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Schooling effects on degree performance: a comparison of the predictive validity of aptitude testing and secondary school grades at Oxford University

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This article examines the cause of school type effects upon gaining a first class degree at Oxford University, whereby for a given level of secondary school performance, private school students perform less well at degree level. We compare the predictive power of an aptitude test and secondary school grades (GCSEs) for final examination performance, using data from the Oxford Admissions Study. Both metrics are predictive of final degree performance but the school effects are only statistically robust for arts students. Private school students perform less well in final examinations relative to their GCSE results when compared with state school students, but they do not under perform relative to their aptitude test scores or in gross terms. It is therefore argued that teaching effects, associated with private school students, distort secondary school grades as an indicator of academic potential in higher education when compared to state school students.

Elite universities in the UK have come under considerable political pressure since 1997 to increase the proportion of state school students admitted to study within them. The Sutton Trust has analysed admissions data and found that, given secondary school achievement, there are 3000 private school students in 13 leading UK universities whose places should be taken up by state school (Local Education Authority [LEA]) students (Sutton Trust, 2004). Oxford University has come under particular scrutiny, as private school students constitute just under half Oxford's intake, the highest proportion of any Russell Group[1] university, whilst only 7% of secondary

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school students in Britain attend private schools (Higher Education Statistics Authority, 2007; Independent Schools Council, 2007; Oxford University Colleges and Admissions Office [OUCAO], 2007). Moreover, Sutton Trust research has also shown that only 200 of the 4000 secondary schools in the UK supply around half of the students that Oxford and Cambridge Universities admit each year, with the most extreme patterns in the UK to be found at Oxford University (Sutton Trust, 2007a).

The debate in the UK has been between advocates of greater 'access' to universities for underrepresented groups and those who oppose the access agenda on the grounds that it constitutes 'social engineering' (c.f. Baker, 2008). 'Underrepresented groups' is a term referring to the working classes, some ethnic minority students and, in the case of elite universities, particularly to students who attended a state funded secondary school. Those promoting an access agenda would like more students from underrepresented groups to attend university. The UK Labour government has invested heavily in access, through both monetary and regulatory means. For example, the *AimHigher* programme encourages underrepresented groups to apply to university through summer schools, master classes and university visits and will cost the government £239.5 million over three years (AimHigher, 2008, p. 4), whilst the government has also paid for dozens of studies into aspects of access (e.g. Emmerson *et al.*, 2005; Kircup *et al.*, 2007). On the regulatory side, the government has set up a government body named the Office For Fair Access (OFFA) to regulate universities' policies on admissions. Under pressure from OFFA and other groups like the Sutton Trust, many universities have adjusted the way they assess the suitability of candidates (Baker, 2008). For opponents, the access agenda is an attempt to force universities to compensate for social inequality, by providing them with university places that they may not deserve on strict academic grounds (hence the term 'social engineering').

An important, but less well known subject of research into university admissions is the *school type effect* (Higher Education Funding Council for England [HEFCE], 2003). The school type effect is a difference between private school and state school students in their degree performance, relative to the grades the students achieved in their A-levels, the final school leaving examinations sat at 18 years of age. In particular, research on the school type effect shows that for a given set of A-level grades, the degree performance of private school students is lower than that of state school students (Smith & Naylor, 2001; HEFCE, 2003). Using administrative data for students graduating in 1993 and 2003, respectively, Smith and Naylor (2001) and HEFCE (2003) found that private school students are 5 to 10 percentage points less likely to achieve a 'good' degree (i.e. at least an upper second class degree) compared to state school students—a school type effect. Smith and Naylor (2001, 42) report that 'in order to have equal probability of obtaining a good degree, the average private school educated student would need about one grade higher at A-level than the LEA-educated student for each of their three A-level subjects (e.g. an A-level grade portfolio of BBB compared to CCC)'. HEFCE (2003) find a similar school type effect, with a state school student with grades of ABB will performing as well as a private school student who has A-level grades of AAA. To be clear, for both state and

private school students, the higher the A-level grades achieved by the individual student, the more likely they are to achieve a good degree. However, at each level of A-level scores, there is a school type effect, whereby private school students have a lower probability than state school students of achieving a good degree.

In addition to the school type effect, there is a *school performance effect* (Smith & Naylor, 2001; HEFCE, 2003). School performance is defined as the average A-level performance of all the students in a school. The school performance effect is a difference in degree performance between students who attended highly performing schools and students who attended schools performing less well, relative to the individual students' own A-level results. In other words, if a student attended a highly performing school where most students did well in their A-levels, they might perform better (or worse) at degree level than a student with the same A-level results but who came from a poorly performing school where fewer students did well in their A-levels.

The school type effect and the school performance effect overlap somewhat, of course. Private schools tend to have higher school performance overall than state schools, not least due to the self-selected nature of the students who can afford to attend private schools (HEFCE, 2003). However it appears school type *per se*, that is, whether a state or private school, and *not* school performance, that is, the average A-level performance of students at a school, is consistently associated with variance in university performance relative to A-level scores. The findings of Smith and Naylor (2001) and HEFCE (2003) conflict as to the direction of the 'school performance' effect and HEFCE (2003) report that the school performance effect differs for males and females. By contrast, however, both Smith and Naylor (2001) and HEFCE (2003) find a consistent school type effect, of a far larger magnitude than the 'school performance' effect. In other words, there is no consistent effect of attending a highly performing school, but there is a consistent effect of attending a private school rather than a state school.

The recent UK government review of admissions to higher education, the Schwartz Commission (Schwartz, 2004), considered as part of its remit whether universities should vary admissions requirements by school type in the light of the school type effect. Schwartz (2004) accepted the evidence for the school type effect, arguing that 'the evidence…suggests that equal examination grades do not necessarily represent equal potential' (5). However, in the appendix of the report directly addressing schooling effects, Schwartz (2004) expressed caution regarding the research: 'the fact that the HEFCE research is rigorous and robust does not mean that it is the definite answer on schooling effects or that it claims to be. Nor does it set out to determine the causes of such effects' (69).

It is true that the causes of the school type effect have not been given sufficient attention, given their political importance, and it is for this reason that we address the issue in this article. Our strategy is to make use of the aptitude test score data from a rich dataset, the Oxford Admissions Study (OAS), which is a sample of those who applied for admission to Oxford University in 2002. Using the OAS, we compare the predictive validity of secondary school grades and aptitude test scores in the

achievement of first class degrees by school type, across arts and science subjects at Oxford University. Whilst technical information regarding the aptitude test is contained in the Methods section below, there are two key points we would like to make about the test at this stage.

Firstly, for practical reasons the particular aptitude test used in the OAS is not likely to be appropriate for use in university admissions. This is because there is only one version of the test and the unseen nature of the test is crucial for its efficacy. Given this fact, the test could not be used without considerable risk of candidates conveying information about the contents of the test, and thus an unfair advantage, to those applying for admission in subsequent years—with greater unfair advantage accruing to schools which send larger numbers of applicants for admission. Moreover, even if new versions of the test were produced, each would have to be validated before use in admissions (Schwartz, 2004).

