Appendix 1

Research Report Commissioned by CPHC

Table of contents

Introduction

The research described in this report was undertaken for the Council of Professors and Heads of Computing (CPHC). The primary aim was to investigate the recent decline in applications to undergraduate courses in Computing/IT at British universities. Many institutions have experienced a drop in the number of applications since 2001, and while a number of explanations have been proposed on the basis of anecdotal evidence, it is likely that the underlying causes are complex.

This project attempted to use national statistics to identify trends in applications and recruitment to Computing/IT courses, and to compare the situation of Computing/IT with that of other subjects. In addition, primary research was undertaken in order to examine perceptions of the subject among secondary education pupils during the period when most decisions about university entry are made. Part One of this report describes the outcomes of an analysis of the annual datasets made publicly available through the UCAS website. Part Two presents the results of a fieldwork phase during which a questionnaire was administered to pupils in 8 schools and colleges, and a small number of focus group interviews were conducted.

The UCAS statistics were used to identify general trends in applications and admissions to Computing/IT courses, to compare different subdisciplines within this field, and to set Computing/IT alongside other subject areas. Issues such as gender balance and demographic patterns (e.g. the distribution of applications among different age, ethnic and social class groups), as well as levels of pre-entry attainment are explored. The bulk of this analysis applies only to UK home students.

Part Two discusses the findings of the primary research with GCSE and A-level students. Participants were asked to complete questionnaires on their subject choices, their reasons for taking or dropping Computing and/or ICT, their plans for post-16 education, and their attitudes to Computing/IT as a subject and as a career. The focus group interviews explored some of these issues in more detail.

Some of the findings are suggestive and potentially useful in developing strategies to increase recruitment to Computing/IT courses. However, it is very important to note that this survey was limited by time and resources, and that it must not be assumed to represent the views of *all* secondary school pupils in the UK. This is largely because of constraints in the sampling procedures, which were determined by region and by the willingness of individual Schools to take part, as well as by the time available for the analysis of data. It was not possible to undertake the rigorous procedures to ensure genuine representativeness of the sort described in, for example, etb 2005 (p.3).

This project took place alongside a series of 'scoping events' organised by the CPHC and the BCS and funded by HEFCE under the 'STEM' initiative to increase the number of students entering higher education courses in a range of 'strategic' science, technology and mathematics subjects. Preliminary reports of some of the findings presented in this document were used in the discussions at these events, and an interim report was made at the 2006 CPHC/BCS conference.

PART ONE: ANALYSIS OF UCAS FIGURES

1:1 Student numbers

In the discussion which follows, all data is based on an analysis of the annual datasets released by UCAS. Unless otherwise stated, the figures for 'computing' represent the group of 'core computing' subjects as defined by UCAS. These are Computer Science, Software Engineering, Information Technology and Artificial Intelligence. In some cases it has been possible to separate figures for each of these disciplines. However, separate data relating to social class and ethnic origin is not available for computing. Therefore the sections on these issues relate to data for the group of subjects Computing and Mathematical Sciences (CMS), which also includes Mathematics, Statistics, Operational Research, combinations with these subjects and with Computing/IT, and other subjects in this general field.

Figures have been generated for four measures: these are the total number of applications to undergraduate courses from UK home students, the total number of acceptances, the total number of acceptances to degree-level programmes, and the total number of acceptances to HND and other diploma-level programmes. Where only two figures are presented in this report, these are normally for the total number of applications to all courses and the total number of acceptances to degree-level programmes, unless otherwise stated. All of the figures in this document relate *only* to UK home undergraduate applicants.

The number of UK home students applying to study Computer Science and related subjects has undergone a series of dramatic changes over the past decade. UCAS figures for the number of applications, acceptances, acceptances to degree courses and acceptances to HND/Diploma courses show a sharp rise which peaked in 2001 (Chart 1/Table 1). Applications rose by 15.8% and acceptances to degree courses by 13.6% in 1999, and the increases in 2000 and 2001 were only slightly smaller. Applications then fell by almost 20% and acceptances to degree courses by 8.6% in 2002, and similar trends were seen in 2003. In 2004 the drop in applications was more dramatic, but only a slight fall occurred in 2005[1].

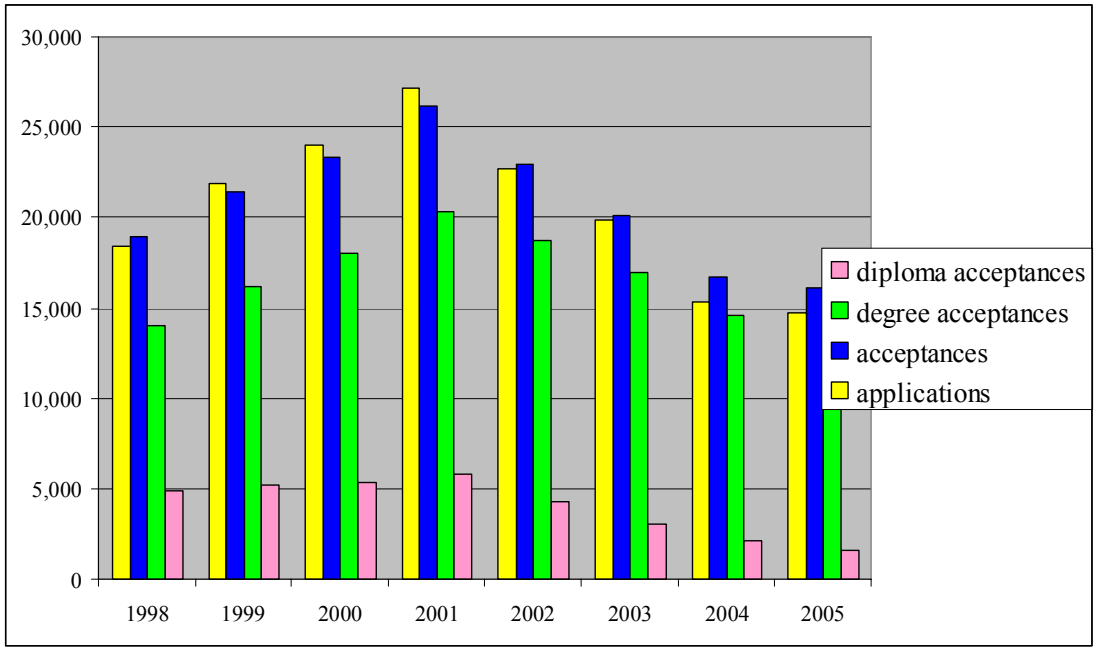

Chart 1: applicants and acceptances to undergraduate courses in core Computing disciplines

[1] The dramatic fall in diploma acceptances is probably due to the phasing out of some HND courses as Foundation Degrees become more widely established.

	applications	acceptances	degree acceptances	diploma acceptances
2005	14,708	16,130	14,489	1,641
2004	15,357	16,725	14,561	2,164
2003	19,856	20,071	16,987	3,083
2002	22,702	22,979	18,719	4,260
2001	27,177	26,160	20,335	5,825
2000	24,016	23,352	18,004	5,348
1999	21,856	21,436	16,227	5,209
1998	18,403	18,918	14,018	4,900

Table 1: applicants and acceptances to undergraduate courses in core Computing disciplines

	applications	acceptances	degree acceptances	diploma acceptances
2005	-4.4	-3.7	-0.5	-31.9
2004	-29.3	-20.0	-16.7	-42.5
2003	-14.3	-14.5	-10.2	-38.2
2002	-19.7	-13.8	-8.6	-36.7
2001	11.6	10.7	11.5	8.2
2000	9.0	8.2	9.9	2.6
1999	15.8	11.7	13.6	5.9

Table 2: percentage change, year on year, in applications & degree acceptances, core Computing

In 2004 the total number of applications to all courses in core Computing disciplines fell below that recorded in 1998, and in 2005 the total number of acceptances to degree courses in this subject area was less than 500 higher than in 1998.

The number of acceptances grew more slowly than the number of applications in 1999. At the point of greatest expansion in 2001, the two were very close indeed. However, the number of acceptances has since then fallen less than the total number of applications.

During the same period, the total number of applications to HE rose steadily to 2004/5, with a slight drop in 2005/6. However, the overall decline (9.3% in applications, 4% in acceptances to degrees) was larger than that seen in core Computing disciplines.

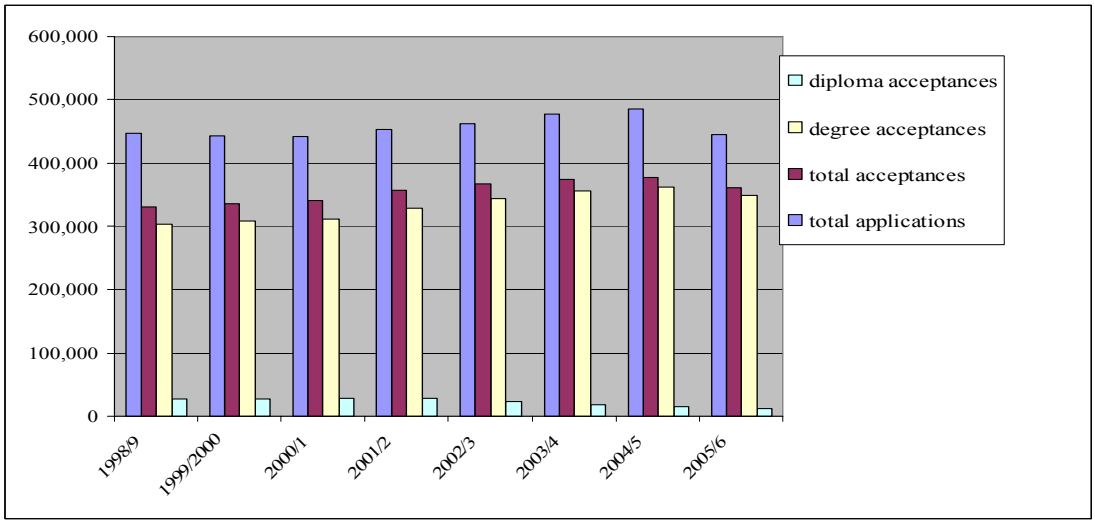

Chart 2: applicants and acceptances to undergraduate HE courses, all subjects

Computing has also seen a decline in numbers by comparison with other subjects. In pre-clinical medicine and dentistry, the biological sciences, physics, chemistry and engineering, the number of

applications and acceptances actually *rose* in 2005, despite the overall drop shown by the UCAS figures. This may be attributable to the initiatives which have been designed to increase pupil interest in these subjects. Even in subjects where numbers have fallen, the proportions involved have not been as dramatic as they have in core Computing disciplines. However, the smaller drop in the number of applications and acceptances which was seen in Computing in 2005 may mean that it is to some extent in line with other science subjects. Chart 3 and Tables 3 and 4 illustrate the trends discussed.

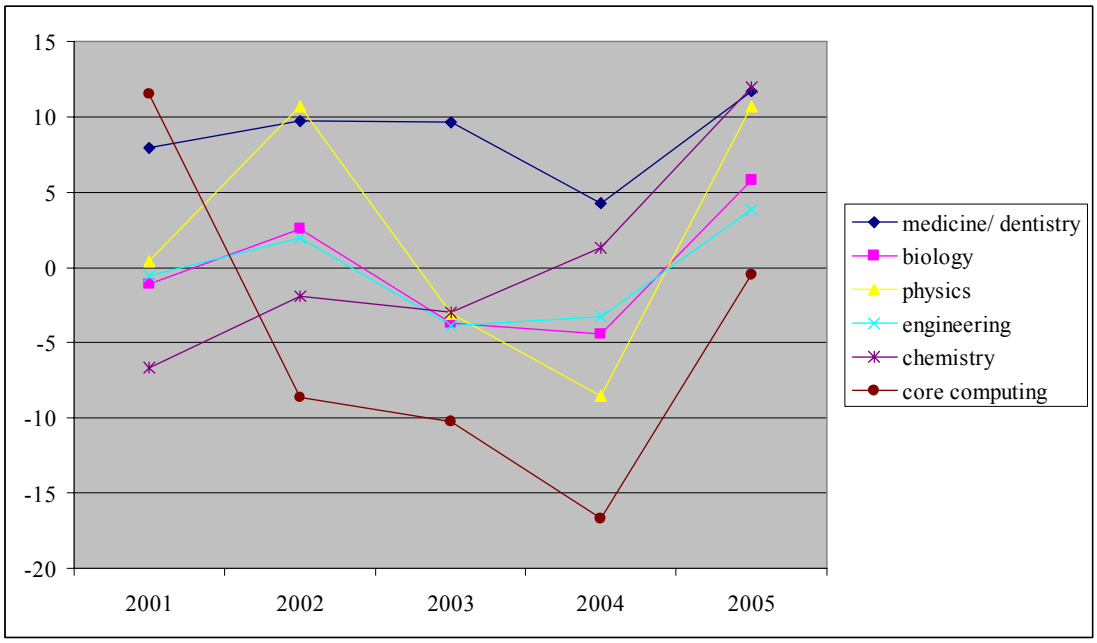

Chart 3: percentage change in number of acceptances to degrees, science disciplines

	medicine/ dentistry	biology	physics	engineering	chemistry	core computing
2005	11.7	5.8	10.7	3.8	12.0	-0.5
2004	4.3	-4.4	-8.5	-3.3	1.3	-16.7
2003	9.6	-3.7	-3.1	-3.9	-3.0	-10.2
2002	9.7	2.6	10.7	1.9	-1.9	-8.6
2001	7.9	-1.1	0.4	-0.6	-6.7	11.5

Table 3: percentage change in number of acceptances to degrees, science disciplines

	medicine/ dentistry	biology	physics	engineering	chemistry
2005	8,220	4,459	2,728	15,262	3,171
2004	7,262	4,201	2,435	14,684	2,790
2003	6,953	4,384	2,642	15,163	2,754
2002	6,287	4,545	2,725	15,754	2,836
2001	5,675	4,425	2,433	15,452	2,889
2000	5,229	4,474	2,423	15,548	3,083

Table 4: number of acceptances to degrees, science disciplines

Other subjects which have enjoyed an increase in the number of applications and students on courses include business studies, humanities, social studies, law, and creative arts and design. Tables 5 and 6 illustrate the change in the number of degree acceptances in each of these disciplines.

	law	business studies	social studies	creative arts & design	humanities	modern languages
2005	2.2	6.3	12.5	11.0	6.5	2.0
2004	4.2	2.3	6.5	6.4	-0.9	-0.5
2003	9.2	1.0	2.0	6.9	2.1	-3.7
2002	13.1	6.9	-14.2	6.3	2.0	-
2001	9.6	3.6	2.1	7.9	-	-

Table 5: percentage change in number of acceptances to degrees, non-science disciplines

	law	business studies	social studies	creative arts & design	humanities	modern languages
2005	16,710	35,637	26,582	39,471	30,505	5,650
2004	16,350	33,383	23,254	35,144	28,523	5,539
2003	15,667	32,630	21,753	32,899	28,783	5,564
2002	14,227	32,318	21,321	30,638	28,190	5,771
2001	12,360	30,104	24,356	28,709	27,618	3,090
2000	11,172	29,035	23,836	26,445		

Table 6: number of acceptances to degrees, non-science subjects

Different trends can be observed within the four 'core computing' disciplines. Table 7 shows the number of applications and degree acceptances in each subject area within the core computing group, and Table 8 shows the percentage change, year on year.

	Computer Science		Software Engineering		Information Technology		Artificial Intelligence	
	Applications	Acceptances - degree	Applications	Acceptances - degree	Applications	Acceptances - degree	Applications	Acceptances - degree
2005	11,554	10,127	734	1,128	2,397	3,162	23	72
2004	11,730	10,171	767	1,078	2,823	3,237	37	75
2003	14,722	11,623	1,012	1,249	4061	4048	60	147
2002	16,609	12,492	1,219	1,436	4,811	4,684	63	107
2001	24,054	15,988	3,046	4,239			77	108
2000	21,600	14,383	2,334	3,497			82	124
1999	19,783	13,109	1,986	3,016			87	102
1998	16,658	11,415	1,671	2,482			74	121

Table 7: number of applications and degree acceptances, core Computing disciplines

	Computer Science		Software Engineering		Information Technology		Artificial Intelligence	
	Applications	Acceptances - degree	Applications	Acceptances - degree	Applications	Acceptances - degree	Applications	Acceptances - degree
2005	-1.5	-0.4	-4.5	4.4	-17.8	-2.4	-60.9	-4.2
2004	-25.5	-14.3	-31.9	-15.9	-43.9	-25.1	-62.2	-96.0
2003	-12.8	-7.5	-20.5	-15.0	-18.5	-15.7	-5.0	27.2
2002	-44.8	-28.0	-149.9	-195.2			-22.2	-0.9
2001	10.2	10.0	23.4	17.5			-6.5	-14.8
2000	8.4	8.9	14.9	13.8			-6.1	17.7
1999	15.8	12.9	15.9	17.7			14.9	-18.6

Table 8: percentage change in number of acceptances to degrees, core computing disciplines

The numbers in Artificial Intelligence are really too small to provide useful indications of trends. Focus group evidence suggests that this area in particular may be subject to 'fashion' and to the appeal of the 'trendy' course title, but the evidence available is little more than anecdotal. It appears that a number of students who apply initially to a course in a different area will eventually join an AI course, perhaps as they learn more about the subject during the process of application.

In Software Engineering, a very dramatic fall occurred in 2002, followed by a smaller but still severe decline in 2003 and 2004. The initial drop in Computer Science was smaller, but a less serious decline in 2003 was followed by a fall of 25% in 2004. Both of these disciplines saw only very small declines in 2005. By contrast, Information Technology suffered a fall of 17.8% in 2005. This represented an improvement on the previous year, but suggests that trends in this subject may be different from those which operate in the more 'technical' areas.

1:2 Gender balance

The low number of women who choose to study computing has been the subject of much concern and many initiatives during the period considered. Table 9 and Chart 4 show the percentage of women who applied for or were accepted to places on courses in the core Computing disciplines. These show that as the total number of Computing students rose, the proportion of women also rose, reaching a high point in 2001.

	applications	acceptances	degree acceptances	diploma acceptances
2005	14.4	15.8	15.8	15.7
2004	15.7	16.0	16.3	14.6
2003	15.9	16.3	16.5	15.0
2002	17.1	17.3	17.5	16.3
2001	17.8	18.2	18.4	17.2
2000	17.3	18.6	18.6	18.6
1999	17.0	18.2	18.1	18.9
1998	16.0	17.5	17.1	18.6

Table 9: Percentage of applications from and acceptances granted to females for courses in core computing disciplines

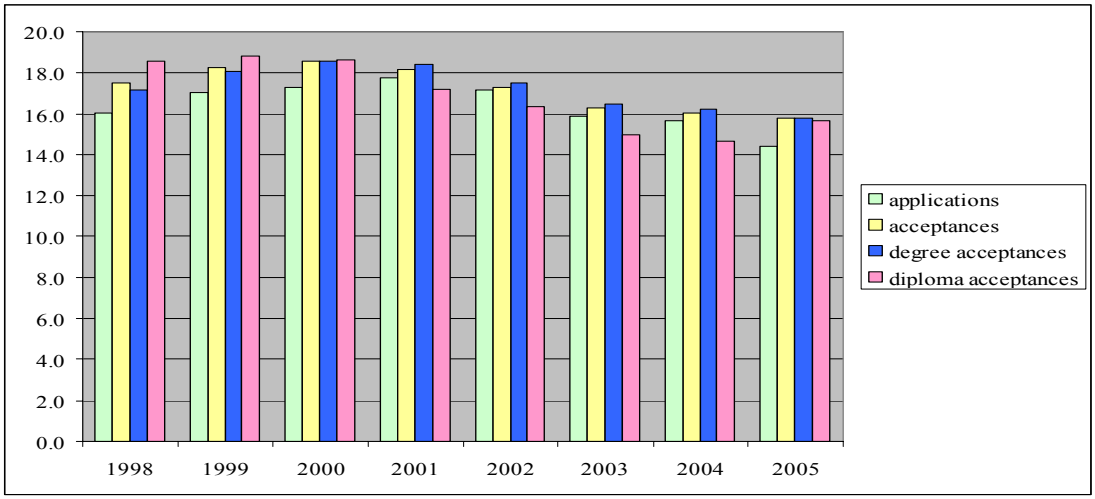

Chart 4: Percentage of applications from and acceptances granted to females for courses in core computing disciplines

However, with the decline in overall numbers has come a decline in the proportion of students who are female. This is now lower than it was in 1998. On Diploma courses, the proportion of women was higher than on degree courses in the late 1990s, but following a substantial fall in 2001 and 2002, the proportion is now almost identical to that for degrees. This may be the result of a higher number of women choosing to study to degree level if they opt for Computing at all.

