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# Success at Veterinary School: Evaluating the Influence of Intake Variables on Year 1 Examination Performance

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55 **Abstract**

56

57 A major challenge in admissions to veterinary medical degrees is to select those students  
58 with most suitability for clinical training programmes and careers from a large pool of  
59 applicants with very high academic ability. Predicting the success of students in a  
60 veterinary course is challenging and relatively few objective studies have been undertaken  
61 to identify factors that will facilitate progression through this educational experience. Prior  
62 educational attainment is considered by some to be a good predictor of success at  
63 undergraduate level.

64 The aims of study were to analyse intake data such as educational history and  
65 demographic factors of students entering the University of Edinburgh and to investigate  
66 possible relationships between these data and academic performance in the first year at  
67 veterinary school.

68 Data were collated for three veterinary intakes including school qualification, subjects,  
69 grades, Grade Point Average (GPA), degree classification, domicile, gender and age.  
70 Performance was measured by marks achieved in first year veterinary degree  
71 examinations. Relationships between marks and the influence of intake variables were  
72 statistically analysed via analysis of variance. For school-leaving entrants, the presence of  
73 straight As in school was linked to a better exam performance. Students with an A in  
74 Chemistry or Biology performed better; Mathematics and Physics did not show a  
75 consistent linkage with performance. Higher GPA was associated with better performance  
76 in first year for students on a graduate entry programme.

77 This study shows that prior educational attainment does appear to be linked with  
78 subsequent performance in the first year at veterinary school.

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84 **Key words:** veterinary admissions, predictors of success, undergraduate  
85 selection, student performance

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99 **Introduction**

100

101 Predicting the success of students in an undergraduate clinical veterinary course is  
102 challenging and relatively few objective studies have been undertaken to identify factors  
103 that will facilitate progression through this educational experience. There are two main  
104 ways of assessing the success of student selection procedures into professional clinical  
105 degree programmes: ability to complete the undergraduate course and success and  
106 competence in a subsequent career (e.g. how “good” a vet or doctor you become). Most  
107 studies on success and selection in medicine focus on performance in medical school  
108 rather than how “good” a doctor you become; indeed more work is needed to determine  
109 further the link between performance at medical school and subsequent success in the  
110 postgraduate domain.<sup>1</sup> In reality, students in courses such as veterinary medicine should  
111 be selected both for their ability to succeed in the course and also in their future  
112 profession<sup>2</sup>; ideally the two aspects should be aligned. According to the Schwartz Report  
113 in the UK on Fair Admissions to Higher Education, identifying “latent talent and potential  
114 which may not fully be demonstrated by examination results” is a legitimate aim in  
115 selection processes.<sup>3</sup> Equally, according to that report, prior educational attainment data  
116 remain the best indicators of success at undergraduate level and accordingly, evaluation of  
117 academic history remains central to the admissions process.

118

119 Previous academic performance (e.g. high school A-Level [AL] results) is considered by  
120 some to be the best predictor of the outcome at medical school.<sup>4</sup> Research from the USA  
121 has shown that in the veterinary course, academic difficulty experienced by veterinary  
122 students was associated with a low pre-requisite Grade Point Average (GPA) achieved  
123 prior to admission.<sup>5</sup> Kogan et al.<sup>6</sup> also showed that a higher incoming GPA was linked with  
124 better performance on course. In a study from South Africa, previous academic  
125 performance was positively correlated with academic performance at veterinary school.<sup>7</sup>  
126 One of the earliest studies in the veterinary setting in the UK found a correlation between  
127 entrance grades and performance in veterinary school.<sup>8</sup> A veterinary study from Austria  
128 showed that previous school performance was the best predictor of performance in first  
129 year examinations for the Austrian (but not German) cohort of students.<sup>9</sup> A further study  
130 from the same group in Austria has shown that the move to a selective admissions  
131 process (including evaluation of previous school performance) from a non-selective  
132 process was correlated with success in first year veterinary examinations.<sup>10</sup> More recently,  
133 again in a study from the USA, Molgaard et al.<sup>11</sup> showed that previous academic  
134 performance such as undergraduate GPA was predictive of performance at veterinary  
135 school. GPA was also found to be predictive of performance in the first two (preclinical)  
136 years at a US veterinary school.<sup>12</sup>

137

138 In terms of the best pre-requisite subjects to facilitate veterinary undergraduate training,  
139 there is limited objective published information. Muzyamba et al.<sup>13</sup> in a study in the UK,  
140 found that A-Level results in Chemistry, Biology and a third subject were predictive of  
141 performance in the early years of the veterinary course. In contrast, workers in the USA did  
142 not find any significant correlation between pre-veterinary course parameters and the class  
143 rank of third year veterinary students.<sup>6</sup> In the medical arena, a correlation has been  
144 demonstrated between performance in the medical course and performance in A-Level  
145 Chemistry and Biology<sup>14-17</sup> but interestingly, not Maths or Physics.<sup>14</sup>

146

147 However, there are contrasting reports both in medicine and veterinary medicine in terms  
148 of the impact of a variety of demographic factors such as age and gender on the  
149 performance of students on these clinical courses.<sup>5,18,19,20</sup>

150

151 The aim of this study was to analyse intake data such as educational history and  
152 demographic factors of students entering a traditional 5 year veterinary degree programme  
153 (5 year) and a 4 year accelerated graduate entry programme (4 year) at the University of

154 Edinburgh. Possible relationships between these data and academic performance in the  
155 first year at veterinary school were investigated.

## 156 **Materials and Methods**

157

### 158 *Data Collection and analysis*

159

160 At the University of Edinburgh, there are two veterinary degree programmes: a traditional 5  
161 year programme (5 year) and a 4 year accelerated graduate entry programme for  
162 graduates holding an appropriate biological or animal science degree (4 year). The  
163 majority of entrants to the 5 year programme come from high school with their school  
164 qualifications being assessed for entry; this is the usual pathway into veterinary medicine  
165 in the UK, unlike North America where graduate entry is more common. However, in  
166 recent years graduate entry is becoming increasingly common in the UK. School-leaving  
167 applicants from the UK (excluding Scotland), and some international students, usually  
168 apply presenting with the school qualification known as A-Level. For the entrants in this  
169 study, the A-Levels were those presented and graded according to a five-point scale (A, B,  
170 C, D, E) from examinations sat at around 17 to 18 years of age. The minimum  
171 requirements for entry into the University of Edinburgh veterinary degree programme for  
172 the non-graduate cohorts studied were AAB at General Certificate of Education (GCE) A-  
173 Level, meaning three A-Levels with awarded grades A, A and B. In Scotland, school-  
174 leaving applicants apply presenting with the school qualifications known as Highers and  
175 Advanced Highers which are usually sat in the last two years of high school by pupils aged  
176 around 16 to 18 years of age. Highers and Advanced Highers are graded according to a  
177 four-point scale (A, B, C, D). For Scottish-domiciled applicants, the minimum requirements  
178 were AAABB at Scottish Qualifications Authority (SQA) Higher Level and BB at Advanced  
179 Higher Level; this means five Highers with awarded grades A, A, A, B, B and two  
180 Advanced Highers with awarded grades B and B. UK undergraduate degrees can be  
181 classified as first class with a final mark  $\geq 70\%$  or upper second class with a final mark of  
182 60-69%; there are also further classifications below these marks. For graduate applicants,  
183 the preferred requirements were a minimum of an upper second class degree (2i), or a  
184 minimum grade point average (GPA) of 3.4 (on a four point scale). Data encompassing  
185 entrant background information were collected and collated for three consecutive annual  
186 intakes (2007, 2008 and 2009).