The second key point we wish to make about the aptitude test is that the scores that candidates receive should not be subject to teaching or coaching effects. It is sometimes suggested that, unlike secondary school grades, aptitude tests have an inherently 'objective' quality, which makes them particularly appropriate for use in university admissions (cf. McDonald *et al.*, 2001). In this case, if the cause of the school type effect upon final degree performance is a temporary teaching effect upon the secondary school grades of private school students, such that for a given level of underlying ability, private school students receive higher secondary school grades, then aptitude tests are argued not to be subject to such effects. Whilst we do not wish to address the general question of the objectivity of aptitude tests, we do argue that OAS participant's aptitude test scores are not subject to such teaching effects. This is due to the particular way that the aptitude test was administered, rather than any inherent quality of aptitude testing. The aptitude test sat as part of the OAS should not be subject to teaching effects because the test was entirely unanticipated for the participants of the study and played no part in the admissions process. There was therefore neither the opportunity nor the incentive for teaching effects to influence the test scores of participants. To reiterate, the usefulness of the aptitude test for the purpose of this article is as a benchmark with which to examine the school type effect for secondary school grades identified by Smith and Naylor (2001), and HEFCE (2003). Whether aptitude tests avoid teaching effects in normal admissions situations is a separate question, which we do not address in this article (see DerSimonian & Laird, 1983; Leman, 1999).

The cause of the school type effect

Two causes have been proposed for the school type effect: teaching effects, and differential incentives/preferences (Smith & Naylor, 2001, 2002; HEFCE, 2003). The important distinction between the two is that the former emphasises pre-university influences upon the grades of private school students, whilst the latter emphasises influences upon private school performance exclusively whilst already at university.

The incentives/preferences argument states that for a given set of secondary school grades, both school types have the same underlying academic potential for

university studies, but that, once at university, a preference for social life over academic work or lower post-university incentives to achieve academically, lead private school students to under-perform relative to state school students. HEFCE (2003) suggests that private school students may be more likely than state school students to neglect academic work at university in favour of a fuller social life and provide preliminary survey evidence for this alleged preference (Universities UK, 2003). The incentives argument begins by pointing out that, other things being equal, the occupational earnings of private school students are higher than those of state school students (Naylor *et al.*, 2002; Power *et al.*, 2006). Moreover, Smith and Naylor (2002) show that, other things being equal, the larger the fees of the private school, the greater the earnings of private school students relative to state school students. Finally, sociological evidence shows that offspring of salariat-class parents who achieve no more than secondary school qualifications have more than double the chances of similarly qualified working-class children to enter the professional salariat, a differential that has widened since the 1970s (Goldthorpe & Jackson, 2006). The argument, then, would be that private school students have lower incentives—in terms of future income and class position—to achieve a good degree and that they therefore invest less effort at university (Smith & Naylor, 2002). It should be noted that Smith and Naylor (2002) tested this argument by separately comparing the earnings boost for achieving a good degree by school type and by the level of private school fees. They found that the earnings boost for achieving a good degree does not statistically significantly differ by school type or by the level of private school fees and, as such, conclude that there is little evidence for the incentives argument in its financial form. Even if financial incentives to achieve a good degree do not apparently differ by social class, Goldthorpe and Jackson's (2006) evidence that mobility chances for those who do not have a university degree differ by social class is clear. Their argument is that students from privileged backgrounds have resources upon which they can draw to retain their parents' elevated class position that working-class students do not have—in particular, soft skills that can lead to managerial or personal service jobs. Therefore, the consequences for privileged students of doing poorly in their degree are far less serious than for working-class students and on this basis the incentives to get a good degree are lower for privileged students than for working class students.

The teaching effects argument holds that, in contrast to the above, for a given set of high school grades, private school students have *less* underlying academic potential for university studies. This is caused by a *short-term* effect upon educational achievement, resulting from private school students receiving 'better' teaching for secondary school examinations than state school students (Smith & Naylor, 2001; HEFCE, 2003). We understand that the idea of 'better' teaching is controversial. By 'better' teaching we merely mean teaching that leads to students achieving higher examination grades for a given level of prior achievement than they would have achieved without this teaching. There are clearly many other desirable objectives of good teaching that we do not investigate in this article. The most parsimonious model of understanding teaching effects is that of Smith and Naylor (2002). They argue that secondary school

achievement can be understood as a simple function of ability and schooling and that, at each level of ability, private school students receive more schooling and therefore that private school students achieve higher secondary school grades for a given ability level. We would like to suggest that a particularly important aspect of schooling is the quality of the teaching within the school and that this in turn is related to characteristics of the teacher, such as their qualifications, experience and motivation.

Sociological research in the UK and elsewhere, however, has tended play down the importance of teaching or school type effects, from the landmark Coleman Report onwards (Coleman *et al.*, 1966; Jencks *et al.*, 1972; Halsey *et al.*, 1980), suggesting that quality of teaching or school resources makes little difference to the grades of students. Moreover, where they are found, such effects are generally attributed to peer effects—the ability mix of the children in a school—rather than the influence of teaching *per se* (Zimmer & Toma, 2000; Sullivan & Heath, forthcoming). Recent sociological research making use of cohort studies in Britain has, however, begun to identify the presence of teaching effects (Blundell *et al.*, 1997; Sullivan & Heath, 2003, forthcoming). Research shows that the greater the qualifications of a teacher, the greater the value added to students' test scores (Ehrenberg & Brewer, 1994, 1995; Rowan *et al.*, 1997; Darling-Hammond, 2000) and that private school teachers tend to have greater qualifications, in terms of more firsts and upper seconds, from higher status universities, than state school teachers (Smithers & Tracey, 2003; Smithers & Robinson, 2005). Further, Smith and Naylor (2002) find that for men, the school type effect is larger the higher the fees of the private school and argue that those greater financial resources allow such schools to attract the most qualified teachers, thereby maximizing teaching effects upon secondary school grades. Finally, with respect to the peer effects argument, the results of Smith and Naylor (2001) and HEFCE (2003) are inconsistent. The school type effect, however, is not only consistent, it is large in magnitude and, as HEFCE (2003) concludes, largely distinct from school performance and other confounding influences.

The statistical analyses below, therefore, examine whether the school type effect is present relative to secondary school grades, aptitude test scores and also in gross terms. Whether there is a gross underperformance—that is, whether students from one school type tend to on average perform worse than the other school type—depends upon the admissions decisions of Oxford tutors, who do, in fact, appear to discount the secondary school grades of private school students at admission (Heath & Zimdars, 2005; Zimdars, 2010). If the incentives/preferences argument is correct, one would expect private school students to underperform relative to *both* aptitude test scores and secondary school grades (and possibly also in gross terms). In this case, both the aptitude test scores and secondary school grades will 'misrepresent' private school students' actual performance at university compared to state school students with the same grades, because private school students subsequently choose, due to different preferences or incentives, to put less effort into their university studies than state school students. Nonetheless, state and private school students might well have the same underlying potential or ability for university studies, for a given set of secondary school grades and aptitude test scores. By contrast, if the teaching

effects argument is correct, the school type effect will only be present relative to secondary school grades, not aptitude test scores (or possibly in gross terms). This would mean that for a given level of secondary school grades, due to teaching effects, private school students have less underlying potential for university studies. However, due to the absence of teaching effects upon aptitude test scores, *at least as administered in the OAS*, private school students would in fact have the same underlying potential for university studies for a given aptitude test score.