Over the same period, the proportion of all undergraduate students in HE who are female has *increased*. Table 10 shows the proportion of applications from and acceptances to female students for all subjects. As in the core Computing disciplines, the proportion of women on diploma courses is lower than the proportion of women on degree courses, but this represents a rise rather than a fall since the late 1990s. In all subjects, a slightly higher proportion of women apply than are accepted; this is the opposite of the pattern seen for the core Computing disciplines.

	applications	acceptances	degree acceptances	diploma acceptances
2005	55.5	54.4	54.7	43.6
2004	55.1	54.4	54.9	41.5
2003	54.3	53.7	54.4	41.5
2002	53.8	53.3	54.2	41.4
2001	53.4	52.9	54.1	40.8
2000	53.4	53.0	54.0	41.7
1999	53.1	52.6	53.7	40.8
1998	52.8	52.1	53.3	40.0

Table 10: Percentage of applications from and acceptances granted to females, all subjects

By themselves, the figures for Computing indicate that the gender imbalance in this subject area is not becoming more even, despite the fact that there are *more* women applying and being admitted to university. Figures for other subject areas, however, suggest that it is difficult to shift traditional 'gender trends' in subject choice, and possibly even that these have become more entrenched in very recent years.

Table 11 and Chart 5 show the proportion of acceptances to degree courses in Physics, Chemistry, Biology and Engineering which were granted to female applicants:

	biology	physics	engineering	chemistry
2005	56.6	21	11.3	38.7
2004	60.1	16.3	11.3	41.5
2003	59.6	18.2	11.1	42.7
2002	60.8	19.2	11.7	43.3
2001	59.9	19.1	15.2	42.4
2000	61.2	18.5	14.9	41.9
1999	56.9	19.3	14.6	40.3
1998	57.40	19.3	14.3	39.3

Table 10: Percentage of degree acceptances granted to females, physical sciences & engineering

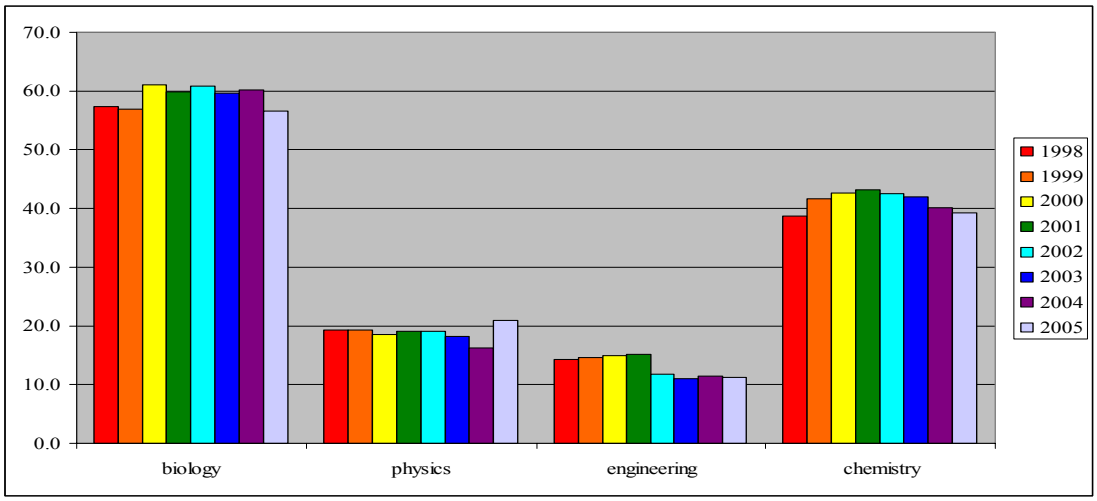

Chart 5: Percentage of degree acceptances granted to females, physical sciences & engineering

In Chemistry and Engineering, the proportion of students who were female increased between 1998 and 2001, just as it did in the core Computing disciplines. The proportion of female Physics students remained fairly stable during this period, and in Biology, the traditionally 'female' science subject, the overall trend was an increase, with its highest point in 2000 and a second small 'peak' in 2002. However, between 2002 and 2005, the trend was for a decrease in all areas. In Chemistry and Biology, the proportion of female students in 2005 was the lowest seen during the period surveyed, and in engineering the proportion appear to be stable at around 11%, with no sign that a return to the higher levels of female representation seen around the turn of the century. The exception to these trends in is Physics, where the decline was sharply reversed in 2005 and the proportion of students who are female rose to over 20%. This may represent a 'blip', or it may reflect the outcomes of particularly effective programmes to increase female participation in Physics courses.

Table 11 and Chart 6 show the representation of women among students accepted to degree courses in medical subjects.

	medicine & dentistry	**nursing**	**medical technologies**
2005	57.9	92.7	72.1
2004	59.9	92.2	72.4
2003	61.6	92.5	69.9
2002	61.2	91.5	75.9
2001	58.2	91.6	-
2000	59.1	92.5	-
1999	56.8	92.6	-
1998	55.60	92.3	-

Table 11: Percentage of degree acceptances granted to females, medical subjects

The decline in the proportion of females studying medicine and dentistry occurs later than the decline seen in the other physical science subjects, but it is still marked. In Nursing and Medical Technologies, the 'traditional' gender stereotype is for *women* to prefer these subjects. While female numbers have not actually increase on these courses, they have remained remarkably stable over the whole period, suggesting that if women are not choosing 'male' subjects, men are not showing any new interest in 'female' ones.

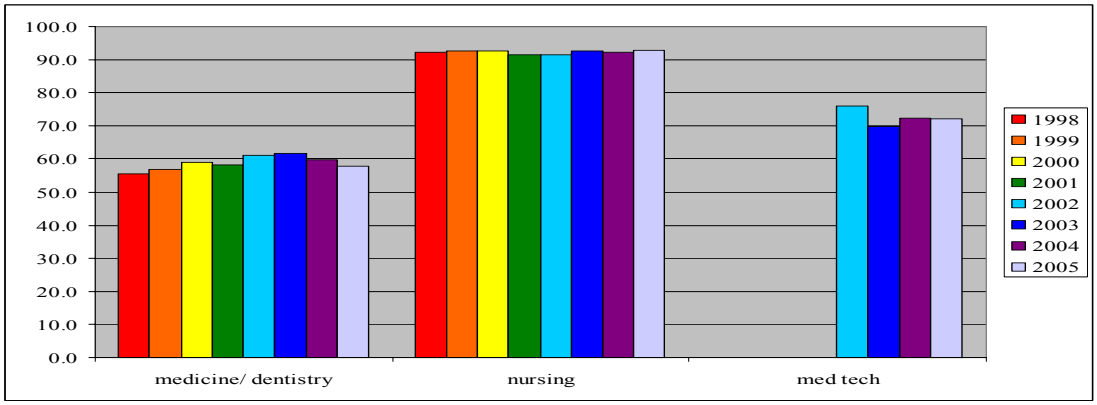

Chart 6: Percentage of degree acceptances granted to females, medical subjects

The Humanities, Modern Languages and Social Sciences are also sometimes seen as 'female' subjects. The figures for these subjects show some evidence of an entrenchment of gender stereotypes in subject choice, but this is by no means as strong a suggestion as the one which can be drawn from the data for the sciences. In the Humanities, the proportion of degree places which are granted to females is almost 10% higher than it was in 1998, but this has not occurred through a gradual increase. This could be due to variations in the subject classifications used by UCAS, or it could show a genuine trend. Social Studies had almost exactly the same proportion of female students in 2005 as in 1998, but it is difficult to identify a clear pattern over the whole period. The proportion of female students in Creative Arts and Design and in Law appears to increase gradually between 1998 and 2004, but both subjects show a fall in 2005, while female numbers declined during the period in both Modern Language and – perhaps more surprisingly – Business Studies.

	Law	business studies	social studies	creative arts & design	humanities	modern languages
2005	63.2	47.4	60.5	60.2	61.4	68.6
2004	64.0	48.7	57.6	61.5	62.1	68.4
2003	64.5	49.1	55.5	60.9	51.1	68.9
2002	64.3	50.1	55.6	60.4	63.4	70.0
2001	63.8	50.3	60.8	58.7	53.2	71.4
2000	63.8	50.0	60.5	59.2	64.2	69.3
1999	62.2	51.1	61.0	58.5	53.8	71.8
1998	61.8	50.2	60.9	58.2	53.0	70.8

Table 12: Percentage of degree acceptances granted to females, non-science subjects

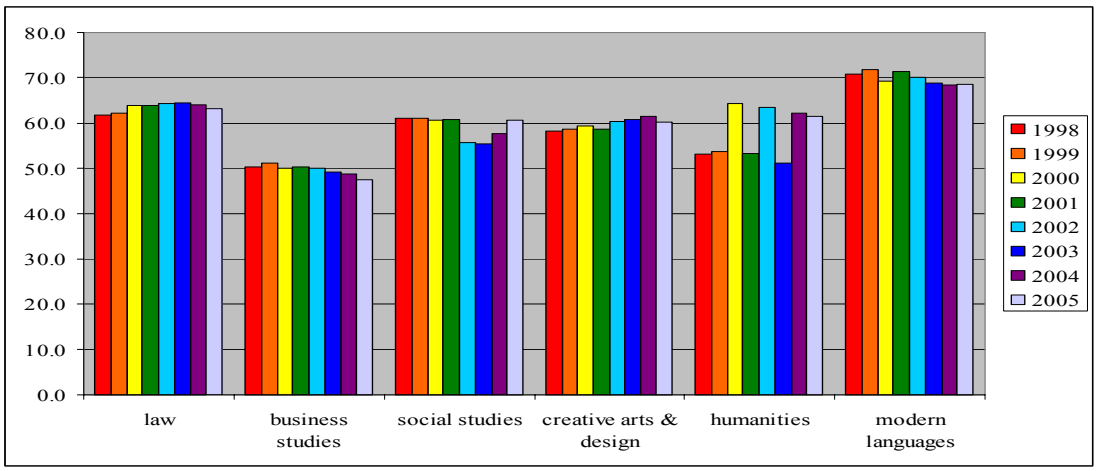

Chart 7: Percentage of degree acceptances granted to females, non-science subjects

The various subjects within the Computing field show different patterns of female representation. Table 13 and Chart 8 shows the proportion of applications which come from females alongside the proportion of degree places awarded to females in each of the different 'core' Computing areas.

	Computer Science		Software Engineering		Information Technology		Artificial Intelligence	
	Applications	Acceptances - degree	Applications	Acceptances - degree	Applications	Acceptances - degree	Applications	Acceptances - degree
2005	11.9	13.5	8.6	8.5	28.4	25.9	4.3	6.9
2004	12.8	13.9	10.8	9.2	29.2	26.3	10.8	12.0
2003	12.3	13.3	9.2	10.1	30.4	27.8	16.4	0.0
2002	13.7	14.6	8.6	9.8	31.2	27.8	11.1	14.0
2001	18.4	19.3	12.7	15.3			13.0	13.0
2000	17.7	19.5	13.9	15.2			13.4	12.9
1999	17.5	18.9	13.1	14.7			6.9	9.8
1998	17	18	12	14			8	19

Table13: Applications from females and degree places awarded to females as a proportion of all applications/places awarded, core Computing disciplines

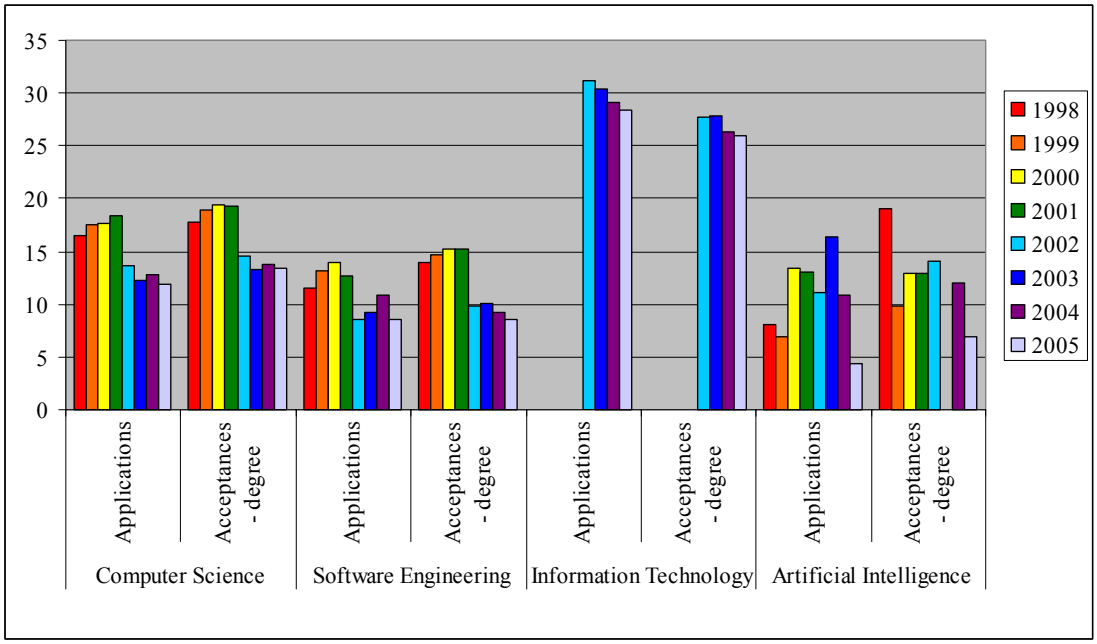

Chart 8: Applications from females and degree places awarded to females as a proportion of all applications/places awarded, core Computing disciplines

The figures for Artificial Intelligence are, again, too small to allow any firm conclusions. However, in the other subject areas a decline in the proportion of students who are female can generally be seen. The exception to this trend is in Software Engineering, when the sharp drop in the proportion of *applicants* who are female following the peak in 2000 and 2001 is followed by another small increase, reversed in 2005. The proportion of women who are admitted to degree courses in this area, however, declines steadily from 2002.

In Computer Science, the proportion of females declines fairly steadily from 2002, with a small rise in 2004 which is reversed in the following year. Perhaps more surprisingly, the number of females applying to study Information Technology declines steadily over the period for which figures are available, despite the relatively greater popularity of this subject among women. This latter trend may be related to the decreasing female numbers in Business and Management studies, demonstrated in Table 12.

1:3 Age profile

A potential area for widening participation in Computing is among mature-age students. Computing is associated with good career prospects, and is often seen as a destination for people who change careers; in addition, university Computing departments may attract those who are already working in this field and wish to update their skills. On the other hand, older students may opt for part-time or FE courses rather than degree or diploma programmes in HE, and computing professionals may prefer to upgrade their skills through vendor qualifications or other training in the workplace.

Table 14 and Chart 9 show the proportion of applications and acceptances to degree courses for students aged over 21.

	all subjects		core computing disciplines	
	applications	degree acceptances	applications	degree acceptances
2005	21.4	17.6	18.4	25.0
2004	25.5	21.8	24.8	27.2
2003	22.7	19.8	19.7	22.8
2002	22.2	19.5	20.4	23.0
2001	21.6	18.8	20.8	22.3
2000	21.1	18.1	19.2	21.3
1999	21.1	18.4	20.4	22.0
1998	22.0	19.1	22.6	23.8

Table 14: proportion of applications and acceptances to degree courses, students aged over 21 – all subjects and core computing disciplines

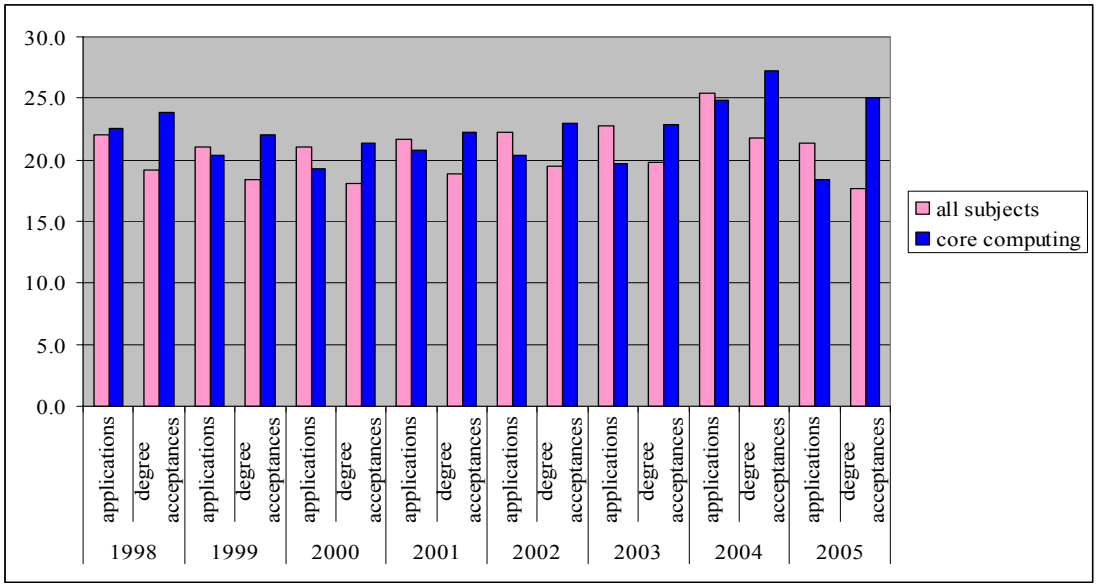

Chart 9: proportion of applications and acceptances to degree courses, students aged over 21 – all subjects and core computing disciplines

It appears from these figures that, while the proportion of mature-age *applicants* to Computing courses is similar to or slightly below the proportion of all undergraduate applications, the proportion of acceptances to degree courses for students aged over 21 is considerably higher than the rate for all subjects. This was especially marked in 2005, when the proportion of mature-age applicants fell substantially from the previous year, but this trend has been observable for the whole of the period considered.

The breakdown of mature age groups is also rather different in computing from the one which can be observed across all subject areas. Charts 10a – 10e show the figures for this breakdown for the year 2005 – 2001 (trends for 1998 – 2000 are similar).