187

188 Data on entrants from high school included: school qualification (e.g. A-Level, Highers,  
189 Advanced Highers), subjects taken including grades, school type (state or independent),  
190 whether a gap year was taken, gender and age (<21 years or not). It was recorded  
191 whether the A-Levels were obtained in the UK or not. Particular additional data collected  
192 for graduate entrants included degree classification (UK 1<sup>st</sup> or 2i), whether the degree was  
193 from the UK, rest of the European Union (rEU) or elsewhere in the world (RoW), student  
194 domiciled in the rEU or North America prior to starting BVM&S course, grade point  
195 average (GPA on a 4.0 point scale) and years elapsed between award of degree and  
196 starting veterinary school. Therefore, RoW applicants would include some students from  
197 North America presenting with an undergraduate degree. Entrants were divided into  
198 whether they were entering the 5- or 4-year BVM&S course and, within that, they were  
199 initially subdivided into four 5-year groups (UK/rEU Scottish Funding Council-funded [SFC]  
200 school leavers, RoW school leavers, UK/rEU graduates and RoW graduates) and two 4-  
201 year groups (UK/rEU graduates, RoW graduates). Any A-Level or Advanced Higher results  
202 from graduate entrants were ignored (not factored into the analysis) as the research focus  
203 was the highest (or most recent) qualification evaluated as part of the admissions process  
204 for entry to the veterinary school.

205

206 The calibre of an entrant's academic institution as profiled by reference sources (Barron's  
207 Profiles of American Colleges<sup>21</sup> and University league tables) was also determined (bands  
208 A to C, see below). Universities in the UK and rEU were ranked by using the Top  
209 European Universities guide (2008 rankings<sup>22</sup>). The overall scores in the Top European  
210 Universities in this guide ranged from 98.9% - 33.8%. The percentage rankings were

211 classified into 3 equal bands within these parameters (A, B and C, universities in  
212 descending order of score band). Where UK and rEU universities did not appear in the  
213 above European rankings, a combination of the world University rankings<sup>22</sup> and the Times  
214 Good University Guide<sup>23</sup> was used to establish a relevant ranking. These Universities were  
215 below the lowest score published on the Top European Universities and hence they were  
216 subsequently all ranked as band C. If the institution was not in either guide, a rank of C  
217 was ascribed.

218

219 The Barron's Profiles of American Colleges, 27<sup>th</sup> Edition<sup>21</sup> was used to rank USA  
220 Universities and Colleges. This profiling resource ranks institutions according to  
221 admissions competitiveness. These institutions were then separated into bands A, B and C  
222 using the following method: A (corresponding to Barron's classification of 'Most  
223 Competitive'; 'Highly Competitive'), B ('Very Competitive') and C ('Less Competitive',  
224 'Competitive+', 'Competitive'). There were some instances whereby two categories were  
225 ascribed for a student, for example, 'Competitive' and 'Most Competitive' as the student  
226 had studied at two institutions in order to obtain a degree qualification but would only  
227 graduate from one. In these cases, the institution where the student had been awarded the  
228 degree qualification was used. The rankings of Canadian universities were firstly taken  
229 from the world rankings.<sup>22</sup> Next, each Canadian university was compared with the nearest  
230 ranked USA university and then assigned the ranking of A, B or C from this comparison.

231

232 The student cohorts were tracked and the results of the examinations for their first year at  
233 veterinary school were collected. Performance was measured by the marks achieved in  
234 first year degree examinations. Only the results from the student's first attempt of the  
235 particular examination diet were used for analysis; i.e. re-sit results were not used. These  
236 marks were the average percentage for the whole year (0-100%) weighted by the number  
237 of credits that courses within the year had accredited to them. Because of the  
238 heterogeneity of subjects studied in individual years and differing teaching and  
239 assessments between 4 year and 5 year degree programmes, the exam results were  
240 calculated as an average percentage for the whole year. In the first year (of both the 5 year  
241 and 4 year programmes) at Edinburgh, subjects covered include studies of the animal  
242 body (incorporating anatomy, physiology, cell biology, biochemistry, introductory  
243 pathology, animal health and welfare).

244

245 The relationships between marks and the influence of intake variables were statistically  
246 analysed using analyses of variance. Normality of residuals was confirmed prior to  
247 reporting of analyses. For all analyses, the cohort that the student formed part of was  
248 initially added into the statistical model as a first fixed effect. Other explanatory variables  
249 were then added to the model. For analysis of grades in examinations undertaken prior to  
250 entry into the vet school, the type of grade - Scottish Advanced Higher, Scottish Higher, A-  
251 Level and GPA, and the University A-C rank described above - were considered  
252 separately. There were not enough students (9) that started the five year programme that  
253 had graduated from a non UK/rEU university for them to be considered as a separate  
254 group to UK/rEU graduates and so these two groups were combined for the analyses.  
255 Analysis of variation in marks and pass rates in the three 5-year groups (UK/rEU SFC  
256 school leavers, RoW school leavers, UK/rEU/RoW graduates) and the two 4-year groups  
257 (UK/rEU graduates and RoW graduates) were considered separately as the 2 programmes  
258 differed markedly in teaching material. All analysis was carried out in R (V3.3.1 © The R  
259 Foundation for Statistical Computing), and  $P < 0.05$  was taken to indicate statistical  
260 significance.

261

262 This Admissions research study was approved by the College of Medicine and Veterinary  
263 Medicine Ethics Committee at the University of Edinburgh.

264

## 265 Results

266

267 The three entrant cohorts totalling 448 students consisted of 130 students in 2007 (93 in 5  
268 year programme and 37 in 4 year), 147 in 2008 (98 in 5 year and 49 in 4 year) and 171 in  
269 2009 (105 in 5 year and 66 in 4 year). The attributes of these students are summarised in  
270 Table 1.

271

272 (Place Table 1 here)

273

274 Fourteen of the entrants (3.0% : 7 UK/rEU SFC-funded school leavers, 2 graduates on the  
275 5 year programme, 5 graduates on the 4 year accelerated programme) withdrew before  
276 the end of their respective first year, precluding any analysis of the end of year mark for  
277 these entrants, leaving 434 students with end of year examination marks. As only 3% of  
278 the entrants withdrew before the end of the year, the statistical power associated with any  
279 analysis of whether withdrawal was dependent on any of the variables was likely to be low,  
280 and therefore the lack of statistical significance for any variable was not surprising  
281 ( $P>0.125$ ). Over 90% of entrants (93.1%, 404 of 434) passed ( $\geq 50\%$  for average Year 1  
282 mark) their first year at the first attempt, again limiting the power likely to be associated  
283 with any analysis.

