Cambridge Assessment

Reformed A level results: Do candidates who take the AS level achieve better grades?

Research Report

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October 2018

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How to cite this publication:

Contents

Executive Summary

Candidates taking a reformed (decoupled) A level may follow an 'AS + A level' route in that subject, taking the decoupled AS level, usually in Year 12, followed by the A level, usually in Year 13. Alternatively, they may follow an 'A level only' route. The research described in this report explored whether there were differences in the A level grades achieved by 'AS + A level' and 'A level only' candidates in summer 2017.

The question is of interest because summer 2017 was the first time reformed A levels were assessed, and the first time that large numbers of A level candidates had followed different routes. Thomson (2018) compared the grades achieved by 'AS + A level' and 'A level only' candidates in reformed A levels, and concluded that candidates who had taken the AS level achieved slightly better results than those who had not. Research by the exam board AQA (Harrison, 2018) also investigated the performance of 'AS + A level' and 'A level only' candidates, and found that 'AS + A level' AQA candidates outperformed similar 'A level only' AQA candidates in many subjects.

Methods
The research analysed data from the 2017 National Pupil Database, the most recent year for which candidate-level reformed A level data was available. The data analysed included all reformed A level results from summer 2017. The data was linked to results from summer 2016 to establish, for each A level result, whether the candidate had also taken the AS level in that subject or had followed an 'A level only' route.

The first stage of analysis compared the distributions of reformed A level grades achieved by 'AS + A level' and 'A level only' candidates.

Logistic regression models were then used to estimate candidates' likelihood of achieving various grade thresholds, to explore whether the likelihoods were different for 'AS + A level' and 'A level only' candidates once candidate and centre characteristics were taken into account. The models were estimated separately for four selected subjects: Biology, English Literature, Fine Art and Psychology. These subjects were chosen in order to include large-entry subjects, and a range of subject types.

In a final, separate set of analyses, Coarsened Exact Matching (CEM) was used to create matched groups[1] of 'AS + A level' and 'A level only' candidates in each reformed subject. The proportions of candidates reaching grades C, A and A* were then compared. These analyses were cross checked against the logistic regression findings.

Findings
The A level outcomes of 'AS + A level' candidates were higher than for 'A level only' candidates in almost all reformed subjects.

After controlling for candidates' gender, Key Stage 4 (KS4) attainment, centre type, income-related deprivation and geographical region, candidates in Biology who had followed an 'AS + A level' route were estimated to be significantly more likely than 'A level only' candidates to

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[1] That is, groups that were balanced in terms of candidates' gender, KS4 attainment, centre type attended, income-related deprivation and geographical region.

achieve a grade C or above, and to achieve a grade A or above[2]. In Psychology, 'AS + A level' candidates were estimated to be significantly more likely than 'A level only' candidates to achieve all three grade thresholds tested: a grade or C or above, a grade A or above, and a grade A*. In Fine Art and English Literature, in contrast to Biology and Psychology, the logistic regression analyses found no statistically significant differences between A level outcomes for 'AS + A level' and 'A level only' candidates once candidate and centre characteristics were taken into account.

The logistic regression findings above were supported by the final analyses, which compared matched 'AS + A level' and 'A level only' candidate groups. For example, the proportions of 'AS + A level' candidates achieving grade C and above and grade A and above in Biology were 4.7 and 1.8 percentage points higher than the corresponding proportions of 'A level only' candidates. In Psychology, the proportions of 'AS + A level' candidates achieving grade C and above, grade A and above and grade A* were 5.9, 2.9 and 0.7 percentage points higher than the corresponding proportions of 'A level only' candidates. In Fine Art and English Literature, the proportions reaching grade thresholds were not found to differ by A level route.

Table 1 summarises the results found by the logistic regression analyses and comparison of CEM-matched groups (in the current research), together with those found by Harrison's (2018) AQA research. The table shows whether each method identified a difference in A level outcomes associated with A level route, for each subject. Where a statistically significant difference was identified, the table lists the route for which A level outcomes were higher. It is important to emphasise that Table 1 does not show the size or educational significance of the differences identified.

The findings from the two different approaches used in this research by Harrison's (2018) AQA research were generally highly consistent. The differences that are evident occur where the current research identified an effect of A level route at one grade threshold but not others, or where the AQA research identified a difference for one specification but not another. As such, we conclude that the differences in reported findings reflect the different research approaches taken rather than substantive differences in findings.

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[2] In other subjects examined, achievement at the grade A* threshold was also modelled. In Biology, we were not able to estimate a satisfactory model for the grade A* threshold and hence only the grade C and grade A thresholds are reported.

Table 1: Differences in A level outcomes associated with A level route, from three methods

Subject and grade threshold	Approaches used in current research		AQA research[3]
	Logistic regression modelling of achievement of grade thresholds	Comparison of grade distributions for CEM-matched groups	Analysis of mean marks for CEM-matched groups
Art & Design	*Not tested*	No effect	No effect
Art & Design (Fine Art)	No effect	No effect	No effect
Art & Design (Photography)	*Not tested*	A level only (A* only)	No effect
Art & Design (Textiles)	*Not tested*	A level only	A level only
Biology	AS + A level	AS + A level	AS + A level
Chemistry	*Not tested*	AS + A level	AS + A level
Physics	*Not tested*	AS + A level	AS + A level
Computer Science	*Not tested*	AS + A level	AS + A level
English Language	*Not tested*	AS + A level (A* only)	No effect
English Lang. & Literature	*Not tested*	A level only (C only)	No effect
English Literature	No effect	No effect	No effect for Lit. B; AS + A level for Lit. A
History	*Not tested*	AS + A level	AS + A level
Business Studies	*Not tested*	AS + A level (C only)	AS + A level
Economics	*Not tested*	AS + A level	AS + A level
Psychology	AS + A level	AS + A level	AS + A level
Sociology	*Not tested*	AS + A level (A & C only)	AS + A level

The differences in A level outcomes associated with A level route were typically small. The marginal effects estimated by the regression analyses were small, and similarly, the differences found between the proportions of matched 'AS + A level' and 'A level only' candidates achieving each grade threshold were typically fairly low. The largest differences were found at the grade C threshold in the science subjects (Biology, Chemistry, Physics, Computer Science), Business Studies, Psychology and Sociology – among these subjects, the proportion of 'AS + A level only' candidates achieving a grade C or higher was between 4.7 and 6.3 percentage points higher than the corresponding proportion of 'A level only' candidates.

Conclusions

In summary, the research showed that in summer 2017, A level outcomes for 'AS + A level' candidates were slightly higher than for 'A level only' candidates in the majority of reformed subjects, both before and after controlling for differences in candidate and centre characteristics. In some reformed subjects, 'AS + A level' candidates achieved higher A level outcomes only at certain grade thresholds. In a few reformed subjects, 'A level only' candidates were found to have higher A level outcomes, though this was not consistent across groups of similar subjects and was usually only observed at certain grade thresholds.

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[3] As reported by Harrison (2018).

The differences identified between A level outcomes for 'AS + A level' and 'A level only' candidates were small, but not sufficiently small to discount. Many of the A level subjects considered in this research have very large entries; thus, relatively small differences in percentages of candidates represent large numbers of actual candidates. Furthermore, if the differences in proportions of candidates reaching grade thresholds are viewed in terms of comparable outcomes tolerances, they could be considered rather large.

Two things must be kept in mind when interpreting the findings from this research. Firstly, the findings show only the differences in A level outcomes for candidates following different A level routes, and not the reasons for these differences. In particular, whilst the analyses controlled for certain known characteristics (gender, KS4 attainment, centre type, income-related deprivation and geographical region), we cannot be certain that the remaining differences in A level performance were caused by candidates' A level route. Further research would be required to understand the causes - these could include differences in candidate motivations, teaching practices, exam-taking practice and more, some of which could be considered effects caused by the AS level itself, and some of which would be classified as candidate and centre characteristics not yet measured and accounted for.

The second important point to take note of is that Key Stage 5 (KS5) education has changed substantially since the candidates analysed in this research undertook their studies. The candidates analysed in this research began their KS5 studies in September 2015, the first year of teaching for reformed AS and A levels. Since then, reformed AS and A levels have been introduced in all remaining subjects, schools and colleges have made changes to their KS5 provision and timetabling, uptake of AS levels has decreased, and the reformed A levels that were 'new' in summer 2017 are now in their fourth year of teaching. For all these reasons, patterns observed in the cohort studied may well not be true of later cohorts.

1.   List of abbreviations

A level   Advanced level
AS level   Advanced Subsidiary level
CEM   Coarsened Exact Matching
d.f.   Degrees of freedom
DfE   Department for Education
FE   Further Education
HoD   Head of Department
IDACI   Income Deprivation Affecting Children Index
KS4   Key Stage 4
KS5   Key Stage 5
NPD   National Pupil Database
Ofqual   Office of Qualifications and Examinations Regulation
SE   Standard error
URN   Unique Reference Number

2.   Introduction

Background

The Department for Education (DfE) announced its intention to reform AS and A levels in 2010 (DfE, 2010). The reformed qualifications featured major changes to subject content and assessment structure; most strikingly, AS levels were 'decoupled' from A levels to form separate, standalone qualifications. Both reformed AS and A levels are assessed linearly, and students taking a decoupled A level are not required to take an AS level at all.

The reforms were not implemented for all subjects at the same time. Decoupled AS and A levels in the first tranche of subjects to be reformed were taught from September 2015, those in the second tranche from September 2016, and those in the third tranche from September 2017[4].

The Research Division has designed and carried out several projects investigating the impact of these recent AS and A level reforms (e.g., Sutch, Zanini, & Benton, 2015; Zanini & Williamson, 2016). In 2016/17, research looked at the uptake and provision of the decoupled AS and A levels, the views of students and Heads of Department towards the reformed qualifications, and the reasons given by students and Heads of Department for choosing to study or not study decoupled AS levels (Williamson & Vitello, 2017).

In the 2017/18 research year, we continued the strand of work outlined above, motivated by the introduction of the third tranche of reformed qualifications in September 2017 and the availability of the first reformed A level results data from summer 2017. We repeated the survey to Heads of Departments, and analysis of national trends in AS level entries; the findings from this work are reported by Williamson and Vitello (2018). The project described in the current report analysed national data in order to explore reformed A level outcomes in summer 2017. Specifically, the project compared candidates who had previously taken the reformed AS level in their A level subject ('AS + A level' candidates) with those candidates who had not taken the AS level ('A level only' candidates).

Our research question was the following:

> In summer 2017, were there differences in the reformed A level outcomes of 'AS + A level' and 'A level only' candidates?

Summary of existing research

Potential AS level impact
There are several means by which candidate performance in a reformed A level could potentially be influenced by taking (or not taking) the decoupled AS level in that subject.

The decoupled AS level could influence A level performance through offering students informed choice about whether to pursue the A level or not. As discussed by Sutch et al. (2015), this became a key function of the pre-reform AS level. Sutch et al. note that "The removal (or reduction) of informed choice after Year 12 would correspond to a change at

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[4] Decoupled A levels (but not AS levels) will be introduced in a fourth and final tranche of subjects in September 2018. This tranche consists of language subjects with low uptake, such as modern Greek. Decoupled AS and A levels in Classical Greek, Latin, and the most commonly studied Modern Foreign Languages (French, German, Spanish, Chinese, Italian and Russian) were introduced earlier, in September 2017.

cohort level in the relationship between GCSE and A level attainment" (Sutch et al., 2015, p. 112). For this reason, if the A level standard was held constant, a higher rate of failures at A level might be expected post-reform amongst students not taking the decoupled AS level, due to these students "entering A levels rather than dropping subjects beforehand based partly on external feedback" (Sutch et al., 2015, p. 112).

The decoupled AS level could also actively prepare candidates for the A level by developing knowledge and skills. The AS level might enhance subject-related knowledge and skills, resulting in improvements to A level learning and performance. The AS level might also improve A level performance through developing test-taking skills. Candidates who had sat the decoupled AS level could then have a higher level of assessment skill compared with those who were last assessed in the subject at KS4 (in the case of subjects previously studied at that level) or never (in the case of subjects taken up for the first time at KS5).

On the other hand, it is possible that the decoupled AS level could negatively affect A level outcomes, for example by reducing the teaching and learning hours available for A level preparation. Increasing A level teaching time was one of the motivations for decoupling the A level (Ofqual, 2012).

Those impacts discussed above resonate with dominant opinions expressed by Heads of Departments in the surveys conducted by Williamson and Vitello. For example, Williamson and Vitello (2017) found that the advantages of (and reasons for offering) decoupled AS levels most frequently cited by Heads of Department were that the AS level gives exam practice (a positive advantage in terms of assessment preparation), and that the AS level helps students know whether to drop the subject (an expression of the 'filtering' idea). The disadvantages of (and reasons for not offering) the AS level most commonly cited by Heads of Department were related to time: that the AS level takes time away from the A level, that there is not enough time in the timetable, and that students' time would be better spent preparing for the A level.

Clearly, it was not possible to compare the actual reformed A level performance of candidates following 'AS + A level' and 'A level only' routes until the first assessment of reformed A levels in summer 2017. Since then, findings from only one study in this area have been shared. This study was an AQA investigation (Harrison, 2018), which used AQA results data to investigate whether candidates who took a decoupled AS level in summer 2016 achieved higher outcomes in the reformed A level taken in the same subject in summer 2017, compared with those who had not taken the AS level. Similar research may have been carried out by other awarding organisations, but findings have not been disseminated.

Harrison (2018) showed that AQA candidates who had taken the AS achieved higher raw marks in their A level than those who had not taken the AS, for most reformed subjects. However, the groups of candidates following 'AS + A level' and 'A level only' routes showed different characteristics. Due to this difference, Coarsened Exact Matching (CEM)[5] was used to form comparable groups. The differences between the mean marks of 'A level only' and 'AS + A level' candidates were then re-compared after weighting by the CEM outcomes. Harrison (2018) concluded that the decoupled AS did give some AQA candidates an

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[5] For an explanation of the Coarsened Exact Matching method, see Iacus, King, and Porro (2017).

advantage in 2017, and suggested that this was due to 'filtering' which students progressed to A level.

Variation across subjects

The AQA findings showed interesting variation across subjects. In summary, the AQA research reported a large positive AS advantage for Computing (mean 'AS + A level' mark 13 marks higher than mean 'A level only' mark), and an AS advantage of over 5 marks for the sciences and Psychology. Smaller positive AS advantages were found for Business, Economics, Sociology, History and English Literature A. For the remaining English specifications and most Art & Design subjects, no statistically significant differences in marks were found. For Textiles, there was a large AS disadvantage, of almost 13 marks.

In the presentation of the AQA findings by Harrison (2018), these subject differences were presented as topics for future research to explain, and we are not aware of any research that has yet done so. However, comparing the findings with views shared by Heads of Department (Williamson & Vitello, 2017) suggests several potential explanations for consideration. First, it is worth noting that both of the two main reasons given for offering decoupled AS levels (providing assessment experience, and informing candidates' A level choices) are factors that could be expected to apply particularly strongly to subjects not studied at KS4, and the AQA findings do show a significant AS advantage for the subjects commonly studied for the first time at KS5 (Psychology, Sociology, Economics). Secondly, both reasons might also apply particularly strongly to subjects where the transition between KS4 and KS5 appears to be in some way challenging. The AQA findings show high AS advantages for science subjects, which are 'difficult' if considered in terms of the A level performance of candidates with medium to high KS4 attainment. Exam practice and filtering mechanisms might therefore have greater importance in these subjects.

There are also plausible arguments for why the negative influence of AS levels could affect subjects differentially. The first argument relates to the coursework or portfolio 'load'. Art & Design subjects have a far higher proportion of portfolio assessment than other A level subjects. This could potentially make the time cost of an AS level particularly steep, and partially explain the AS disadvantage reported in the AQA results. The second potential argument relates to the structure of knowledge and the curriculum within different subjects. Subjects in which knowledge builds in a more vertical manner (ladder or pyramid – e.g., Sciences and Maths) might suffer less "loss" of time spent on an AS level in comparison with subjects where knowledge builds more in breadth (e.g., English Literature). This point relates to the structure of particular specifications, but more fundamentally, to the structure of knowledge within particular subjects (see, for example, Donald, 1983). This is not to say that students in, for example, Sociology and English Literature do not build upon skills and concepts learned at AS level, but rather that the reliance is less direct than it is in Maths or Science, for example. The difference could be both actual and perceived.

The aim of the current project was to extend the investigation of whether differences in reformed A level outcomes differed according to A level route (i.e., 'AS + A level' or 'A level only'). The aim was to investigate this question using national data rather than data from only one awarding body, and to apply different methods of analysis.

3.   Data and methods

Data

We analysed KS5 data from the 2017 NPD. This contained results for all AS and A level entries, and information about candidates and centres. We analysed all reformed A level results from summer 2017 for candidates who were awarded a grade (A*-E, or U). A levels listed in the NPD for which a candidate had received "X" were excluded from analysis. We restricted analysis to candidates who were age 17 at the start of academic year 2016/17 (i.e., in Year 13, by age).

From the NPD data, we selected the following variables:

- Candidate's result in A level(s) taken in summer 2017
- Candidate's results in AS levels taken in summer 2016, if any
- Candidate's main provider[6] URN
- Candidate age
- IDACI score of candidate's home area
- Average GCSE and equivalent point score per entry.

We then derived the following variables:

A level route (classification[7])
- 'AS + A level' if the student took the decoupled AS level in summer 2016, and the decoupled A level in the same subject in summer 2017
- 'A level only' if the student took the A level, and did not take the AS in summer 2016[8].

Region (classification variable)

Students were classified according to the geographical region in which their school or college (the institution listed as their main provider for 2016/17) was located. Using school or college location instead of pupil address enabled region to be determined for all students of interest; student addresses are collected only from certain centre types and thus would have led to a high proportion of missing data.

Deprivation group (classification)

We used the NPD variable IDACI score to calculate terciles within all 2017 Year 13 A level candidates. We used this to form a four way classification:

- Low deprivation: the candidate came from an area with income-related deprivation in the lowest third of A level candidates in their cohort

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[6] Since 2016, candidate results in the NPD have been allocated "to the provider where the student has enrolled to take their main programme of study … all results taken in that year will be allocated to the main provider, irrespective of where they were taken" (DfE, 2017, p. 9).

[7] Note that this classification variable classifies the candidate's A level route within a particular A level subject. It does not say anything about the candidate's overall programme of KS5 study.