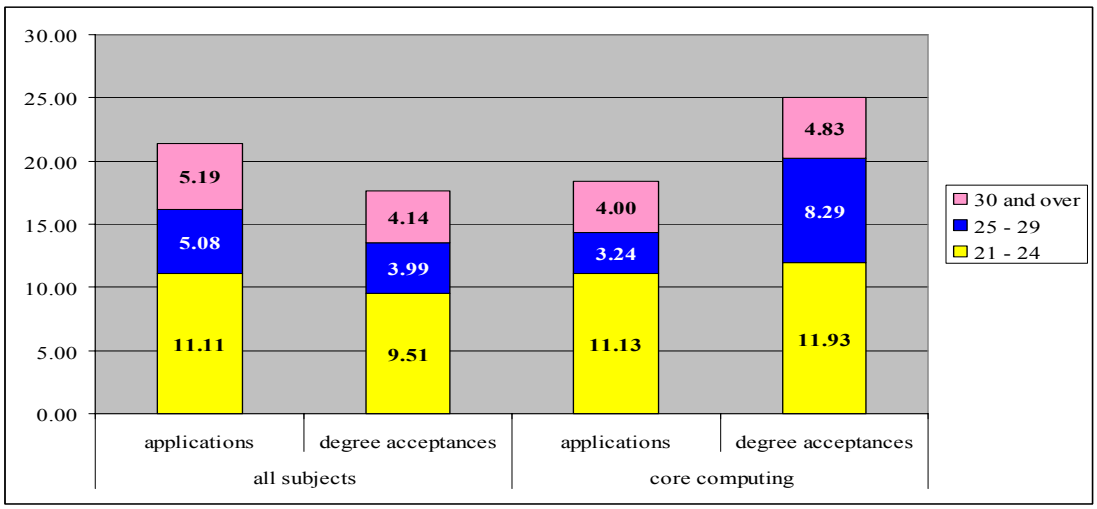

Chart 10a: applications and acceptances to degrees, all subject areas & core computing disciplines, ***2005***

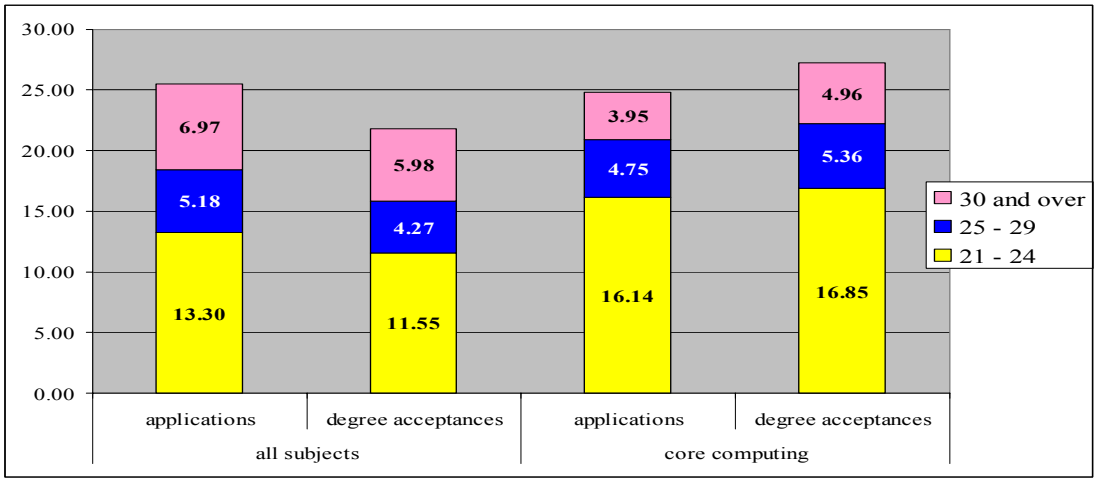

Chart 10b: applications and acceptances to degrees, all subject areas & core computing disciplines, ***2004***

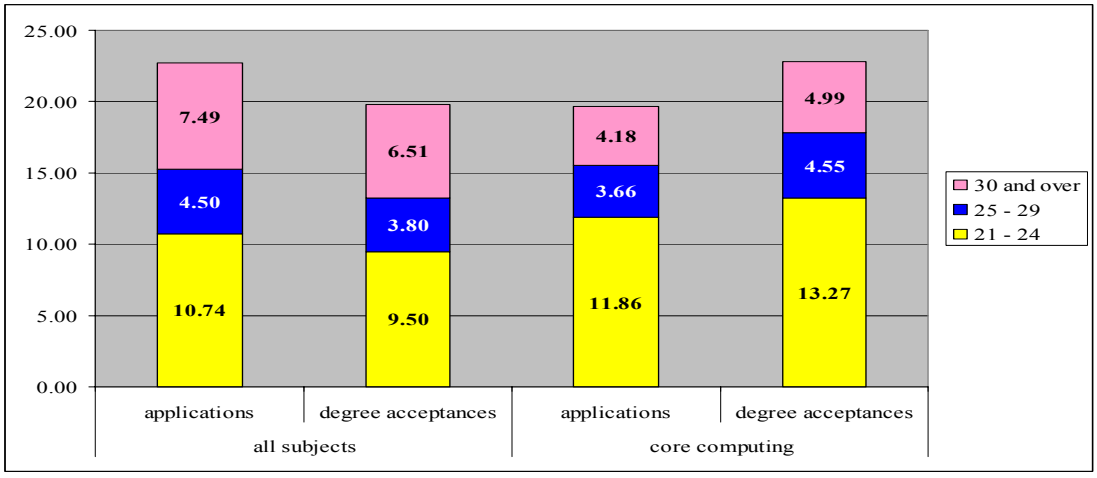

Chart 10c: applications and acceptances to degrees, all subject areas & core computing disciplines, ***2003***

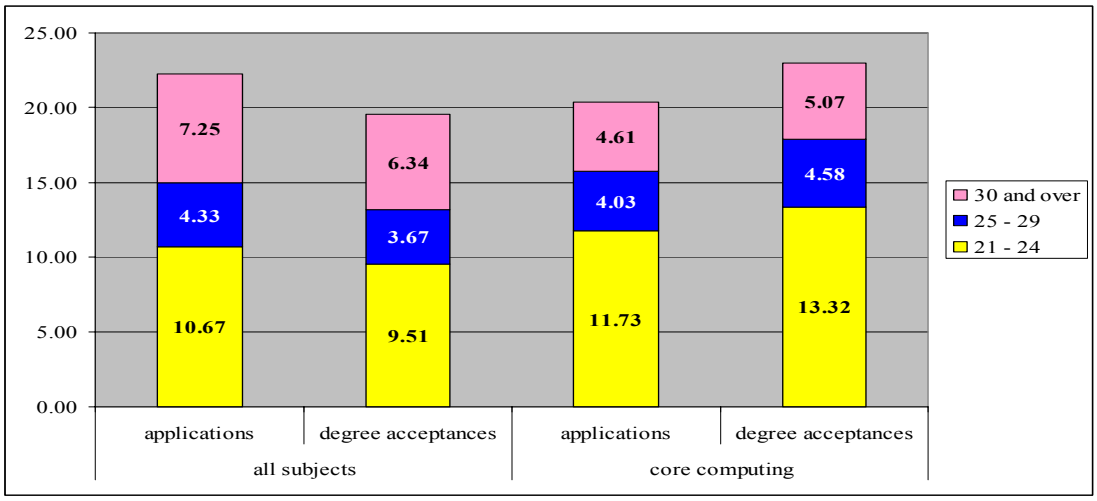

Chart 10d: applications and acceptances to degrees, all subject areas & core computing disciplines, ***2002***

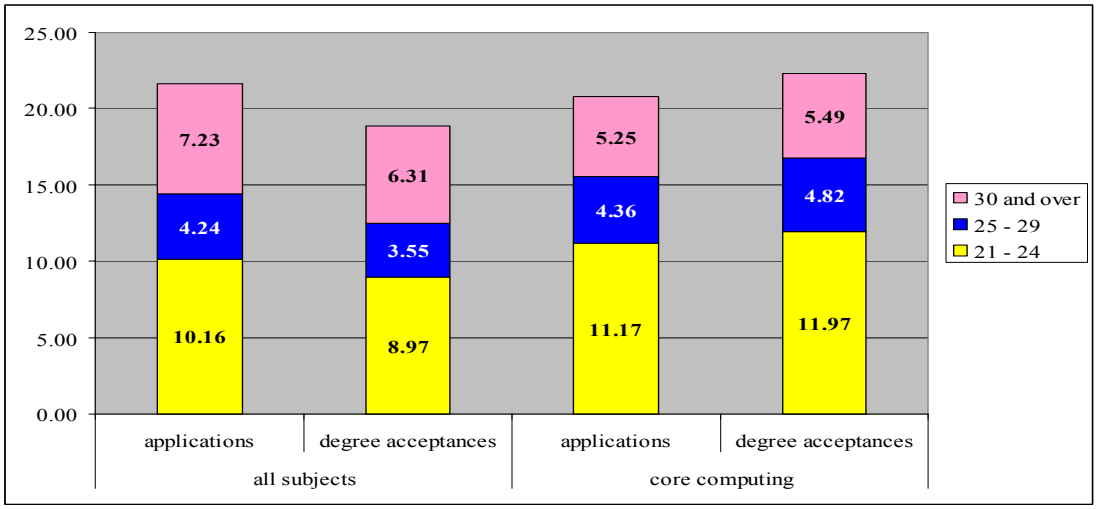

Chart 10e: applications and acceptances to degrees, all subject areas & core computing disciplines, ***2001***

Prior to 2005, the proportion of applications and acceptances for the 21-24 age group is generally higher in core Computing disciplines than in the student population as a whole. In other words, these subjects appear to attract the youngest group of 'more mature' students rather more strongly. Among students aged 25-29, the proportion of applications is similar in core Computing disciplines to the average for all subjects. However, a higher proportion of acceptances to degree programmes are granted to students in this age group in core Computing disciplines than in the university population as a whole. Among students over 30, the proportion of both applications and acceptances is higher in core Computing disciplines than across all subjects.

In 2005, some of these patterns changed. The proportion of applications from the 21-24 age group was almost identical in core Computing disciplines to that seen across all subjects, although the proportion of acceptances to degree programmes was slightly higher. However, the proportion of both applications and acceptances to degree courses for students aged 25-29 was considerably higher in core Computing disciplines than across all subjects. Among those over 30, the proportion of applications was slightly lower in core Computing disciplines, but the proportion of acceptances to degree courses was very similar.

The implications of this for widening participation among older students are unclear. It seems that full-time undergraduate courses in Computing may be less attractive to older students than higher education courses in general, but that university departments are inclined, for whatever reason, to admit a high proportion of older students who do apply.

Charts 11a and 11b show the proportion of applications and acceptances for mature-age students to other science disciplines in 2004 and 2005.

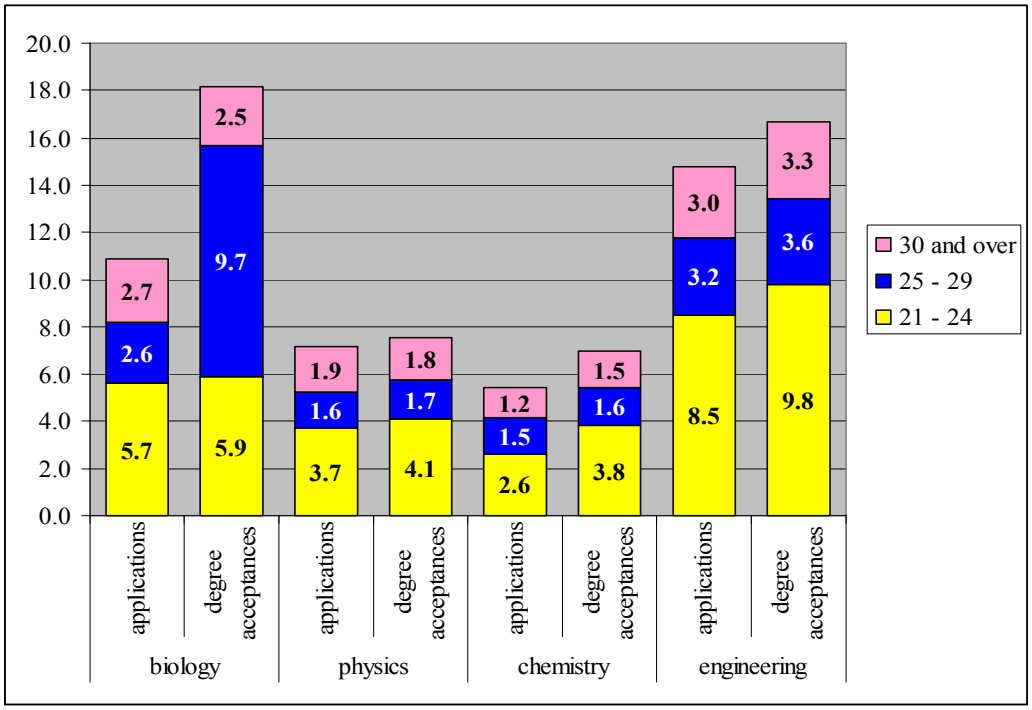

Chart 11a: applications and acceptances to degrees, science disciplines, ***2005***

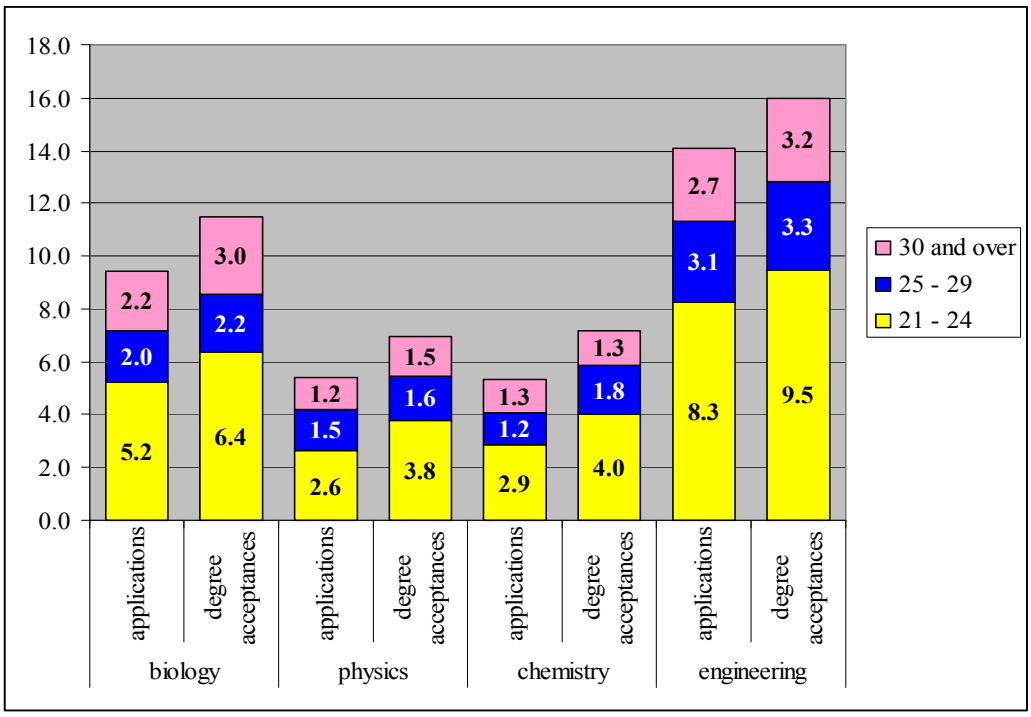

Chart 11b: applications and acceptances to degrees, science disciplines, ***2004***

As in Computing, the proportion of acceptances to degree courses from mature-age students is higher than the proportion of applications received from this group. For other science subjects, the overall proportion of mature-age applicants and students accepted to degree courses is lower than it is for the core computing disciplines. The number of applications was under 6% in 2004 for both Chemistry and Physics, although it rose in 2005 for Physics; no such rise was seen for Chemistry. Degree applications from mature-age students remain under 8% for both of these subjects. Engineering has a slightly older age profile, with applications around 14% and acceptances around 16% in both years, rising slightly in 2005. The sharpest change was in Biology, with applications rising from around 9% to around 11% and acceptances from around 11% to around 18%.

For all of these subjects, the proportion of students aged 25-29 and over 30 remains considerably smaller than it is in Computing, and the proportion of mature-age students accepted to degree programmes is also lower. However, the trend appears to be towards an older age profile, while this may not be the case for Computing.

1:4 Social class

Computing is regarded by many commentators as a subject with strong potential for widening participation among students from backgrounds in the lower class groups, and/or where there is little or no history of higher education within the family. This is partly because of the excellent job prospects offered by the subject, a factor which is believed to be especially influential on the subject choices of students from these backgrounds.

Charts 12a – 12c show the proportion of applications received from and degree acceptances awarded to students, broken down by social class background where this is known, for Computing and Mathematical Sciences and for all subject. Unfortunately, only limited data is available in this area, and for both Computing and Mathematical Sciences and for the university population as a whole, social class background cannot be determined for around one fifth of applicants and entrants. However, these figures suggest that Computing and Mathematical Sciences has indeed both attracted and admitted a higher proportion of students lower social class backgrounds.

In 2005, 20.2% of applicants to Computing and Mathematical Sciences courses came from the three lowest social class backgrounds, and 18.19% of students accepted to degrees came from these groups. This compares with 17% of all applications and 16.34% of acceptances to degree courses in all subjects. The different is greatest among students from routine and semi-routine backgrounds, with similar numbers coming from lower supervisory and technical backgrounds. By contrast, around 31% of applications and acceptances to degree courses in Computing and Mathematical Sciences relate to students from the two highest social classes, compared to 34.15% of applications and 35.68% of degree acceptances in all subjects.

The 2005 figures reflect a long-standing trend in Computing and Mathematical Sciences. 2005 in fact saw an overall fall in the number of students from lower-class backgrounds, and there was also a fall in their numbers in Computing and Mathematical Sciences. In 2004, 23.49% of applications in Computing and Mathematical Sciences were from students from lower class backgrounds, and in 2003 the figure was 23.43%. 21.27% of admissions to degrees in these subjects in 2004 were granted to students from lower class backgrounds, and the figure for 2003 was 20.86%. Similarly stable figures were seen for all subjects in 2004 and 2003, with around 19% of applications and 18.9% of admissions relating to students from backgrounds in these groups. The greatest contrast appears to be in the number of students recruited from the lowest class groupings, and the smaller number of Computing and Mathematical Sciences students from the higher social class groups also appears to be a consistent trend.