284

### 285 *End of Year 1 examination mark*

286

287 The end of Year 1 performance marks are summarised in Tables 2a and 2b. There was a  
288 statistically significant difference between the 5 year overall end of year 1 mark (64%)  
289 compared to the 4 year mark (60%,  $P<0.001$ , Table 2a). The average end of year 1  
290 examination marks did not statistically significantly differ between either the three 5 year  
291 groups of entrants (63-64%,  $P=0.879$ ; or the two 4 year groups of entrants (60%,  $P=0.975$ ,  
292 Table 2a). In addition, there was no statistically significant difference between cohorts in  
293 either the 5 year or 4 year programmes ( $P>0.052$ , Figure 1a), nor was there any  
294 statistically significant interaction between cohort and either the three 5 year groups of  
295 entrants ( $P=0.891$ ) or the two 4 year groups of entrants ( $P=0.763$ , Figure 1b).

296

297 (Place Table 2a here)

298

299 For school-leaving entrants to veterinary school, the presence of straight As in school  
300 subjects (A-Level [AL], Advanced Higher [AH] and Higher) was linked to statistically  
301 significantly better exam performance in end of first year examinations compared to  
302 students with grades less than A ( $P<0.001$ ; AL: 67% vs 60%, AH: 67% vs 59%, Higher:  
303 64% vs 57%; Table 2a, Figure 2a). However, this was not dependent on whether UK AL  
304 were taken or not ( $P=0.055$ , Table 2a).

305

306 While there was no statistically significant cohort-dependent effect with the A Level results  
307 ( $P=0.205$ ), there was a significant cohort effect with whether school-leaving entrants  
308 achieved all grade A in their AH ( $P=0.023$ , Figure 2a) : there was no statistically significant  
309 difference in the end of year mark in the Entry Cohort 2 (2008) with whether the school-  
310 leaving entrants achieved all As in their AH ( $P=0.318$ , All A:61%, Not all A:59%), but the  
311 statistically significant difference remained for Entry Cohorts 1 and 3 (2007 – All A: 73%,  
312 Not all A: 60% - and 2009 - All A: 69%, Not all A: 58%% -, Figure 2a,  $P<0.003$ ).

313

314 If just whether school-leaving entrants had obtained an A in Biology was considered, again  
315 there were statistically significant differences ( $P<0.001$ ; AL: A 67% vs <A 50%, AH: A 65%  
316 vs <A 58%, H: A 63% vs <A 49%; Table 2a, Figure 2b), and again this was not entry  
317 cohort dependent ( $P>0.477$ ), nor was the AL difference UK/non-UK dependent ( $P=0.881$ ).  
318 In addition, school-leaving entrants gaining an A in AH Chemistry had statistically  
319 significantly higher end of first year examination marks ( $P<0.001$ , 65% vs < A 57%, Figure



320 2c, Table 2a), with too few school-leaving entrants (N=4) obtaining less than an A in AL  
321 Chemistry to facilitate analysis. The reason for this is that, in the main, candidates with  
322 less than A in AL chemistry are not admitted due to the entrance requirements. In contrast,  
323 no statistically significant differences in end of first year examination marks were observed  
324 depending on whether school-leaving entrants had obtained an A or not in either  
325 Mathematics (at AL or AH) or Physics (at AL, AH or H) ( $P>0.090$ , Table 2a).

326  
327 As mentioned above, for those Scottish-educated students that would have also taken  
328 Highers, as with the Advanced Highers, there was statistically significantly better exam  
329 performance in end of first year examinations with straight As compared to students with  
330 grades less than A ( $P<0.001$ ; 64% vs 57%, Table 2a, Figure 2a), and this was not entry  
331 cohort dependent ( $P=0.895$ ). In addition, this statistically significant effect remained if just  
332 whether a grade A Higher was obtained in Biology ( $P<0.001$ ; A 63% vs < A 49%, Table 2a,  
333 Figure 2b) and Mathematics ( $P=0.038$ ; A 63% vs < A 58%, Table 2a, Figure 2d), but no  
334 statistically significant differences were observed with Physics ( $P=0.116$ ; A 63% vs < A  
335 57%) and Chemistry ( $P=0.359$ ; 62% vs 57%; Table 2a). Again, very few candidates are  
336 accepted with < A in Higher Chemistry as this is a minimum entry requirement.

337  
338 There was some evidence of differences in year 1 performance if school-leaving entrants  
339 from the UK had been to an independent (66%) or state school (63%,  $P=0.028$ , Table 2a),  
340 though the impact was not large (Figure 3a). However, there was a statistically significant  
341 interaction between school type and whether a grade A had been obtained in an AH  
342 Biology ( $P=0.001$ ), with a greater difference in exam performance between those Scottish  
343 school-leaving entrants that attended an independent school (A: 68%, <A: 48%) compared  
344 to a state school (A: 64%, <A: 60%, Table 2a, Figure 3b). This statistically significant  
345 difference was not reflected in the differences in average marks between those school-  
346 leaving entrants that had or had not achieved either all As in Highers or A in a particular  
347 Higher subject ( $P>0.112$ ).

348  
349 Only two of the 21 graduates on the 5 year programme obtained a UK 1<sup>st</sup> class degree,  
350 precluding any statistical analysis of a 1<sup>st</sup> compared to a 2i. For the 4 year programme,  
351 there was no statistically significant improvement in exam performance of graduates with a  
352 1<sup>st</sup> compared to a 2i ( $P=0.057$ , Table 2b). In addition, in graduate entrants from outside the  
353 UK on the 5 year programme there was no improved exam performance in those with a  
354 higher GPA ( $\geq 3.4$ ) ( $P=0.964$ , Table 2b). In contrast, in graduate entrants from outside the  
355 UK on the 4 year programme there was a statistically significantly improved exam  
356 performance in those with a higher GPA ( $\geq 3.4$ ) compared to those with a GPA < 3.4 (62 vs  
357 56%,  $P=0.015$ , Table 2b, Figure 4). For all entrants, increased age ( $\geq 21$  years of age) at  
358 the onset of veterinary studies was associated with a statistically significantly reduced  
359 exam performance ( $P=0.003$ ,  $\geq 21$ : 61%, <21: 64%, Table 2b). However, this is  
360 confounded by whether entrants have done a degree or not, as no entrants with a previous  
361 degree were <21, and only 2% of school entrants were  $\geq 21$ . If entrants were sub-divided  
362 into whether a school leaver or with a previous degree, then there was no statistically  
363 significant relationship between actual age and exam performance in either group  
364 ( $P>0.262$ ).

