634*	0.2646**	0.2652**	0.2645*
	(0.1350)	(0.1349)	(0.1350)	(0.1349)
Math 3rd grade	0.1673	0.1650	0.1753	0.1656
	(0.1275)	(0.1277)	(0.1277)	(0.1276)
Reading 4th grade	-0.0313	-0.0314	-0.0264	-0.0327
	(0.1231)	(0.1232)	(0.1231)	(0.1231)

Note: Each cell is associated with a separate regression. Preschool fixed effects regression with control for year 2007 dummy, household income, whether parents divorced before the child turned five, whether child belongs to ethnic minority, mother's age, whether the mother has above 12 years of education, a dummy for low birth weight, birth month, regional dummies, share of staff with training, sick leave, managers, teachers, assistants, a new manager, average age and experience, number of children, whether the preschool had less than 12 employees, share of girls, children from ethnic minorities, mothers with above 12 years of education, children from nuclear families and children with low birthweight as well as average log(household income) and age of mothers. All preschool characteristics are measured for the preschool the child attended in the previous year. In addition, the regressions include controls for missing values and a dummy for being a newly established preschool in 2006. Standard errors in parenthesis clustered at the preschool level. * p<0.1, ** p<0.05, *** p<0.01.