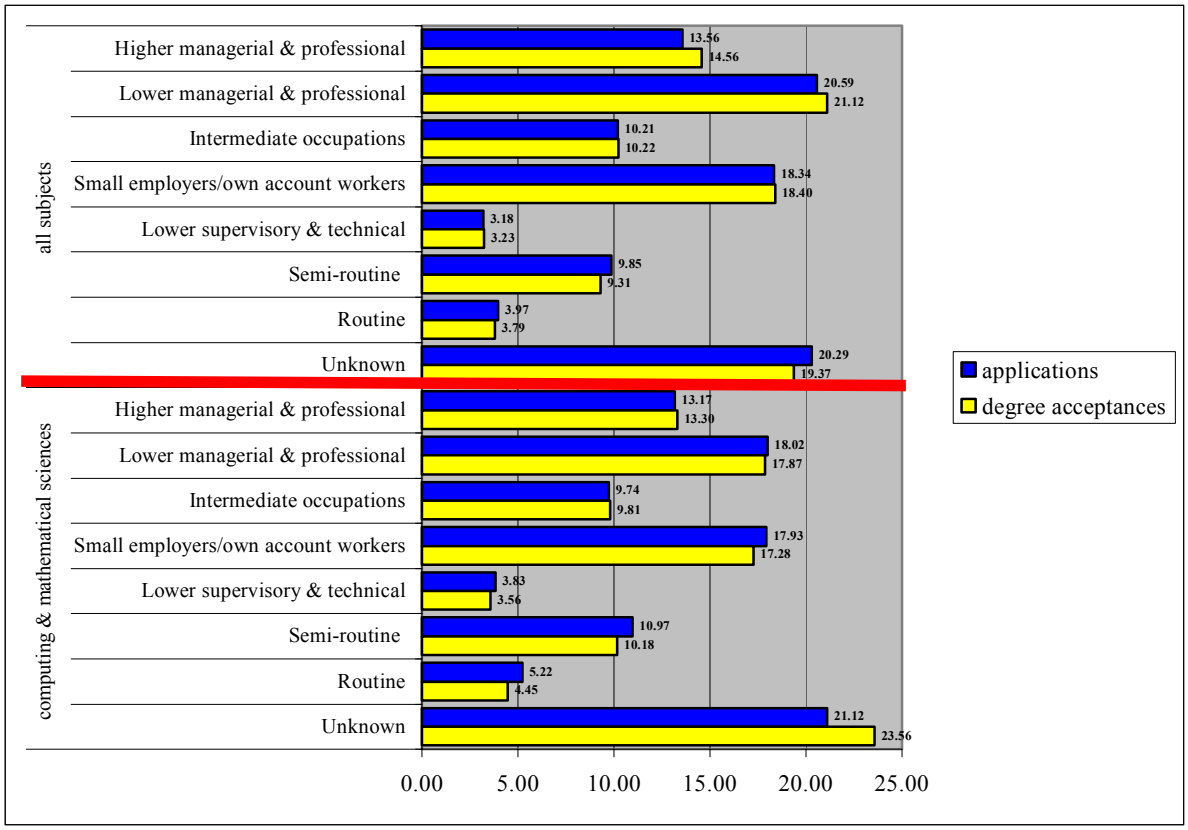

Chart 12a: 2005 Applications and acceptances to degree courses, by social class: all subjects compared to Computing and Mathematical Sciences

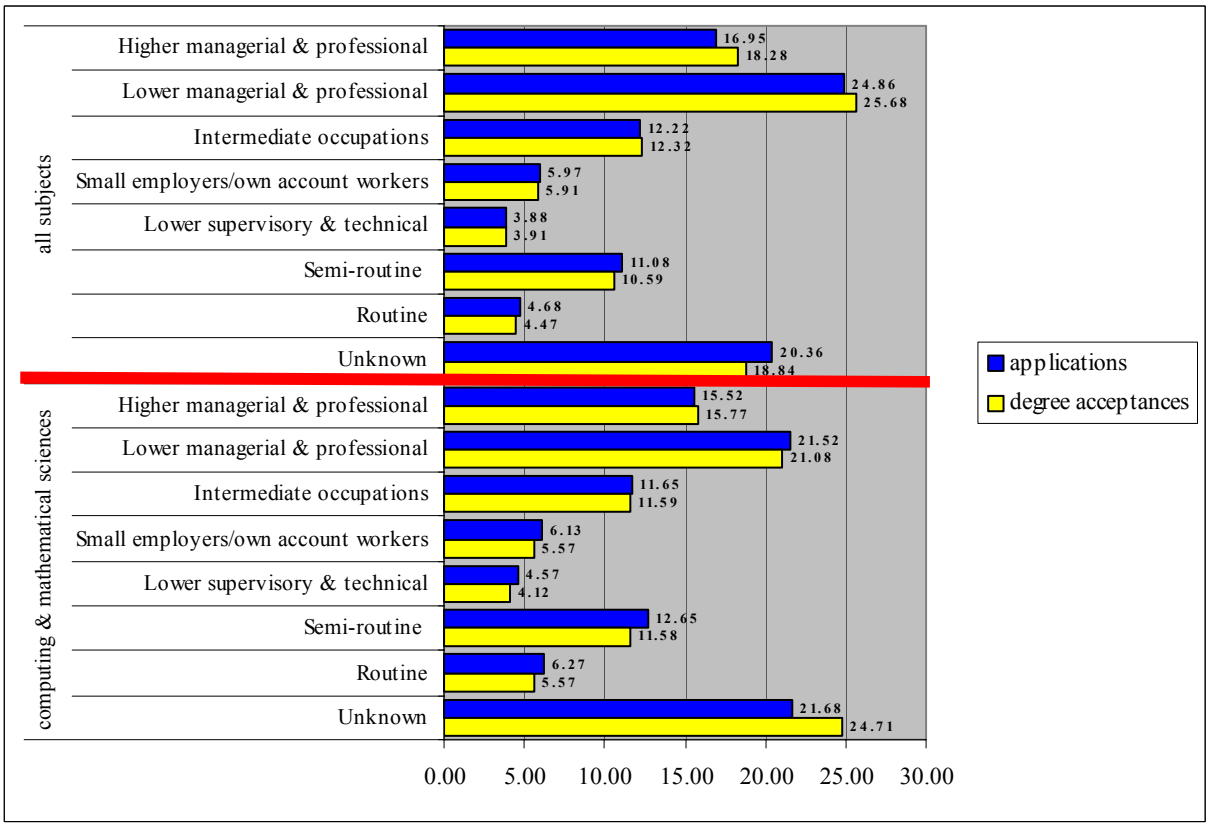

Chart 12b: 2004 Applications and acceptances to degree courses, by social class: all subjects compared to Computing and Mathematical Sciences

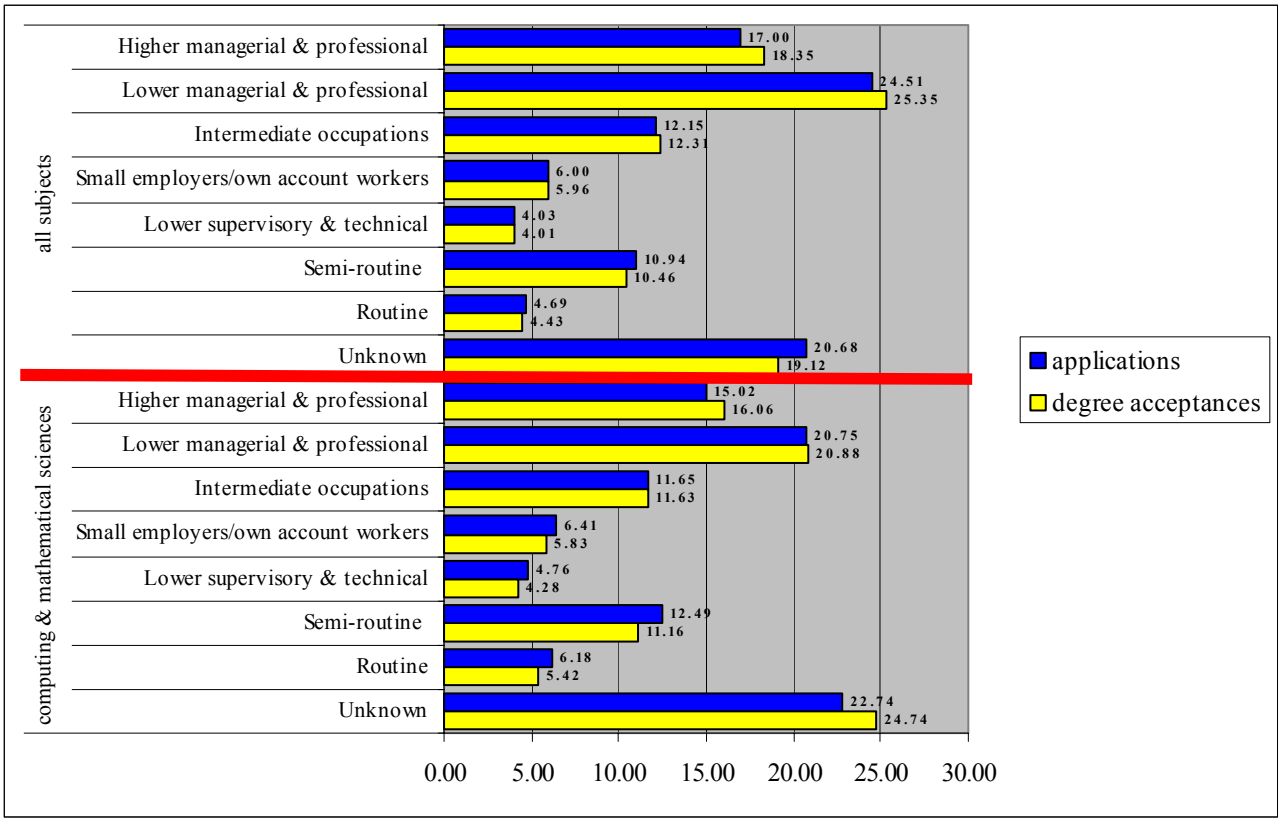

Chart 12c: 2003 Applications and acceptances to degree courses, by social class: all subjects compared to Computing and Mathematical Sciences

Table 15 provides a digest of figures for 1998 – 2005, demonstrating the stability of this pattern. The higher figures for 2001 and before appear because of changes in the methodology used by UCAS, rather than any actual change in the composition of the student population.

		applications	degree acceptances
2005	All subjects	17.00	16.32
	CMS	20.02	18.19
2004	All subjects	19.65	18.97
	CMS	23.49	21.27
2003	All subjects	19.66	18.90
	CMS	23.44	20.86
2002	All subjects	19.65	18.76
	CMS	23.32	20.59
2001	All subjects	24.35	23.23
	CMS	29.14	26.39
2000	All subjects	24.73	23.48
	CMS	29.29	26.30
1999	All subjects	24.90	23.54
	CMS	29.71	26.68
1998	All subjects	24.95	23.67
	CMS	28.87	26.43

Table 15: Percentage of applications and acceptances to degrees, students from lower social classes: all subject and Computing & Mathematical Sciences

Table 16 compares the figures for applications and degree acceptances relating to students from the lowest social class groups for a range of subjects between 2005 and 2000.

		applications	degree acceptances
2005	medicine	9.98	8.82
	subjects allied to medicine	20.19	18.35
	biological sciences	17.46	16.64
	physical sciences	15.57	15.18
	engineering	18.42	17.09
	humanities	11.34	10.77
	business studies	18.29	16.77
2004	medicine	11.63	10.11
	subjects allied to medicine	23.78	21.40
	biological sciences	20.31	19.60
	physical sciences	18.30	17.77
	engineering	21.65	19.88
	humanities	12.52	12.67
	business studies	18.90	17.32
2003	medicine	9.34	8.77
	subjects allied to medicine	20.81	18.64
	biological sciences	18.53	17.69
	physical sciences	16.07	15.96
	engineering	20.27	18.83
	humanities	13.40	13.12
	business studies	19.44	17.48
2002	medicine	9.34	8.77
	subjects allied to medicine	20.81	18.64
	biological sciences	18.53	17.69
	physical sciences	16.07	15.96
	engineering	20.27	18.83
	humanities	13.40	13.12
	business studies	19.44	17.48
2001	medicine	19.63	18.17
	subjects allied to medicine	35.34	33.81
	biological sciences	31.73	30.46
	physical sciences	30.66	30.33
	engineering	33.12	31.60
	humanities	27.41	27.07
	business studies	34.77	32.67
2000	medicine	20.47	18.65
	subjects allied to medicine	35.19	33.22
	biological sciences	31.64	30.45
	physical sciences	30.41	30.31
	engineering	33.79	32.20
	humanities	27.38	27.34
	business studies	35.18	33.18

Table 16: Percentage of applications and acceptances to degrees, students from lower social class backgrounds, range of subjects

These figures indicate that since the overall drop in Computing and Mathematical Sciences applications, subjects in these area have had a class 'mix' which is more similar to that of the group of Subjects Allied to Medicine than that of the physical sciences, medicine, the humanities or even business studies. Engineering has a similar profile, although it is still more 'middle class' than Computing and Mathematical Sciences.

However, around the time of the peak in application numbers, Computing and Mathematical Sciences actually attracted and admitted *fewer* students from the lowest social class groups than the majority of the subjects considered here, with the exceptions of medicine and the humanities. This may reflect relative levels of access to computer facilities in the home, and hence experience of the subject. The prestige of Computing/IT, discussed below, may also have shifted during the period examined.

1:5 Ethnic origin

Table 17 shows the percentage of applications from and degree acceptances to students from different ethnic backgrounds, for all undergraduate courses in the UK. Table 18 shows the same information for Computing and Mathematical Sciences only. These figures indicate that Computing and Mathematical Sciences attracts a substantially higher proportion of students from British Asian and Chinese backgrounds than is typical in the undergraduate population as a whole. The proportion of students from British Black backgrounds has generally been slightly higher in Computing and Mathematical Sciences than in all subjects; once again the atypical figure for 2004 may not indicate a changing trend. The proportion of students from a mixed ethnic background is very similar in Computing and Mathematical Sciences and in the population as a whole.

These figures suggest that Computing and Mathematical Sciences courses attract a higher proportion of applications from students from non-white ethnic backgrounds than do university courses as a whole, and that these courses admit a more ethnically diverse range of students than the average. This is in line with the trend noted in other studies such as Connor et al 2004 and Jones and Elias 2005.

It has not been possible to obtain statistics in which the ethnic origins of students are broken down by institution and/or region. However, anecdotal evidence suggests that participation in Computing and Mathematical Sciences courses by students from minority ethnic backgrounds may not be evenly spread across universities. It may be the case that, even in a subject with a high level of participation by minority students, these students are concentrated in their 'home' regions and in post-1992 institutions, mirroring some of the trends of participation by non-white students which are noted by writers on widening participation (Archer et al 2001, Connor et al 2004, DfES 2004, Reay et al 2005)[2].

Turner (1999) also suggests that there may be a mismatch between the number of computing students who come from non-white backgrounds, and the number of graduates from minority ethnic backgrounds entering employment in Computing, but once again, national statistics are not readily available in this area. Connor et al (2004, 85) note that disadvantage in the labour market is marked for certain non-white groups.

However, Jones and Elias (2004) argue that certain ethnic groups (Indian, African and Chinese) are highly represented in SET employment, while others (Caribbean and Bangladeshi) are underrepresented. They found that among non-white employees in SET, a relatively high proportion work in IT (Jones and Elias 2004, 13). While around 1.05 of the UK's White population work in IT, the figure is 2.83% for the British Indian population, 2.68 for the British Chinese population, 1.62% for the Black African population, and 1.47% for the British Pakistani population. By contrast, only 0.97% of the Black Caribbean population and 0.62% of the British Bangladeshi population were employed in IT in the period surveyed by Jones and Elias (2005, 42).

[2] It is likely that the relatively high levels of participation among students from lower social class backgrounds is also geographically and institutionally uneven, again following the patterns described by Reay et al.

		Applications	Degree acceptances
2005	White	76.4	77.8
	All Black British backgrounds	5.2	4.4
	All Asian British backgrounds	8.5	8.3
	Chinese	0.9	0.9
	Mixed ethnic origin	2.6	2.6
	Other/unknown	6.4	5.9
2004	White	76.0	77.4
	All Black British backgrounds	4.5	3.9
	All Asian British backgrounds	8.6	8.5
	Chinese	1.0	1.0
	Mixed ethnic origin	2.2	2.3
	Other or unknown ethnicity	7.6	6.9
2003	White	76.0	77.3
	All Black British backgrounds	4.2	3.7
	All Asian British backgrounds	8.6	8.4
	Chinese	0.9	1.0
	Mixed ethnic origin	2.0	2.0
	Other or unknown ethnicity	8.3	7.7
2002	White	75.7	77.0
	All Black British backgrounds	3.7	3.2
	All Asian British backgrounds	8.5	8.3
	Chinese	0.9	1.0
	Mixed ethnic origin	1.9	1.9
	Other or unknown ethnicity	9.3	8.6
2001	White	75.7	77.6
	All Black British backgrounds	3.6	3.1
	All Asian British backgrounds	9.0	8.7
	Chinese	0.9	1.0
	Mixed ethnic origin	1.7	1.7
	Other or unknown ethnicity	9.0	7.9
2000	White	76.7	78.8
	All Black British backgrounds	3.8	3.2
	All Asian British backgrounds	9.0	8.6
	Chinese	0.9	1.0
	Mixed ethnic origin		
	Other or unknown ethnicity	9.6	8.5
1999	White	77.1	79.3
	All Black British backgrounds	3.6	3.0
	All Asian British backgrounds	8.7	8.1
	Chinese	0.9	0.9
	Mixed ethnic origin		
	Other or unknown ethnicity	9.6	8.7
1998	White	77.2	79.6
	All Black British backgrounds	3.6	2.9
	All Asian British backgrounds	8.3	7.7
	Chinese	0.9	0.9
	Mixed ethnic origin		
	Other or unknown	9.9	8.8

Table 17: Percentage of applications & degree acceptances by ethnic background, all students

		Applications	Degree acceptances
2005	White	68.4	66.9
	All Black British backgrounds	6.1	6.0
	All Asian British backgrounds	16.3	15.5
	Chinese	2.0	2.1
	Mixed ethnic origin	2.4	2.5
	Other/unknown	4.7	7.0
2004	White	66.16	65.32
	All Black British backgrounds	5.81	5.12
	All Asian British backgrounds	18.67	16.92
	Chinese	2.08	2.15
	Mixed ethnic origin	2.07	1.96
	Other or unknown ethnicity	5.21	8.53
2003	White	63.4	63.4
	All Black British backgrounds	5.7	5.2
	All Asian British backgrounds	21.6	18.8
	Chinese	2.0	2.1
	Mixed ethnic origin	1.7	1.7
	Other or unknown ethnicity	5.6	8.9
2002	White	61.0	60.2
	All Black British backgrounds	6.1	5.0
	All Asian British backgrounds	23.2	20.4
	Chinese	2.1	2.1
	Mixed ethnic origin	1.7	1.7
	Other or unknown ethnicity	5.9	10.7
2001	White	60.0	61.0
	All Black British backgrounds	5.7	5.1
	All Asian British backgrounds	23.9	21.7
	Chinese	2.1	2.2
	Mixed ethnic origin	1.5	1.5
	Other or unknown ethnicity	6.8	8.5
2000	White	61.2	62.5
	All Black British backgrounds	5.5	4.8
	All Asian British backgrounds	23.2	21.1
	Chinese	2.0	2.1
	Mixed ethnic origin	.	.
	Other or unknown ethnicity	8.1	9.6
1999	White	63.3	65.4
	All Black British backgrounds	5.5	4.4
	All Asian British backgrounds	21.6	19.2
	Chinese	2.0	2.1
	Mixed ethnic origin	.	.
	Other or unknown ethnicity	7.6	8.9
1998	White	65.3	66.4
	All Black British backgrounds	5.3	4.5
	All Asian British backgrounds	18.8	17.9
	Chinese	2.1	2.1
	Mixed ethnic origin	.	.
	Other or unknown	8.5	9.1

Table 18: Percentage of applications and degree acceptances by ethnic background, Computing and Mathematical sciences

Chart 13a shows figures for the percentage of students accepted to degrees who come from British Asian and British Black backgrounds. The overall figure for students from British Asian backgrounds has remained very stable since 1998. In Computing and Mathematical Sciences, however, the proportion of students from British Asian backgrounds rose as the total number of applications rose in the period prior to 2001. With the fall in applications since 2002, the proportion of students from British Asian backgrounds also fell, reaching its lowest level in 2005 (when there was also a fall in the overall percentage of students who came from British Asian backgrounds).