365  
366 (Place Table 2b here)

367  
368 No statistically significant association with exam performance was found for any of the  
369 other variables (gender, domicile, whether a gap year was taken, time elapsed since  
370 previous study, where degree was obtained or university grade) in both the 4- and 5-year  
371 programmes ( $P>0.131$ , Table 2b).

372  
373  
374

## 375 Discussion

376

377 This study showed that some intake variables, primarily previous academic history, were  
378 associated with subsequent academic success or otherwise in the first year at veterinary  
379 school. In the veterinary setting, most studies show a link between prior attainment and  
380 performance in the early years<sup>9,11,12</sup> with fewer showing a link with performance in later or  
381 final years.<sup>7</sup>

382

383 This study encompassed three entry cohorts (2007, 2008 and 2009); this had the benefit of  
384 generating a large sample size for analysis and allowed the identification of any particular  
385 cohort effects. Although there were occasional cohort effects, these were not common and  
386 it was still possible to draw conclusions about the impact of intake variables independent of  
387 particular cohort effects. It is important to note that the analysis of veterinary school results  
388 for the students was on the basis of their first attempt at the exams, rather than re-sits; it  
389 was considered that this was the best way of comparing students with their peers in  
390 relation to their intake variables and when sitting the same schedule of exams. In each diet  
391 of exams, there is a small number of students who sit the exams with special  
392 circumstances (e.g. ill health) and they are allowed to then sit the exam at a later re-sit  
393 diet, but have this subsequent attempt viewed as a first attempt. Also, there is a small  
394 number of students who move between cohorts e.g. if they dropped down a year due to  
395 intercalating studies or having to repeat a year; it was not possible to track these students  
396 in this study. Therefore, it was considered that the small number of students who fell into  
397 this category would not impact the statistical evaluation of the large dataset of the first  
398 attempt results of the entire year cohorts. This small group of students could potentially be  
399 looked at in future studies, but it would be difficult to draw conclusions owing to the small  
400 numbers involved.

401

402 Students (school-leaving entrants) that had straight As in high school subjects achieved  
403 better exam performance in the first year at veterinary school. When evaluating the impact  
404 of school subjects studied, it was found that Biology and Chemistry had more effect on  
405 subsequent performance than Maths and Physics. This is largely in agreement with the  
406 findings in veterinary medicine<sup>13</sup> and medicine<sup>14,15,17</sup> where prior attainment in Chemistry  
407 and Biology is linked with performance on course. An exception to this trend was the  
408 finding from an Italian veterinary study where the performance in the Biology section of an  
409 admissions test was not linked with performance on course; accordingly the Biology  
410 requirement in the test was removed.<sup>24</sup> Furthermore, Muzyamba et al.<sup>13</sup> found that  
411 performance in the third A-Level subject (in addition to Chemistry and Biology) was linked  
412 with performance in the early years at vet school and Montague and Odds<sup>14</sup> found that A-  
413 Level Maths and Physics grades had no correlation with performance at medical school. In  
414 this current Edinburgh study, an A in Biology at AL, AH and H was linked with better exam  
415 performance; similarly, an A in AH Chemistry was associated with better exam  
416 performance. It was unsurprising that an effect of AL and H Chemistry on subsequent  
417 performance was not observed; this is because at the time of entry an A in these  
418 qualifications was a minimum entry requirement, so that there were too few students  
419 entering the course with < A to permit statistical analysis. Interestingly, although the effect  
420 of Maths was not as strong as Chemistry and Biology, an A in H Maths was associated  
421 with better performance in Year 1.

422

423 There was a small effect of the type of school attended (state vs independent) on exam  
424 performance, with students who attended an independent school doing slightly better. For  
425 Scottish-educated students, this effect appeared to be counter-balanced by a greater drop  
426 off in performance in students who achieved < A in AH Biology from an independent  
427 school compared to students from a state school. There are limited reports detailing the  
428 impact of school type on performance in veterinary medicine and medicine. Muzyamba et  
429 al.<sup>13</sup> reported that students from independent school were more likely to pass final year in

430 a UK veterinary degree. Lumb and Vail<sup>18</sup> found that school type had no effect on  
431 performance in the third year of medical school. In contrast, in a study at the University of  
432 Edinburgh across a broad range of subjects from humanities to sciences, students from  
433 independent schools did not achieve as good outcomes in their degrees as peers from  
434 state schools.<sup>25</sup>

435  
436 For graduate entrants to the 4-year programme, prior educational attainment such as GPA  
437  $\geq 3.4$  was linked with better exam performance. The apparent effect of increased age  
438 negatively impacting exam performance was likely due to the confounding effect of being a  
439 graduate. The literature regarding the impact of age on performance is conflicting with  
440 some studies showing that, in the veterinary setting, increased age ( $\geq 35$  years) was linked  
441 with academic difficulty<sup>5</sup> and that, in a medical study, older students were more likely to  
442 have difficulty passing the final degree.<sup>15</sup> However other studies in the medical setting  
443 reported that age had no impact on performance<sup>18</sup> or knowledge acquisition.<sup>20</sup>

444  
445 Furthermore, although on face value it would appear that the 5-year students performed  
446 better in first year when compared to the 4-year students, this comparison is not really  
447 realistic. The respective two courses that these students are taking are completely  
448 different, both in terms of delivery and assessment; accordingly one is not comparing 'like  
449 with like'.

450  
451 There was no effect of any of the other variables on performance in the first year at  
452 veterinary school for either the 5-year or 4-year programmes; these variables were gender,  
453 domicile, whether a gap year was taken, time elapsed since previous study, where degree  
454 obtained and university grade. A potential limitation of this study is the difficulty in  
455 characterizing and ranking the wide range of educational and personal background  
456 experiences of the candidates applying to our veterinary school. However, the groupings  
457 and characterization of the candidates as detailed above (including GPA preferred  
458 minimum entry thresholds, Barron's Profiles of American Colleges and university league  
459 tables etc.) made some attempt to evaluate the 'heterogeneous' nature of the veterinary  
460 school applicants, including their educational histories.

461  
462 Therefore it can be seen that prior educational attainment does appear to be correlated  
463 with performance in the first year at veterinary school. Biology and Chemistry appear to  
464 have the greatest impact, with Biology having slightly more of an effect than Chemistry.  
465 These subjects have more of an effect than Maths and Physics; this perhaps has  
466 implications on the existing perceptions regarding the entry criteria (both in terms of  
467 required subjects and grades) that a particular institution sets for entry onto the veterinary  
468 course. For instance, at Edinburgh, insisting on an A in Chemistry (at AL and H) as an  
469 entry requirement for entry was in place at the time of these study cohorts rather than  
470 insisting on the same for Biology, which is now the case. In addition, at the time of the  
471 study cohorts, the preferred requirements for AL were Chemistry, Biology and one of  
472 Physics/Maths. The results of this study suggest that pre-requisites might be changed  
473 without negatively impacting performance in the first year at veterinary school. The results  
474 of the intake studies provided an evidence base to help inform the University of  
475 Edinburgh's Veterinary Admissions Committee's decision to change the subject entrance  
476 requirements and the number of A grades required (since 'all As' was linked with better  
477 performance). Subsequent to these cohorts, admissions requirements have been changed  
478 to AAA at AL and AAAAB in Highers (with A in both Chemistry and Biology, rather than just  
479 Chemistry); Also the requirement for the third subject at A-Level to be Maths or Physics  
480 has been removed, in favour of a third approved subject (from a large list of subjects); this  
481 adds flexibility to an applicant's subject choices and also may add to the breadth of  
482 educational experience that students have before university.