In contrast to the HEFCE (2003) and Smith and Naylor (2001) studies, we examine the school type effect with reference to the achievement of firsts only and not good degrees (upper seconds and firsts). The latter kind of analysis is less illuminating in the Oxford context because relatively few students with high A-level scores achieve less than an upper second class degree (HEFCE, 2003) and so very few students at Oxford do not achieve a 'good degree' under the definition used by HEFCE (2003) and Smith and Naylor (2001). A final note of caution concerns the exceptional character of Oxford University's final university assessment. The finals system predominantly involves long, often three-hour, examinations, which are held at the end of an extended period of study of one to three years in length. Assessment by coursework or theses is relatively unusual. The finals system, especially in arts subjects, has been criticised as biased against women because it tends to reward a strong argumentative style, a style that is allegedly a masculine trait (Hahn & Clayton, 1996; McCrum, 1996; Mellanby & Rawlins, 1997). We are, however, leaving questions of gender aside for the purposes of this article. Since there is no suggestion that finals are biased by school type, for the purposes of this paper we regard finals as a valid measure of a student's achievements at Oxford.

Data and method

The subsequent statistical analyses are based on data from the OAS and publicly available data on finals performance at Oxford University (OUCAO, 2006). The OAS is a cohort study, which administered a detailed questionnaire and an aptitude test to applicants to Oxford University during the interview period in December 2002 (see Zimdars, 2007, pp. 51–53). Research participants were subsequently followed on through to their final examinations at Oxford University.

Our chosen method of analysis is multinomial logistic regression of finals classification. Finals classifications are the grades that Oxford University awards to candidates according to the quality of their degree work. As Table 1 shows, a 2:1 (or upper second class) is by far the modal category (see also HEFCE, 2003). A first is

Table 1. Finals classification for the OAS and Oxford final examinations 2006

	First (%)	2:1 (%)	Below 2:1 (%)	*N*
OAS	28.7	64.5	6.7	476
Finals 2006	27.3	63.1	9.6	3206

the highest grade of degree that can be awarded, whilst results lower than a 2:1 are relatively rare.

The analyses focus on all OAS participants for whom final degree performance at Oxford and GCSE performance is available, which results in a sample of 476 students. Table 1 shows that the sample is broadly representative of the population performance of Oxford students who sat finals in 2006 (see also Zimdars, 2007, p. 58). In this analysis, we focus upon the predictors of gaining a first as against gaining a 2:1. We included in the analyses those who achieved less than a 2:1 for comparative purposes, to ensure predicted probabilities of achieving a first class degree were not unduly inflated by the exclusion of poorly performing students, but we do not present the results for those who gained less than a 2:1 due to space constraints.[2]

Social background

The most robust class cleavage in degree performance across UK universities as a whole is between manual and non-manual parental occupational backgrounds (Smith & Naylor, 2001). However, mirroring the privileged class composition of Oxford undergraduates, only 10 students in the OAS data set have two parents from manual-class backgrounds. We chose to include dummy variables for neither parent having a salariat-class occupation—Goldthorpe classes I and II (Erikson & Goldthorpe, 1992)—for as close an approximation to class disadvantage as is possible at Oxford University. Similar reasoning is applied with regards to parental education and ethnicity, which are operationalised as neither parent holding an undergraduate degree and for not being white. The distributions within the OAS are shown in the Appendix (Tables A1–A5) and broadly reflect the wider Oxford population.

School type and gender

We use dummy variables for females and private school students throughout the analysis. Note that there is considerable heterogeneity amongst both the private and state school sectors. Analyses breaking down reported state school type, i.e. grammar, comprehensive and sixth-form college or by combining the non-selective state school categories, provided no statistically significant results. This coheres with the results regarding school performance discussed above.

Structural controls

There is a great deal of variation between subjects in the proportion of firsts awarded at Oxford University. At one extreme, in law, only around 14% of students were awarded firsts in 2000–2007, whilst at the other end of the extreme, 39% of mathematics students were awarded a first. This variation is not a neat divide between arts and sciences—18% were awarded firsts in physiology, compared to 38% in English and modern languages.

This variation in the proportion of firsts awarded reflects at least three differences between subjects. First, the nature of the subject matter. Arguably, natural science examinations are conducive to more extreme patterns of results (i.e. more excellent performances and more poor performances) than those of the humanities and the social sciences, because in the latter there is greater scope for ambiguity in the extent to which an answer is 'correct'. Second, it reflects the quality of the intake. For example, admission to law course 2, which is a four-year degree course including a year in Europe, is more competitive than admission for law course 1. The courses also differ significantly in degree performance, with 32% of students gaining a first on law course 2 compared with only 13% within law course 1, even though both subjects are regarded as a single subject for the purpose of marking final examinations. Thirdly, it reflects conventions within subjects of what is of sufficient merit to be awarded a first and of how many firsts should be awarded each year. Whilst it is not obvious that Oxford's English students are more select than its law students, the former receive 24 and the latter 14% firsts in final examinations.

As discussed above, if, for example, state school students (or males) are more likely to study sciences and sciences award more firsts, then a state school student (or male) is more likely than a private school student (or female) to leave Oxford with a first purely because of the large number of firsts awarded in science subjects. It is crucial, therefore, to create appropriate controls for differences in propensities for subjects to award firsts. Since there is no statistically significant correlation between the proportion of firsts awarded in a subject and the average GCSE grade or the aptitude test score of the students studying the subject, we believe it is the first and third differences discussed in the paragraph above that drive the different proportion of first class degrees awarded across subjects. We therefore include the average proportion of firsts awarded in each subject, 2000–2007, as a control ranging from 0.14–0.41.[3]

Achievement variables

Most students at Oxford University achieve three As at A-level (OUCAO, 2006). A-levels are the examinations normally sat at 18 years of age in the UK and performance in A-levels normally governs the allocation of university places to students. This lack of variation meant that the inclusion of A-level results made little difference to any of the results and means that Oxford selectors have a difficult task in choosing between students with very similar grades. There was no robust advantage to having more than three A-levels at A grade and, although the disadvantage of having less than three As was large, since there are only 20 such students in the dataset this cannot be conclusively examined.

To avoid this problem of a lack of variation in available data, the main achievement variable used in this article will be GCSEs, the examinations sat at 16 years of age in the UK (Heath & Zimdars, 2005). GCSEs are qualifications in subjects like mathematics, English and science and are generally assessed by a combination of examinations and coursework. The grades in the GCSEs taken by the participants were scored A* = 8, A = 7, B = 6, C = 5, D = 4, E = 3, F = 2, G = 1 and a fail, grade

U, was given zero points. An A* is the highest grade and any grade down to a C is considered a good pass grade and the vast majority of grades in our dataset are Cs or above. We use the mean GCSE grade as our variable.

However, there are risks associated with this strategy because state school students tend to sit more GCSEs. In the OAS sample, private school students have an average of 9.88 GCSEs, compared to 10.55 for state school students ($p < 0.000$). One might argue that private school students concentrate greater effort upon a smaller number of GCSEs and thereby achieve a higher average grade. Indeed, taking the nine best GCSE grades from candidates studying English ($n = 48$), for example, the gap in average GCSE point score between state and private school students is 0.21, compared to 0.28 for the unadjusted dataset. Although data are not publicly available, we suspect that the smaller sizes of private schools means that private school students are generally less likely to sit short course GCSEs and that this partly accounts for the difference in the number of GCSEs sat. The short course GCSE is a course set at the same standard as the full GCSE, often using the same examination papers, but requires half the study time and counts as half the value of a full GCSE. They are frequently reported as full GCSEs and, unfortunately, the OAS did not ask which GCSEs were short course GCSEs. Furthermore, there is an artificial ceiling upon GCSE performance (the A* grade), which means that when taking a discrete number of the best GCSE grades for the purposes of analysis, private school students' average GCSE grade will not increase proportionally to the likely underlying performance in the examination, because they have higher gross average GCSE grades than state school students (i.e. they have mostly A*s to begin with). To put it another way, if there were an A** and perhaps an A*** grade, the private school advantage in average GCSEs might well be retained in such a modified measure.