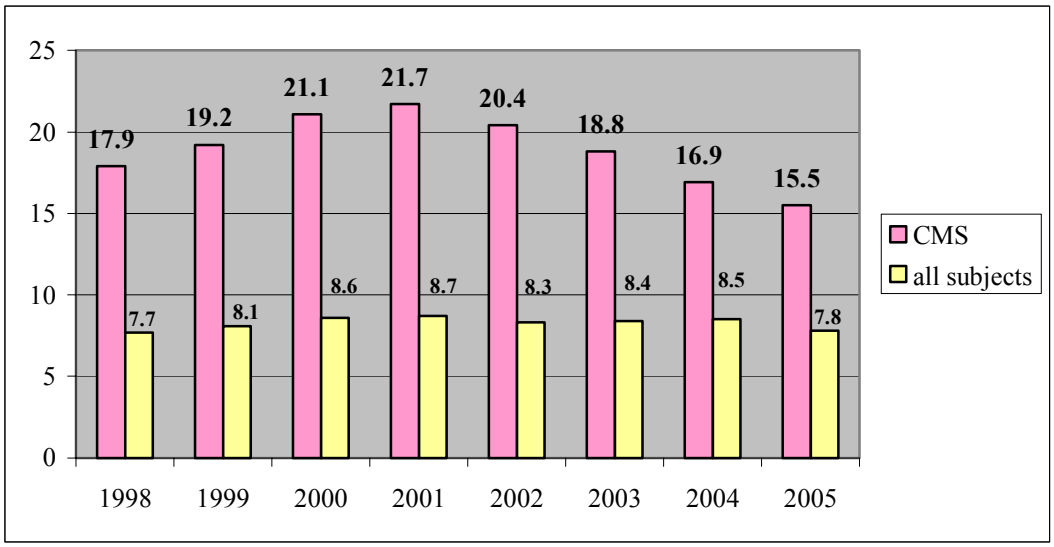

Chart 13a: Degree acceptances awarded to students from British Asian backgrounds, Computing and Mathematical Sciences compared to all subjects

The overall proportion of students of Black British origin has risen since 1998, with a steady increase to 2004 and slightly greater rise in 2005. The proportion of students from Black British backgrounds in Computing and Mathematical Sciences rose slightly to 2003, with a small fall in 2004 which was reversed in the following year.

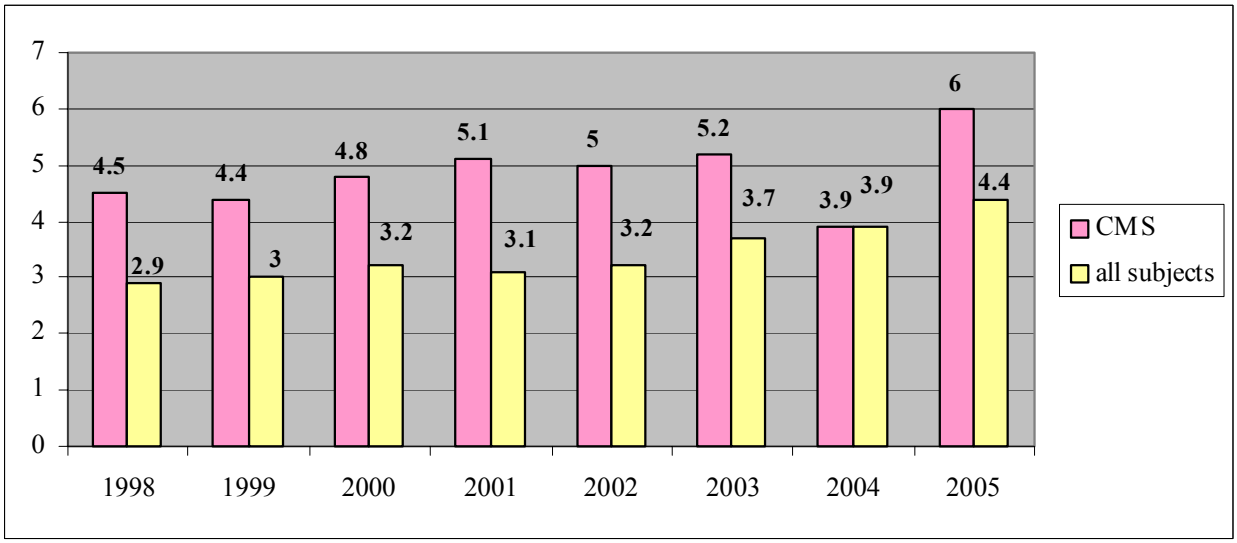

Chart 13b: Degree acceptances awarded to students from British Black backgrounds, Computing and Mathematical Sciences compared to all subjects

Tables 19a and b and Charts 14a and b show the proportion of students who were accepted to degrees in a range of subjects who came from British Asian and British Black backgrounds.

	CMS	medicine	subjects allied to medicine	biological sciences	physical sciences	engineering	business studies	humanities	all subjects
2000	21.1	23.1	9.5	7.1	4.4	8.9	10.8	2.2	8.6
2001	21.7	22.0	9.3	6.4	4.5	8.8	11.0	1.9	8.7
2002	20.4	20.8	12.1	5.2	4.2	9.7	10.8	2.9	8.3
2003	18.8	19.1	11.5	5.5	4.5	9.7	11.8	3.0	8.4
2004	16.9	21.4	12.5	6.1	5.0	10.0	13.0	2.9	8.5
2005	15.5	20.9	13.3	5.6	4.1	9.9	13.8	2.8	8.3

Table 19a: Degree acceptances awarded to students from British Asian backgrounds, various subjects

	CMS	medicine	subjects allied to medicine	biological sciences	physical sciences	engineering	business studies	humanities	all subjects
2000	4.8	3.4	5.8	3.2	1.8	6.2	5.9	1.4	3.2
2001	5.1	4.3	5.6	3.3	2.0	6.2	5.8	1.5	3.1
2002	5.0	2.4	4.3	2.1	1.1	4.1	4.1	1.2	3.2
2003	5.2	8.0	9.0	4.2	2.7	8.7	9.1	1.5	3.7
2004	3.9	2.1	5.3	2.7	1.5	5.3	10.4	2.1	3.9
2005	6.0	2.8	6.0	3.4	1.6	6.1	6.9	1.3	4.4

Table 19b: Degree acceptances awarded to students from British Black backgrounds, various subjects

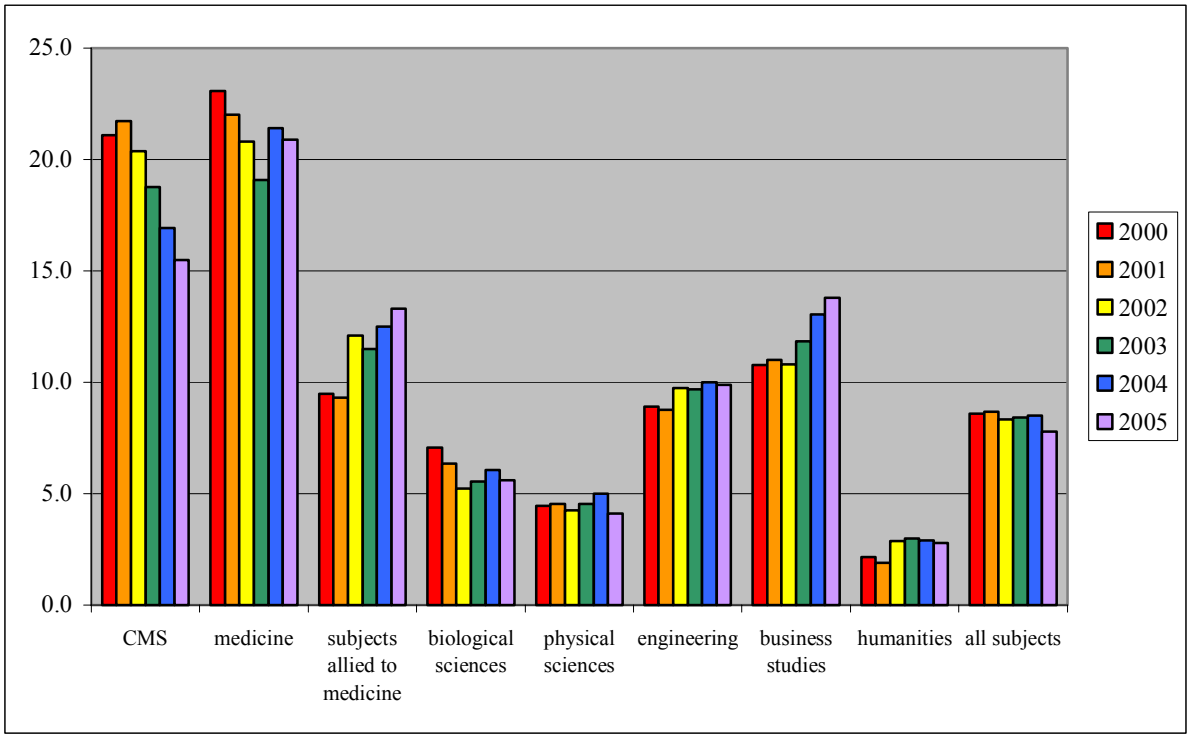

Chart 14a: Degree acceptances awarded to students from British Asian backgrounds, various subjects

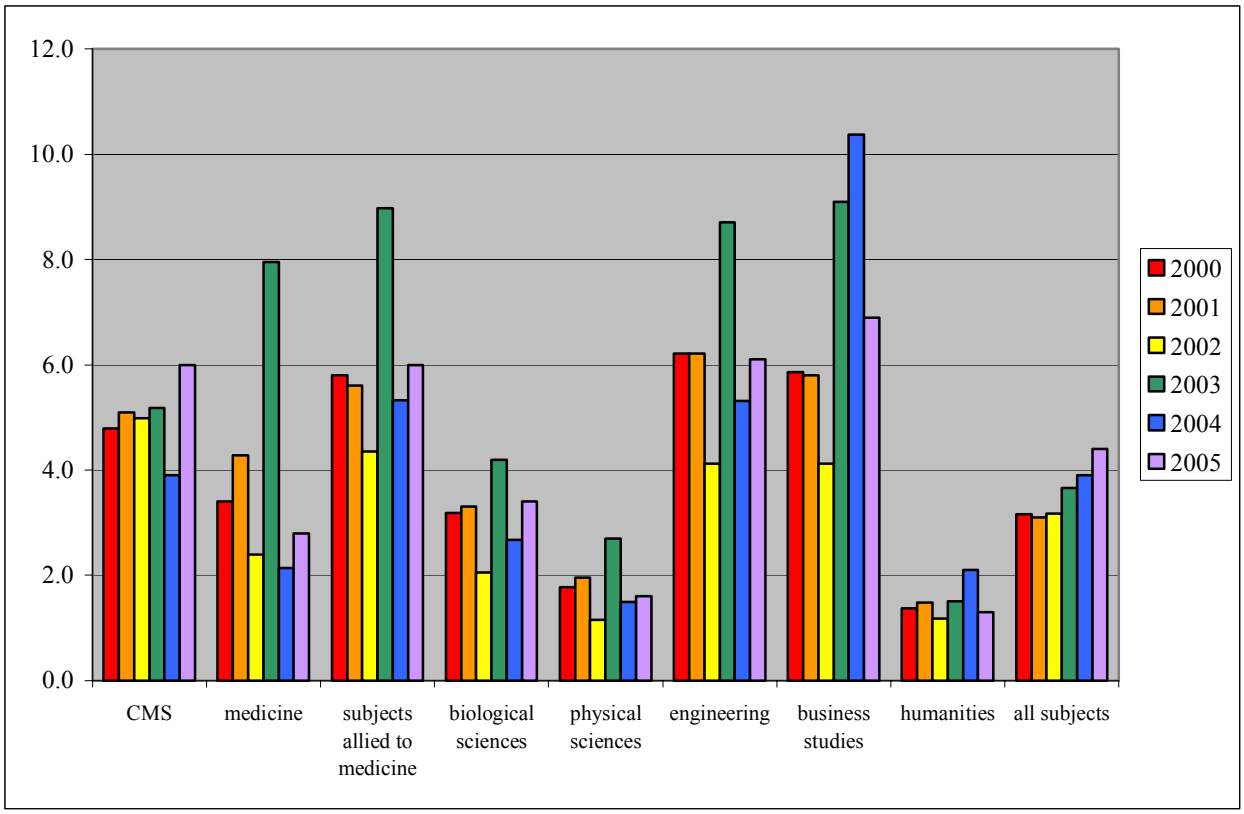

Chart 14b: Degree acceptances awarded to students from British Black backgrounds, various subjects

Historically, among these subjects it is only in Medicine that a higher proportion of the students admitted to degree course come from British Asian backgrounds than is the case in Computing and Mathematical Sciences. The Physical and Biological sciences in particular have a relatively small intake of students from Asian backgrounds, and this does not appear to be rising. However, in both Medicine and Computing and Mathematical Sciences, the trend appears to be for a fall in the proportion of students who come from British Asian backgrounds. This contrasts with a rise in other 'vocational' disciplines such as Business Studies, Subjects Allied to Medicine, and Engineering during the period surveyed.

The proportion of students who come from British Black backgrounds is in general smaller and rather less stable, although the trend in all subjects appears to be for a rise in the proportion of students in this category. This seems to be accompanied by a rise in the number of students from British Black backgrounds in Computing and Mathematical Sciences (the dip observed in 2004 appears to be atypical). A similar rise may be taking place in Business Studies, but elsewhere it is difficult to observe a pattern. The subjects where this group of students are most strongly represented are Business Studies, Engineering and the Subjects Allied to Medicine.

Table 20 shows the proportion of *all* applications from students from each ethnic background and of *all* acceptances awarded to students from each ethnic background which are received/ awarded in Computing and Mathematical Sciences. The figures presented here indicate that historically Computing and Mathematical Sciences has been the site for a high proportion of the representation of British non-white students in higher education in the UK. Between 2000 and 2002, around one fifth of applications from and degree acceptances to students from British Asian backgrounds were in this subject area, and although these proportions have now reduced, the figures are still high.

		applications	degree acceptances
2005	White	4.4	5.1
	Black - all	5.8	7.9
	Asian - all	9.4	10.9
	Chinese	11.1	13.1
	Mixed race	4.6	5.6
	Other/unknown	3.7	6.9
2004	White	4.7	5.3
	Black - all	6.9	8.2
	Asian - all	11.6	12.4
	Chinese	11.3	13.0
	Mixed race	4.9	5.4
	Other or unknown ethnicity	3.7	7.7
2003	White	5.4	5.8
	Black - all	8.8	9.9
	Asian - all	16.3	15.6
	Chinese	14.1	15.0
	Mixed race	5.4	5.8
	Other or unknown ethnicity	4.4	8.2
2002	White	5.9	6.0
	Black - all	12.2	12.0
	Asian - all	20.1	18.7
	Chinese	16.2	16.3
	Mixed race	6.6	6.9
	Other or unknown ethnicity	4.7	9.5
2001	White	7.0	6.9
	Black - all	13.8	14.5
	Asian - all	23.4	22.1
	Chinese	19.5	19.6
	Mixed race	8.0	7.8
	Other or unknown ethnicity	6.7	9.5
2000	White	6.5	6.7
	Black - all	11.9	12.8
	Asian - all	21.0	20.7
	Chinese	17.2	17.8
	Other or unknown ethnicity	6.8	9.5
1999	White	6.1	6.6
	Black - all	11.3	11.7
	Asian - all	18.4	18.9
	Chinese	16.2	17.7
	Other or unknown ethnicity	5.9	8.2
1998	White	5.4	6.0
	Black - all	9.4	11.2
	Asian - all	14.5	16.7
	Chinese	15.8	16.5
	Other or unknown	5.5	7.5

*Table 20: Percentage of **all** applications and degree acceptances for each ethnic group in any subject which were in Computing and Mathematical Sciences*

While the representation of women from all ethnic backgrounds is low in Computing and Mathematical Sciences, the representation of males from ethnic groups which overall have low participation rates appears to be somewhat higher.

Tables 21 – 24 and Charts 15 – 18 show the proportion of *all* degree acceptances awarded to males from certain ethnic groups which are awarded in different subject areas (these figures roughly parallel the proportion of all applications to university which are attracted from each group in each subject area).