[8] Since we were explicitly investigating potential effects of taking a decoupled AS level, we excluded AS levels taken in earlier years (which must necessarily have been legacy AS levels rather than decoupled specifications). We also excluded from consideration any decoupled AS levels taken by Year 13 students at the same time as their decoupled A level in the same subject, of which there were very few indeed, since the hypothesised effects (chiefly providing exam practice, and the 'filtering' facilitated by gaining feedback at the end of Year 12) explicitly concern effects of the decoupled AS level on a decoupled A level taken at a later, different date.

- Medium deprivation: the candidate came from an area with income-related deprivation in the middle third of A level candidates in their cohort
- High deprivation: the candidate came from an area with income-related deprivation in the top third of A level candidates in their cohort
- No deprivation data: no IDACI data was available for the candidate.

Methods of analysis

Initial descriptive analysis
As a basic comparison, we compared A level outcomes for 'AS + A level' and 'A level only' students for all subjects using whole subject populations. Cumulative grade distributions were calculated to examine any differences between outcomes for the two groups.

We next produced descriptive statistics of student and centre characteristics for students following each A level route. The characteristics of students taking the 'AS + A level' route compared with 'A level only' route were of interest in themselves, and we also wished to identify differences between the two candidates groups before further analysis of their A level outcomes.

Logistic regression modelling
Logistic regression modelling was used to compare the A level outcomes of 'A level only' and 'AS + A level' candidates after taking into account known background variables. We selected four subjects, and for each of these used a series of multilevel logistic regression models to estimate the probability of achieving at least a given grade in that subject, including A level route and candidates' background characteristics as independent variables.

Multilevel models were used in order to account for the clustering of candidates within centres. Each model had the following general form:

$$log\left(\frac{p_{ij}}{1 - p_{ij}}\right) = \beta_0 + \beta_1 X1_{ij} + \beta_2 X2_{ij} + \cdots + \beta_k Xk_{ij} + u_j$$

where p_{ij} is the probability of candidate i from centre j of achieving a given grade or above, β_0 is the expected value of the log odds of achieving the given grade or above for a candidate in the reference group (that is, $Xk = 0$ for all k), $X1$ to Xk are the independent variables, β_1 to β_k are the regression coefficients and u_j is a random variable at centre level (so that the expected log odds of achieving the given grade or above for a candidate in the reference group in centre j is $\beta_0 + u_j$).

For each subject, three models were estimated, for the following binary outcomes:

- Achieving a grade A*
- Achieving at least a grade A
- Achieving at least a grade C.

These points were chosen due to their relation to grading, the high level of interest in grade A*, and in order to examine the effects of A level route at different levels of A level achievement.

The following independent variables were included in each model, in this order:

11

- Gender
- KS4 attainment (average points per entry for GCSE and equivalents)
- Deprivation group (derived from IDACI terciles)
- Centre type
- Geographical region
- A level route ('AS + A level' or 'A level only').

Before estimating the models described above, propensity score analysis was used to check the comparability of 'AS + A level' and 'A level only' candidates, particularly since Harrison (2018) had found the two groups imbalanced. Within each subject, we modelled the likelihood of a candidate following the 'A level only' route in that subject, using a multilevel logistic regression model with the independent variables gender, KS4 attainment, deprivation group, centre type and geographical region. We then calculated the predicted probability of each candidate following an 'A level only' route, thus providing an estimate for the propensity score. To the extent that all characteristics affecting the dependent variable are observed and included in the specification of the regression model, the propensity score contains all the information needed to compare the two groups of candidates defined by the dependent variable (Rosenbaum & Rubin, 1983). We therefore compared the 'AS + A level' and 'A level only' groups by examining their propensity score distributions, and, specifically, the range of scores for which the distributions overlapped (the zone of common support). The logistic regression models for the achievement of grade thresholds were estimated only for candidates within the zones of common support identified for each subject.

Coarsened Exact Matching (CEM)
To check the robustness of the findings obtained from the logistic regression modelling, we also carried out comparisons of A level outcomes for matched groups of 'AS + A level' and 'A level only' candidates. Matching was carried out within each tranche 1 subject separately, and carried out using the Coarsened Exact Matching (CEM) method, as used in the AQA "AS advantage?" research (Harrison, 2018).

CEM is straightforward matching technique based on stratification. A key contrast with other matching methods is that the number of matched observations is a result of the level of coarsening chosen for the observable variables used in the matching, rather than the reverse: "the researcher chooses the maximum level of allowed imbalance ex-ante and CEM subsequently produces a matched sample of an a-priori unknown size" (Berta, Bossi, & Verzillo, 2017, p. 229). Berta et al. (2017, p. 228) note that CEM is "expressly designed to overcome the issue of increasing imbalance on some variables while improving it for others", a significant problem in, for example, propensity score matching. Iacus et al. (2017) discuss and summarise the numerous advantages of CEM over other commonly used matching methods, noting that the method shows superior performance in terms of reducing "imbalance, model dependence, estimation error, bias, variance, mean square error and other criteria" (p. 2).

To perform the matching, we used the SAS macro "%CEM" developed by Berta et al. (2017). The CEM procedure matched candidate groups on the following variables:

- Gender (binary)
- KS4 attainment: average points per entry for GCSE and equivalents

- Deprivation group (four categories, derived from IDACI terciles and a "missing data" category)
- Centre type (categorical)
- Geographical region (categorical).

For the four categorical variables, coarsening choices were already made (by using the categories themselves as strata). For KS4 attainment, we specified that %CEM should automatically test a set of possible 'bins' (e.g., centiles, deciles) and choose the most efficient in terms of overall balance across all variables.

The CEM process resulted in subgroups of 'A level only' candidates corresponding to 'AS + A level' subgroups, containing counterpoint candidates weighted to produce two overall matched groups. After creating the matched groups within each subject, we compared A level outcomes by A level route. We produced cumulative grade distributions, and used chi-square tests to test for differences between A level routes in the proportion of candidates achieving A*, A and C grades.

4.   Results

To examine the possible effects of decoupled AS levels on Year 13 candidates' A level performances, we grouped candidates according to A level route. 'AS + A level' candidates were those who took a reformed A level in summer 2017 having taken the decoupled AS level in the same subject in summer 2016. 'A level only' candidates were those who took a reformed A level without having taken the corresponding reformed AS level in that subject. The results concern tranche 1 subjects only, the only subjects in which reformed A levels were assessed in summer 2017.

Proportion of A level candidates per route
For each (tranche 1) reformed subject, Table 2 shows the proportion of A level candidates in summer 2017 who followed each route (either 'AS + A level' or 'A level only'). The proportions varied by subject, although for every subject the 'A level only' route was less popular than the 'AS + A level' route. In most cases the 'A level only' route was taken by less than a third of the candidates.

For most Art & Design subjects, over 40% of candidates took the A level only, whilst for Biology, Chemistry and Physics, about 30% of candidates took the A level only. The lowest proportions of A level only entries were in English Language and Sociology (both 21% A level only). It is particularly interesting to note the difference between English Language entries (21% A level only) and English Literature entries (33% A level only).

Table 2: Reformed A level candidates in summer 2017, by subject and A level route

Subject	Route			
	AS + A level		A level only	
	N	%	N	%
Art & Design	2,536	50.9	2,449	49.1
Art & Design (3d Studies)	464	59.7	313	40.3
Art & Design (Critical Studies)	81	71.7	32	28.3
Art & Design (Fine Art)	6,452	52.2	5,910	47.8
Art & Design (Graphics)	2,366	61.0	1,512	39.0
Art & Design (Photography)	6,219	59.2	4,291	40.8
Art & Design (Textiles)	1,686	58.4	1,200	41.6
Biology	33,678	70.9	13,855	29.1
Business Studies: Single	17,440	73.9	6,147	26.1
Chemistry	27,892	69.4	12,314	30.6
Computer Studies/Computing	4,785	70.8	1,974	29.2
Economics	16,902	68.3	7,851	31.7
English Language	13,587	79.0	3,610	21.0
English Language & Literature	6,711	72.5	2,549	27.5
English Literature	26,083	67.2	12,727	32.8
History	28,134	68.2	13,111	31.8
Physics	19,527	69.0	8,786	31.0
Psychology	37,388	75.2	12,344	24.8
Sociology	22,400	79.0	5,954	21.0
All	274,331	70.1	116,929	29.9

Table 3 shows the proportions of candidates following each A level route according to student and centre characteristics (considering all reformed subjects together). Like the by-subject breakdown shown in Table 2, this shows variations in the proportions of A level only entries, particularly by centre type. For example, only 11% of reformed A level entries from FE Colleges were A level only, compared with 56% of entries from independent schools. Independent schools were the only centre type in which the majority of A level candidates followed the A level only route. The percentage of 'A level only' candidates was also high for other selective schools (selective academies and grammar schools). Somewhat surprisingly, non-academy Secondary Moderns also had a high percentage of 'A level only' candidates compared with the other types of centres.

There was some variation between different regions in England, although less variation than between different types of centres. For example, centres in the South East and West Midlands had the highest percentages of 'A level only' candidates (38% and 37% respectively) whereas centres in Yorkshire and the North East had the lowest (20% and 21% respectively).

There was little difference in the distribution of routes by gender or level of income-related deprivation.

Table 3: Reformed A level entries in 2017 by route, by candidate characteristic

Characteristic		Route			
		AS + A level		A level only	
		N	%	N	%
Gender	**F**	163,799	70.7	67,752	29.3
	M	110,532	69.2	49,177	30.8
Centre type	**6th Form College**	57,210	75.7	18,328	24.3
	Academy (comp)	107,412	74.5	36,843	25.5
	Academy (mod)	2,853	71.1	1,159	28.9
	Academy (sel)	19,666	56.9	14,896	43.1
	Comprehensive	40,766	74.7	13,797	25.3
	FE College	20,687	89.1	2,527	10.9
	Grammar	3,513	62.0	2,157	38.0
	Independent	20,878	44.1	26,516	55.9
	Other	519	90.3	56	9.7
	Secondary Modern	648	53.1	572	46.9
	[centre missing]	179	69.6	78	30.4
Region	**East Midlands**	22,474	72.9	8,334	27.1
	East of England	33,500	71.3	13,469	28.7
	London	45,005	71.8	17,709	28.2
	North East	11,828	79.3	3,088	20.7
	North West	37,036	75.8	11,822	24.2
	South East	47,229	62.4	28,444	37.6
	South West	25,817	66.8	12,822	33.2
	West Midlands	24,206	62.7	14,417	37.3
	Yorkshire and The Humber	27,094	80.0	6,766	20.0
	[region missing]	142	71.0	58	29.0

Characteristic		Route			
		AS + A level		A level only	
		N	%	N	%
Deprivation	No deprivation data	99,268	67.6	47,636	32.4
	Low	61,328	73.3	22,360	26.7
	Medium	58,013	71.2	23,443	28.8
	High	55,722	70.3	23,490	29.7
	All	274,331	70.1	116,929	29.9

A level outcomes by A level route

Figures 7 to 10 show the cumulative grade distributions for reformed A level subjects in summer 2017, by A level route ('AS + A level', or 'A level only'). The underlying data for the figures is shown in Table 4.

The grouping by subject area highlights similarities between related subjects, in terms of the relationship observed between the grade distribution of the 'AS + A level' candidates and the grade distribution of the 'A level only' candidates.

Among the Art & Design subjects (Figure 1), most showed advantages for 'A level only' candidates. This pattern was most evident for Art & Design, Art & Design (Fine Art) and Art & Design (Textiles). For these subjects, the higher grades (A* to D) were achieved by larger percentages of 'A level only' candidates than 'AS + A level' candidates. Textiles showed the largest grade advantages of 'A level only' candidates. For example, the cumulative percentages of 'A level only' candidates achieving grades A, B and C were 6, 9 and 5 percentage points higher than the percentages for 'AS + A level' candidates respectively. The 'A level only' advantage for Textiles was consistent with the findings of AQA's AS level study (Harrison, 2018). 3D Studies showed the opposite pattern of differences: the cumulative percentages of candidates achieving B, C and D were higher for the 'AS + A level' candidates than the 'A level only' candidates.
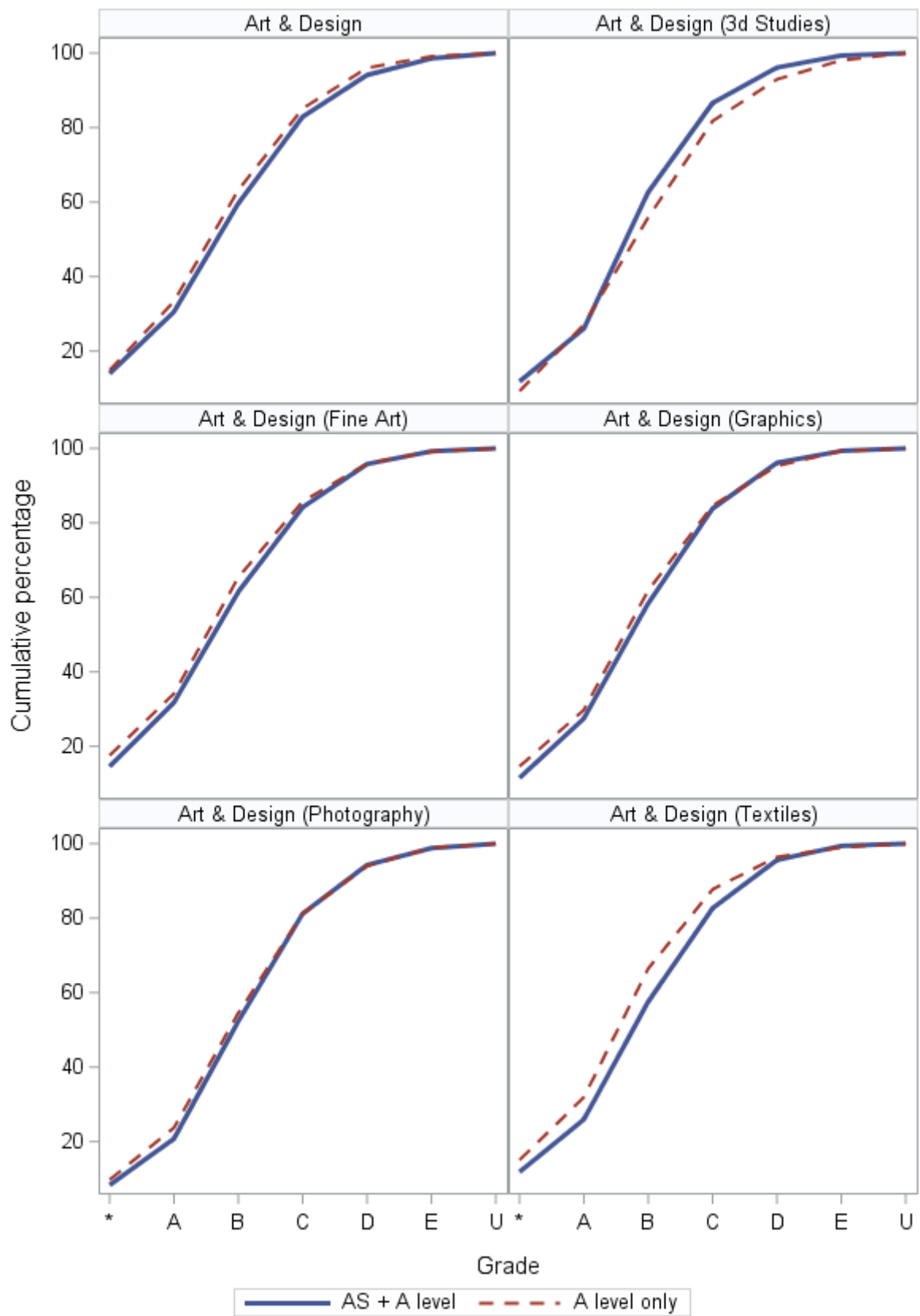
Figure 1: Cumulative grade distributions for 2017 A levels in Art & Design subjects

Among the science subjects (Figure 2), Biology, Chemistry and Physics showed very similar grade distributions. Each of those subjects showed little difference between the A level routes with regard to the percentages of candidates achieving the top two grades (A* and A). However, at grades B and below, 'AS + A level' candidates performed better than 'A level only' candidates. The grade advantages for 'AS + A level' candidates were largest for grades C and D, although they were not large. The percentages of candidates achieving these grades were between 3 and 5.2 percentage points higher for the 'AS + A level' candidates than those for the 'A level only' candidates. Computer Science also showed grade advantages for 'AS + A level' candidates, at all grades. Similar to the other science subjects, the largest grade differences were for grades C and D. These findings are in line with the AQA study, which found that 'AS + A level' candidates achieved higher marks in their science A levels than 'A level only' candidates.
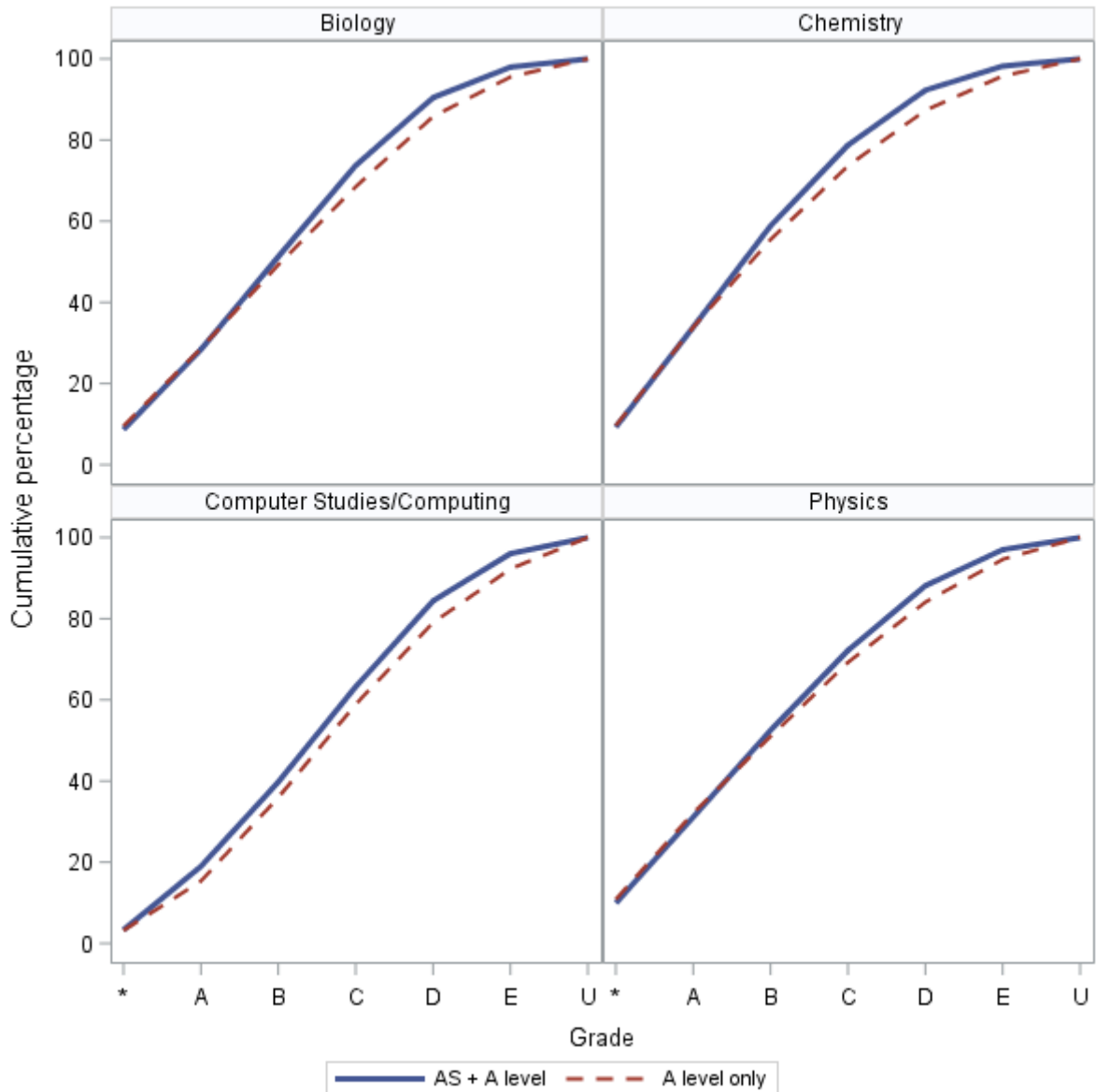
Figure 2: Cumulative grade distributions for 2017 A levels in science subjects