Therefore, despite possible problems, we take the overall mean GCSE score as the main achievement variable. The variable is centred on zero, to reduce the standard errors of a variable that would otherwise vary from 5.5 to 8. We also examine a model with a polynomial term (GCSEs squared) for an increasing effect of GCSE results at the top and bottom ends of the scale, as Zimdars (2007) found this to be a significant predictor of admissions chances and examination success.

Aptitude variables

Participants sat a modified and shortened version of the 'AG' version of the Alice Heim (AH) aptitude test, where 'AG' means the test is designed for 'arts students and general'. Normally, the AG test is composed of 60 questions, which are to be answered in 35 minutes, half of which are verbal reasoning questions, a quarter numerical and a quarter diagrammatic. Consistent with earlier uses of AH, only the verbal section of the test was predictive for finals performance at Oxford (Mellanby *et al.*, 2000). In Heim *et al.* (1983), the original validation of the AH test, a far stronger correlation with A-level results was found for the verbal score than for a *combined* numerical and diagrammatic section. Prior to Mellanby *et al.* (2000), however, the diagrammatic section had not been used separately from the numerical section. The

lack of correlation of the diagrammatic section with finals achievement in Mellanby *et al.* (2000) and in analyses below suggests that it is the numerical section that does most of the predictive work for the combined numerical/diagrammatic section. In the analyses below, the zero-order correlation of the diagrammatic score was negatively correlated with final examination results and did not reach statistical significance when included in regressions, so it was excluded.

We examined the utility of a polynomial term for the AH test but no coefficient was close to statistical significance, so we did not include them in the analysis. We standardised the scores to a 0–1 distribution with 1 representing the highest possible score, 12. Finally, the effective exclusion of international students by excluding participants who did not sit GCSEs also improves the evaluation of the AH test: Heim (1983) reports that 'having a mother tongue other than English puts a Subject [sic] at a disadvantage' (19).

Results

Table 2 shows the baseline regression model, whilst Tables 3 and 4 show results for arts and natural science students, respectively. Model 1 represents the gross performance of students from various social backgrounds. Consistent with other studies (e.g. Mellanby *et al.*, 2000) there is a large and highly statistically significant gross under-performance of women in the achievement of firsts. However, there is no detectable effect, at conventional levels of statistical significance, of having non-salariat parents, parents without degrees or being an ethnic minority upon an individual's likelihood of achieving a first class degree. This holds true in all the models examined (with one exception), which means that there is no under-performance relative to average GCSE grade or AH scores for these students either. The single statistically significant coefficient is a headline figure for ethnic minorities in Table 3, Model 1. Its significance disappears in Model 2, implying that at least part of this effect is due to ethnic minority students tending to study subjects which award a lower proportion of firsts (compared with white students), although it should be noted that the size of the coefficient is not much reduced. As this coefficient is based upon only 28 ethnic minority arts students in the dataset, it should be treated with caution. With regards to private school students, although the sign on the private school coefficient in Table 2, Model 1 is negative, we cannot conclude that private school students perform less well in final examinations than state school students in gross terms. Note that it is relative to A-level scores, *not* in gross terms as in Model 1, that HEFCE (2003) and Smith and Naylor (2001) identified a school type effect.

Model 2 examines whether subject concentrations influence the relative chances of the various groups to achieve a first.[4] The results suggest that they do, largely only for the gender variable, driven to a great extent by a steep fall in the coefficient for female science students. This means that part of the difference between males and females in the proportion of firsts awarded, is due to females being more likely to study science subjects, which award a smaller number of firsts. The proportion of firsts in subject variable is highly statistically significant in all models in which it is used and

Table 2. Coefficients of baseline multinomial logistic regression of finals classification

	First versus upper second						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	−0.18	−2.48***	−2.66***	−2.85***	−3.88***	−3.80***	−3.96***
Social background:							
Non-white	−0.81	−0.75	−0.61	−0.59	−0.64	−0.59	−0.53
Non-salariat parents	0.45	0.43	0.45	0.45	0.40	0.43	0.42
Non-degree parents	−0.37	−0.36	−0.28	−0.25	−0.32	−0.25	−0.27
Female	−0.76***	−0.59**	−0.78**	−0.78**	−0.49*	−0.70**	−0.64**
Private school	−0.38	−0.34	−0.59*	−0.64**	−0.36	−0.57*	−0.62*
Structural control:							
Proportion of firsts in subject		0.09***	0.10***	0.10***	0.09***	0.10***	0.10***
Achievement controls:							
GCSE centred			2.14***	2.46***		1.96***	0.90
GCSE centred squared				1.30			
Aptitude controls							
Verbal ability					2.43***	1.95**	1.95**
Interaction effects							
GCSE/subject							1.97*
Verbal ability/subject							−0.03
Pseudo R^2	0.039	0.092	0.142	0.151	0.120	0.158	0.172
N	476	476	476	476	476	476	476

Notes. *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$; upper second is the reference category.

Table 3. Coefficients of multinomial logistic regression of finals classification of arts students only

	First versus upper second					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	−0.53*	−2.33***	−2.99***	−3.15***	−3.29***	−3.54***
Social background:						
Non-white	−1.51*	−1.44	−1.22	−1.17	−1.38	−1.23
Non-salariat parents	0.59	0.57	0.64	0.64	0.51	0.59
Non-degree parents	−0.61	−0.56	−0.55	−0.54	−0.55	−0.53
Female	−0.53	−0.63*	−0.92**	−0.80*	−0.53	−0.76*
Private school	−0.16	−0.26	−0.70*	−0.75*	−0.26	−0.67*
Structural control:						
Proportion of firsts in subject		0.09**	0.12***	0.12***	0 .08**	0.12***
Achievement controls:						
GCSE centred			3.00***	3.19***		2.88***
GCSE centred squared				1.30		
Aptitude controls						
Verbal ability					1.85*	1.04
Pseudo R^2	0.040	0.071	0.156	0.168	0.090	0.162
N	301	301	301	301	301	301

Notes. *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$; upper second is the reference category.

the fit of the model considerably improves. Moreover, the intercept term in all tables becomes negative and large, which is to be expected given that, other things being equal, achieving a first is relatively unlikely.

The remaining Models 3–7 are those of primary interest for the purposes this article. Models 3–4 examine the performance of the various groups relative to the GCSE results; Models 5–6 relative to the AH verbal ability score; Model 7 examines interaction effects.

Model 3 introduces GCSEs to the regression and, consistent with Zimdars (2007), the overall results show that average GCSE grade is a strong predictor of achieving a first and that a school type effect is present when GCSEs are introduced into the model. Table 2, Model 3, finds that holding all other variables constant, private school students are only 56% ($p = 0.015$) as likely as a state school student to achieve a first instead of a 2:1. Figure 1 plots the predicted probabilities of achieving a first when holding all other variables in the regression at their mean values. It shows that at the highest level of average GCSE attainment, A*, state school students have more than a 50% chance of a first, whilst private school students have less than a 40% chance.