	CMS	medicine	subjects allied to medicine	biological sciences	physical sciences	engineering	humanities	business studies
2000	33.0	3.9	7.3	2.1	2.5	10.2	0.4	12.4
2001	35.1	4.3	6.8	1.8	2.3	8.6	0.6	11.1
2002	29.5	4.2	7.8	2.6	2.4	10.6	1.4	13.1
2003	25.9	4.0	6.9	2.4	2.2	8.8	1.2	14.1
2004	21.6	10.7	8.7	3.0	2.7	9.3	1.3	18.4
2005	17.0	4.9	10.1	3.0	2.4	8.8	1.3	19.5

*Table 21: Percentage of **all** degree acceptances awarded to men from Asian Pakistani backgrounds in the UK which were awarded in various subjects*

	CMS	medicine	subjects allied to medicine	biological sciences	physical sciences	engineering	humanities	business studies
2000	30.1	2.3	5.2	2.8	3.7	11.0	1.5	10.8
2001	31.8	3.6	3.3	2.1	2.7	7.9	0.4	14.8
2002	28.2	1.9	3.7	3.6	2.5	9.8	2.4	13.3
2003	23.3	2.5	4.2	3.6	2.0	8.5	2.2	16.3
2004	20.7	3.4	5.8	4.0	2.5	7.1	1.6	18.3
2005	18.3	2.4	5.9	4.7	2.7	6.5	2.7	21.4

*Table 22: Percentage of **all** degree acceptances awarded to men from Asian Bangladeshi backgrounds in the UK which were awarded in various subjects*

	CMS	medicine	subjects allied to medicine	biological sciences	physical sciences	engineering	humanities	business studies
2000	22.7	1.9	6.5	2.5	1.6	15.1	0.7	13.7
2001	26.0	1.7	6.5	2.4	1.2	13.3	0.8	12.9
2002	21.5	2.0	5.4	3.0	1.8	14.6	1.7	14.7
2003	16.5	1.3	6.8	2.9	2.1	13.2	1.6	15.7
2004	14.4	1.4	7.7	3.5	1.8	14.2	1.5	18.6
2005	13.5	1.5	7.6	4.2	1.6	14.1	1.1	20.3

*Table 23: Percentage of **all** degree acceptances awarded to men from Black African backgrounds in the UK which were awarded in various subjects*

	CMS	medicine	subjects allied to medicine	biological sciences	physical sciences	engineering	humanities	business studies
2000	18.6	1.3	6.5	2.8	1.1	8.8	1.5	11.9
2001	18.5	0.7	5.9	2.5	2.5	6.3	1.6	12.6
2002	15.9	1.4	2.9	5.5	2.0	9.1	3.8	9.7
2003	15.0	0.7	3.0	7.2	1.6	5.8	3.8	12.8
2004	13.3	0.5	3.0	9.0	2.0	6.7	4.0	14.1
2005	13.4	0.7	3.2	9.5	1.6	6.1	3.5	13.7

*Table 24: Percentage of **all** degree acceptances awarded to men from Black Caribbean backgrounds in the UK which were awarded in various subjects*

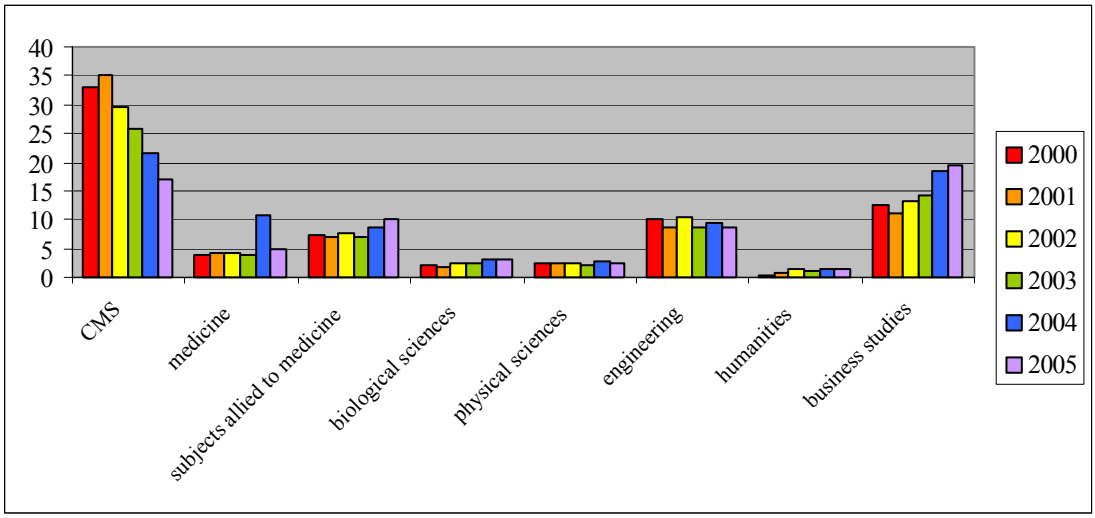

*Chart 15: Percentage of **all** degree acceptances awarded to men from Asian Pakistani backgrounds in the UK which were awarded in various subjects*

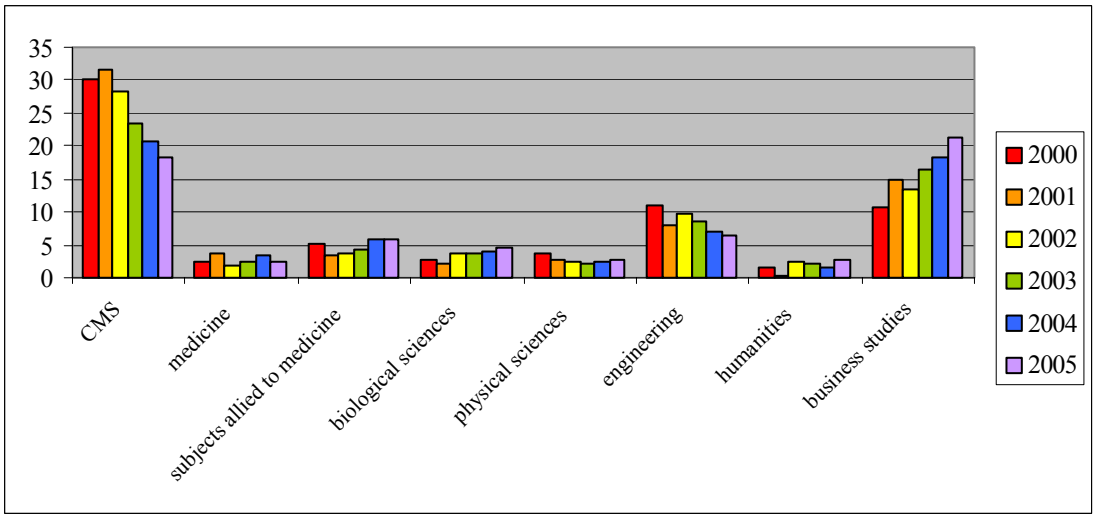

*Chart 16: Percentage of **all** degree acceptances awarded to men from Asian Bangladeshi backgrounds in the UK which were awarded in various subjects*

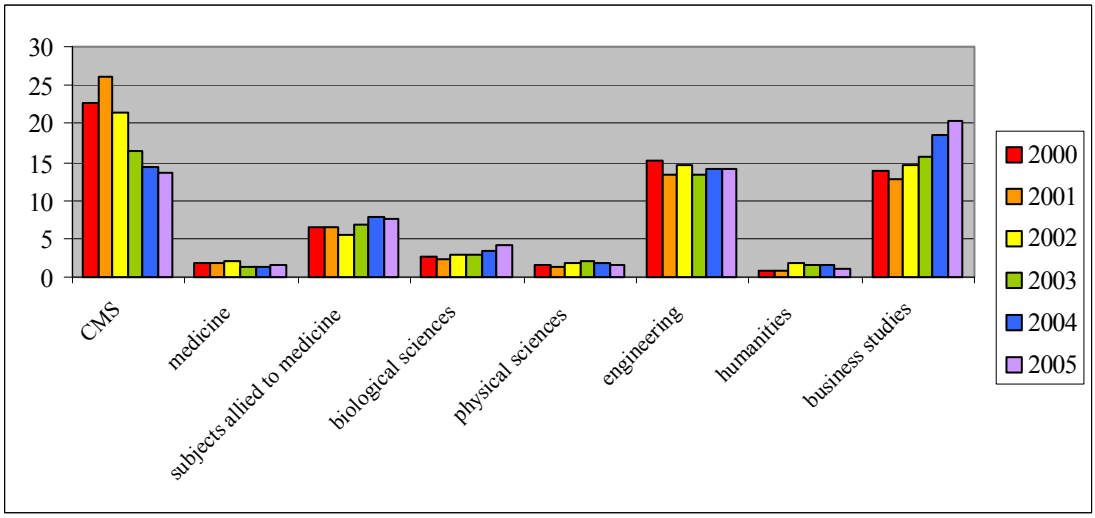

*Chart 17: Percentage of **all** degree acceptances awarded to men from Black African backgrounds in the UK which were awarded in various subjects*

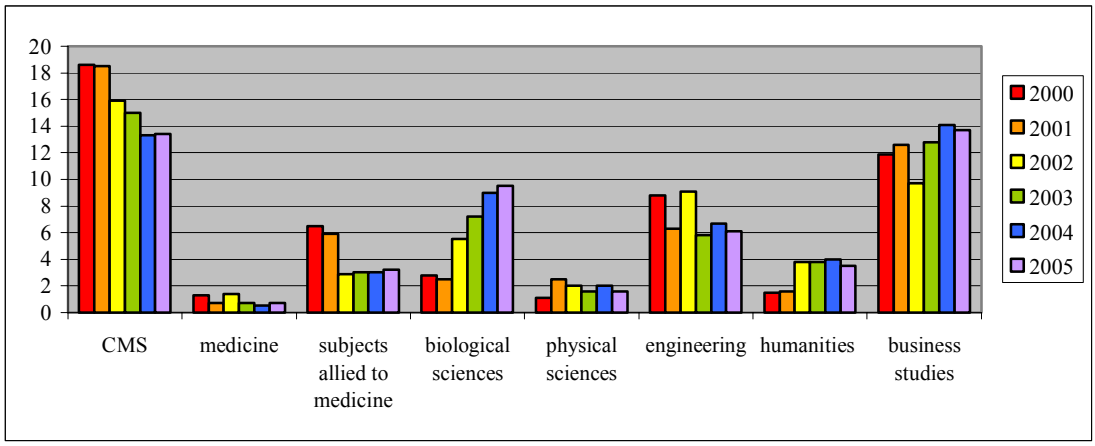

*Chart 18: Percentage of **all** degree acceptances awarded to men from Black Caribbean backgrounds in the UK which were awarded in various subjects*

Dwyer et al (2006, 2) note that, while participation rates among Pakistani and Bangladeshi men are higher than those for white males, they are less likely to enter higher education or to possess degrees than other British males from South Asian backgrounds (also Connor et al 2004, 18). Jones and Elias (2004) also note that people from Bangladeshi backgrounds are relatively under-represented in SET education and employment. Several writers, from Dearing (1997) on, note that men from Caribbean backgrounds are under-represented in HE, and Jones and Elias also note that this group are under-represented in SET. They also state that the overall rise in the number of HE students from Black African backgrounds noted by UUK (2004) may not be accompanied by a rise in the proportion of students from these backgrounds in SET subjects (although they are generally well-represented in IT).

Table 25 and Chart 19 show the number of men from each of these ethnic backgrounds accepted to degrees between 1998 and 2005. Table 26 and Chart 20 show the proportion of all students accepted to degrees who were men from these ethnic backgrounds

.

	1998	1999	2000	2001	2002	2003	2004	2005
Black Caribbean	878	897	891	1,062	1,049	1,136	1,207	1,477
Black African	1986	2,093	2,212	2,630	2,896	3,750	3,834	4,737
Asian Pakistani	3158	3,213	3,469	3,895	3,753	4,467	4,098	4,323
Asian Bangladeshi	889	946	1,088	1,139	1,148	1,208	1,403	1,355

Table 25: Number of men from selected Black and Asian ethnic backgrounds admitted to degree courses

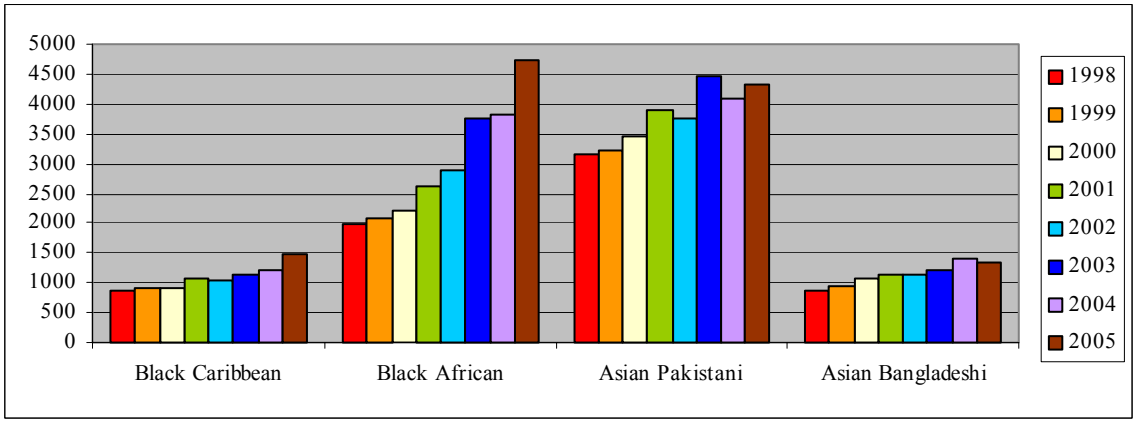

Chart 20: Number of men from selected Black and Asian ethnic backgrounds admitted to degree courses

	1998	1999	2000	2001	2002	2003	2004	2005
Black Caribbean	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.4
Black African	0.7	0.8	0.8	0.9	0.9	1.2	1.2	1.3
Asian Pakistani	1.2	1.2	1.2	1.3	1.2	1.4	1.3	1.2

Table 26: Proportion of all students admitted to degree courses who were men from selected Black and Asian ethnic backgrounds

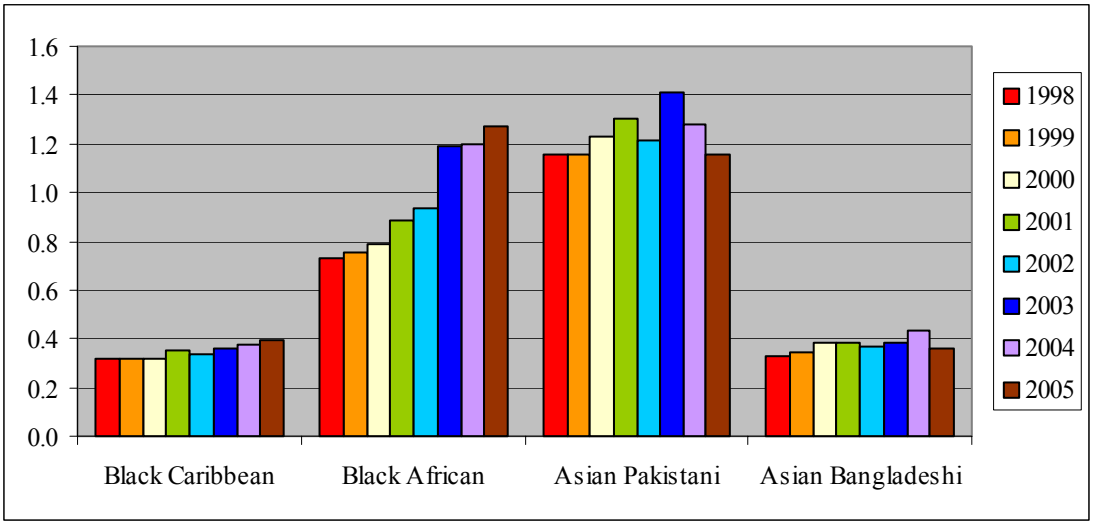

Chart 21: Proportion of all students admitted to degree courses who were men from selected Black and Asian ethnic backgrounds

While all of these ethnic groups saw an overall rise in the number of males admitted to degree courses during the period considered, there was a fall in the proportion of these degree acceptances which were to courses in Computing and Mathematical Sciences. However, the proportion of degree acceptances which were in Computing and Mathematical Sciences remains relatively high in all cases. For all of these ethnic groups, there was a rise in the number of degree acceptances which were to courses in Business Studies. For all groups apart from students from Caribbean backgrounds, there was also a small rise in the proportion of acceptances which were to courses in Subjects Allied to Medicine.

Among men from Asian Pakistani backgrounds, there was little shift in the proportion of degree acceptances which were in the Physical and Biological Sciences, Engineering or the Humanities. The proportion of degree acceptances granted to men from Asian Bangladeshi backgrounds which were in Engineering fell, although this group saw a small rise in the proportion of acceptances to degrees which were in the Biological Sciences. Interestingly, the other group whose numbers and whose 'share' of higher education places remains small, men from Caribbean backgrounds, also saw a sharp rise in the proportion of admissions to degrees which were in the Biological Sciences. The substantial rise in the number and proportion of male students who came from Black African backgrounds was accompanied by a small rise in the proportion of admissions which were in Biological Sciences, although their numbers in Engineering remained stable.

Overall, it appears that Computing and Mathematical Sciences continues to account for a large part of participation in higher education by students from minority ethnic backgrounds, in particular male students. However, as overall numbers of students from these backgrounds rise, their distribution between different subjects appears to be becoming slightly more even.

1:6 Entry qualifications

Inevitably, overall figures for entry qualifications will mask a huge range of variation between different courses and institutions. However, entry qualifications for Computing and Mathematical Sciences were examined in order to test the anecdotal assertion that students in this subject are often accepted with 'poorer' qualifications than average, or than those required for comparable disciplines. The proportion of students whose UCAS tariff point score falls into each of the bands indicated is shown in Table 27. Figure are shown from 2002, because of changes in the way entry qualifications are recorded by UCAS in that year.

In fact, it appears that while Computing and Mathematical Sciences attracts and accepts a higher proportion of students from the lowest tariff bands, it also attracts around twice as many from the *highest* bands, and accepts a higher than average proportion of students in this group. The most marked contrast applies to applicants with between 240 and 479 points, who appear to apply in smaller numbers to Computing and Mathematical Sciences courses, and to be admitted in commensurately smaller numbers. By contrast, more students with between 80 and 239 points apply and are admitted. The discrepancy between the proportion of applications and the proportion of admissions for students with 0 – 80 points which is seen for all applications is not present for Computing and Mathematical Sciences. This may relate to the relatively high entry from older students, who are more likely to hold non-standard qualifications than are traditional 'young' entrants.

		Computing and Mathematical Sciences		**All subjects**	
		applications	**degree acceptances**	**applications**	**degree acceptances**
2005	480 and over	8.3	8.9	5.6	6.6
	360 – 479	11.3	12.6	14.1	16
	240 – 359	17.5	18.5	20.4	21.9
	120 – 239	38.1	36.3	37.1	37
	80 – 119	4.6	3.3	2.5	1.9
	0 – 80	20.3	20.5	20.3	16.6
2004	480 and over	9.8	10.7	7.4	8.9
	360 – 479	13.0	14.5	18.0	20.8
	240 – 359	20.6	22.4	26.1	28.2
	120 – 239	24.9	22.3	18.9	17.8
	80 – 119	5.6	3.6	3.5	2.6
	0 – 80	26.1	26.5	26.2	21.7
2003	480 and over	7.5	9.0	6.3	7.6
	360 – 479	11.1	13.3	16.8	19.7
	240 – 359	20.2	23.2	25.8	28.6
	120 – 239	27.1	23.7	20.2	19.1
	80 – 119	5.9	3.5	3.9	2.8
	0 – 80	28.2	27.3	27.0	22.2
2002	480 and over	6.9	8.5	5.7	7
	360 – 479	10.5	12.9	15.2	18
	240 – 359	19.8	22.9	25.2	28.7
	120 – 239	26.0	23.8	21.2	20.7
	80 – 119	6.4	3.8	4.6	3.3
	0 – 80	30.5	28.2	28.1	22.3

Table 27: Percentage of all applications and degree acceptances, for students with various UCAS point scores: Computing and Mathematical Sciences compared with all subjects

Tables 28a – d compare the entry qualifications of applicants and accepted students in Computing and Mathematical Sciences with those of students in other disciplines.