In English Language, English Language & Literature, and History, the cumulative grade distributions for 'A level only' candidates were almost identical to those for 'AS + A level' candidates (Figure 3). In contrast, in English Literature, higher percentages of 'A level only' candidates achieved the top grades, especially A*-C, compared to the percentages of 'AS + A level' candidates, with differences of between 2.2 to 4.6 percentage points.
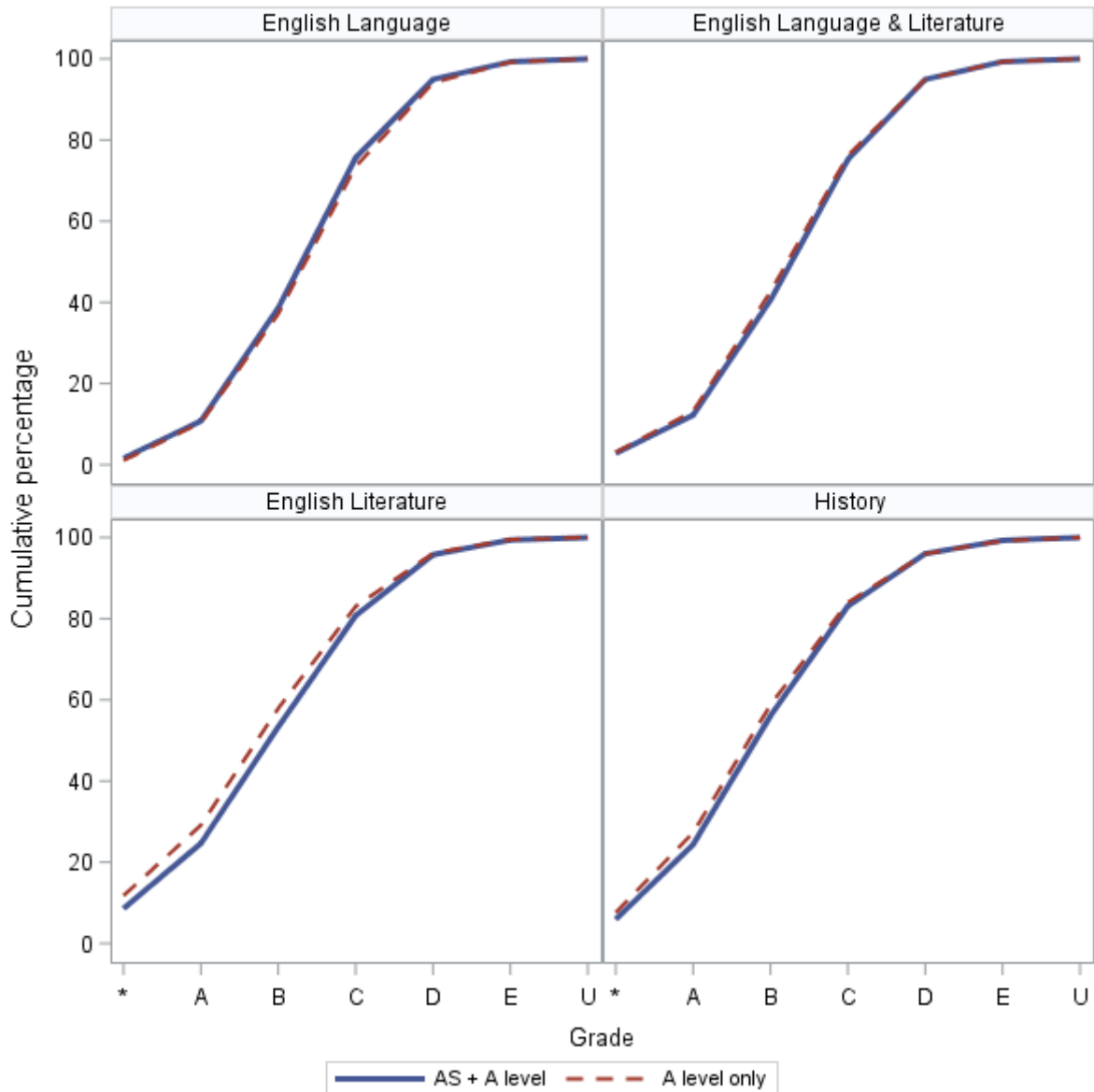
Figure 3: Cumulative grade distributions for 2017 A levels in English and History

Figure 4 shows the cumulative distributions for the remaining tranche 1 subjects: Psychology, Sociology, Business Studies and Economics. Psychology and Sociology showed a similar pattern; the 'AS + A level' candidates performed better at all grades than A level only candidates. These grade advantages were largest for grades B and C; the percentages of candidates achieving these grades were between 6.2 and 8.3 percentage points higher for the 'AS + A level' candidates than those for the 'A level only' candidates.

In Business Studies, the percentage of 'A level only' candidates achieving A* and A grades was very similar to the percentage among 'AS + A level' candidates. At lower grades, 'AS + A level' candidates outperformed 'A level only' candidates, with a difference of between 1.1 and 4.8 percentage points.

In Economics, there was little difference between the cumulative grade distributions of the two A level routes. 'A level only' candidates were very slightly ahead at the top grades, whilst 'AS + A level' candidates were very slightly ahead at the lower grades.

Figure 4: Cumulative grade distributions for 2017 A levels in remaining reformed subjects

Table 4: Cumulative grade distributions for reformed A levels in 2017, by entry route

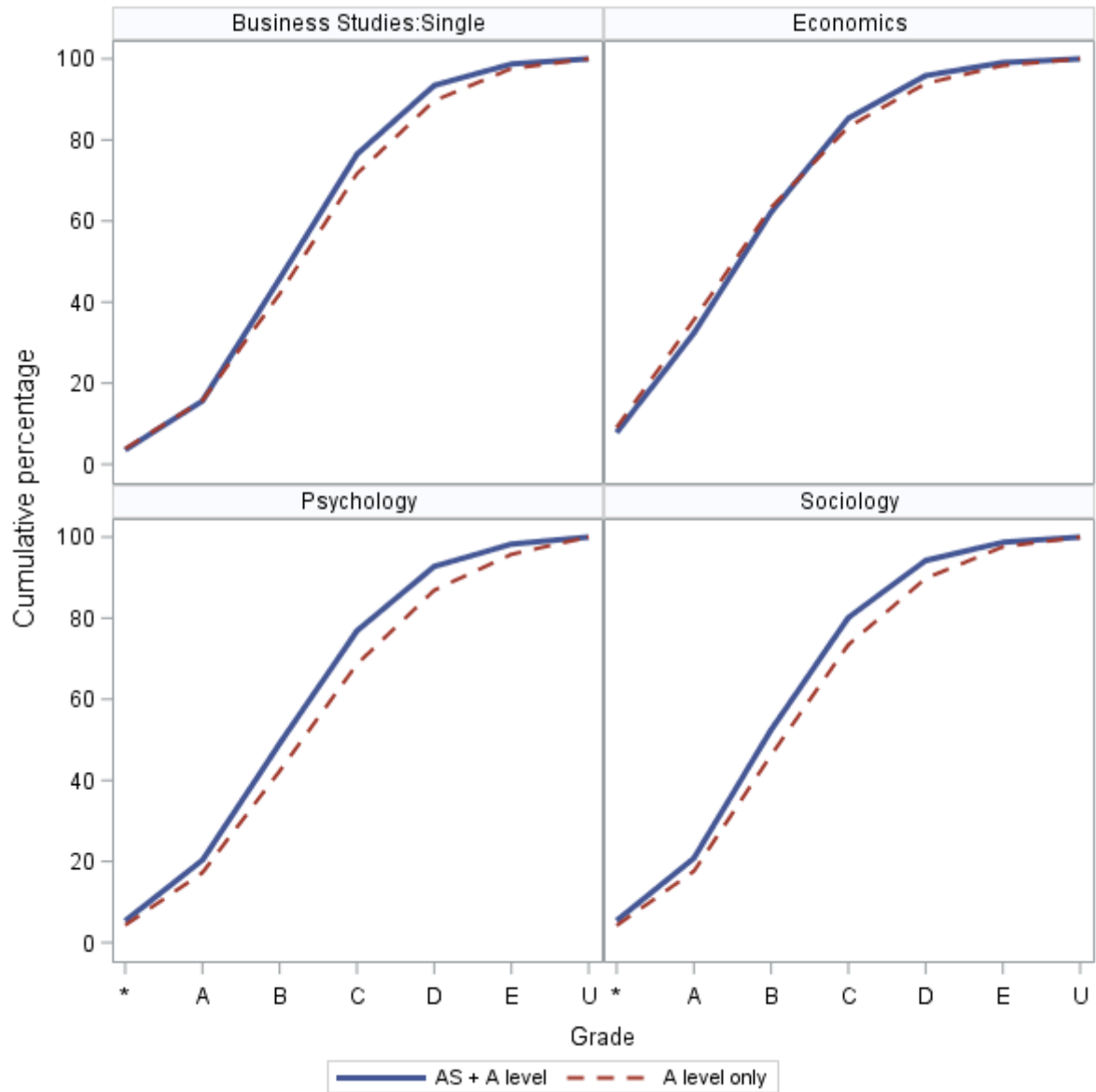| Subject and route		N All	A*	A	B	C	D	E	U
					Grade (cumulative %)				
Art & Design	AS + A level	2,536	14.0	30.6	59.7	82.9	94.1	98.6	100.0
	A level only	2,449	14.9	33.4	63.3	85.1	96.0	99.1	100.0
Art & Design (3d Studies)	AS + A level	464	11.9	26.1	62.7	86.6	96.1	99.4	100.0
	A level only	313	9.3	27.2	55.9	81.8	93.0	98.1	100.0
Art & Design (Critical Studies)	AS + A level	81	11.1	21.0	54.3	75.3	91.4	100.0	100.0
	A level only	32	9.4	18.8	53.1	71.9	90.6	100.0	100.0
Art & Design (Fine Art)	AS + A level	6,452	14.6	31.8	61.5	84.2	95.8	99.2	100.0
	A level only	5,910	17.6	34.2	65.4	85.7	96.0	99.2	100.0
Art & Design (Graphics)	AS + A level	2,366	11.5	27.5	58.4	83.9	96.2	99.3	100.0
	A level only	1,512	14.6	29.8	61.9	84.7	95.3	99.3	100.0
Art & Design (Photography)	AS + A level	6,219	8.3	20.8	52.3	81.2	94.3	98.8	100.0
	A level only	4,291	9.8	23.7	54.6	81.3	94.0	98.9	100.0
Art & Design (Textiles)	AS + A level	1,686	11.9	26.0	57.6	82.7	95.6	99.4	100.0
	A level only	1,200	15.1	31.9	66.5	87.8	96.4	99.0	100.0
Biology	AS + A level	33,678	8.7	28.4	51.3	73.7	90.4	98.0	100.0
	A level only	13,855	9.6	28.7	49.3	68.5	85.8	95.6	100.0
Business Studies: Single	AS + A level	17,440	3.5	15.6	45.8	76.5	93.4	98.7	100.0
	A level only	6,147	3.9	15.7	42.0	71.7	89.7	97.6	100.0
Chemistry	AS + A level	27,892	9.3	33.9	58.9	78.7	92.3	98.2	100.0
	A level only	12,314	9.7	33.9	55.5	73.6	87.3	95.8	100.0
Computer Studies/Computing	AS + A level	4,785	3.3	19.0	39.8	63.2	84.4	96.0	100.0
	A level only	1,974	3.2	15.3	36.0	58.9	79.0	92.3	100.0
Economics	AS + A level	16,902	7.8	32.3	62.2	85.3	95.9	99.1	100.0
	A level only	7,851	9.1	35.6	63.4	83.3	93.9	98.3	100.0
English Language	AS + A level	13,587	1.6	10.8	38.6	75.6	94.9	99.3	100.0
	A level only	3,610	1.1	10.4	37.2	73.5	94.1	99.2	100.0
English Language & Literature	AS + A level	6,711	2.8	12.2	40.6	75.2	94.9	99.3	100.0
	A level only	2,549	3.1	13.2	42.6	76.2	94.9	99.3	100.0
English Literature	AS + A level	26,083	8.6	24.6	53.3	80.8	95.8	99.4	100.0
	A level only	12,727	11.8	29.1	57.9	83.0	96.1	99.5	100.0
History	AS + A level	28,134	5.9	24.4	56.1	83.1	96.0	99.3	100.0
	A level only	13,111	7.6	27.3	58.8	84.0	96.0	99.2	100.0
Physics	AS + A level	19,527	10.0	31.1	52.5	72.2	88.1	97.0	100.0
	A level only	8,786	10.9	32.1	51.0	69.2	84.1	94.7	100.0
Psychology	AS + A level	37,388	5.3	20.3	49.1	76.9	92.7	98.3	100.0
	A level only	12,344	4.3	17.2	42.3	68.6	86.9	95.8	100.0
Sociology	AS + A level	22,400	5.4	20.8	52.5	80.2	94.2	98.7	100.0
	A level only	5,954	4.2	17.6	46.3	73.5	89.8	97.6	100.0

Comparability of A level candidates following different A level routes

Before investigating the A level outcomes of 'AS + A level' and 'A level only' candidates further, we checked the comparability of the two groups.

Descriptive statistics

The student and centre characteristics of entries for each A level route are described in Tables 7 to 10, and Figure 5.

Table 5 shows a very similar gender distribution for the two A level routes. Both routes were taken by a higher percentage of female than male candidates, with the percentages differing by less than two percentage points between the routes.

Table 6 shows certain differences in the distributions of centre types between the two A level routes. The largest difference concerned independent schools. The percentage of candidates who came from independent schools was much higher among the 'A level only' candidates (23%) than among the 'AS + A level' candidates (8%). Independent schools represented the second largest centre type among 'A level only' candidates whereas it was the fourth largest amongst the 'AS + A level' candidates. The percentages of candidates from selective academies, grammar schools and, to a lesser extent, secondary moderns were also higher amongst the 'A level only' candidates than the 'AS + A level' candidates. In contrast, smaller percentages of 'A level only' candidates came from comprehensive academies, sixth form colleges, comprehensive schools and FE colleges relative to those percentages amongst the 'AS + A level' candidates. Nevertheless, in both A level routes, the largest group of candidates came from comprehensive academies, comprising 32% of 'A level only' candidates and 39% of 'AS + A level' candidates.

Table 7 shows a broadly similar distribution of candidates from different regions in England for the two A level routes. The largest differences were for the South East and Yorkshire regions. A larger percentage of 'A level only' candidates came from the South East compared to the percentage amongst the 'AS + A level' candidates (24% vs. 17%) whereas the percentages of candidates from Yorkshire was lower amongst the 'A level only' than the 'AS + A level' candidates (6% vs. 10%).

Table 8 shows little difference in the distributions of income-related deprivation between the A level routes. Each route had similar percentages of candidates from areas of low, medium and high deprivation.

Figure 5 shows the distribution of KS4 attainment (average KS4 point score) for each A level route, by subject. Every subject showed large overlap between the distributions for the two routes, with little difference between the median point scores.