483  
484 All veterinary schools are always trying to refine and improve their admissions process in  
485 the knowledge that a successful admissions process will ultimately lead to a better

486 teaching and student experience on course, and hopefully on into postgraduate life. It is  
487 clear that admissions research with linkage into the teaching continuum is needed; this will  
488 help future evidence-based development of admissions processes. Furthermore,  
489 identification of patterns and predictors for success on our course will allow institutions to  
490 identify 'at risk' students and tailor our teaching programme and associated support  
491 mechanisms accordingly.

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648 **Figure Captions**

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650 **Figure 1:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3  
651 entry cohorts (2007, 2008 and 2009: EC 1-3) that completed their first year and had  
652 started (a) either the 5- year or 4- year accelerated graduate entry programme; (b) had  
653 started the 5- year programme as a school-leaver, either UK/rest of EU (rEU) Scottish  
654 Funding Council-funded (SFC) or rest of the world (RoW)); or had graduated either from a  
655 UK, rest of the EU or rest of the world university (UK/rEU/RoW); or had started the 4- year  
656 accelerated programme either as a UK/rEU graduate or a graduate from the rest of the  
657 world (RoW). Average marks (%) for the whole year were weighted by number of credits  
658 attached to courses within the Year 1. The width of each violin plot at any one value  
659 reflects the frequency of that mark in that group. Boxes within the violins represent the  
660 interquartile range, and the round symbols the medians. Numbers in brackets are number  
661 of students in a particular group. \*\*\* P<0.001.

662

663 **Figure 2:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3  
664 entry cohorts (2007, 2008 and 2009: 1-3) that completed their first year and (a) had  
665 undertaken either A-Levels or Scottish Advanced Highers and Highers; (b) Biology A-  
666 Level, Advanced Higher and Higher; (c) Chemistry (A-level and Advanced Higher) and (d)  
667 Mathematics (Higher) in relation to whether they had achieved all grade A in these  
668 examinations. The width of each violin plot at any one value reflects the frequency of that  
669 mark in that group. Boxes within the violins represent the interquartile range, and the round  
670 symbols the medians. Numbers in brackets are number of students in a particular group.  
671 \*\*\* P<0.001, \* P<0.05.

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673 **Figure 3:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3  
674 entry cohorts (2007, 2008 and 2009: 1-3) in relation to whether the students had (a)  
675 attended an independent or state school and (b) attended an independent or state school  
676 and achieved a Grade A or less in Advanced Higher Biology. The width of each violin plot  
677 at any one value reflects the frequency of that mark in that group. Boxes within the violins  
678 represent the interquartile range, and the round symbols the medians. Numbers in  
679 brackets are number of students in a particular group. \*\*\* P<0.001, \* P<0.05.

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681 **Figure 4:** Violin density plots of average marks in Year 1 of the 4- year accelerated  
682 BVM&S programme for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) in relation  
683 to whether non-UK graduate students had obtained a grade point average (GPA)  $\geq 3.4$  or  
684  $<3.4$  in their previous degree. The width of each violin plot at any one value reflects the  
685 frequency of that mark in that group. Boxes within the violins represent the interquartile  
686 range, and the round symbols the medians. Numbers in brackets are number of students  
687 in a particular group. \* P<0.05.

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704 **Tables**

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706 **Table 1. Summary of attributes associated with students in the 3 cohorts entering**  
707 **the BVM&S Programme in 2007 (Cohort 1), 2008 (Cohort 2) and 2009 (Cohort 3)**  
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	Entry Cohort 1	Entry Cohort 2	Entry Cohort 3
Five year programme entrants	93	98	105
<i>UK/rEU School leavers</i>	72	72	72
<i>RoW School leavers</i>	13	14	19
<i>UK/rEU Graduates</i>	6	9	8
<i>RoW Graduates</i>	2	3	6
Four year graduate entrants	37	49	66
<i>UK/rEU Graduate</i>	13	21	21
<i>Overseas Graduate</i>	24	28	45
Cohort Total	130	147	171
Gender : Female (%)	79.2	78.2	75.4
Age (years)			
<i>Average ± SD</i>	20.5 ± 3.7	21 ± 3.8	21.5 ± 3.9
≥ 21 (%)	35.4	42.9	49.1
School education			
<i>A-Levels (Non-Scottish)</i>	31	36	53
<i>All A grade (%)</i>	67.7	75.0	73.6
<i>Biology A (%)</i>	93.5	80.6	92.5
<i>Chemistry A (%)</i>	93.5	94.4	98.1
<i>Mathematics A (%)</i>	91.3	88.9	92.9
<i>Physics A (%)</i>	66.7	100.0	62.5
<i>Advanced Highers (Scottish)</i>	49	41	30
<i>All A grade (%)</i>	22.4	41.5	40.0
<i>Biology A (%)</i>	40.4	73.7	55.2
<i>Chemistry A (%)</i>	61.2	65.9	56.7
<i>Mathematics A (%)</i>	40.0	35.7	80.0
<i>Physics A (%)</i>	70.6	80.0	66.7
<i>Highers (Scottish)</i>	49	41	31
<i>All A grade (%)</i>	83.7	70.7	67.7
School type (UK students)			
<i>State</i>	57	50	53
<i>Independent</i>	13	22	19
Gap year between school and university (SFC-funded UK/rEU students)	7	8	15
Domicile (Graduates)			
<i>UK / rEU</i>	21	29	30
<i>USA / Canada</i>	24	33	50
Grade point average (Graduates)			
<i>Average ± SD</i>	3.59 ± 0.19	3.51 ± 0.20	3.47 ± 0.21
≥ 3.4 (%)	84.0	67.9	59.1
University Grade (Graduates)			
<i>A</i>	13	17	31
<i>B</i>	21	25	22
<i>C</i>	11	20	28
UK Degree qualification			
1 <sup>st</sup>	6	5	3
2i	14	25	26

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**Table 2a : Summary of the end of BVM&S Year 1 performance mark (P value, average  $\pm$  SD)**