		Computing and Mathematical Sciences		medicine		subjects allied to medicine	
		applications	degree acceptances	applications	degree acceptances	applications	degree acceptances
2005	480 and over	8.3	8.9	22.2	39.8	2.4	4.3
	360 - 479	11.3	12.6	30.2	36.5	10.6	16.1
	240 - 359	17.5	18.5	16.9	9.2	19.4	21.4
	120 - 239	38.1	36.3	22.1	11.1	34.7	32.6
	80 - 119	4.6	3.3	0.8	0.3	2.7	1.8
	0 - 80	20.3	20.5	7.8	3.3	30.2	23.9
2004	480 and over	9.8	10.7	27.3	43.7	2.9	4.9
	360 - 479	13.0	14.5	35.4	40.2	12.9	18.8
	240 - 359	20.6	22.4	20.8	10.5	24.6	27.0
	120 - 239	24.9	22.3	6.6	1.9	19.0	14.9
	80 - 119	5.6	3.6	1.1	0.2	3.7	2.5
	0 - 80	26.1	26.5	8.8	3.4	36.9	31.9

Table 28a: Percentage of all applications and degree acceptances, for students with various UCAS point scores: Computing & Mathematical Sciences compared with medical disciplines

		Computing and Mathematical Sciences		biological sciences		engineering	
		applications	degree acceptances	applications	degree acceptances	applications	degree acceptances
2005	480 and over	8.3	8.9	5.0	5.2	10.6	10.2
	360 - 479	11.3	12.6	16.4	17.8	17.4	17.3
	240 - 359	17.5	18.5	24.1	24.3	18.9	19.0
	120 - 239	38.1	36.3	38.5	36.3	32.5	32.1
	80 - 119	4.6	3.3	2.1	1.6	2.5	2.2
	0 - 80	20.3	20.5	13.9	14.8	18.1	19.1
2004	480 and over	9.8	10.7	7.1	7.3	12.8	12.7
	360 - 479	13.0	14.5	21.6	23.2	21.6	21.6
	240 - 359	20.6	22.4	31.6	31.9	24.3	23.9
	120 - 239	24.9	22.3	19.3	16.5	16.8	15.6
	80 - 119	5.6	3.6	3.0	2.0	3.0	2.4
	0 - 80	26.1	26.5	17.4	19.2	21.6	23.8

Table 28b: Percentage of all applications and degree acceptances, for students with various UCAS point scores: Computing & Mathematical Sciences compared with biological sciences/engineering

		Computing and Mathematical Sciences		physics		chemistry	
		applications	degree acceptances	applications	degree acceptances	applications	degree acceptances
	480 and over	8.3	8.9	28.5	27.6	7.2	6.5
	360 - 479	11.3	12.6	25.8	27.6	20.8	20.5
	240 - 359	17.5	18.5	17.4	17.2	27.5	27.9
	120 - 239	38.1	36.3	23.6	22.0	40.3	38.3
	80 - 119	4.6	3.3	0.7	0.5	0.8	0.8
2005	0 - 80	20.3	20.5	3.9	5.1	3.5	5.9
	480 and over	9.8	10.7	9.2	8.1	35.6	32.2
	360 - 479	13.0	14.5	27.9	28.7	32.4	34.3
	240 - 359	20.6	22.4	40.3	39.2	19.9	20.6
	120 - 239	24.9	22.3	17.0	15.4	6.9	6.4
	80 - 119	5.6	3.6	1.5	1.1	0.9	0.5
2004	0 - 80	26.1	26.5	4.1	7.5	4.2	6.0

Table 28c: Percentage of all applications and degree acceptances, for students with various UCAS point scores: Computing & Mathematical Sciences compared with physical sciences

		CMS		business studies		humanities	
		applications	degree acceptances	applications	degree acceptances	applications	degree acceptances
	480 and over	8.3	8.9	2.31	2.66	22.2	22.3
	360 - 479	11.3	12.6	10.79	11.73	15.4	15.1
	240 - 359	17.5	18.5	23.08	23.74	23.6	23.1
	120 - 239	38.1	36.3	44.78	42.83	32.5	31.5
	80 - 119	4.6	3.3	3.89	2.38	0.9	0.8
2005	0 - 80	20.3	20.5	15.16	16.67	5.5	7.3
	480 and over	9.8	10.7	2.44	2.9	6.2	6.7
	360 - 479	13.0	14.5	10.32	11.4	17.9	19.1
	240 - 359	20.6	22.4	22.75	23.3	23.3	23.1
	120 - 239	24.9	22.3	45.37	43.3	46.7	46.3
	80 - 119	5.6	3.6	4.38	2.7	3.0	2.4
2004	0 - 80	26.1	26.5	14.75	16.4	3.0	2.4

Table 28d: Percentage of all applications and degree acceptances, for students with various UCAS point scores: Computing & Mathematical Sciences compared with business studies and humanities

Overall, the highest qualification levels are found in Medicine, Physics and the Humanities. The subjects with the most similar profile to Computing and Mathematical Sciences are the Subjects Allied to Medicine, Business Studies, and Engineering. However, the first two of these do *not* have as high a proportion of applicants and entrants with very high points scores of the sort seen in Computing and Mathematical Sciences and Engineering. It is possible that this reflects the diversity of course types on offer in the latter two subjects, and the fact that these subjects are offered in the majority of both 'elite' and other universities.

1:7 A-level candidates

Table 29 and Chart 22 show the number of candidates entered for A-level and AS examinations in Computer Studies and ICT between 2002 and 2004 (disaggregated figures are not readily available for earlier years). These indicate a steep fall in the popularity of both subjects among school pupils, in line with their decreasing popularity among applicants to higher education.

	Computing		ICT	
	A-level	AS	A-level	AS
2002/3	8,464	11,957	16,664	26,647
2003/4	6,860	9,430	14,466	22,363
2004/5	5,810	8,354	12,852	19,826

Table 29: Number of candidates, A-level and AS Computer Studies and ICT

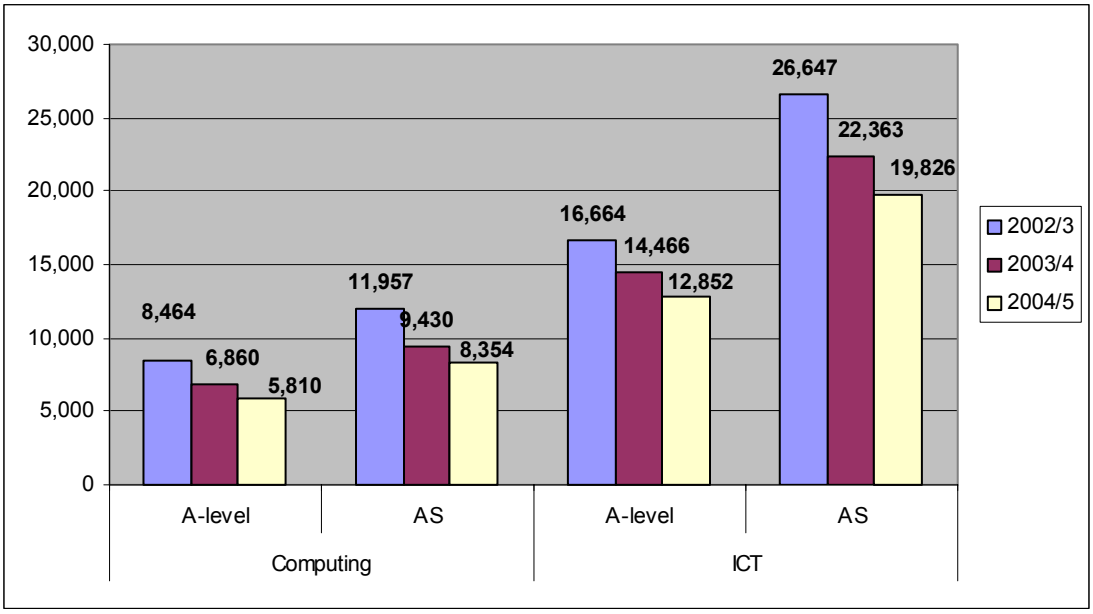

Chart 22: Number of candidates, A-level and AS Computer Studies and ICT

Tables 30a – d show student attainment in A-level and AS Computer Studies and ICT. These indicate that the more 'technical' Computer Studies enjoys a considerably higher rate of attainment than ICT at both levels.

	A	B	C	D	E	A-E
2004/5	14.6	18.6	22.3	22.1	16.2	93.8
2003/4	14.0	18.8	21.7	22.0	16.4	92.9
2002/3	12.4	17.4	22.0	22.1	17.4	91.3

Table 30a: Attainment, A-level Computer Studies

	A	B	C	D	E	A-E
2004/5	7.3	16	24.2	27.1	18.9	93.4
2003/4	6.8	16.3	25.6	27.1	17.8	93.6
2002/3	5.9	14.8	23.8	26.6	20.3	91.5

Table 30b: Attainment, A-level ICT

	A	B	C	D	E	A-E
2004/5	10	13.8	17.6	18.5	16.7	76.6
2003/4	10.5	14.1	17.8	18.3	16.7	77.5
2002/3	11.0	12.7	16.3	18.3	17.3	75.7

Table 30c: Attainment, AS Computing

	A	B	C	D	E	A-E
2004/5	4.5	10.6	17.6	23	22.2	77.9
2003/4	4.0	10.4	18.0	23.0	22.4	77.9
2002/3	4.0	9.1	17.3	22.4	22.0	74.9

Table 30d: Attainment, AS ICT

Table 30e shows the number of students taking ICT at GCSE, and the percentage of these who gain the highest grades, A*, A and B. Some anecdotal evidence presented at the HEFCE-funded events organised by CPHC and the BCS suggested that certain schools might use ICT as a subject in which it is easy to get a 'high pass rate' at GCSE. The A-level and AS figures indicate that, while overall pass rates at these levels are indeed high, the highest grades are achieved by a relatively low proportion of entrants. Table 30e compares GCSE ICT with other subject taken by similar numbers of candidates, the closest being various disciplines within Design and Technology and Drama (slightly higher numbers), and Business Studies and Single Award Science (lower numbers). These subjects in fact show similar or slightly lower numbers of passes in the very high range. However, by comparison with some of the 'traditional academic' subjects in the table, including the physical and biological sciences, GCSE ICT does indeed have a low rate of achievement at the highest levels.

	Number of students (thousands)	**Percentage of students gaining A* or A**	**Percentage of students gaining A*, A or B**
Art and Design	192.0	21.3	41.5
Geography	189.4	23.5	40.6
Physical Education	145.3	18.0	37.6
Religious Studies	132.0	28.7	49.7
German	99.7	20.7	38.5
D & T: Resistant Materials	98.7	13.1	26.8
Drama	94.1	20.8	46.1
D & T: Food Technology	94.0	16.7	31.5
D & T: Graphic Products	86.7	15.5	32.3
Information Technology	85.2	17.4	35.9
Business Studies	78.7	14.7	30.0
Single Award Science	66.5	2.3	6.3
Music	53.0	28.1	50.4
Spanish	52.5	26.9	43.0
Biological Sciences	49.1	46.2	71.3
D & T: Textiles Technology	48.2	24.5	42.7
Chemistry	46.5	47.5	71.6
Physics	46.0	48.5	73.0
Media/Film/Television Studies	41.2	15.0	34.5

Table 30e: GCSE ICT, number of students and passes at A - B*

PART TWO: QUESTIONNAIRE SURVEY DATA AND ANALYSIS

2:1 The survey

2:1.1 Methodology

Questionnaires were distributed in a total of six schools and one sixth-form college, and also to pupils attending a City Learning Centre. A number of institutions in the North-East of England, London and the South-East, and Wales were invited to take part, via contact with the principal teachers of ICT/Computing in these schools. In some cases these schools were selected from a list of local educational institutions where Computer Science/ICT were taught, and in others they were selected from lists held by the BCS. In the end, only one-sixth of the institutions to whom invitation letters were sent actually took part. Five of the schools/colleges included were comprehensives, one was a voluntary aided school, and one was an independent school.

Due to limitations of resources, it was not possible to recruit participants in a way which ensured accurate representation of the whole UK school population in the manner achieved by earlier surveys (e.g. ETB 2005). In addition, institutions which took part usually did so because of the enthusiasm of an individual ICT/Computer Studies teacher or department. Most of the teachers involved were themselves IT graduates, whether they had studied the subject as their initial degree programme or retrained via a university course. Several were involved in ongoing BCS initiatives, and were aware of the issues being discussed in relation to the school Computer Science/ICT curriculum. In the majority of cases, teachers described ways in which they had chosen to enhance the 'official' curriculum and/or offer additional extracurricular activities related to computing. This meant that the pupils surveyed may have an atypical experience of teaching and learning in these subjects.

Teachers distributed questionnaires to A-level and AS classes in Computer Studies (henceforth CS) and ICT. In addition, a number of students who had not yet sat their GCSE examinations were surveyed, as were A-level and AS students who were taking neither CS nor ICT. The selection of these latter two groups of students was guided by the convenience of the individual school or college, and was not in any way scientific. It would have been impractical to survey an entire school 'year', given the resources available to this project. In addition, it was not possible to collect any data on the social or ethnic backgrounds of students in the study.

Focus group interviews were carried out in four of the institutions surveyed. In all cases, it was possible to meet with at least one group of A-level or AS CS and/or ICT students and with one group of post-GCSE students who were taking neither of these subjects. Once again, the composition of focus groups was dependent on the convenience of participating schools and did not reflect a scientific sampling process.

It is very important, therefore, that the results discussed in this section of the report are not taken to represent the views of all pupils in the UK, or even of all students taking A-level or AS CS or ICT. The findings of this project might be used as the basis for a larger and more scientifically sampled survey. However, at present they simply offer an interesting 'snapshot' of opinion among school-age students.

2:1.2 Terminology

In the discussion which follows, the term 'students' will be used to refer to all individuals who returned questionnaires or took part in focus group interviews. This reflects the preferred terminology of the majority of participating institutions. Students referred to themselves by a variety of terms (ranging from 'pupils' to 'kids').

An unexpected but consistent finding was that there was great confusion over the difference between 'ICT' and 'computing'. This was not the case in every institution surveyed, but it would be fair to say that it was found in the majority of cases. In the section at the end of the questionnaire where students could write questions or comments, by far the most common was some variation on 'What is the difference between computing and ICT?', and this question was also asked in several of the focus group interviews.

The confusion was most marked among pre-GCSE students and among post-GCSE students who were taking neither CS nor ICT. However, some students taking A-level or AS ICT were also uncertain. No A-level or AS CS students posed this question, and in the focus group interviews and some of the questionnaire comments this group were aware that others did not know the difference.

The term 'IT' is not used widely in secondary education contexts. 'ICT' is the name of the GCSE and AS/A-level courses in this area, and there is also an AS/A-level course in Computer Studies. In the questionnaire and the focus group interviews, therefore, the term IT was avoided. It was not introduced at any point by the student participants, suggesting that they are unfamiliar with this term. 'ICT' and 'Computing' were used to refer to the subjects studied at school. When referring to possible courses in HE, the composite 'Computer Science/ICT' was used. Elsewhere, this composite or 'Computing' were used to refer to the area of study or employment.

2:1.3 Return

A total of 858 usable questionnaire returns were received. Unfortunately it was not possible to determine precisely how many questionnaires were distributed in each institution, especially in the case of pre-GCSE and non-Computer Science/ICT post-GCSE students. A total of 39 completed or partially completed questionnaires were excluded from the survey.

The characteristics of these students are shown in Tables 31a – 31e.

male	60.6
female	39.4

Table 31a: sex of students in the study

pre-GCSE	46.8
post-GCSE	53.2

Table 31b: education stage of students in the study

pre-GCSE	46.8
year 12	30.9
year 13	22.3

Table 31c: education stage of students in the study, with post-GCSE years separated

	Number	% of post-GCSE
A-level or AS Computing, *not* ICT	95	20.8
A-level or AS ICT, *not* Computing	90	19.7
A-level or AS ICT *and* A-level or AS Computing	19	4.2
Neither ICT nor Computing at A-level or AS	236	51.8

Table 31d: A-level and AS Computing/ICT students in the study

Comprehensive school	63.0
Voluntary aided/independent school	19.4
6th form college	17.6

Table 31e: Percentage of students at each type of educational institution

Among students who are taking AS/A-level Computer Studies but *not* ICT, 90.4% were male and 9.6% were female. Among those taking ICT but not Computer Studies, 58.7% were male and 41.3% were female. Of the 19 students taking both Computer Studies and ICT at AS or A-level, 11 were male and 8 were female. 49.8% of the AS and A-level students who were taking neither of these subjects were male and 50.2% were female.

Charts 23 shows the range of subjects which were being taken by post-GCSE students who were *not* taking either CS or ICT. These figures indicate the way in which questionnaires were distributed within the institutions surveyed, and *not* the popularity of subjects among the school population as a whole. However, they are useful as an indicator of the constitution of the group whose opinions are discussed in this document.

The most popular balance of subjects appears to be a combination of fairly 'traditional' subjects, i.e. at least one Humanities subject or Modern Language alongside at least one Biological or Physical Science. However, this is a pattern favoured by AS students, more than one third of whom are studying combinations of this sort. In Year 13, there is a dramatic increase in the number who 'drop' their scientific and/or mathematical studies to sit A-levels in the Humanities and Modern Languages only. In addition, a small number drop other subjects in order to focus solely on Business Studies or Art, Design and Graphics. By contrast, specialisation in Mathematics and Physical Sciences seems to be slightly less common.

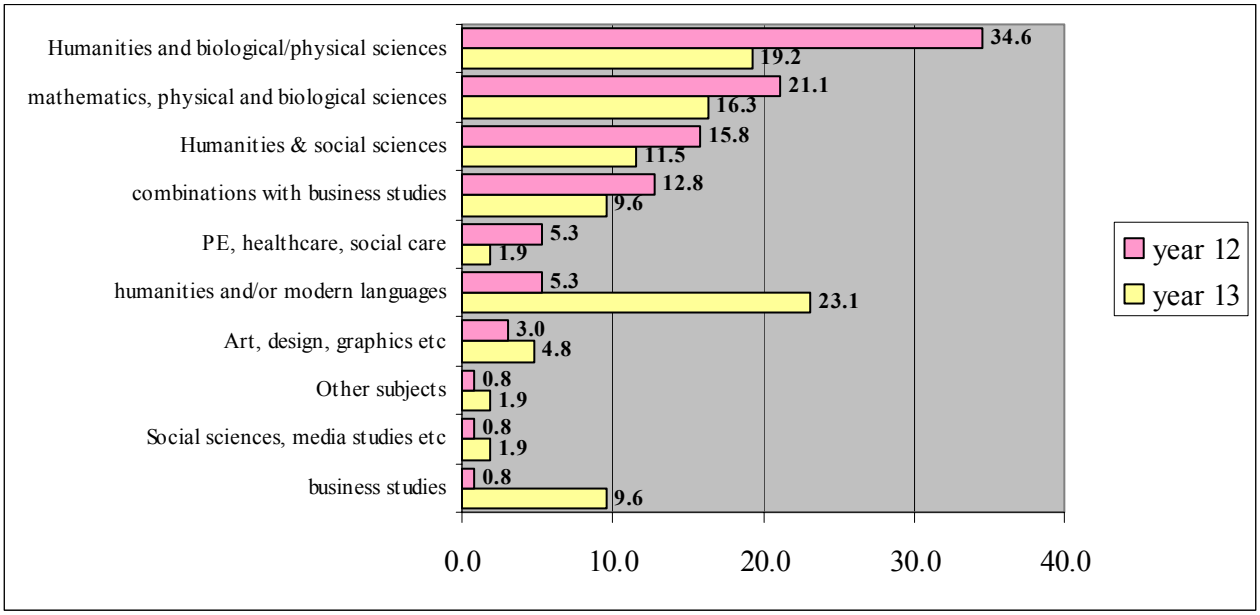

Chart 23b: Subjects taken at A/AS levels by non-CS/ICT students, year 12 and year 13

2:2 Computing in the curriculum

One issue which is perhaps peculiar to IT subjects is the degree of flexibility over where they 'sit' in the secondary curriculum, both in practical terms and in the conceptualisation of the curriculum by students. The position of these subjects was indicated by comments made by teachers and students, by the selection of other A or AS-level subjects alongside these subjects, and even by the physical location of teaching facilities within schools.

ICT is variously seen as 'belonging with' Business Studies, Technology, or even Media Studies. There was also some sense among students who were not taking ICT at AS/A-level that it was a subject without a distinct 'home' of its own, and that its main function was to support studies in other areas. The association between ICT and the sciences was generally weak, if it was present at all. Only one ICT student (a keen 'hobby computer' enthusiast in a school where CS was not offered) identified his ICT studies closely with his work in Physics.