Table 5: Proportions of 2017 reformed A level entries by route and gender

Gender	AS + A level		A level only	
	N	%	N	%
F	163,799	59.7	67,752	57.9
M	110,532	40.3	49,177	42.1
All	274,331	100.0	116,929	100.0

Table 6: Proportions of 2017 reformed A level entries by route and centre type

Centre type	Route			
	AS + A level		A level only	
	N	%	N	%
6th Form College	57,210	20.9	18,328	15.7
Academy (comp)	107,412	39.2	36,843	31.5
Academy (mod)	2,853	1.0	1,159	1.0
Academy (sel)	19,666	7.2	14,896	12.7
Comprehensive	40,766	14.9	13,797	11.8
FE College	20,687	7.5	2,527	2.2
Grammar	3,513	1.3	2,157	1.8
Independent	20,878	7.6	26,516	22.7
Other	519	0.2	56	0.0
Secondary Modern	648	0.2	572	0.5
[centre missing]	179	0.1	78	0.1
All	274,331	100.0	116,929	100.0

Table 7: Proportions of 2017 reformed A level entries by route and region

Region	Route			
	AS + A level		A level only	
	N	%	N	%
East Midlands	22,474	8.2	8,334	7.1
East of England	33,500	12.2	13,469	11.5
London	45,005	16.4	17,709	15.1
North East	11,828	4.3	3,088	2.6
North West	37,036	13.5	11,822	10.1
South East	47,229	17.2	28,444	24.3
South West	25,817	9.4	12,822	11.0
West Midlands	24,206	8.8	14,417	12.3
Yorkshire and The Humber	27,094	9.9	6,766	5.8
[region missing]	142	0.1	58	0.0
All	274,331	100.0	116,929	100.0

Table 8: Proportions of 2017 reformed A level entries by route and deprivation group

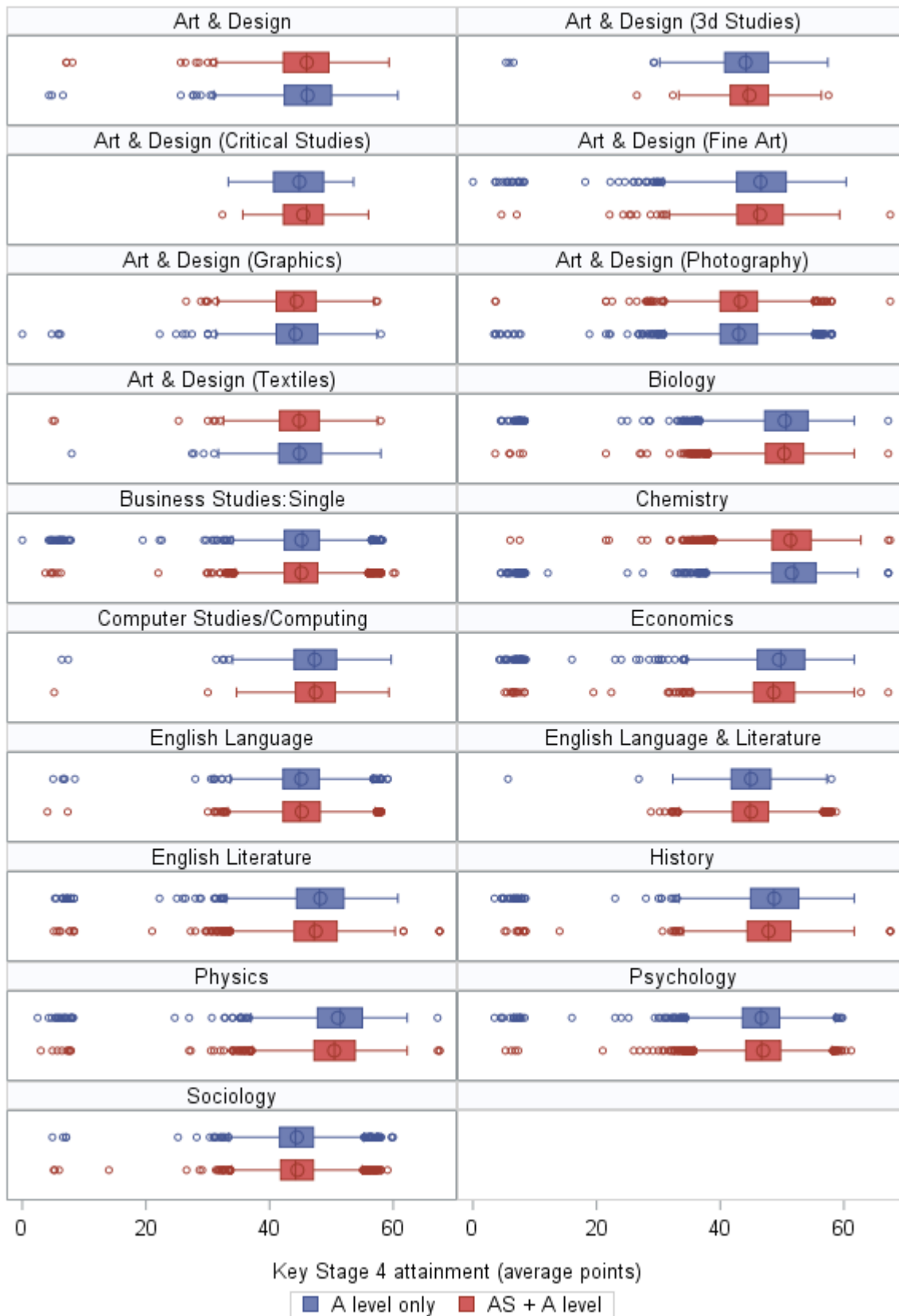| Deprivation group	Route			
	AS + A level		A level only	
	N	%	N	%
No deprivation data	99,268	36.2	47,636	40.7
Low	61,328	22.4	22,360	19.1
Medium	58,013	21.1	23,443	20.0
High	55,722	20.3	23,490	20.1
All	274,331	100.0	116,929	100.0

Figure 5: Prior attainment of reformed A level candidates, by route and subject

Propensity score analysis of group comparability

As explained in the 'Methods of analysis' section (see p. 11), we used multilevel logistic regression models to estimate the probability of candidates achieving grade thresholds in four particular A level subjects. For these subjects, we first estimated propensity scores (for likelihood of following an 'A level only' route in that subject), and compared the distributions of the propensity scores for 'AS + A level' and 'A level only' candidates. The graphs showing the extent of distribution overlap can be found in Appendix A (Figures 14 to 17).

Within each subject, the overall similarity of the 'AS + A level' and 'A level only' candidates was confirmed by almost perfect overlap in the propensity score distributions. Although there were differences between the shapes of the two distributions, there was common support for both groups (i.e., the range of estimated propensities shown by each group was the same), indicating that the two candidate groups were fundamentally comparable. The different proportions of students with particular propensity scores varied, and needed to be accounted for in comparisons, but the common support showed that such comparison was possible.

Modelling likelihood of achieving grade thresholds

The multilevel logistic regression models estimated the probability of achieving grade thresholds in particular A level subjects, accounting for the differences between the characteristics of 'AS + A level' and 'A level only' candidates (which the raw cumulative grade distributions do not account for). Three models were estimated for each subject chosen:

1. Probability of candidate achieving grade A*
2. Probability of candidate achieving grade A or above
3. Probability of candidate achieving grade C or above.

The four subjects selected for the logistic regression analyses were Art & Design (Fine Art), Biology, English Literature and Psychology. The subjects were selected in order to represent a range of subject types, and included those for which previous research had found an AS advantage (Psychology, Biology) and those for which previous research had found no AS advantage or disadvantage (English Literature, Fine Art) (Harrison, 2018).

In each of the four subjects, the models were estimated using all Year 13 candidates who fell within the zone of common support identified by the propensity score analysis described in the previous section. It should be noted that candidates with missing data, for whom propensity scores could not be estimated, were thus excluded. Table 9 shows the resulting percentages of Year 13 A level candidates in each of the four subjects that were used in the estimation of the grade threshold models.

Table 9: A level candidates used to estimate grade threshold models

Subject	Year 13 candidates awarded A level in summer 2017	Used in estimation of grade threshold models	
	N	**N**	**%**
Art & Design (Fine Art)	12,362	12,063	97.6
Biology	47,533	46,630	98.3
English Literature	38,810	38,210	98.5
Psychology	49,732	49,082	98.7

Art & Design (Fine Art)

After accounting for candidate and centre characteristics, there was no significant effect of A level route on the probability of achieving any of the grade thresholds modelled in Fine Art (p = .5, see Table 18, Table 19, Table 20 in Appendix B).

In terms of the other variables in the models, at all three grade thresholds there were significant effects of KS4 attainment (candidates with higher KS4 attainment were more likely to meet the grade thresholds than those with lower KS4 attainment) and region (candidates at centres in the East or West Midlands were less likely to meet the grade thresholds than those at centres in London).

In addition, there were also significant effects found for some grade thresholds and not others. The effect of centre type was significant for candidates from comprehensive schools and FE colleges, who were significantly less likely than those from comprehensive academies to achieve grade A or above. At the grade C threshold, there were significant effects of gender (males were less likely than females to achieve grade C or above), deprivation (candidates from areas of high deprivation were less likely than those from areas of low deprivation to achieve C or above) and again centre type (candidates from comprehensive schools were less likely than those from comprehensive academies to achieve C or above).

Biology

For both the grade A and grade C thresholds, A level route had a significant effect on the predicted probability of a candidate meeting the threshold. After accounting for candidate and centre characteristics included in the model (prior attainment, gender, centre type, income-related deprivation, and geographical region), candidates following an 'A level only' route were significantly less likely to achieve an A or above, and significantly less likely to achieve a C or above (see Table 21 and Table 22 in Appendix B).

In terms of the other variables in the models, for both the grade A and grade C thresholds there were also significant effects of gender (males were more likely than females to meet the grade threshold), KS4 attainment (candidates with higher KS4 attainment were more likely to meet the grade thresholds than those with lower KS4 attainment), income-related deprivation (candidates from areas of high and medium deprivation were less likely than those from areas of low deprivation to meet the thresholds), and region (candidates at centres in the West Midlands were less likely to meet the grade thresholds than those at centres in London, and candidates at centres in Yorkshire were more likely than those at centres in London to meet the thresholds).

In addition to these effects, candidates at centres in the East Midlands and the South West were significantly more likely than candidates at centres in London to achieve grade A or above, and candidates attending selective academies were significantly more likely to achieve grade C or above than candidates from comprehensive academies.

In the grade A model for Biology, the estimated coefficient for the variable 'A level only' (an indicator variable) was -0.211 (SE 0.041). Thus, the estimated effect of following an 'A level only' route was to reduce a candidate's odds of achieving grade A or above, with the odds scaled by a factor of 0.81 (the exponential of the coefficient). In the grade C model, the estimated coefficient was -0.405 (SE 0.041), so that following an 'A level only' route

corresponded to scaling a candidate's predicted odds of achieving grade C or above by a factor of 0.67.

To aid interpretation of the predicted effects, Figure 6 shows the predicted probabilities of 'A level only' and 'AS + A level' candidates achieving a grade C or above in Biology (green and purple lines) and of achieving a grade A or above in Biology (red and blue lines), according to candidates' KS4 attainment and their A level route. The estimated probabilities shown are for a female candidate from an area of low deprivation, studying at a comprehensive academy in London. For both grade thresholds, the predicted probability of achievement was lower for candidates following an 'A level only' route.
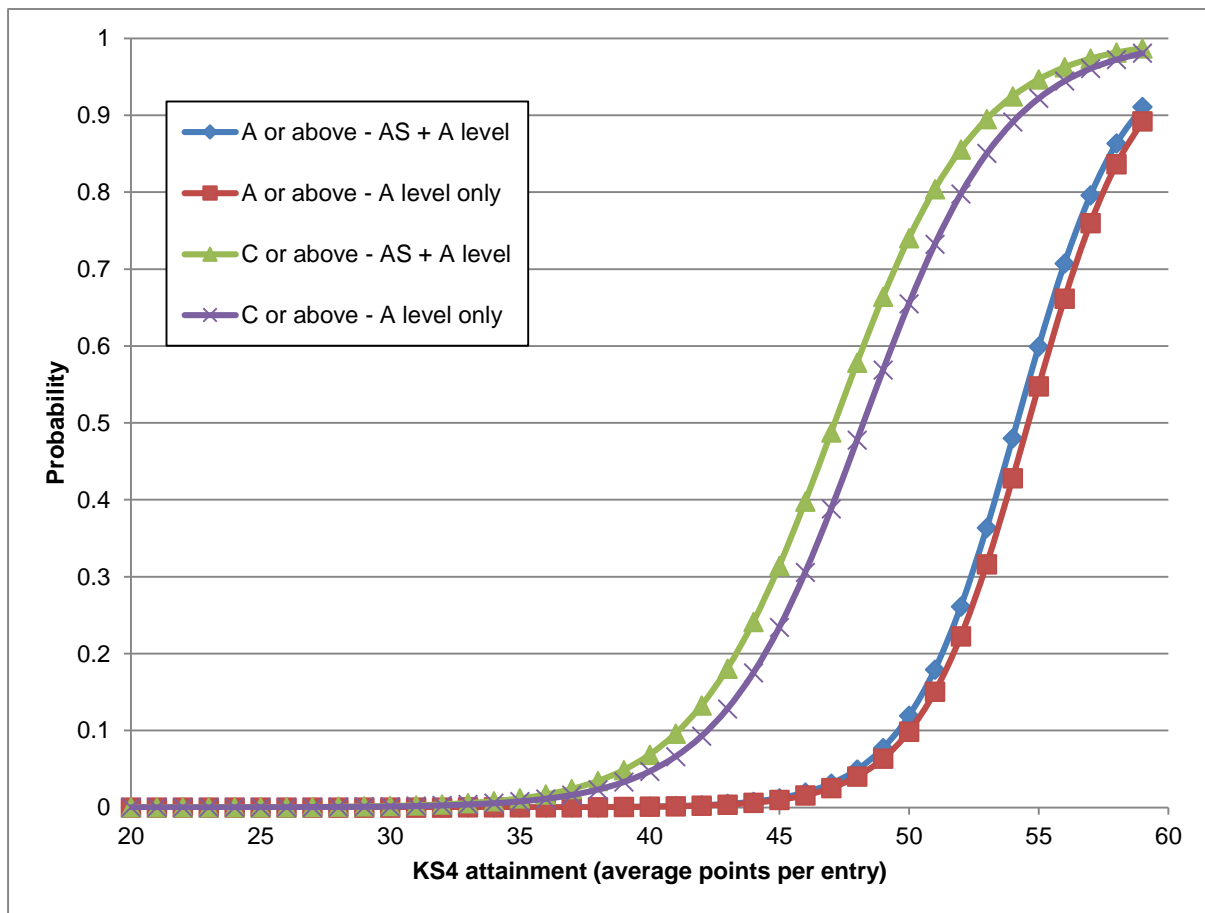
Figure 6: Predicted probabilities of achieving grade thresholds in A level Biology, by A level route (female, low deprivation, comprehensive academy, London)

For a female candidate from an area of low income-related deprivation, attending a comprehensive academy in London, the estimated probabilities of achieving each grade threshold can be read directly from Figure 6. The probabilities of achieving grade C or above differed most for a candidate of medium to high KS4 attainment. For a female candidate from an area of low income-related deprivation, attending a comprehensive academy in London, with an average KS4 attainment score of 46 (equivalent to an average grade of B at GCSE), the estimated probability was 0.40 if following an 'AS + A level' route and 0.31 if following an 'A level only' route. The differences in predicted probability of achieving grade C

or above were smaller for candidates with lower KS4 attainment, and for candidates with very high KS4 attainment. The differences between predicted probabilities of achieving grade A or above were smaller than the differences between predicted probabilities of achieving grade C or above.

Figure 6 showed the predicted probabilities of achieving the grade thresholds for a female candidate from an area of low income-related deprivation, attending a comprehensive academy in London. To summarise the predicted effect of A level route for *all* candidates in Biology, Table 10 shows the estimated change in the probability of achieving each grade threshold, for any two candidates who differed only in A level route. For example, if the predicted probability of an 'AS + A level' candidate achieving grade A or above was 0.40, the predicted probability of an otherwise identical 'A level only' candidate achieving grade A or above was 0.35. If the probability of an 'AS + A level' candidate achieving grade C or above was 0.40, the predicted probability of an otherwise identical 'A level only' candidate achieving grade C or above was 0.31.

Table 10: Effect of A level route on predicted probabilities of meeting grade thresholds, Biology

Probability of achieving threshold conditional on 'AS + A level' route	Predicted probability of achieving threshold, and difference in predicted probability, for otherwise identical candidate on an 'A level only' route			
	Grade A or above		Grade C or above	
	Probability	Difference	Probability	Difference
0.1	0.08	-0.02	0.07	-0.03
0.2	0.17	-0.03	0.14	-0.06
0.3	0.26	-0.04	0.22	-0.08
0.4	0.35	-0.05	0.31	-0.09
0.5	0.45	-0.05	0.40	-0.10
0.6	0.55	-0.05	0.50	-0.10
0.7	0.65	-0.05	0.61	-0.09
0.8	0.76	-0.04	0.73	-0.07
0.9	0.88	-0.02	0.86	-0.04
1.0	1.00	0.00	1.00	0.00

To summarise further still, we calculated the marginal effects of A level route at the average probabilities of achieving each threshold, a summary suggested by Mood (2010). These were obtained by multiplying the values of the probability density functions at the average predicted probabilities by the estimated coefficients of A level route, for each model. The marginal effect of an 'A level only' route on the probability of achieving a grade A or above, conditional on having the average probability of achieving grade A or above, was -0.03. The marginal effect of an 'A level only' route on the probability of achieving a grade C or above, conditional on having the average probability of achieving grade C or above, was -0.07.

A satisfactory logistic regression model for the grade A* in Biology could not be estimated.

English Literature
After accounting for candidate and centre characteristics, there was no significant effect of A level route on the probability of achieving any of the grade thresholds modelled in English Literature (p = .5, Table 23, Table 24, Table 25 in Appendix B).

In terms of the other variables in the models, at all three grade thresholds there were significant effects of gender (males were more likely than females to meet the grade thresholds), KS4 attainment (candidates with higher KS4 attainment were more likely to meet the grade thresholds than those with lower KS4 attainment), income-related deprivation (candidates from areas of high and medium deprivation were less likely than those from areas of low deprivation to meet the grade thresholds) and region (candidates at centres in Yorkshire were less likely than candidates at centres in London to meet the grade thresholds).

In addition to these effects, there were also significant effects found for some grade thresholds and not others. Candidates from FE colleges were less likely than those from comprehensive academies to achieve a grade A*, or grade A or above, and candidates from the East of England were less likely than those from London to achieve an A*, or grade A or above. Candidates at centres in the East and West Midlands were also less likely than those at centres in London to achieve grade A or above. Finally, candidates from secondary modern schools and secondary modern academies were less likely than those from comprehensive academies to achieve grade C or above, and candidates at centres in the East Midlands were less likely than those at centres in London to achieve grade C or above.

Psychology
For all three grade thresholds modelled in Psychology, A level route had a significant effect on the predicted probability of a candidate meeting the threshold. After accounting for candidate and centre characteristics, those following an 'A level only' route were significantly less likely to meet the grade thresholds than candidates following an 'AS + A level' route (Table 26, Table 27, Table 28 in Appendix B).

In terms of the other variables in the models, for all three grade thresholds there were significant effects of gender (males were less likely than females to meet the grade thresholds), KS4 attainment (candidates with higher KS4 attainment were more likely to meet the grade thresholds than those with lower KS4 attainment) and income-related deprivation (candidates from areas of high deprivation were less likely than those from areas of low deprivation to meet the thresholds).

In addition to these effects, there were also significant effects found for some grade thresholds and not others. Candidates from areas of medium income-related deprivation were less likely than those from areas of low deprivation to achieve grade A*, and candidates from grammar schools were less likely than those from comprehensive academies to achieve grade A*. Candidates from grammar schools were also less likely to achieve grade A or above. Candidates at centres in the East and West Midlands and Yorkshire were less likely than those at centres in London to achieve grade A or above.

Finally, candidates from areas of medium income-related deprivation were less likely than those from areas of low deprivation to achieve grade C or above, and candidates at centres not in London were less likely than those at centres in London to achieve grade C or above.