Variable	P value	Group	
Programme		5 Year	4 year
Overall	<b>&lt;0.001</b>	63.5 $\pm$ 9.4	60.1 $\pm$ 9.1
<i>UK/rEU SFC School leavers</i>		63.7 $\pm$ 9.4	-
<i>RoW School leavers</i>	0.879	62.9 $\pm$ 10.3	-
<i>UK/rEU/RoW Graduates</i>		63.1 $\pm$ 7.9	-
<i>UK/rEU Graduates</i>	0.975	-	59.9 $\pm$ 8.7
<i>RoW Graduates</i>		-	60.1 $\pm$ 9.4
A-Levels (Non-Scottish)		Yes	No
<i>All A grade</i>	<b>&lt;0.001</b>	66.8 $\pm$ 8.1	59.7 $\pm$ 11.7
<i>UK</i>	0.055	67.0 $\pm$ 7.1	61.9 $\pm$ 12.2
<i>RoW</i>		66.3 $\pm$ 10.8	53.0 $\pm$ 6.8
<i>Biology A</i>	<b>&lt;0.001</b>	66.5 $\pm$ 8.0	50.3 $\pm$ 11.2
<i>Chemistry A</i>	0.622	64.9 $\pm$ 9.8	63.0 $\pm$ 5.2
<i>Mathematics A</i>	0.795	64.3 $\pm$ 10.2	65.0 $\pm$ 7.1
<i>Physics A</i>	0.409	66.3 $\pm$ 10.9	65.2 $\pm$ 8.6
Advanced Highers (Scottish)		Yes	No
<i>All A grade</i>	<b>&lt;0.001</b>	66.9 $\pm$ 8.3	59.3 $\pm$ 8.8
<i>Biology</i>	<b>&lt;0.001</b>	65.0 $\pm$ 8.3	58.1 $\pm$ 9.6
<i>Chemistry</i>	<b>&lt;0.001</b>	64.7 $\pm$ 8.9	57.2 $\pm$ 8.2
<i>Mathematics</i>	0.091	67.1 $\pm$ 10.8	60.6 $\pm$ 8.8
<i>Physics</i>	0.847	62.3 $\pm$ 8.7	63.1 $\pm$ 4.6
Highers (Scottish)		Yes	No
<i>All A grade</i>	<b>&lt;0.001</b>	63.7 $\pm$ 8.7	56.8 $\pm$ 9.2
<i>Biology A</i>	<b>&lt;0.001</b>	62.8 $\pm$ 8.9	49.4 $\pm$ 6.6
<i>Chemistry A</i>	0.359	62.1 $\pm$ 9.4	57.0 $\pm$ 0.0
<i>Mathematics A</i>	<b>0.038</b>	62.8 $\pm$ 9.4	58.1 $\pm$ 9.0
<i>Physics A</i>	0.116	62.5 $\pm$ 9.7	57.3 $\pm$ 7.3
School type		Independent	State
<i>Overall</i>	<b>0.028</b>	65.8 $\pm$ 9.9	62.9 $\pm$ 9.2
<i>Advanced Highers Biology : A</i>	<b>0.001</b>	68.1 $\pm$ 9.0	64.3 $\pm$ 8.0
<i>Advanced Highers Biology : &lt; A</i>		48.0 $\pm$ 9.5	59.6 $\pm$ 8.8
<i>Highers : All A</i>	0.113	66.1 $\pm$ 9.8	63.3 $\pm$ 8.5
<i>Highers : At least 1 &lt; A</i>		53.0 $\pm$ 14.9	57.7 $\pm$ 7.4

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721 **Table 2b : Summary of the end of BVM&S Year 1 performance mark (P value,**  
 722 **average  $\pm$  SD)**  
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Variable	P value	Group		
Degree mark (UK Graduates)		1 <sup>st</sup>	2i	
5 year programme	- <sup>a</sup>	70.0 $\pm$ 2.8	62.0 $\pm$ 9.2	
4 year programme	0.057	65.5 $\pm$ 6.3	59.5 $\pm$ 8.7	
GPA (Non UK graduates)		$\geq$ 3.4	< 3.4	
5 year programme	0.964	64.6 $\pm$ 8.0	62.8 $\pm$ 5.8	
4 year programme	<b>0.015</b>	62.1 $\pm$ 10.2	55.8 $\pm$ 6.3	
Gender		Female	Male	
5 year programme	0.348	63.8 $\pm$ 8.8	62.5 $\pm$ 10.9	
4 year programme	0.784	60.2 $\pm$ 9.4	59.5 $\pm$ 8.0	
Age at start of degree	<b>0.003</b>	<21 years	$\geq$ 21 years	
		63.6 $\pm$ 9.5	60.6 $\pm$ 9.1	
Gap year taken (UK/rEU school)	0.760	Yes	No	
		63.2 $\pm$ 7.6	63.7 $\pm$ 9.7	
Domicile (Graduates)		UK/rEU	USA/Canada	
5 year programme	0.244	61.4 $\pm$ 7.9	64.4 $\pm$ 8.0	
4 year programme	0.551	60.7 $\pm$ 8.5	59.8 $\pm$ 9.6	
Where Degree obtained		UK	rEU/RoW	
5 year programme	0.132	61.1 $\pm$ 8.5	64.8 $\pm$ 7.5	
4 year programme	0.385	61.1 $\pm$ 8.4	59.5 $\pm$ 9.5	
University Grade		A	B	C
5 year programme	0.053	67.1 $\pm$ 4.8	59.9 $\pm$ 8.5	61.7 $\pm$ 8.5
4 year programme	0.842	60.5 $\pm$ 11.2	60.4 $\pm$ 7.9	59.0 $\pm$ 8.1

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725 <sup>a</sup> Only 2 entrants on 5 year programme with a 1<sup>st</sup>