Model 4 tests for the presence of an exponential effect of GCSE average grade upon the probability of achieving a first. Whilst the substantive effect is large in Tables 2–4, the coefficient lacks statistical significance, such that there is little evidence for an exponential effect of GCSE in the pooled sample.

Table 4. Coefficients of multinomial logistic regression of finals classification of science students only

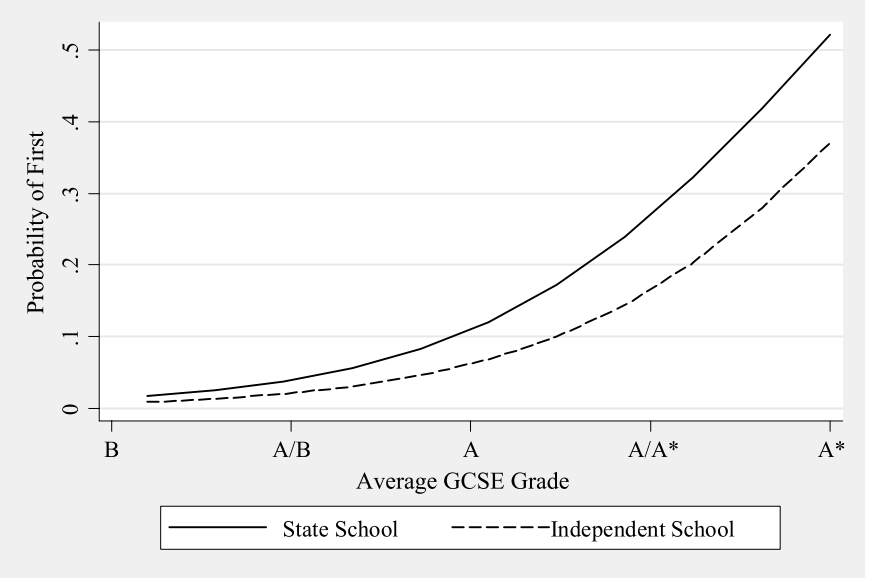
	First versus upper second					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	.20	−3.75***	−3.67***	−3.79***	−5.55***	−5.34***
Social background:						
Non-white	0.01	0.03	0.08	0.10	0.12	0.10
Non-salariat parents	0.27	0.03	0.01	−0.00	0.09	0.11
Non-degree parents	0.06	−0.03	0.06	0.12	0.04	0.10
Female	−0.95**	−0.42	−0.61	−0.65	−0.34	−0.51
Private school	−0.65	−0.52	−0.61	−0.67*	−0.58	−0.62
Structural control:						
Proportion of firsts in subject		0.13***	0.13***	0.13***	0.12***	0.12***
Achievement controls:						
GCSE centred			1.10	1.53*		0.84
GCSE centred squared				1.33		
Aptitude controls						
Verbal ability					3.46**	3.25**
Pseudo R^2	0.052	0.116	0.140	0.147	0.156	0.173
N	175	175	175	175	175	175

Notes. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; upper second is the reference category.

However, it seems that GCSE grades are much better predictors of exam success for arts students than for scientists. The small coefficient for the average GCSE grade variable for scientists only reaches statistical significance upon the inclusion of the polynomial term.

Model 5 examines whether AH scores predict the achievement of a first. The pooled regression in Table 2 suggests that they do, strongly. Figure 2 shows predicted probabilities of achieving a first by AH score holding other variables at their mean values. The probability of achieving a first increases with AH score in an almost linear fashion. Note that we do not present separate probability curves for state and private school students because there is not a statistically significant difference in the predicted probabilities of achieving a first for these two groups.

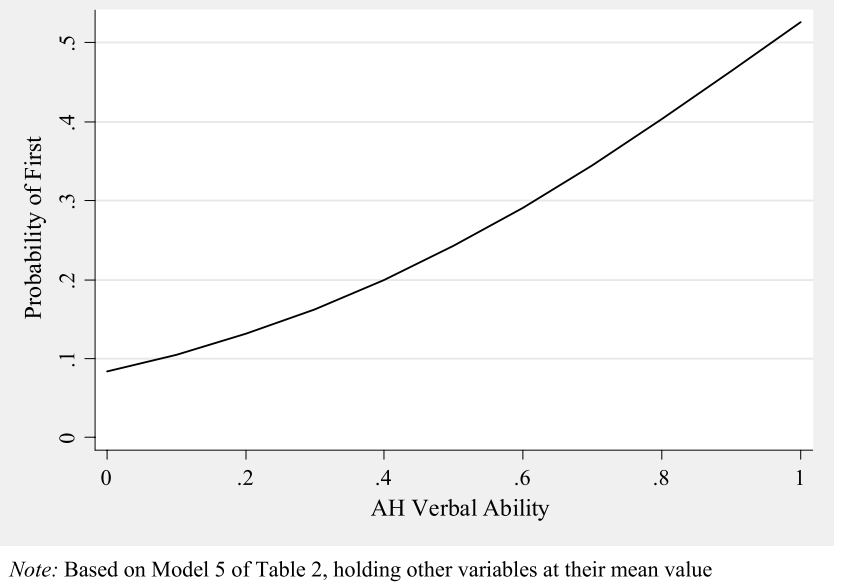
Model 6 tests the robustness of the AH test by controlling for GCSE average grade. The coefficient for both GCSE and AH scores are highly statistically significant in the pooled samples, though both coefficients are reduced in magnitude. This means that within every GCSE average grade, AH scores vary in such a way that predicts achieving a first. This in turn implies that AH scores examine constructs distinct from GCSE grades and that AH scores add to the prediction of finals achievement over and above secondary school grades.



Note: Based on Model 3 of Table 2, holding other variables at their mean value

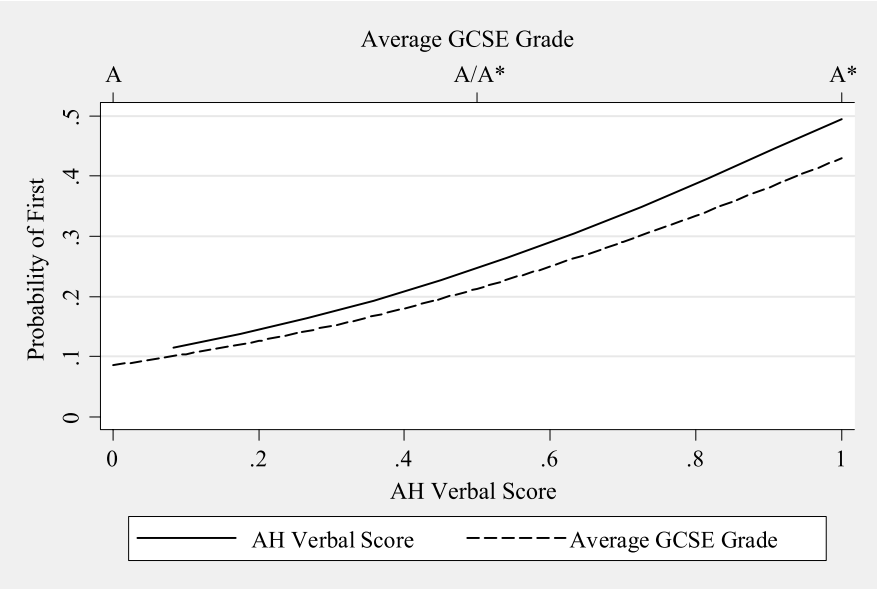
Figure 1. Probability of first by average GCSE grade and school type

Figure 3 compares the probability of achieving a first for average GCSE grades and AH score whilst controlling for one another. The curves are highly similar, although those with the highest AH scores are slightly more likely to achieve a first than those with the highest average GCSE grades.