In the A* model for Psychology, the estimated coefficient for the variable 'A level only' (an indicator variable) was -0.266 (SE 0.075). Thus, the estimated effect of following an 'A level only' route was to reduce a candidate's odds of achieving grade A*, with the odds scaled by a factor of 0.77 (the exponential of the coefficient). In the grade A model, the estimated

coefficient was -0.242 (SE 0.051), so that following an 'A level only' route corresponded to scaling a candidate's predicted odds of achieving grade A or above by a factor of 0.79. In the grade C model, the estimated coefficient was -0.434 (SE 0.046), so that following an 'A level only' route corresponded to scaling a candidate's odds of achieving grade C or above by a factor of 0.65.

To aid interpretation of the predicted effects, Figure 7 shows the estimated probabilities of achieving each grade threshold in Psychology A level, according to candidates' KS4 attainment and their A level route. The estimated probabilities shown are for a female candidate from an area of low deprivation, studying at a comprehensive academy in London. For each grade threshold, the predicted probability of achievement was lower for candidates following an 'A level only' route.
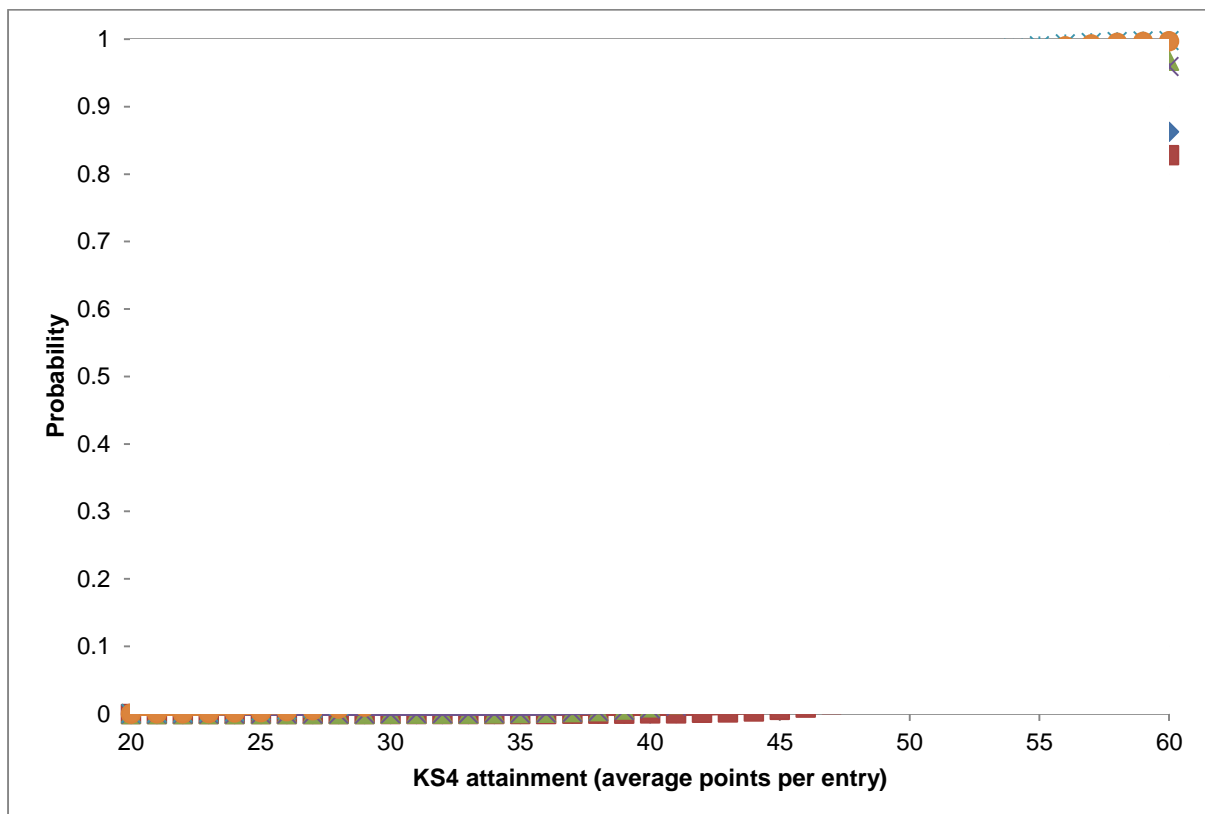
Figure 7: Predicted probabilities of achieving grade thresholds in A level Psychology, by A level route (female, low deprivation, comprehensive academy, London)

Figure 7 shows that the differences in predicted probabilities for 'AS + A level' and 'A level only' candidates varied with level of KS4 attainment. For a female candidate from an area of low deprivation, studying at a comprehensive academy in London, as shown in Figure 7, the predicted probabilities of achieving grade C or above differed most for a candidate with medium levels of KS4 attainment: for a candidate with average KS4 points of 40 (equivalent to grade C at GCSE), the predicted probability of achieving grade C or above was 0.41 for a candidate on an 'AS + A level route' and 0.31 for a candidate on an 'A level only' route. The predicted probabilities of achieving grade A or above, by contrast, differed most for candidates with higher prior attainment: for candidates with average KS4 points of 52 for example (equivalent to grade A at GCSE), the predicted probability of achieving grade A or

above was 0.55 for 'AS + A level' candidates and 0.49 for 'A level only' candidates. The predicted probabilities of achieving grade A* differed most for candidates with the highest KS4 attainment. For those with average KS4 points of 58 (equivalent to grade A* at GCSE), the predicted probability of achieving A* was 0.72 for candidates on an 'AS + A level' route and 0.66 for those on an 'A level only' route.

The predicted probabilities shown in Figure 7, as stated, are those calculated for a female candidate from an area of low deprivation, studying at a comprehensive academy in London. To summarise the predicted effect of A level route for *all* candidates in Psychology, Table 11 shows the estimated change in the probability of achieving each grade threshold, for any two candidates who differed only in A level route. For example, if the predicted probability of an 'AS + A level' candidate achieving grade C or above was 0.40, the predicted probability of an otherwise identical 'A level only' candidate achieving grade C or above was 0.30.

Table 11: Effect of A level route on predicted probabilities of meeting grade thresholds, Psychology

Probability of achieving threshold conditional on 'AS + A level' route	Predicted probability of achieving threshold, and difference in predicted probability, for otherwise identical candidate on an 'A level only' route					
	Grade A*		Grade A or above		Grade C or above	
	Probability	Difference	Probability	Difference	Probability	Difference
0.1	0.08	-0.02	0.08	-0.02	0.07	-0.03
0.2	0.16	-0.04	0.16	-0.04	0.14	-0.06
0.3	0.25	-0.05	0.25	-0.05	0.22	-0.08
0.4	0.34	-0.06	0.34	-0.06	0.30	-0.10
0.5	0.43	-0.07	0.44	-0.06	0.39	-0.11
0.6	0.53	-0.07	0.54	-0.06	0.49	-0.11
0.7	0.64	-0.06	0.65	-0.05	0.60	-0.10
0.8	0.75	-0.05	0.76	-0.04	0.72	-0.08
0.9	0.87	-0.03	0.88	-0.02	0.85	-0.05
1.0	1.00	0.00	1.00	0.00	1.00	0.00

As for the Biology models estimated, we finally calculated the marginal effects of A level route at the average probabilities of achieving each threshold. As in Biology, the marginal effects were small, but larger for the grade C threshold than for higher grades. The marginal effect of an 'A level only' route on the probability of achieving a grade A*, conditional on having the average probability of achieving grade A*, was -0.003. The marginal effect of an 'A level only' route on the probability of achieving a grade A or above, conditional on having the average probability of achieving grade A or above, was -0.02. Finally, the marginal effect of an 'A level only' route on the probability of achieving a grade C or above, conditional on having the average probability of achieving grade C or above, was -0.07.

A level routes compared using CEM

As explained in the 'Methods of analysis' (see p. 12), we carried out a further comparison of A level outcomes for 'AS + A level' and 'A level only' candidates by creating matched groups using Coarsened Exact Matching (CEM). This provided a way to check the robustness of the findings obtained from logistic regression modelling, and also to provide a point of comparison with the AQA research findings (Harrison, 2018), which were obtained using a CEM method.

The candidates included in the matched 'AS + A level' and 'A level only' groups are shown in Table 12.

Table 12: Candidates included in groups matched by CEM

Subject	Total Y13 candidates	Total number matched	Percentage matched
Art & Design	4,985	1,391	27.9
Art & Design (Fine Art)	12,362	5,409	43.8
Art & Design (Photography)	10,510	4,438	42.2
Art & Design (Textiles)	2,886	884	30.6
Biology	47,533	28,791	60.6
Business Studies	23,587	11,692	49.6
Chemistry	40,206	22,744	56.6
Computer Science/Computing	6,759	2,029	30.0
Economics	24,753	12,897	52.1
English Language	17,197	6,918	40.2
English Language & Literature	9,260	3,258	35.2
English Literature	38,810	24,189	62.3
History	41,245	24,825	60.2
Physics	28,313	14,651	51.8
Psychology	49,732	31,205	62.8
Sociology	28,354	14,960	52.8

The cumulative grade distributions for the matched 'AS + A level' and 'A level only' groups in each subject can be found in Appendix C (Table 29, and Figure 12 to Figure 15), and these cumulative grade distributions show differences in A level outcomes by A level route. To test whether differences in the proportions of 'AS + A level' and 'A level only' candidates reaching each grade threshold were statistically significant, chi squared tests were carried out. The results are shown in Table 13 to Table 16.

For Art & Design subjects, few statistically significant differences in A level outcomes were found (Table 13). In Photography, there was a significant AS 'disadvantage' but only at grade A*, where the percentage of 'AS + A level' candidates achieving A* was 1.8 percentage points lower than the corresponding percentage of 'A level only' candidates. In Textiles, there was a statistically significant AS 'disadvantage' for both grade A* and C: the percentage of 'AS + A level' candidates achieving A* was 5.5 percentage points lower than the corresponding percentage of 'A level only' candidates, and the percentage of 'AS + A level' candidates achieving grade C or above was 4.8 percentage points lower than the corresponding percentage of 'A level only' candidates.

Table 13: Post-CEM tests - Art & Design A levels

Subject and grade threshold		Statistically significant difference?	Difference in percentage reaching threshold	N	d.f.	X^2	p
Art & Design	A*	No	-1.5	1,391	1	0.55	0.46
Art & Design	≥ A	No	-4.1	1,391	1	2.56	0.11
Art & Design	≥ C	No	-0.7	1,391	1	0.13	0.71
Art & Design (Fine Art)	A*	No	-0.7	5,409	1	0.50	0.48
Art & Design (Fine Art)	≥ A	No	-0.3	5,409	1	0.06	0.81
Art & Design (Fine Art)	≥ C	No	-0.4	5,409	1	0.20	0.66
Art & Design (Photography)	A*	AS disadvantage	-1.8	4,438	1	4.86	0.03
Art & Design (Photography)	≥ A	No	-2.1	4,438	1	2.68	0.10
Art & Design (Photography)	≥ C	No	0.5	4,438	1	0.20	0.66
Art & Design (Textiles)	A*	AS disadvantage	-5.5	884	1	5.12	0.02
Art & Design (Textiles)	≥ A	No	-4.6	884	1	2.15	0.14
Art & Design (Textiles)	≥ C	AS disadvantage	-4.8	884	1	4.62	0.03

A higher number of statistically significant differences between A level routes were found for science subjects (Table 14). In contrast to the differences found for Art & Design subjects, in science subjects all significant differences showed an AS 'advantage'. In all science subjects (Biology, Chemistry, Physics and Computer Science), the proportions of 'AS + A level' candidates achieving grade A or above, and achieving grade C or above, were significantly higher than the corresponding proportions of 'A level only' candidates. In all four subjects, the difference in percentage points was smaller at the grade A and above threshold. In Biology, the differences were 1.8 and 4.7 percentage points for grade A or above and grade C or above thresholds, respectively. In Chemistry, the differences were 3 and 6.3 percentages points, in Physics, 2.3 and 5.7 percentage points, and in Computer Science, 3.7 and 5.2 percentage points.

In Chemistry, the proportions of candidates achieving grade A* also differed significantly between routes: the proportion of 'AS + A level' candidates achieving A* was 1.3 percentage points higher than the corresponding 'A level only' proportion.

Table 14: Post-CEM tests - science A levels

Subject and grade threshold		Statistically significant difference?	Difference in percentage reaching threshold	N	d.f.	X^2	p
Biology	A*	No	0.5	28,791	1	2.04	0.15
Biology	≥ A	AS advantage	1.8	28,791	1	10.24	<.01
Biology	≥ C	AS advantage	4.7	28,791	1	73.50	<.0001
Chemistry	A*	AS advantage	1.3	22,744	1	8.82	<.01
Chemistry	≥ A	AS advantage	3.0	22,744	1	21.51	<.0001
Chemistry	≥ C	AS advantage	6.3	22,744	1	125.78	<.0001
Physics	A*	No	0.5	14,651	1	0.80	0.37

Physics	≥ A	AS advantage	2.3	14,651	1	8.18	<.01
Physics	≥ C	AS advantage	5.7	14,651	1	57.23	<.0001
Computer Science	A*	No	0.7	2029	1	0.79	0.37
Computer Science	≥ A	AS advantage	3.7	2029	1	4.95	0.03
Computer Science	≥ C	AS advantage	5.2	2029	1	5.49	0.02

In English subjects and History (Table 15), the results were mixed. In English Language, the only statistically significant difference was found at grade A*, where the proportion of 'AS + A level' candidates meeting the threshold was slightly higher (0.6 percentage points) than for 'A level only' candidates. In English Language & Literature, by contrast, the only significant difference was at grade C or above, where the proportion of 'AS + A level' candidates meeting the threshold was 4.1 percentage points *lower* than the corresponding proportion of 'A level only' candidates. In English Literature, no significant differences were found. In History, all three grade thresholds were met by a significantly higher proportion of 'AS + A level' candidates than 'A level only' candidates. The differences were 0.9, 2.5, and 1.1 percentage points at grade A*, grade A or above, and grade C or above respectively.

Table 15: Post-CEM tests – English and History A levels

Subject and grade threshold		Statistically significant difference?	Difference in percentage reaching threshold	N	d.f.	X^2	p
English Language	A*	AS advantage	0.6	6,918	1	5.31	0.02
English Language	≥ A	No	0.9	6,918	1	1.20	0.27
English Language	≥ C	No	0.0	6,918	1	< 0.01	0.97
English Lang. & Literature	A*	No	0.4	3,258	1	0.42	0.52
English Lang. & Literature	≥ A	No	0.2	3,258	1	0.03	0.86
English Lang. & Literature	≥ C	AS disadvantage	-4.1	3,258	1	6.84	0.01
English Literature	A*	No	0.4	24,189	1	0.92	0.34
English Literature	≥ A	No	0.1	24,189	1	0.06	0.81
English Literature	≥ C	No	0.1	24,189	1	0.07	0.79
History	A*	AS advantage	0.9	24,825	1	5.94	0.01
History	≥ A	AS advantage	2.5	24,825	1	18.12	<.0001
History	≥ C	AS advantage	1.1	24,825	1	5.22	0.02

In the remaining tranche 1 subjects, results showed an AS 'advantage' at many grade thresholds. In Business Studies, the only significant difference was at grade C or above, where the proportion of 'AS + A level' candidates meeting the threshold was 5.5 percentage points higher than the corresponding proportion of 'A level only' candidates. In Economics and Psychology, all three grade thresholds were met by a significantly higher proportion of 'AS + A level' candidates than 'A level only' candidates. In Economics, the differences were 2.6, 4.4, and 4.4 percentage points at grade A*, grade A or above, and grade C or above respectively. In Psychology, the differences were 0.7, 2.9 and 5.9 percentage points respectively. In Sociology, the proportion of 'AS + A level' candidates achieving grade A or above was 2.7 percentage points higher than for 'A level only' candidates, and the

proportion achieving grade C or above was 6 percentage points higher than for 'A level only' candidates.

Table 16: Post-CEM tests – other tranche 1 subject A levels

Subject and grade threshold		Statistically significant difference?	Difference in percentage reaching threshold	N	d.f.	X^2	p
Business Studies	A*	No	0.2	11,692	1	0.21	0.65
Business Studies	≥ A	No	0.9	11,692	1	1.55	0.21
Business Studies	≥ C	AS advantage	5.5	11,692	1	44.09	<.0001
Economics	A*	AS advantage	2.6	12,897	1	21.20	<.0001
Economics	≥ A	AS advantage	4.4	12,897	1	25.05	<.0001
Economics	≥ C	AS advantage	4.4	12,897	1	55.30	<.0001
Psychology	A*	AS advantage	0.7	31,205	1	7.36	0.01
Psychology	≥ A	AS advantage	2.9	31,205	1	35.68	<.0001
Psychology	≥ C	AS advantage	5.9	31,205	1	123.13	<.0001
Sociology	A*	No	0.7	14,960	1	3.41	0.06
Sociology	≥ A	AS advantage	2.7	14,960	1	14.77	0.0001
Sociology	≥ C	AS advantage	6.0	14,960	1	64.88	<.0001

5.   Discussion

Analysis of the grade distributions of 'AS + A level' and 'A level only' candidates showed that, before accounting for any differences in candidate and centre characteristics, the A level outcomes of the two groups differed. The differences between 'AS + A level' and 'A level only' varied across subjects, and were in line with those reported by the AQA research (Harrison, 2018).

Since differences had been identified, two approaches (multilevel logistic regression and coarsened exact matching) were used to look at whether A level outcomes for Year 13 students in summer 2017 varied according to A level route once candidate and centre characteristics were taken into account.

In summary, the findings from the two approaches were consistent. They showed that after controlling for candidates' gender, KS4 attainment, centre type, income-related deprivation and geographical region, candidates in Biology who had followed an 'AS + A level' route were significantly more likely than 'A level only' candidates to achieve a grade C or above, and to achieve a grade A or above. The estimated marginal effect of A level route on the likelihood of achieving grade C or above in Biology, for a candidate with average probability of achieving this threshold, was -0.07, whilst the estimated marginal effect on the likelihood of achieving a grade A or above (similarly, for a candidate with average probability of achieving this threshold) was -0.03. The comparison of CEM-matched candidate groups showed that the proportions of 'AS + A level' candidates achieving grade C and above and grade A and above in Biology were 4.7 and 1.8 percentage points higher the corresponding proportions of 'A level only' candidates respectively.

The results also showed that candidates in Psychology who had followed an 'AS + A level' route were significantly more likely than 'A level only' candidates to achieve all three grade thresholds tested: a grade or C or above, a grade A or above, and a grade A*. The estimated marginal effects of A level route in Psychology (in each, the marginal effect on the likelihood of achieving the grade threshold, for a candidate with average probability of achieving the grade threshold) were -0.07 at grade C, -0.02 at grade A, and -0.003 at grade A*. The comparison of CEM-matched candidate groups showed that the proportions of 'AS + A level' candidates meeting these grade thresholds were 5.9, 2.9 and 0.7 percentage points higher than the corresponding proportions of matched 'A level only' candidates for grades C, A, and A* respectively. In both Biology and Psychology, A level route was estimated to have a larger effect on the likelihood of achieving a grade C or above than on achieving the highest grades.