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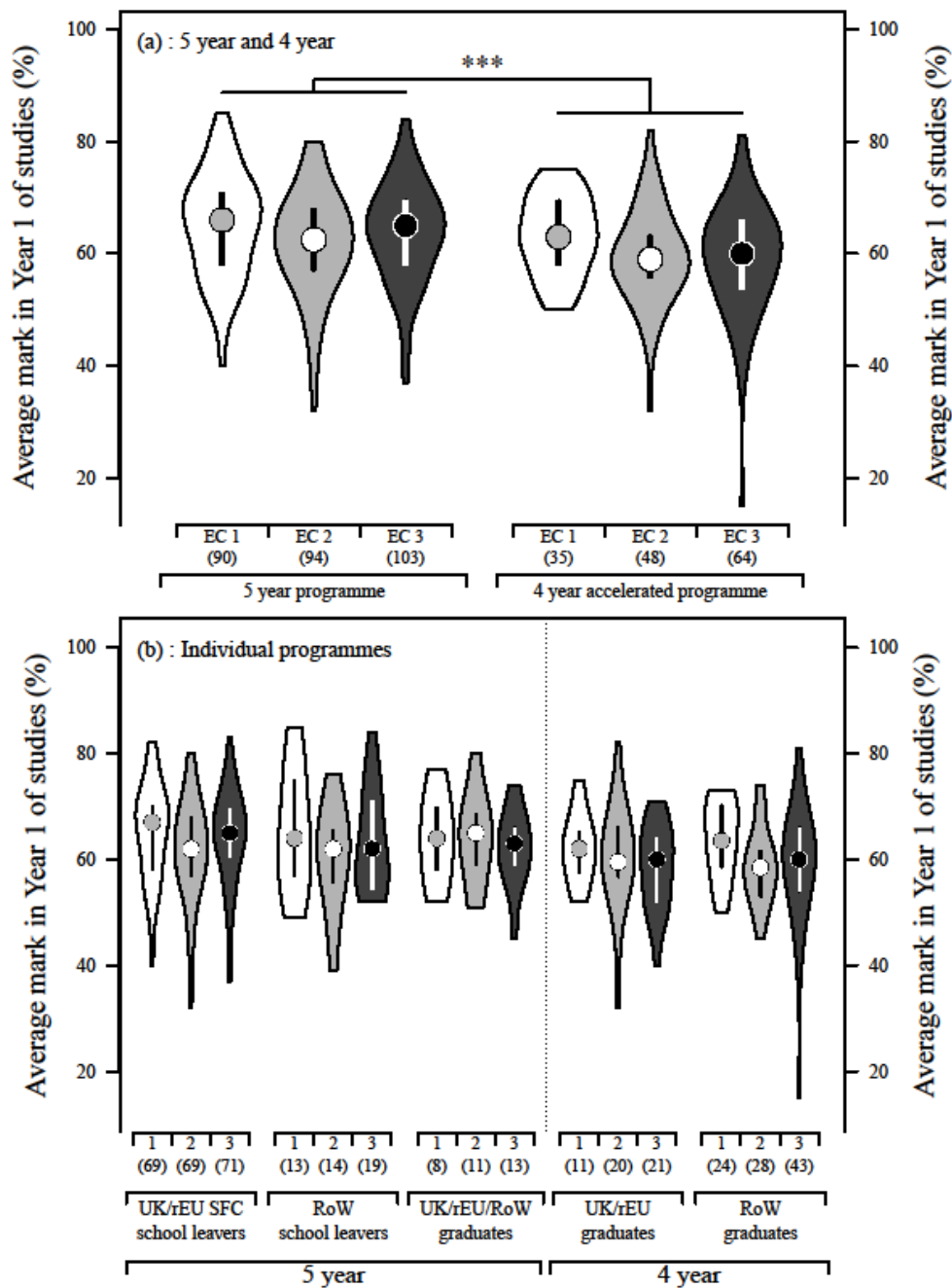
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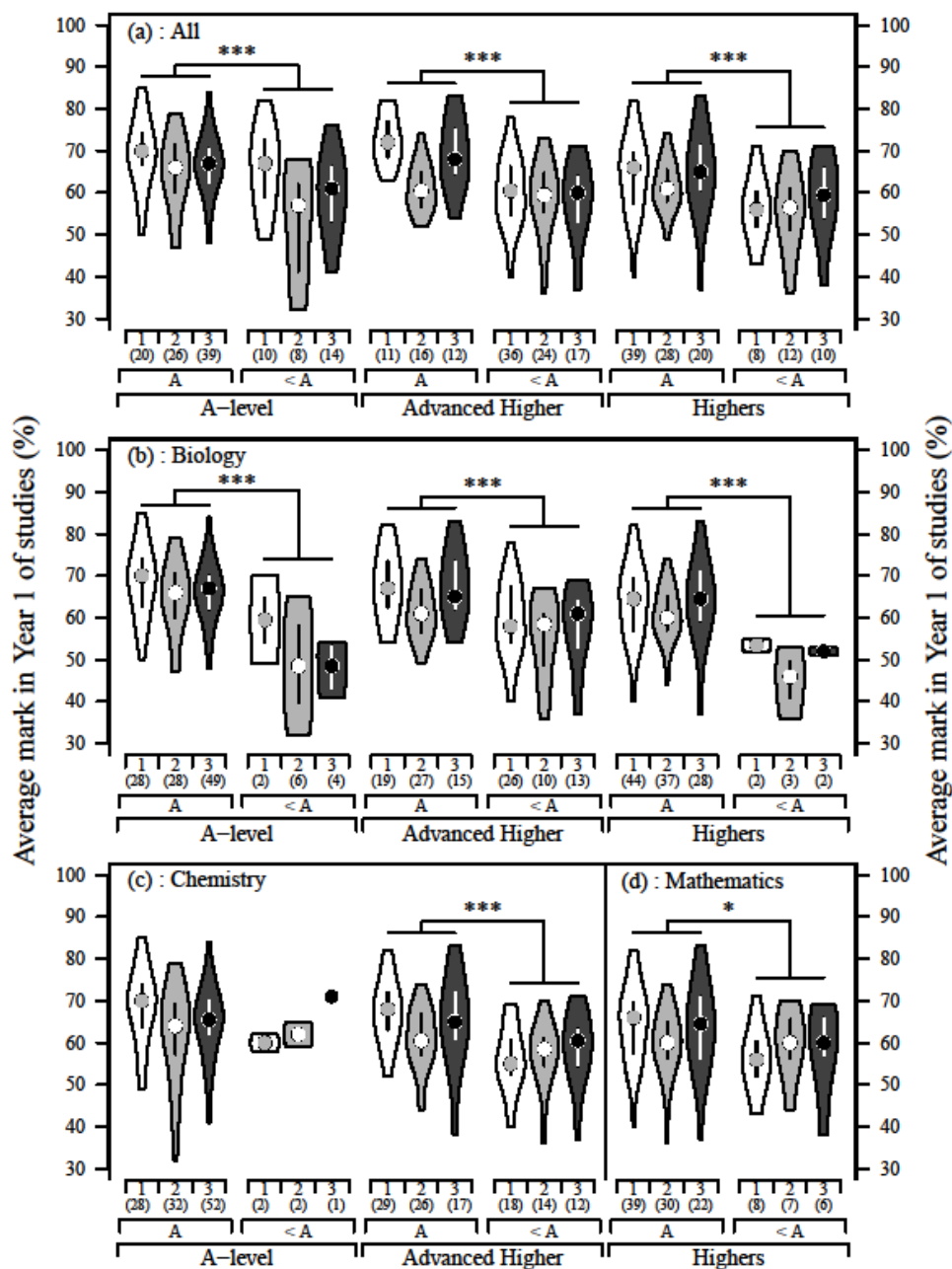
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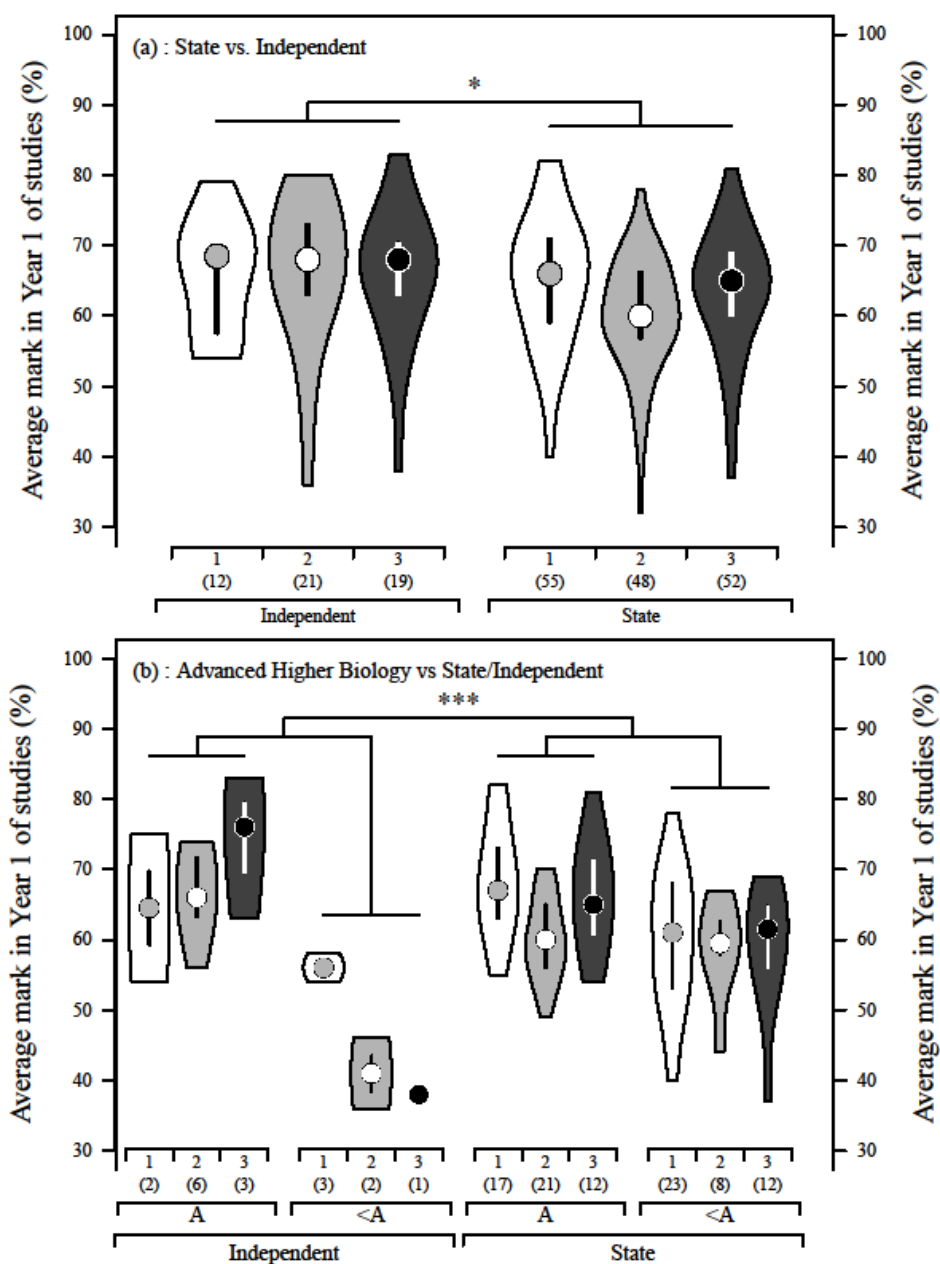
**Figure 1:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3 entry cohorts (2007, 2008 and 2009: EC 1-3) that completed their first year and had started (a) either the 5- year or 4- year accelerated graduate entry programme; (b) had started the 5- year programme as a school-leaver, either UK/rest of EU (rEU) Scottish Funding Council-funded (SFC) or rest of the world (RoW)); or had graduated either from a UK, rest of the EU or rest of the world university (UK/rEU/RoW); or had started the 4- year accelerated programme either as a UK/rEU graduate or a graduate from the rest of the world (RoW). Average marks (%) for the whole year were weighted by number of credits attached to courses within the Year 1. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. \*\*\* P<0.001.