Note: Based on Model 5 of Table 2, holding other variables at their mean value

Figure 2. Probability of first by AH verbal ability

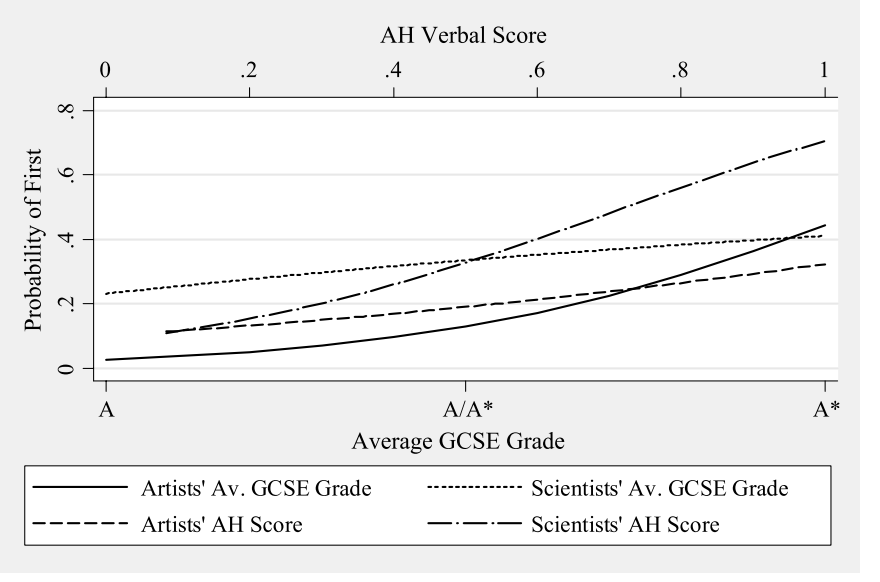


Note: Based on Model 6 of Table 2, excluding average GCSE grades below A and holding other variables at their mean value

Figure 3. Probability of first by AH verbal ability and average GCSE grade

Tables 3 and 4 show that the patterns differ by subject type. The trends for the AH score seem to be driven primarily by the predictive strength of the AH verbal ability score for *scientists*. The comparison of Model 5 in Tables 3 and 4 shows that the coefficient for the AH score is much larger for scientists. For example, when holding all other variables at their mean value in Model 5, for arts students with the top score in the AH verbal test have a 40% chance of achieving a first, whilst scientists have a 70% chance. Examining Model 6 for Tables 3 and 4, the AH score retains statistical significance when controlling for GCSEs *only* for scientists. Indeed, for scientists in Table 4, GCSEs actually lose statistical significance in Model 6, whilst the coefficient for AH scores remains substantively large and highly statistically significant. This means that within each AH score, GCSE scores do not vary in a way that is predictive of finals performance. Figure 4 illustrates how the probability of achieving a first changes with AH scores and average GCSE grade. Alice Heim scores strongly predict the achievement of a first for scientists, but weakly for arts students. Similarly, GCSE scores weakly predict the attainment of a first for scientists, but for arts students, as the average grade increases past the A/A* mark the probability of a first increases markedly.

Model 7 is a formal test for interaction effects between subject type and AH verbal ability and between subject type of average GCSE grade. Interacting average GCSE grade and a dummy variable for arts students results in a statistically significant coefficient, thereby confirming the varying predictive power of average GCSE grade by subject type. The interaction between AH verbal ability and subject type is, however, not confirmed—the coefficient in Model 7 both lacks statistical significance and is close



Note: Based on Model 6 of Table 2, excluding average GCSE grades below A and holding other variables at their mean value

Figure 4. Probability of first by AH score and average GCSE grade by subject type

to zero. However, the differences between the measures should not be overstated. Both AH score and GCSEs are predictive of finals results for both arts students and scientists, it is just that for scientists AH score is a relatively better predictor than GCSEs and for arts students GCSEs are a relatively better predictor than AH score. The difficulties the measures have in attaining statistical significance are probably partly due to the relatively low N when dividing the sample between scientists and arts students, in addition to differences in the relative predictive power of the two measures.

In sum then, the analysis shows that private school students show a statistically significant underperformance *only* relative to GCSE results, not relative to AH verbal scores. This is most clearly shown in Table 2. Furthermore, this effect is largely concentrated in arts subjects, as shown by the contrast in Tables 3 and 4. The same trends in Table 2 described above are present in Table 3; however, in Table 4, for scientists, the school type effect is only present when the exponential effect of average GCSE grade is included into Model 4. In the sciences, it is AH verbal scores that most strongly predict the achievement of a first and there is no statistically significant coefficient for private school under-performance relative to AH verbal scores in Table 4. Private school under-performance relative to GCSE results is therefore largely driven by arts subjects.

Discussion

This article aims to investigate school type effects on final degree performance at the University of Oxford. Our findings support the existence of teaching effects that

temporarily increase observed examination performance in GCSEs among private school students above their level of underlying ability. Specifically, we find that there is a school type effect controlling for GCSE grades, but not for AH scores or in gross terms. This provides considerable evidence that the school type effect discussed at the beginning of this article is caused by teaching effects, at least for the select Oxford cohort examined here. Whilst Smith and Naylor (2002) provide some evidence that negates the incentives hypothesis, the results presented here tell against both the incentives and preferences hypotheses and provide *positive* evidence for the existence of teaching effects. If incentives or preferences drove the school type effect, one would expect to see this effect relative to *both* AH and GCSE grades. However, the school type effect is present only relative to their GCSE grades, and largely in arts subjects. In the following, we examine this difference in some detail.

The mean private school GCSE grade is marginally greater than that of state school students, as shown by Table 5. The difference in the mean grades for state school students is the rough equivalent of dropping down to an A from an A* on one subject in the average 10 GCSEs taken by students in the OAS dataset. The average private school student therefore has six A*s and four As, whilst the average state school student will have roughly five A*s and five As. This difference is much narrower, however, in science subjects, as shown by Table 5. However, in order to have equal probability of achieving a first, the average private school student would need about one grade higher at GCSE than the state school student for two of eight GCSE subjects sat (it is around two and a half subjects at one grade higher if the average 10 GCSE subjects are sat); i.e. for the same probability of achieving a first, an private school student requires eight A*s for the state school students' six A*s and two As. Consistent with earlier work (Smith & Naylor, 2001; HEFCE, 2003), the effect is therefore relatively small at the highest ability levels.

By contrast to GCSEs, the mean AH scores of each school type do not differ. Table 6 shows that there is no statistically significant difference in AH scores for any subject group.