In Fine Art and English Literature, in contrast to Biology and Psychology, the logistic regression analyses found no statistically significant differences between A level outcomes for 'AS + A level' and 'A level only' candidates, once candidate and centre characteristics were taken into account. The comparison of CEM-matched candidate groups supported this finding: the proportions of candidates achieving grade C or above, grade A or above, and grade A* were not found to differ by A level route, in either Fine Art or English Literature.

AQA's research on the 'AS advantage' (Harrison, 2018) investigated 2017 A level outcomes in terms of the difference in mean marks achieved by 'AS + A level' and 'A level only' candidates, rather than grades achieved. The investigation was also restricted to AQA

candidates only, rather than all Year 13 candidates in England. The findings of the current research are, however, very largely in agreement with the AQA findings. In Biology, Harrison (2018) reported that 'AS + A level' candidates achieved a mean mark 6.14 marks higher than 'A level only' candidates, after weighting using CEM to match the candidate groups. In Psychology, the reported difference in mean marks (after weighting) was 6.43 marks, a larger 'AS advantage' than in Biology, as found in the current research. Harrison (2018) found no significant difference between 'AS + A level' and 'A level only' candidates in Fine Art, again, a result in line with the findings of the current research. A comparison of the findings for English Literature is complicated by the fact that the AQA investigation reported results for English Literature A and English Literature B specifications separately, whilst the NPD data analysed in the current research analysed all English Literature A level results. Harrison (2018) reported a small AS 'advantage' for English Literature A ('AS + A level' candidates achieving a mean mark 2.74 marks higher than 'A level only' candidates), and no significant difference in mean marks for English Literature B. These results are not inconsistent with the finding in the current research of no significant difference in achievement of grade thresholds.

Logistic regression modelling of achievement at grade thresholds was carried out for only the four selected subjects discussed above. The comparison of grade distributions for matched 'AS + A level' and 'A level only' groups, however, was carried out for all[9] tranche 1 subjects. With few exceptions, the findings were again in line with the results reported by Harrison (2018).

Table 17 summarises the results of both methods used to investigate the effect of A level route in the current research, together with the results of the AQA investigation (Harrison, 2018). The table shows whether each method identified a difference in A level outcomes associated with A level route, for each subject. Where a statistically significant difference was identified, the table lists the A level route for which A level outcomes were higher. It is important to highlight that this summary indicates only the presence or absence and direction of statistically significant effects. It does not include the size of these effects, or judge whether they are educationally significant.

[9] Excluding Art & Design (3D Studies) and Art & Design (Critical Studies), both of which had very low entries.

Table 17: Differences in A level outcomes associated with A level route, from three methods

Subject and grade threshold	Approaches used in current research		AQA research[10]
	Logistic regression modelling of achievement of grade thresholds	Comparison of grade distributions for CEM-matched groups	Analysis of mean marks for CEM-matched groups
Art & Design	*Not tested*	No effect	No effect
Art & Design (Fine Art)	No effect	No effect	No effect
Art & Design (Photography)	*Not tested*	A level only (A* only)	No effect
Art & Design (Textiles)	*Not tested*	A level only	A level only
Biology	AS + A level	AS + A level	AS + A level
Chemistry	*Not tested*	AS + A level	AS + A level
Physics	*Not tested*	AS + A level	AS + A level
Computer Science	*Not tested*	AS + A level	AS + A level
English Language	*Not tested*	AS + A level (A* only)	No effect
English Lang. & Literature	*Not tested*	A level only (C only)	No effect
English Literature	No effect	No effect	No effect for Lit. B; AS + A level for Lit. A
History	*Not tested*	AS + A level	AS + A level
Business Studies	*Not tested*	AS + A level (C only)	AS + A level
Economics	*Not tested*	AS + A level	AS + A level
Psychology	AS + A level	AS + A level	AS + A level
Sociology	*Not tested*	AS + A level (A & C only)	AS + A level

The differences between the current findings and AQA findings that are shown in Table 17 all occur where the current research identified an effect of A level route at one grade boundary but not others, or where the AQA research identified a difference for one specification but not another. As such, we conclude that the differences in reported findings reflect the different approaches taken rather than substantive differences in findings.

The effects of A level route that were identified by the current research were typically small. In Biology, the estimated marginal effect of following an 'A level only' route on the likelihood of achieving a grade A or higher, for a candidate with an average probability of doing so, was -0.03, whilst in Psychology it was -0.02. The estimated marginal effect on the probability of achieving a grade C or higher was -0.07 for both Biology and Psychology. Similarly, the differences found between the proportions of matched 'AS + A level' and 'A level only' candidates achieving each grade threshold were typically fairly low. The largest differences were found at the grade C threshold in the science subjects (Biology, Chemistry, Physics, Computer Science), Business Studies, Psychology and Sociology – among these subjects, the proportion of 'A level only' candidates achieving a grade C or higher was between 4.7 and 6.3 percentage points lower than the corresponding proportion of matched 'AS + A level' candidates.

The differences between A level outcomes for 'AS + A level' and 'A level only' candidates were small, but not sufficiently small to discount. Many of the A level subjects considered in this research have very large entries; thus, relatively small differences in percentages of

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[10] As reported by Harrison (2018).

candidates represent large numbers of actual candidates. Furthermore, if the differences in proportions of candidates reaching grade thresholds are viewed in terms of comparable outcomes tolerances, they could be considered rather large.

Two things must be kept in mind when interpreting the findings from this research. Firstly, the current research focused only on identifying and quantifying differences in A level outcomes for candidates following different A level routes, and not the reasons for these differences. In particular, whilst the analyses controlled for certain known characteristics (gender, KS4 attainment, centre type, income-related deprivation and geographical region), we cannot be certain that the remaining differences in A level performance were caused by candidates' A level route. Further research would be required to understand the causes - these could include differences in candidate motivations, teaching practices, exam-taking practice and more, some of which could be considered effects caused by the AS level itself, and some of which would be classified as candidate and centre characteristics not yet measured and accounted for.

The second important point to take note of is that KS5 education has changed substantially since the candidates analysed in this research undertook their studies. The candidates analysed in this research began their KS5 studies in September 2015, the first year of teaching for reformed AS and A levels. Since then, reformed AS and A levels have been introduced in all remaining subjects, schools and colleges have made changes to their KS5 provision and timetabling, uptake of AS levels has decreased, and the A levels that were 'new' in summer 2017 are now in their fourth year of teaching. Therefore, patterns observed in the cohort studied may well not be true of later cohorts.

6. References

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7. Appendix A – propensity score distributions
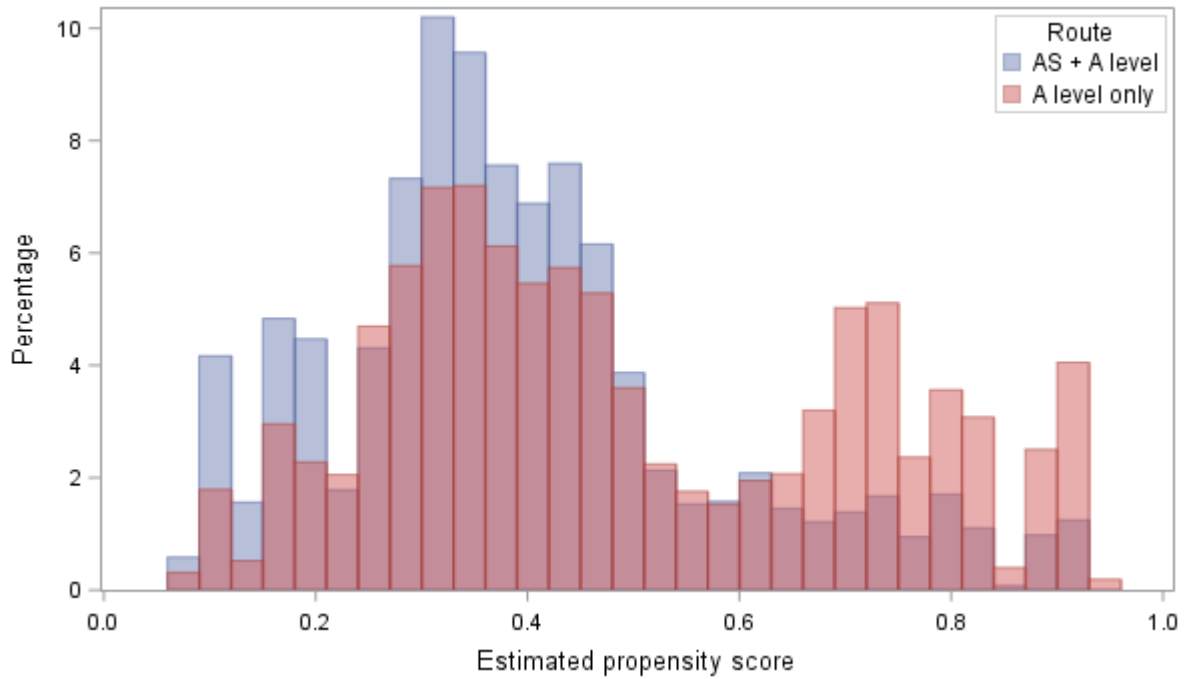
Figure 8: Estimated propensity score distributions (likelihood of following A level only route), A level Art & Design (Fine Art) candidates 2017
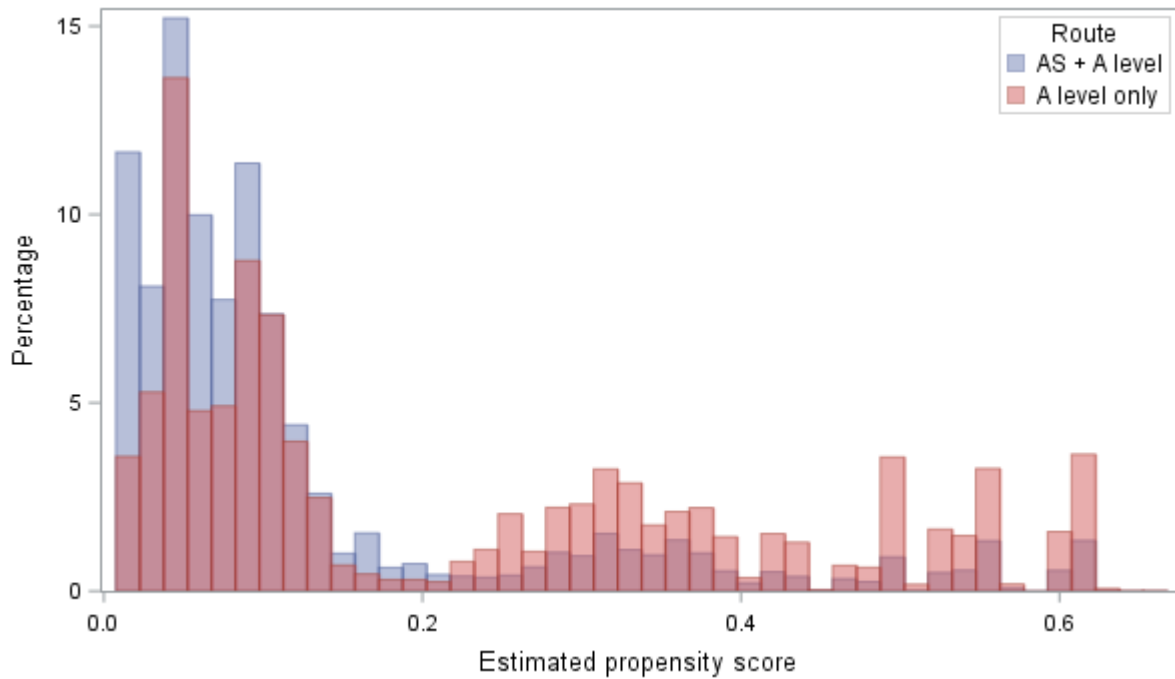
Figure 9: Estimated propensity score distributions (likelihood of following A level only route), A level Biology candidates 2017
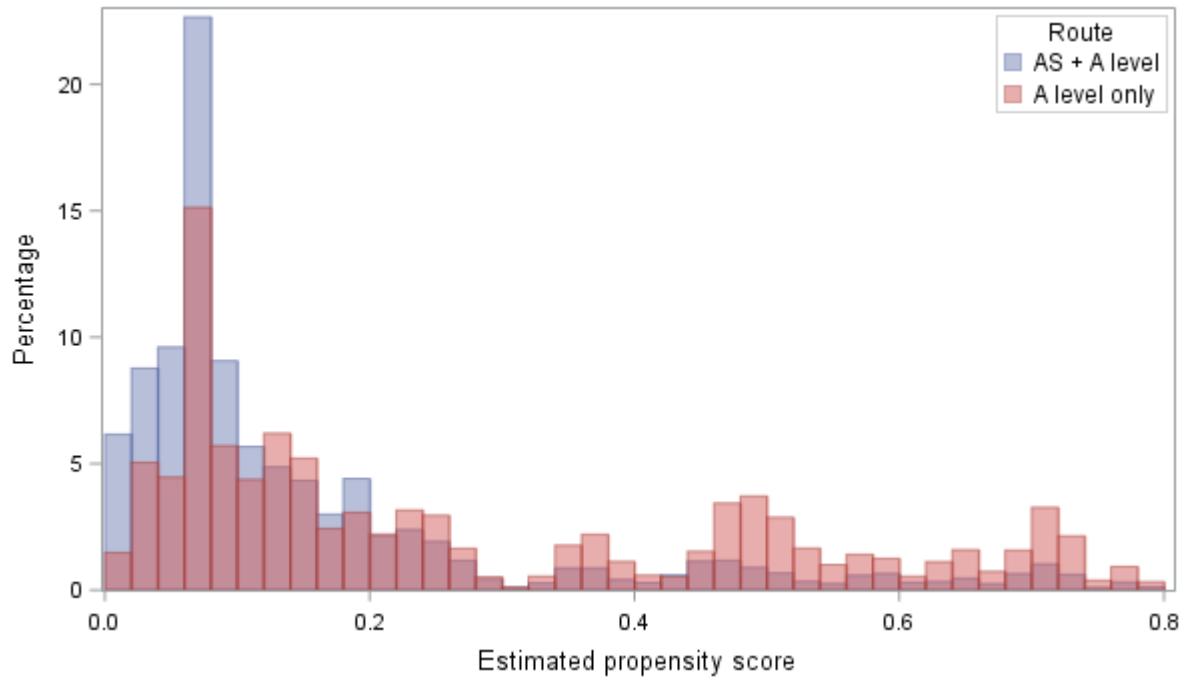
Figure 10: Estimated propensity score distributions (likelihood of following A level only route), A level English Literature candidates 2017
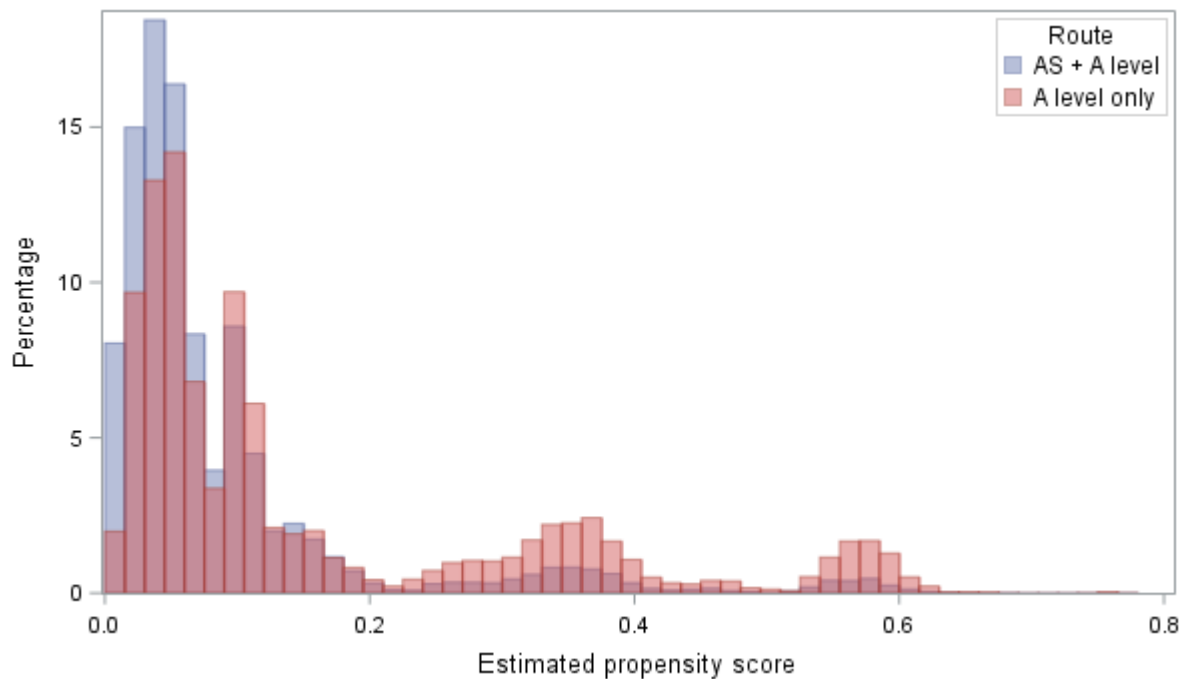
Figure 11: Estimated propensity score distributions (likelihood of following A level only route), A level Psychology candidates 2017

8. Appendix B – logistic regression outcomes

Table 18 to Table 28 show the parameter estimates for the logistic regression models used for modelling candidates' probabilities of meeting A level grade thresholds (as explained in the 'Methods of analysis' section, p. 11). Models were estimated for three grade thresholds (grade A*, grade A or above, and grade C or above) in each of Fine Art, Biology, English Literature and Psychology. In each table, statistically significant values (at 0.05 level) are shown in bold.