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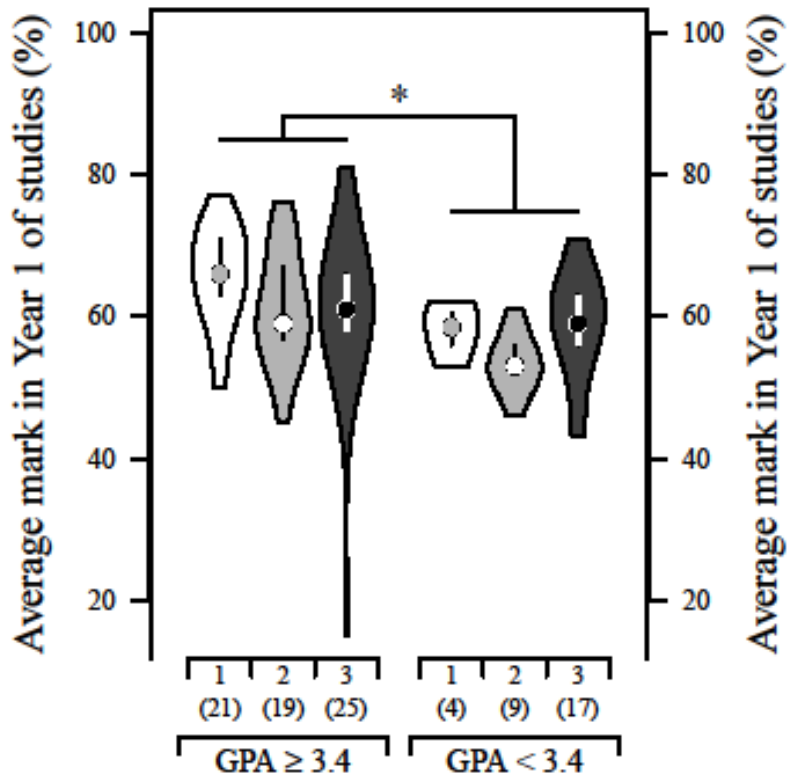
**Figure 2:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) that completed their first year and (a) had undertaken either A-Levels or Scottish Advanced Highers and Highers; (b) Biology A-Level, Advanced Higher and Higher; (c) Chemistry (A-level and Advanced Higher) and (d) Mathematics (Higher) in relation to whether they had achieved all grade A in these examinations. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. \*\*\* P<0.001, \* P<0.05.

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**Figure 3:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) in relation to whether the students had (a) attended an independent or state school and (b) attended an independent or state school and achieved a Grade A or less in Advanced Higher Biology. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. \*\*\*  $P < 0.001$ , \*  $P < 0.05$ .

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**Figure 4:** Violin density plots of average marks in Year 1 of the 4- year accelerated BVM&S programme for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) in relation to whether non-UK graduate students had obtained a grade point average (GPA)  $\geq 3.4$  or  $< 3.4$  in their previous degree. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. \*  $P < 0.05$ .