Figures 5 and 6 use the pooled sample to show that *within each finals classification*, the school types differ in their average GCSE grades but not in their AH verbal scores. In particular, Figure 5 shows that the median GCSE grade for private school students who achieved firsts is much higher than that of state school students. Conversely, the

Table 5. Average GCSE grade by school type

		N	Score	95% CI	
Overall	State	269	7.54*	7.49	7.58
	Private	207	7.65*	7.61	7.70
Arts	State	165	7.52*	7.45	7.58
	Private	136	7.67*	7.61	7.73
Sciences	State	104	7.57	7.50	7.63
	Private	71	7.62	7.53	7.70

Note. *$p < 0.001$

Table 6. Alice Heim verbal reasoning scores by school type and subject type

		N	Score	95% CI	
Overall	State	269	0.55	0.52	0.57
	Private	207	0.55	0.52	0.58
Arts	State	165	0.55	0.51	0.58
	Private	136	0.56	0.53	0.59
Sciences	State	104	0.55	0.51	0.59
	Private	71	0.53	0.48	0.58

Note. *$p < 0.001$

distribution of GCSE grades for state school students achieving firsts spreads far lower down the average GCSE grade scale than for private school students. In other words, a relatively worse performance by state school students at GCSE level is nonetheless compatible with the achievement of a first at Oxford University, but far less so for private school students.

By contrast, Figure 6 shows that the distribution of AH verbal scores do not vary by school type within finals classifications. As suggested by the regressions above, scores tend to be higher for higher classifications of finals results and in the same way for both school types.

It is somewhat curious, though, that a supposedly 'verbal' ability test seems to be a more powerful predictor of examination success for students of science than for students of arts subjects (although the formal test of an interaction was not statistically significant for the AH test). Perhaps the kind of questions in the AH test, being short and analytical, better discriminates between the abilities of scientists than it

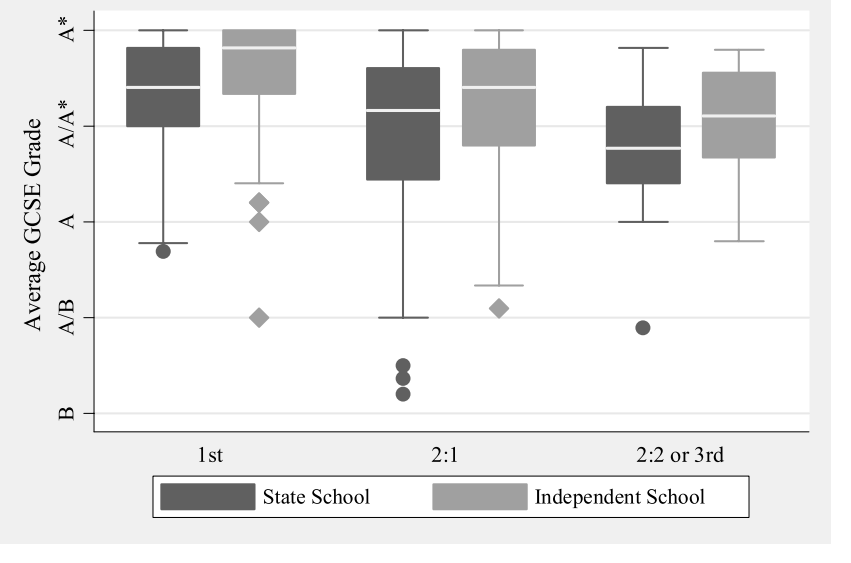


Figure 5. Box plot of average GCSE grade by school type and finals mark

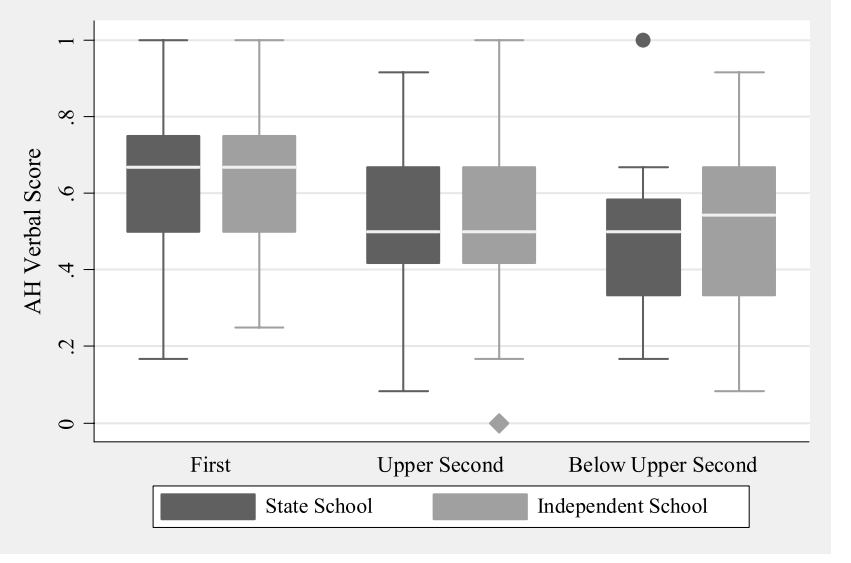


Figure 6. Box plot of AH verbal scores by school type and finals mark

does for arts students. Arts students may be better assessed by more discursive questions, which the curt questions in the AH test do not model particularly well. Indeed, Oxford finals follow this distinction between discursive questions in arts subjects and shorter analytical questions in the sciences. It is clear, however, that GCSEs are a relatively better predictor of examination success for arts students than for science students, given that the interaction term testing for this was strongly statistically significant. This may be partly due to the much larger proportion of combined degrees, known as joint schools, in the arts compared to the sciences. Joint schools are degrees that combine two or more different subjects in a single degree, for example, mathematics and philosophy. Tables A1 and A2 (see Appendix) give a full list of the subjects studied in the dataset, which show that 10% of science students study joint schools, compared to 31% of arts students. Joint schools presumably require a wider range of 'skills' than single subject degrees, because the student is studying more than one subject, often with the subjects being completely different in character. GCSEs test a wide range of subjects, each of which will require different skills. So GCSEs are probably a relatively better predictor of examination performance in arts subjects than science subjects, given that there are many more arts degrees that are joint schools than science degrees. It might be, of course, that for some psychological or other reason a wide skill set is more important in art subjects than science subjects, regardless of the joint schools issue.

Turning to the policy implications of our findings, from an admissions point of view, we are interested in predicting who is most likely to complete the requirements of the course by succeeding at university examinations (Schwartz, 2004), rather than to reward those who did well in their secondary school grades. As the government

review of admissions to higher education recommended, whilst applicants should be assessed as individuals, 'admissions staff have the discretion to vary the weight they give to examination results and other indicators of achievement and potential and therefore to vary the offer that they make to applicants' (Schwartz, 2004). With Schwartz, therefore, we argue that higher education is part of the 'merit development process' (Zimdars, 2007, p. 17) and not a reward for ostensive for 'merit', where merit is taken to be secondary school grades. As our above analysis shows, for a given level of GCSE performance, and conditional upon selection for admission to Oxford, private school students have lower potential to achieve a first at Oxford University, particularly in arts subjects. Or, to put it another way, the same average GCSE grade for a private school student and a state school student do not mean the same thing; they do not represent the same potential to achieve a first class degree at Oxford University.

It has already been noted that there is no consistent relationship between school performance and degree performance (HEFCE, 2003). The findings of this article suggest that the cause of the school type, at Oxford University, is teaching effects. If, therefore, admissions at Oxford are to be more lenient with particular groups at all, given the objective of admitting those students who are most likely to complete the course, it should be on the grounds of school type rather than school performance.