Art & Design (Fine Art)
Table 18: Probability of achieving grade A* in A level Art & Design (Fine Art)

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-13.05**	**0.41**	**-32.17**	**<.0001**
Gender	M	0.15	0.08	1.85	0.06
	[F]				
Key Stage 4 attainment		**0.24**	**0.01**	**31.41**	**<.0001**
Deprivation group	No deprivation data	-0.31	0.69	-0.45	0.65
	High	-0.15	0.11	-1.33	0.18
	Medium	-0.04	0.09	-0.44	0.66
	[Low]				
Centre type	6th Form College	-0.21	0.71	-0.29	0.77
	Academy (mod)	0.34	0.38	0.90	0.37
	Academy (sel)	-0.31	0.18	-1.77	0.08
	Comprehensive	-0.14	0.14	-1.05	0.30
	FE College	-1.17	0.74	-1.58	0.12
	Grammar	-0.59	0.40	-1.48	0.14
	Independent	0.55	0.69	0.79	0.43
	Secondary Modern	-0.06	0.84	-0.07	0.95
	[Academy (comp)]				
Region	East of England	0.01	0.17	0.08	0.94
	East Midlands	**-0.74**	**0.20**	**-3.66**	**<.01**
	North East	-0.06	0.24	-0.27	0.79
	North West	-0.21	0.20	-1.06	0.29
	South East	-0.07	0.15	-0.42	0.67
	South West	0.00	0.17	0.02	0.98
	West Midlands	**-0.50**	**0.19**	**-2.68**	**0.01**
	Yorkshire and The Humber	-0.08	0.21	-0.39	0.70
	[London]				
A level route	A level only	0.15	0.09	1.64	0.10
	[AS + A level]				

Table 19: Probability of achieving grade A or above in A level Art & Design (Fine Art)

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-11.49**	**0.32**	**-36.01**	**<.0001**
Gender	M	0.07	0.06	1.03	0.30
	[F]				
Key Stage 4 attainment		**0.23**	**0.01**	**38.23**	**<.0001**
Deprivation group	No deprivation data	0.26	0.52	0.50	0.62
	High	-0.13	0.09	-1.48	0.14
	Medium	-0.13	0.08	-1.72	0.09
	[Low]				
Centre type	6th Form College	-0.70	0.53	-1.31	0.19
	Academy (mod)	-0.13	0.32	-0.39	0.69
	Academy (sel)	-0.03	0.15	-0.19	0.85
	Comprehensive	**-0.23**	**0.11**	**-2.05**	**0.04**
	FE College	**-1.26**	**0.55**	**-2.29**	**0.02**
	Grammar	-0.28	0.33	-0.85	0.40
	Independent	0.20	0.52	0.37	0.71
	Secondary Modern	0.40	0.54	0.74	0.46
	[Academy (comp)]				
Region	East of England	-0.05	0.14	-0.36	0.72
	East Midlands	**-0.51**	**0.16**	**-3.18**	**<.01**
	North East	0.05	0.20	0.24	0.81
	North West	0.01	0.16	0.06	0.95
	South East	-0.06	0.13	-0.48	0.63
	South West	-0.18	0.14	-1.28	0.20
	West Midlands	**-0.45**	**0.15**	**-2.95**	**<.01**
	Yorkshire and The Humber	-0.03	0.17	-0.17	0.86
	[London]				
A level route	A level only	-0.01	0.07	-0.16	0.87
	[AS + A level]				

Table 20: Probability of achieving grade C or above in A level Art & Design (Fine Art)

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-7.59**	**0.37**	**-20.60**	**<.0001**
Gender	**M**	**-0.19**	**0.07**	**-2.65**	**0.01**
	[F]				
Key Stage 4 attainment		**0.22**	**0.01**	**29.41**	**<.0001**
Deprivation group	No deprivation data	0.46	0.92	0.50	0.62
	High	**-0.31**	**0.10**	**-3.06**	**<.01**
	Medium	-0.17	0.10	-1.78	0.08
	[Low]				
Centre type	6th Form College	-0.99	0.93	-1.07	0.29
	Academy (mod)	-0.24	0.33	-0.73	0.46
	Academy (sel)	0.04	0.23	0.17	0.87
	Comprehensive	**-0.28**	**0.12**	**-2.37**	**0.02**
	FE College	-1.41	0.93	-1.52	0.13
	Grammar	-0.37	0.43	-0.85	0.40
	Independent	0.60	0.93	0.64	0.52
	Secondary Modern	-0.07	0.57	-0.12	0.90
	[Academy (comp)]				
Region	East of England	-0.22	0.18	-1.23	0.22
	East Midlands	**-0.59**	**0.19**	**-3.13**	**<.01**
	North East	-0.04	0.24	-0.18	0.86
	North West	0.22	0.20	1.06	0.29
	South East	-0.14	0.17	-0.79	0.43
	South West	-0.01	0.18	-0.06	0.95
	West Midlands	**-0.52**	**0.18**	**-2.89**	**<.01**
	Yorkshire and The Humber	-0.07	0.21	-0.32	0.75
	[London]				
A level route	A level only	0.17	0.09	1.86	0.06
	[AS + A level]				

Biology

Table 21: Probability of achieving grade A or above in A level Biology

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-26.03**	**0.27**	**-94.96**	**<.0001**
Gender	**M**	**0.74**	**0.03**	**24.45**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.48**	**0.01**	**95.41**	**<.0001**
Deprivation group	No deprivation data	-0.84	0.45	-1.87	0.06
	High	**-0.29**	**0.05**	**-6.28**	**<.0001**
	Medium	**-0.14**	**0.04**	**-3.46**	**<.01**
	[Low]				
Centre type	6th Form College	0.81	0.45	1.78	0.08
	Academy (mod)	-0.15	0.22	-0.69	0.49
	Academy (sel)	0.07	0.06	1.06	0.29
	Comprehensive	-0.05	0.06	-0.85	0.39
	FE College	0.75	0.46	1.63	0.10
	Grammar	0.01	0.13	0.06	0.95
	Independent	0.71	0.45	1.56	0.12
	Secondary Modern	-0.87	0.55	-1.57	0.12
	[Academy (comp)]				
Region	East of England	0.14	0.07	1.94	0.05
	East Midlands	**0.21**	**0.08**	**2.63**	**0.01**
	North East	0.19	0.10	1.89	0.06
	North West	0.02	0.07	0.24	0.81
	South East	0.09	0.06	1.46	0.14
	South West	**0.17**	**0.07**	**2.36**	**0.02**
	West Midlands	**-0.16**	**0.08**	**-2.06**	**0.04**
	Yorkshire and The Humber	**0.17**	**0.08**	**2.25**	**0.02**
	[London]				
A level route	**A level only**	**-0.21**	**0.04**	**-5.13**	**<.0001**
	[AS + A level]				

Table 22: Probability of achieving grade C or above in A level Biology

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-17.23**	**0.22**	**-79.77**	**<.0001**
Gender	**M**	**0.67**	**0.03**	**23.88**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.37**	**0.00**	**87.39**	**<.0001**
Deprivation group	No deprivation data	-0.25	0.32	-0.78	0.44
	High	**-0.12**	**0.04**	**-2.86**	**<.01**
	Medium	**-0.08**	**0.04**	**-1.98**	**0.05**
	[Low]				
Centre type	6th Form College	0.26	0.33	0.80	0.42
	Academy (mod)	-0.14	0.17	-0.83	0.41
	Academy (sel)	**0.15**	**0.07**	**2.09**	**0.04**
	Comprehensive	0.02	0.05	0.34	0.73
	FE College	0.14	0.33	0.41	0.68
	Grammar	0.11	0.16	0.71	0.48
	Independent	0.59	0.32	1.82	0.07
	Secondary Modern	-0.33	0.28	-1.15	0.25
	[Academy (comp)]				
Region	East of England	0.14	0.07	1.89	0.06
	East Midlands	0.04	0.08	0.57	0.57
	North East	0.18	0.10	1.70	0.09
	North West	0.00	0.08	-0.01	0.99
	South East	0.08	0.07	1.25	0.21
	South West	0.00	0.08	-0.06	0.96
	West Midlands	**-0.19**	**0.07**	**-2.67**	**0.01**
	Yorkshire and The Humber	**0.16**	**0.08**	**1.98**	**0.05**
	[London]				
A level route	**A level only**	**-0.40**	**0.04**	**-9.90**	**<.0001**
	[AS + A level]				

English Literature

Table 23: Probability of achieving grade A* in A level English Literature

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-20.22**	**0.34**	**-60.22**	**<.0001**
Gender	**M**	**0.29**	**0.05**	**5.71**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.36**	**0.01**	**57.58**	**<.0001**
Deprivation group	No deprivation data	0.67	0.50	1.35	0.18
	High	**-0.16**	**0.07**	**-2.29**	**0.02**
	Medium	**-0.21**	**0.06**	**-3.27**	**<.01**
	[Low]				
Centre type	6th Form College	-0.90	0.50	-1.78	0.08
	Academy (mod)	-0.13	0.32	-0.39	0.70
	Academy (sel)	0.01	0.09	0.10	0.92
	Comprehensive	-0.08	0.08	-0.98	0.33
	FE College	**-1.35**	**0.53**	**-2.58**	**0.01**
	Grammar	-0.04	0.19	-0.19	0.85
	Independent	-0.74	0.50	-1.49	0.14
	Secondary Modern	-1.38	1.03	-1.35	0.18
	[Academy (comp)]				
Region	**East of England**	**-0.20**	**0.10**	**-1.99**	**0.05**
	East Midlands	-0.21	0.12	-1.79	0.07
	North East	-0.09	0.15	-0.61	0.55
	North West	-0.12	0.11	-1.10	0.27
	South East	-0.16	0.09	-1.87	0.06
	South West	-0.10	0.10	-0.93	0.35
	West Midlands	-0.22	0.11	-1.95	0.05
	Yorkshire and The Humber	**-0.41**	**0.12**	**-3.35**	**<.01**
	[London]				
A level route	A level only	0.02	0.06	0.27	0.79
	[AS + A level]				

Table 24: Probability of achieving grade A or above in A level English Literature

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-17.36**	**0.22**	**-78.35**	**<.0001**
Gender	**M**	**0.29**	**0.04**	**7.82**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.33**	**0.00**	**78.91**	**<.0001**
Deprivation group	No deprivation data	0.64	0.37	1.71	0.09
	High	**-0.22**	**0.05**	**-4.33**	**<.0001**
	Medium	**-0.11**	**0.04**	**-2.39**	**0.02**
	[Low]				
Centre type	**6th Form College**	**-0.92**	**0.38**	**-2.41**	**0.02**
	Academy (mod)	-0.19	0.20	-0.92	0.36
	Academy (sel)	-0.02	0.08	-0.23	0.82
	Comprehensive	-0.07	0.06	-1.14	0.26
	FE College	**-1.13**	**0.39**	**-2.90**	**<.01**
	Grammar	-0.01	0.17	-0.07	0.95
	Independent	-0.58	0.38	-1.55	0.12
	Secondary Modern	-0.57	0.37	-1.55	0.12
	[Academy (comp)]				
Region	**East of England**	**-0.20**	**0.08**	**-2.47**	**0.01**
	East Midlands	**-0.19**	**0.09**	**-2.03**	**0.04**
	North East	0.00	0.12	0.00	1.00
	North West	-0.12	0.09	-1.38	0.17
	South East	-0.12	0.07	-1.65	0.10
	South West	0.03	0.08	0.35	0.73
	West Midlands	**-0.18**	**0.09**	**-2.05**	**0.04**
	Yorkshire and The Humber	**-0.36**	**0.09**	**-3.88**	**<.01**
	[London]				
A level route	A level only	-0.01	0.05	-0.27	0.79
	[AS + A level]				

Table 25: Probability of achieving grade C or above in A level English Literature

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-12.22**	**0.22**	**-55.61**	**<.0001**
Gender	**M**	**0.09**	**0.04**	**2.43**	**0.02**
	[F]				
Key Stage 4 attainment		**0.31**	**0.00**	**66.62**	**<.0001**
Deprivation group	No deprivation data	0.16	0.44	0.37	0.71
	High	**-0.17**	**0.05**	**-3.29**	**<.01**
	Medium	**-0.12**	**0.05**	**-2.44**	**0.01**
	[Low]				
Centre type	6th Form College	-0.52	0.45	-1.17	0.24
	Academy (mod)	**-0.35**	**0.17**	**-2.08**	**0.04**
	Academy (sel)	0.13	0.11	1.17	0.24
	Comprehensive	-0.12	0.06	-1.89	0.06
	FE College	-0.77	0.45	-1.72	0.09
	Grammar	-0.25	0.23	-1.07	0.29
	Independent	0.36	0.45	0.82	0.41
	Secondary Modern	**-0.61**	**0.24**	**-2.57**	**0.01**
	[Academy (comp)]				
Region	East of England	-0.14	0.09	-1.52	0.13
	East Midlands	**-0.26**	**0.10**	**-2.54**	**0.01**
	North East	-0.19	0.13	-1.43	0.15
	North West	-0.15	0.10	-1.51	0.13
	South East	-0.01	0.08	-0.09	0.93
	South West	-0.12	0.10	-1.26	0.21
	West Midlands	-0.17	0.10	-1.74	0.08
	Yorkshire and The Humber	**-0.24**	**0.10**	**-2.41**	**0.02**
	[London]				
A level route	A level only	0.01	0.05	0.10	0.92
	[AS + A level]				

Psychology

Table 26: Probability of achieving grade A* in A level Psychology

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-24.86**	**0.42**	**-58.86**	**<.0001**
Gender	**M**	**-0.30**	**0.07**	**-4.29**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.45**	**0.01**	**56.23**	**<.0001**
Deprivation group	No deprivation data	0.43	0.53	0.80	0.43
	High	**-0.18**	**0.08**	**-2.20**	**0.03**
	Medium	**-0.17**	**0.07**	**-2.36**	**0.02**
	[Low]				
Centre type	6th Form College	-0.50	0.54	-0.92	0.36
	Academy (mod)	0.40	0.27	1.48	0.14
	Academy (sel)	-0.10	0.11	-0.92	0.36
	Comprehensive	-0.01	0.09	-0.14	0.89
	FE College	-0.90	0.56	-1.63	0.10
	Grammar	**-0.71**	**0.30**	**-2.36**	**0.02**
	Independent	-0.68	0.54	-1.26	0.21
	Secondary Modern	0.74	0.46	1.61	0.11
	[Academy (comp)]				
Region	East of England	-0.17	0.12	-1.45	0.15
	East Midlands	-0.18	0.14	-1.33	0.18
	North East	-0.09	0.18	-0.51	0.61
	North West	-0.01	0.12	-0.07	0.95
	South East	-0.17	0.11	-1.56	0.12
	South West	0.03	0.12	0.26	0.79
	West Midlands	-0.23	0.13	-1.81	0.07
	Yorkshire and The Humber	-0.25	0.14	-1.82	0.07
	[London]				
A level route	**A level only**	**-0.27**	**0.08**	**-3.54**	**<.01**
	[AS + A level]				

Table 27: Probability of achieving grade A or above in A level Psychology

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-20.68**	**0.24**	**-85.31**	**<.0001**
Gender	**M**	**-0.24**	**0.04**	**-6.51**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.40**	**0.00**	**85.50**	**<.0001**
Deprivation group	No deprivation data	-0.11	0.37	-0.29	0.77
	High	**-0.12**	**0.05**	**-2.41**	**0.02**
	Medium	-0.06	0.04	-1.50	0.13
	[Low]				
Centre type	6th Form College	0.04	0.38	0.09	0.92
	Academy (mod)	0.06	0.18	0.32	0.75
	Academy (sel)	-0.07	0.09	-0.80	0.42
	Comprehensive	-0.04	0.06	-0.58	0.56
	FE College	-0.33	0.38	-0.87	0.38
	Grammar	**-0.49**	**0.21**	**-2.29**	**0.02**
	Independent	0.06	0.37	0.16	0.88
	Secondary Modern	0.31	0.30	1.06	0.29
	[Academy (comp)]				
Region	East of England	-0.14	0.08	-1.66	0.10
	East Midlands	**-0.19**	**0.09**	**-1.99**	**0.05**
	North East	-0.22	0.13	-1.68	0.09
	North West	-0.12	0.09	-1.34	0.18
	South East	-0.08	0.08	-1.00	0.32
	South West	-0.13	0.09	-1.41	0.16
	West Midlands	**-0.20**	**0.09**	**-2.31**	**0.02**
	Yorkshire and The Humber	**-0.20**	**0.10**	**-2.11**	**0.04**
	[London]				
A level route	**A level only**	**-0.24**	**0.05**	**-4.77**	**<.0001**
	[AS + A level]				

Table 28: Probability of achieving grade C or above in A level Psychology

Effect		Estimate	Standard Error	t Value	Pr > |t|
Intercept		**-13.80**	**0.20**	**-69.02**	**<.0001**
Gender	**M**	**-0.21**	**0.03**	**-7.24**	**<.0001**
	[F]				
Key Stage 4 attainment		**0.34**	**0.00**	**80.77**	**<.0001**
Deprivation group	No deprivation data	-0.47	0.31	-1.53	0.13
	High	**-0.14**	**0.04**	**-3.37**	**<.01**
	Medium	**-0.11**	**0.04**	**-2.78**	**0.01**
	[Low]				
Centre type	6th Form College	0.35	0.32	1.09	0.27
	Academy (mod)	-0.04	0.16	-0.24	0.81
	Academy (sel)	-0.02	0.10	-0.19	0.85
	Comprehensive	-0.01	0.06	-0.21	0.84
	FE College	0.08	0.32	0.24	0.81
	Grammar	-0.11	0.22	-0.47	0.64
	Independent	0.57	0.31	1.81	0.07
	Secondary Modern	-0.41	0.24	-1.72	0.09
	[Academy (comp)]				
Region	**East of England**	**-0.21**	**0.08**	**-2.54**	**0.01**
	East Midlands	**-0.26**	**0.09**	**-2.88**	**<.01**
	North East	**-0.38**	**0.12**	**-3.14**	**<.01**
	North West	**-0.18**	**0.09**	**-2.07**	**0.04**
	South East	-0.14	0.08	-1.79	0.07
	South West	**-0.19**	**0.09**	**-2.26**	**0.02**
	West Midlands	**-0.21**	**0.08**	**-2.53**	**0.01**
	Yorkshire and The Humber	**-0.34**	**0.09**	**-3.77**	**<.01**
	[London]				
A level route	**A level only**	**-0.43**	**0.05**	**-9.42**	**<.0001**
	[AS + A level]				

9. Appendix C – CEM outcomes

Table 29 and Figure 12 to Figure 15 show the cumulative grade distributions for 'AS + A level' and 'A level only' candidate groups, matched using CEM. The principal comparisons of CEM-matched groups are presented in the main results (pp. 32). The full cumulative grade distributions of the matched groups are provided here for reference.

Table 29: Cumulative grade distributions for 2017 tranche 1 A levels by route, after CEM

| Subject and route		N All	Grade (cumulative %) A*	A	B	C	D	E	U
Art & Design	AS + A level	681	15.9	35.0	64.4	86.2	96.5	99.2	100
Art & Design	A level only	710	17.3	39.2	66.6	86.9	96.9	99.9	100
Art & Design (Fine Art)	AS + A level	2734	18.0	36.2	65.5	86.7	96.6	99.6	100
Art & Design (Fine Art)	A level only	2675	18.7	36.5	66.6	87.1	96.5	99.3	100
Art & Design (Photography)	AS + A level	2497	7.4	21.1	52.5	82.9	95.1	98.8	100
Art & Design (Photography)	A level only	1941	9.3	23.2	55.7	82.4	94.7	99.3	100
Art & Design (Textiles)	AS + A level	500	12.5	29.2	59.8	85.9	96.0	99.3	100
Art & Design (Textiles)	A level only	384	18.0	33.9	70.1	90.6	97.4	99.5	100
Biology	AS + A level	18086	9.9	30.0	52.1	73.1	89.8	97.5	100
Biology	A level only	10705	9.3	28.2	48.8	68.4	86.0	95.6	100
Business Studies	AS + A level	7517	3.9	16.4	47.1	77.2	93.4	98.4	100
Business Studies	A level only	4175	3.8	15.5	41.6	71.7	89.4	97.5	100
Chemistry	AS + A level	13644	11.4	37.4	61.8	80.4	92.9	98.4	100
Chemistry	A level only	9100	10.1	34.4	55.8	74.1	87.6	96.0	100
Computer Science/Computing	AS + A level	1173	3.1	17.7	40.9	62.2	84.3	95.1	100
Computer Science/Computing	A level only	856	2.5	14.0	33.6	57.0	79.2	92.2	100
Economics	AS + A level	7626	12.5	41.7	69.4	89.0	96.8	99.2	100
Economics	A level only	5271	9.9	37.3	65.8	84.6	95.1	98.7	100
English Language	AS + A level	4510	1.4	11.2	36.8	74.2	95.4	99.4	100
English Language	A level only	2408	0.8	10.3	37.1	74.3	94.6	99.3	100
English Language & Literature	AS + A level	2015	3.0	12.2	38.6	72.8	94.7	99.4	100
English Language & Literature	A level only	1243	2.7	12.0	41.5	76.9	94.9	99.4	100
English Literature	AS + A level	14643	12.4	29.5	58.3	83.4	96.5	99.6	100
English Literature	A level only	9546	11.9	29.3	58.1	83.3	96.2	99.6	100
History	AS + A level	15095	8.2	29.7	61.3	85.5	96.5	99.3	100
History	A level only	9730	7.4	27.2	59.2	84.5	96.1	99.3	100
Physics	AS + A level	8748	11.5	34.9	56.8	74.8	89.3	97.2	100
Physics	A level only	5903	11.0	32.7	51.1	69.2	84.0	94.5	100
Psychology	AS + A level	21205	5.1	20.4	48.1	75.4	92.1	98.3	100
Psychology	A level only	10000	4.4	17.6	43.2	69.5	87.5	96.0	100
Sociology	AS + A level	10466	5.2	20.3	51.9	79.5	94.2	98.9	100
Sociology	A level only	4494	4.5	17.6	46.0	73.5	89.6	97.6	100
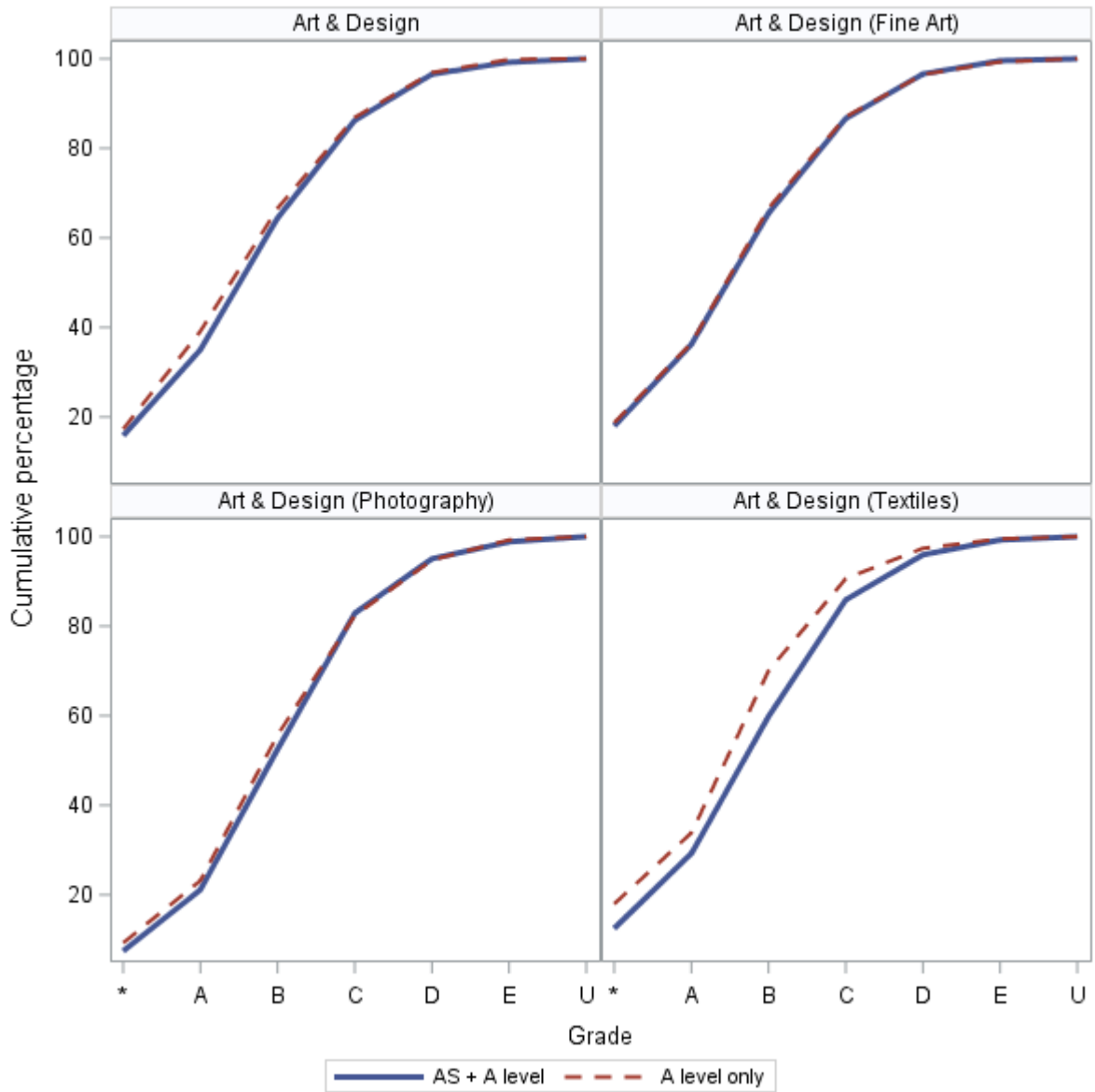
Figure 12: Cumulative grade distributions for 2017 A levels in Art & Design subjects, matched candidate groups
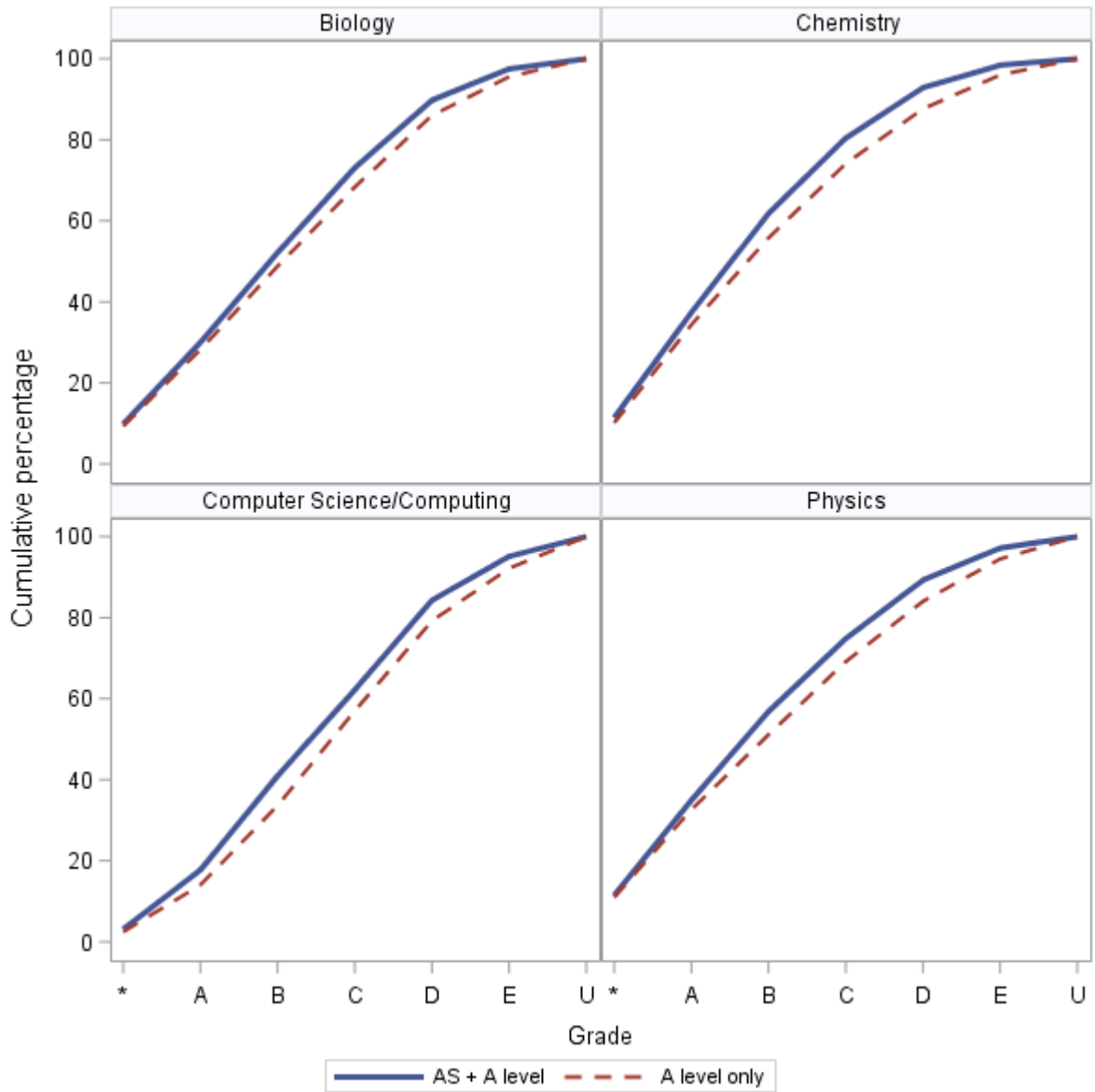
Figure 13: Cumulative grade distributions for 2017 A levels in science subjects, matched candidate groups
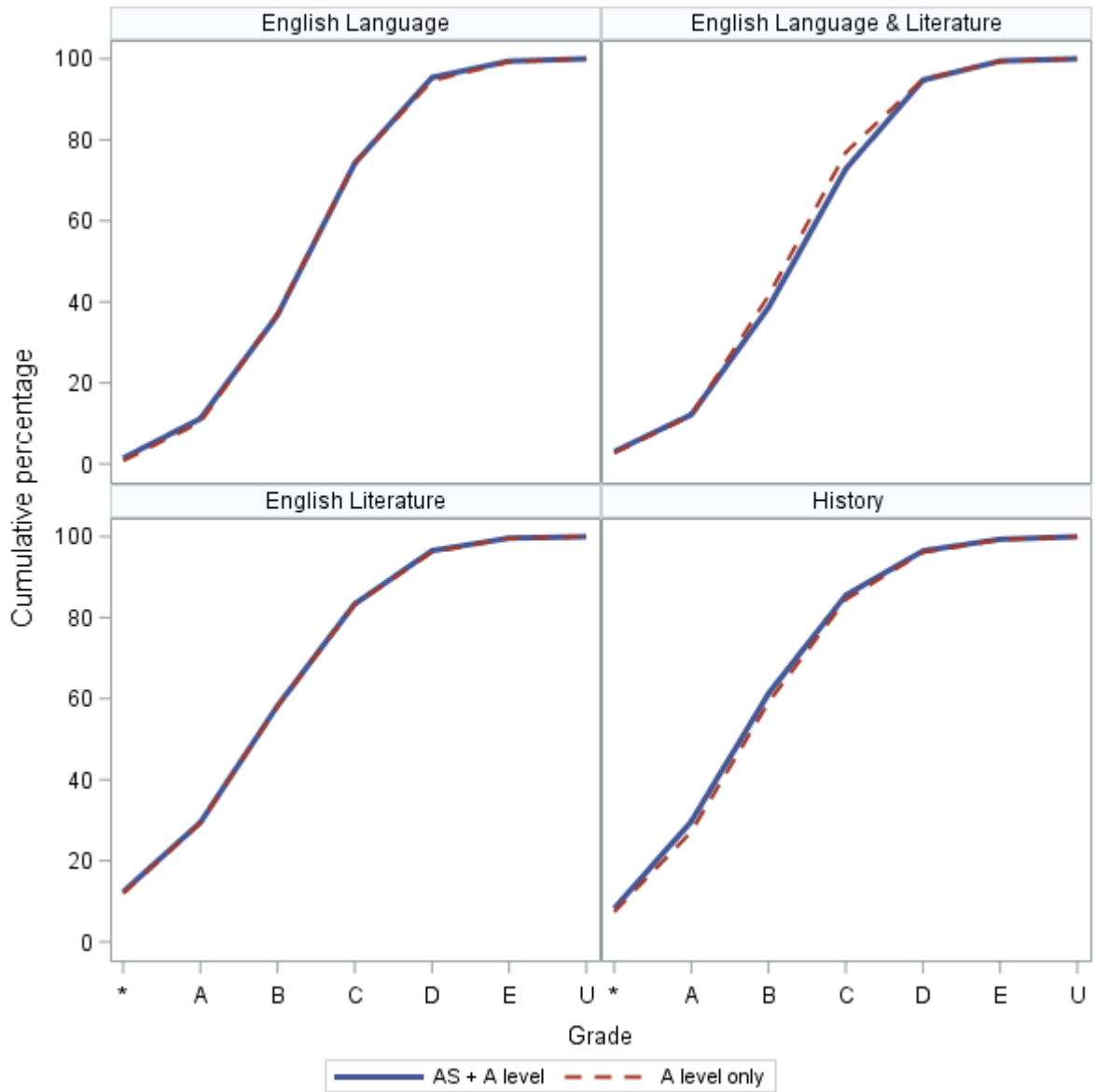
Figure 14: Cumulative grade distributions for 2017 A levels in English and History, matched candidate groups
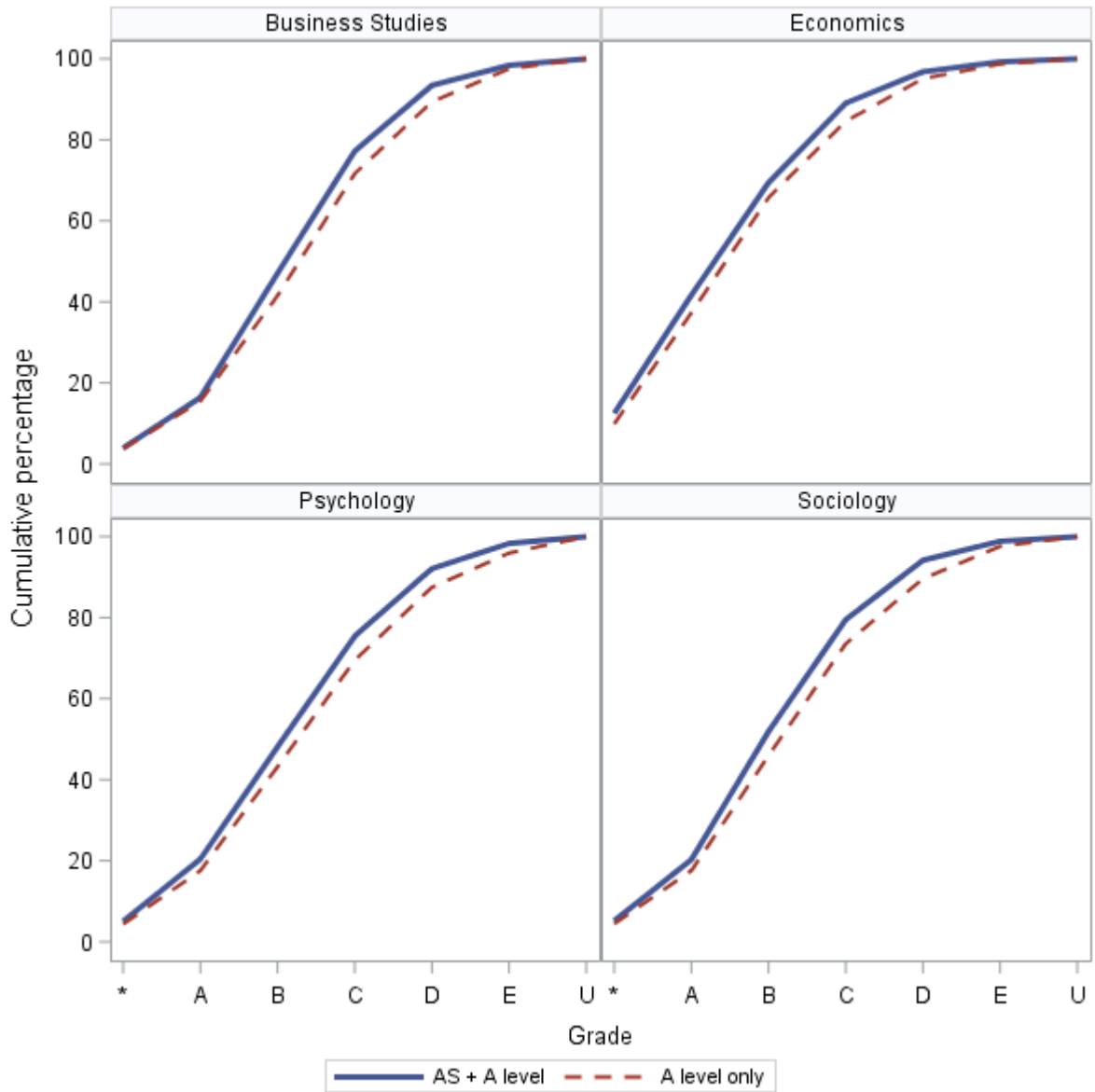
Figure 15: Cumulative grade distributions for 2017 A levels in remaining reformed subjects, matched candidate groups