But why is it that school type effects, rather than school performance effects, seem to be present in university degree results? Or to put it another, why is it that private schools have this effect, in a way that high performing state schools apparently do not? In this article we can only speculate, but in the introduction we suggested that teachers, and their qualifications, are a particularly important driver of the school type effect. HEFCE (2003) suggests that teachers are important insofar as they coach their students to do better in their exams, and that 'the lessons of this coaching would have to be irrelevant to assessment within HE [higher education]. Examples of such temporary added value might include accurate advice as to what questions are likely to come up, identification of examination boards, and syllabuses within those boards, where higher grades are more likely and more active and effective appeals over the grades first awarded' (p. 25). HEFCE (2003) therefore suggests that private schools do well due to a more deft manipulation of the examination system than schools in the state sector. For example, one of the major differences between private schools and state schools is that private schools do not have to follow the national curriculum. We are grateful for the suggestion by an anonymous reviewer of this paper that private schools might be far less willing than state schools to enter students for subjects that they were bad at. It may also simply be that private school teachers have a greater motivation to manipulate the examinations system in this way because they are paid directly by the parents of the students. Payment for education would, following this argument, be a much greater incentive for these teachers than pressures in the state system for higher results, for example through school league tables. We cannot be sure which of the explanations generated our findings but we feel this will be an important issue for debate and future research.

It is also worthwhile considering the extent to which our findings can be applied to the admission processes at other universities in the UK. In short, they will not apply to the vast majority of other universities, because their students are very different to those in our dataset. It may be reasonable to suppose that the findings will be roughly applicable to students at the top of the ability range at other elite universities in the UK. But to really know whether teaching effects is the cause of the school type effect at other universities will require further research, because there are probably reasons why Oxford students are different to students at other universities (cf. Zimdars *et al.*, 2009, Zimdars, forthcoming).

Finally, we wish to return specifically to the issue of admissions at Oxford University. The selectors face a difficult task. On the one hand, evidence from this article and HEFCE (2003) and Smith and Naylor (2001) shows that the school type effect is smallest in magnitude at higher A-level point scores, the very constituency that Oxford University recruits from. On the other hand, Smith and Naylor (2002) find that the largest school type effects are found at private schools that charge the highest level of fees. Indeed, over the entire university system, an extra £2000 in school fees is associated with a 1% drop in the probability of achieving a good degree (Smith & Naylor, 2002). Again, private schools with large fees are a large recruiting pool for the University of Oxford, as the recent Sutton Trust report documents (Sutton Trust, 2007b).

We feel that the evidence from our study justifies slightly lower admissions requirements for state school students than for private school students at Oxford University on the grounds that private school students' grades are increased by teaching effects within private schools. The difference is very slight—only a few GCSE grades—but those few grades provide a real advantage in gaining admission to Oxford University (Heath & Zimdars, 2005). This ought to be accounted for in the admissions process. However, according to earlier research using the OAS dataset, the selectors at Oxford in fact appear to already discount the GCSE grades of private school students (Heath & Zimdars, 2005; Zimdars forthcoming). One might therefore be tempted to suggest that the selectors at Oxford have done their job of getting the best students to Oxford fairly well. After all, the lack of a statistically significant gross private school underperformance (i.e. Model 1, Tables 2–4) suggests that of those who do get in, private school students perform about as well as state school students. However, the issue for Oxford's admissions system is not whether state schools students *who gained a place* do as well as private school students who gained a place: it is whether some of the state school students who *did not* gain a place would be likely to perform better in final examinations than some private school students who *did* get a place. At the end of this article, the sociological evidence is now clearer: the school type effect at Oxford University is likely to be driven by short-term teaching effects upon the secondary school grades of private school students.

Notes

1. The Russell Group is composed of the UK's elite universities, similar to the Ivy League in the USA.

2. For example, if comparing only the achievement of first class degrees with achieving a 2:1, a given group may seem to do well on this metric whilst also be more likely to achieve less than a 2:1. Using only a first/2:1 comparison would therefore give a misleading impression of examination performance. The same issue applies, of course, to dropping out from university altogether. Complete multinomial regression tables are available from the authors upon request.
3. The correlation between the proportion of firsts awarded and the proportion of lower than 2:1s awarded across Honour Schools is only 0.10. The results of regressions for the likelihood of gaining less than a 2:1 should therefore be regarded as highly provisional.
4. Model 2 also suggests that a portion of the female protection against *lower than a 2:1* is the result of gender segregation by subject.

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Appendix

Table A1. Average percentage first class degrees awarded 2000–2006/7 by honour school and arts/science categorisation at Oxford University: arts

Arts	First class (%)	Average population *N*	OAS *N*
Archaeology and anthropology	17	5	2
Classical archaeology and ancient history	19	18	4
Classics (literae humaniores)	20	116	10
Classics and modern languages	30	10	2
Classics and English	34	10	5
Economics and management	20	82	9
English	25	256	48
English and modern languages	38	25	3
European and Middle Eastern languages*	14	4	0
Fine art	31	19	3
Geography	19	97	10
History	21	272	53
History (ancient and modern)	24	22	3
History and economics*	23	9	0
History and English	24	13	1
History and modern languages	37	23	1
History and politics	18	41	7
Law and law with law studies in Europe	13	270	46
Mathematics and philosophy	41	22	2
Modern languages	22	192	26
Music	21	56	9
Oriental studies	29	39	3
Philosophy and modern languages	27	24	2
Philosophy, politics and economics (PPE)	17	285	43
Philosophy and theology	16	25	7
Theology	14	60	2
Weighted average	20		
Arts total *N*		2048	301

Note: *Subject not represented in the OAS dataset used.

Table A2. Average percentage first class degrees awarded 2000–2006/7 by honour school and art/science categorisation at Oxford University: sciences

Sciences	First class (%)	Average population *N*	OAS *N*
Biochemistry, molecular and cellular	24	81	13
Biological sciences	26	99	14
Chemistry	36	161	36
Computer science	29	23	8
Earth sciences	31	26	3
Engineering science	29	96	4
Engineering, economics and management*	28	30	0
Experimental psychology (EP)	25	54	7
Human sciences	20	55	8
Materials, economics and management*	23	5	0
Materials science	29	14	2
Mathematics	39	182	18
Mathematics and computer science	32	26	5
Mathematics and statistics	36	25	3
Medicine	21	145	22
Physics	31	158	22
Physics and philosophy*	41	12	0
Physiological sciences	18	93	4
Psychology, philosophy and physiology (PPP)	26	36	6
Weighted average	30		
Sciences total *N*		1288	175

Note: *Subject not represented in the OAS dataset used.

Table A3. Arts and sciences

	First class (%)	Average population *N*	OAS *N*
Total weighted average	24		
Total *N*		3336	476

Table A4. Descriptive statistics of OAS sample: sex and school type

Sex	School type		
	Non-independent school	Independent school	Total
Female	144	99	243
Male	125	108	233
Total	269	207	476

Table A5. Descriptive statistics of OAS sample: ethnicity, parent education and class

	Class		
Ethnicity	Salariat parents	Non-salariat parents	Total
Ethnicity			
White	383	49	432
Non-white	38	6	44
Education parent			
Degree	337	13	350
No degree	84	42	126
Total	421	55	476