Where Computer Studies and ICT were both offered in the same school, they were taught within the same department. However, the focus group interviews suggested that students who were studying only one of these subjects did not necessarily consider them to be particularly similar. Unfortunately, none of the students interviewed were studying both CS and ICT at AS or A-level, so it was not possible to examine their views on this issue.

Computer Studies was unlikely to be associated with Business or Media Studies, although the association with Technology was also found for this subject. Among students who were not taking Computer Studies at AS/A-level, as noted above, there was some confusion over what was actually studied on this course. Students taking CS at AS/A-level, however, tended to self-identify with the scientific disciplines, naming Physics or Mathematics as close associates. Many students taking AS or A-level Computer Studies in fact referred to the discipline as 'Computer Science', indicating their view of the subject.

Chart 24 shows the other subjects taken at AS or A-level with CS and ICT. These indicate a marked difference between the ways in which each is combined with other disciplines.

More than 10% of students who are taking ICT at AS/A-level are not studying any other subject. By contrast, no students were taking CS by itself. The most frequent combination with CS is a some mixture of Mathematics and Physical Sciences; 43% of CS students are studying these. By contrast, only 12.3% of ICT students are studying Mathematics and Physical Sciences. The most common 'home' for ICT is with Business Studies; 7.5% of ICT students are taking *only* subjects in Business and Finance, and 20.8% are taking combinations including at least one subject in these areas. This other subject is usually in the Humanities or Social Sciences; only two students are taking a Business or Finance subject, ICT and a Physical Science or Mathematics subject. Compared with more than a quarter of ICT students, fewer than 10% of CS students are taking a subject in the Business/Finance area.

28.1% of students who are taking CS are also taking a mixture of Humanities/Modern Languages and traditional Science subjects. Only 10.4% of ICT students combine it in this way. ICT is also taken in combination with Art, Design and Graphics and PE, Health and Social Care. CS was not selected alongside these 'vocational' subjects by any of the students in the study. Almost equal, small numbers of students combine CS or ICT with subjects in the Humanities/Modern Languages and Social Sciences/Media studies groups.

Two of the 19 students taking both CS and ICT are not taking any subject apart from these. Seven of the others are taking only Mathematics and Sciences, and four are taking Business and Financial subjects; a further student is taking Business Studies and Mathematics. Two are taking Humanities subjects, and three are taking a mixture of Humanities and Mathematics/ Sciences.

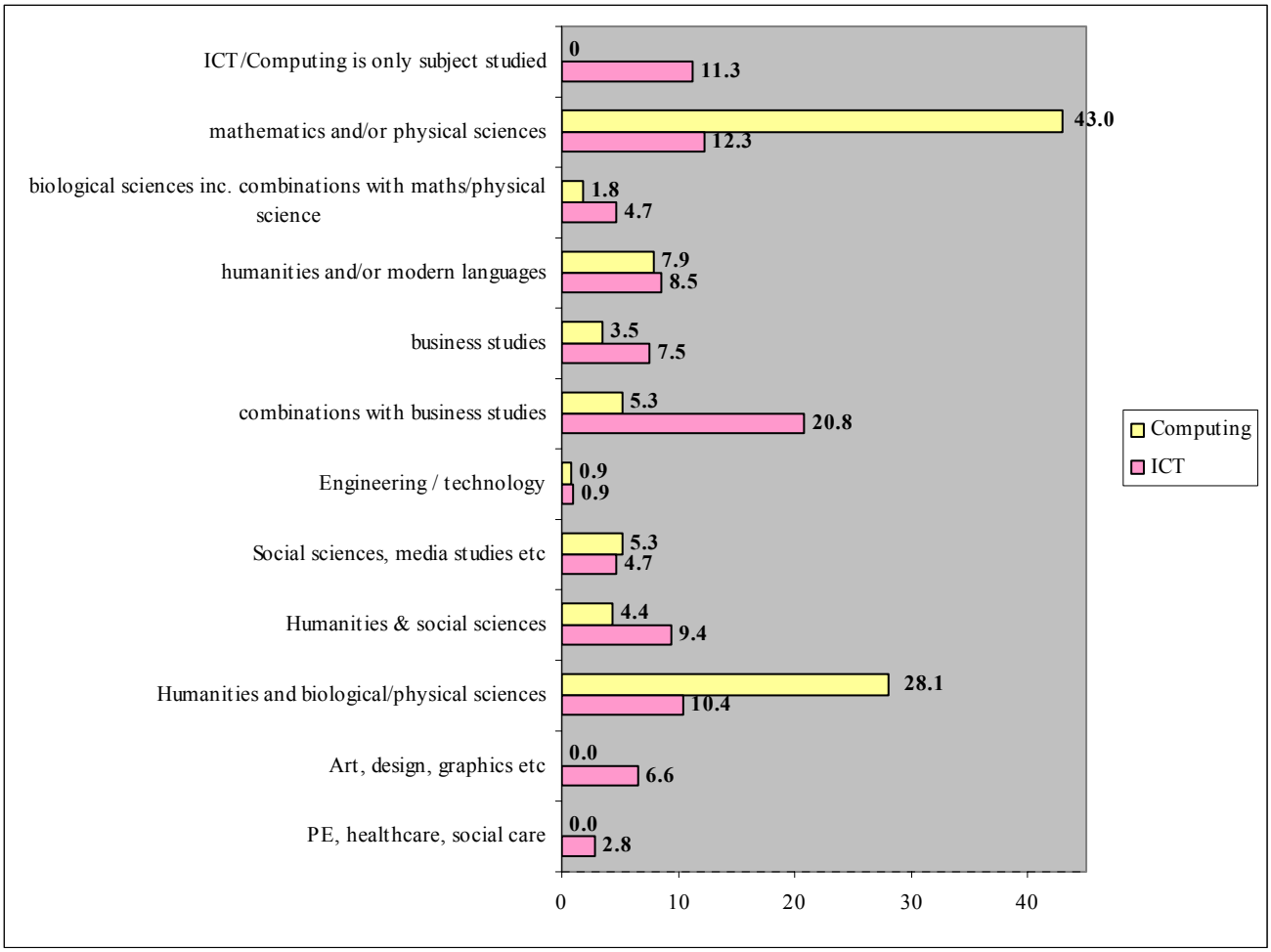

Chart 24: Subjects taken with A/AS Computer Science/ICT

There is also some variation in the number of subjects taken with CS and ICT. Among students who are taking CS at AS, the mean number of subjects studied is 3.87, and among A-level CS students the mean number of subjects studied is 3.57. However, the mean number of subjects studied by AS ICT students is 3.21, while the mean number of subjects studied by A-level ICT students is 2.57. For students taking neither CS nor ICT, the mean number of subjects studied at AS is 3.6 and the mean number of subjects studied at A-level is 3.56.

The patterns described above indicate that CS may be conceptualised as one of the 'hard sciences', grouped, if not enjoying equal parity, with subjects such as Physics and Mathematics. It is likely to be combined with 'traditional academic' disciplines and to be taken by students who study a high number of subjects at AS and even A-level. By contrast, ICT is found less often alongside the 'traditional academic' disciplines. It is most frequently combined with Business or Finance disciplines, or with other 'vocational' subjects. In addition, students taking ICT are less likely to be sitting the traditional 'three A-levels' in their final year of secondary education.

A tentative hypothesis was made on the basis of these observations. It is assumed that there are three 'constituencies' of students who either are taking Computer Science/ICT, or whose combination of subject choices might accommodate or support one of these subjects. These are students concentrating on Mathematics and/or Physical Sciences, students taking a combination of these with the Humanities, and Business/Finance students. The first two groups may be more relevant to CS, and the latter to ICT. These groups can be regarded both as subgroups within the IT subject area, and also as potential recruits to these subjects.

If both CS and IT students in secondary education are regarded as potential recruits to Computing courses in HE, then it is worth examining the attitudes of all of these groups. However, it is also important to note that some substantial differences emerge between them. If these contrasts are already entrenched in secondary education, it may be important to address the relationship between CS and ICT in the school curriculum and university computing courses. On the basis of the findings of this survey, the two cannot safely be considered as equivalents, or even as very similar to one another. CS may have more in common with Mathematics or Physics, while ICT is more similar to Business Studies.

Groups of post-GCSE students which are of particular interest were identified as follows:

- students taking any combination of subjects including Mathematics
- students taking any combination of subjects including Mathematics and/or a physical science subject
- students taking *only* mathematics and physical sciences, or taking *only* these subjects alongside CS/ICT
- students taking at least one humanities subject, whether or not this is taken in combination with CS/ICT
- students taking at least one Business/Finance subject, whether or not this is taken in combination with CS/ICT
- students taking at least one Mathematics/Physical Science subject *and also* at least one Humanities/Social Science subject, whether or not this is taken in combination with CS/ICT

A student may, of course, belong to more than one of these groups. For example, a student who is taking Mathematics, Physics, Chemistry and Computing would be counted in each of the first three groups.

In addition, some data was collected for students who stated that they had already chosen to study Mathematics, Physical Science, Engineering or Medicine at university (this group was identified on the basis of responses to the items discussed below).

2:3 CS and ICT at AS/A-level

2:3.1 Reasons for taking CS or ICT

Students who were taking CS or ICT at AS/A-level were asked to reflect on the reasons why they had chosen to study these subjects. Tables 32a and b show the reasons named by these students for choosing each subject. Chart 25 contrasts the reasons stated for each subject.

I am interested in Computing	93.9
I want to learn new things and explore new areas	73.7
I am considering further study/work in Computing	55.3
I think studying Computing will improve my job prospects	61.4
Computing is a useful skill to have alongside other subjects	69.3
My friends are doing Computing	12.3
I was advised to study Computing	6.1
I like the staff in Computing at my school	23.7
I believe I can achieve good grades in Computing	52.6

Table 32a: reasons for taking A/AS Computing, post-GCSE Computing students

I am interested in ICT	83.8
I want to learn new things and explore new areas	57.1
I am considering further study/work in ICT	51.4
I think studying ICT will improve my job prospects	83.8
ICT is a useful skill to have alongside other subjects	83.8
My friends are doing ICT	18.1
I was advised to study ICT	15.2
I like the staff in ICT at my school	22.9
I believe I can achieve good grades in ICT	65.7

Table 32b: reasons for taking A/AS ICT, post-GCSE ICT students

The most frequently named reason is straightforward interest in the subject, which was named by over 90% of CS students and just over 80% of those taking ICT. This suggests that the *content* of the subject is important to a higher proportion of CS students than ICT students, but that in each case there is enough 'about' the content that appeals to potential candidates. The 'thrill factor' of the subject is considerably higher for CS; the item intended to measure this was chosen by almost 75% of CS students, but by only 57% of those taking ICT. ICT may be less frequently regarded as a course on which 'exciting' and 'new' things are learnt.

Job prospects are named by 83.8% of ICT students, but by only 61.4% of CS students. The number of CS students who state that this course will provide them with useful skills alongside other subjects is also lower, at 69.3%, than the number of ICT students who named this item (83.8%). This does not mean that the other CS students believe CS will be *irrelevant* to their job prospects and overall skills mix, but simply that this is not a particularly salient reason, in their minds, for their decision to study CS. However, it is important to a higher number of ICT students. Specific career plans are named by an almost identical proportion of students taking each subject.

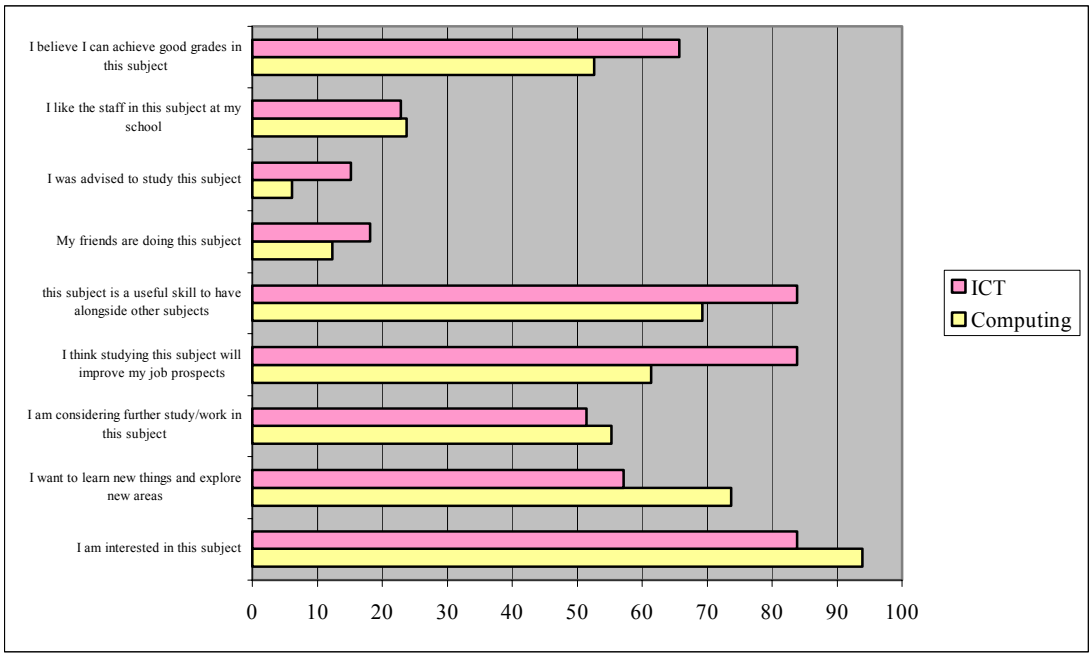

Chart 25: reasons for taking A/AS Computer Science/ICT, post-GCSE Computer Science/ICT students

A slightly higher percentage of students taking ICT state that their friends' subject choices influenced this decision, and more than twice as many ICT as CS students took this course because of advice which they had received. In each case, liking the staff who teach the subject is important to almost 25% of students. This emphasises the importance of good delivery and possibly also of local 'role models' in the subject. A number of the comments at the end of the questionnaire mentioned individual school staff as being excellent teachers.

2:3.2 Experience of studying CS/ICT at AS/A-level

Students who were taking CS or ICT at AS/A-level were asked to reflect on their experience of studying these subjects at this level. Tables 33a and b show the percentage of students who agreed with each statement about studying CS or ICT. Chart 26 compares the responses for each subject.

I'm really enjoying this subject	56.6
I'm enjoying this subject, but not as much as I expected	28.3
I'm not enjoying this subject	7.1
This subject is very interesting	49.6
This subject is boring	12.4
If I could choose again, I'd still take this subject	69
This course is much easier than I expected	15.9
This course is much harder than I expected	23.9
I'm learning things in this subject which I didn't expect to encounter	10.6

Table 33a: Experiences of studying A/AS Computing, post-GCSE Computing students

I'm really enjoying this subject	51.4
I'm enjoying this subject, but not as much as I expected	42.9
I'm not enjoying this subject	10.5
This subject is very interesting	39.4
This subject is boring	10.5
If I could choose again, I'd still take this subject	66.7
This course is much easier than I expected	16.2
This course is much harder than I expected	28.6
I'm learning things in this subject which I didn't expect to encounter	7.6

Table 33b: Experiences of studying A/AS ICT, post-GCSE ICT students

Overall, the profile is quite similar for CS and ICT. A slightly higher number of CS students state that they are 'really enjoying this subject', but over 40% of ICT students state that they are 'enjoying [this subject] but not as much as… expected', compared with 28.3% of CS students. Fewer than 10% of CS students and only slightly more ICT students are *not* enjoying the subject, and only around 10% in each case feel that the subject is boring. Around 50% of CS students feel that their studies in this are a are 'very interesting', compared with around 40% of ICT students. Almost equal numbers in each area find the subject harder or easier than expected, and around two-thirds would choose the subject again if they had the chance.

Unfortunately, constraints of time and space meant that it was not possible to gather responses to the same items in relation to subjects in other areas; for example, it would have been interesting to see how students felt about Mathematics or Business Studies. However, it appears from these figures that there is a reasonably good level of satisfaction with AS/A-level CS and ICT, although satisfaction may be a little higher for CS.

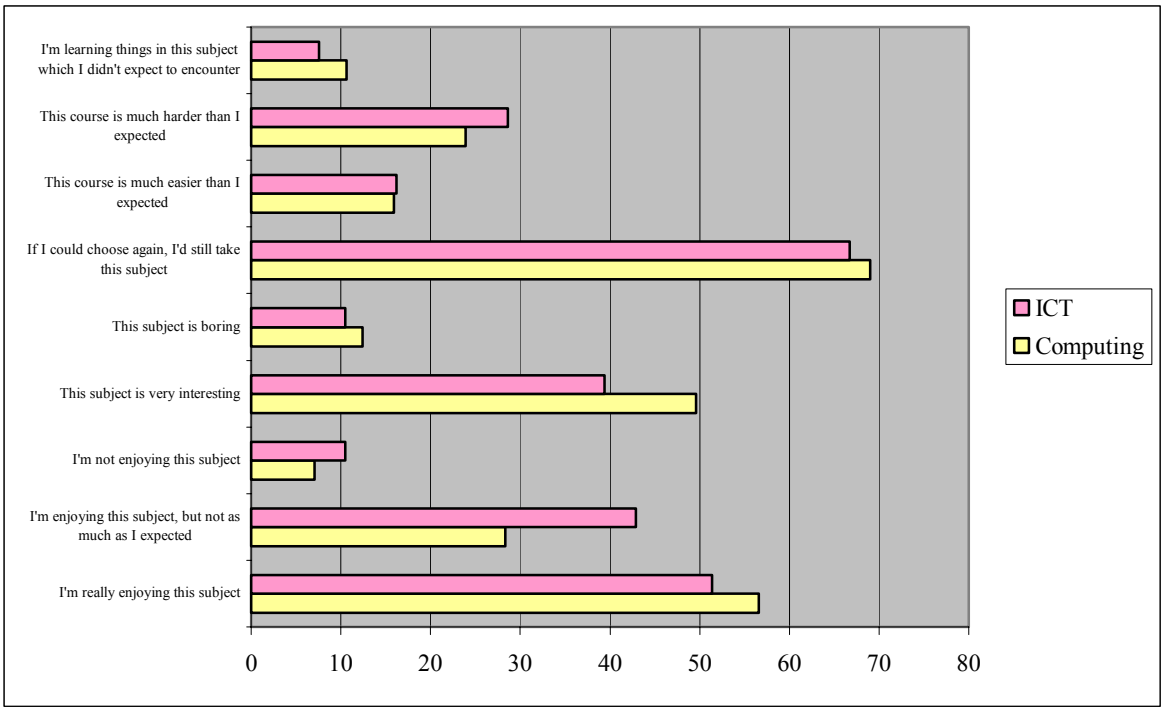

Chart 26: Experiences of studying A/AS Computer Science/ICT, post-GCSE Computer Science/ICT students

2:3.3 Experience of studying ICT at GCSE

Students were not asked about their experience of studying ICT at GCSE. However, a number of comments on GCSE ICT were volunteered either during focus group interviews or in the 'free text' section at the end of the questionnaire.

By contrast with the positive attitudes reported above in relation to AS/A-level ICT, very few of the comments on the GCSE curriculum and experiences of studying this subject were favourable. Even among students who were taking ICT at AS/A-level, students were likely to state how much more enjoyable their post-GCSE studies were in this area.

Many of the students who were taking neither CS nor ICT at AS/A-level stated that their negative experience of GCSE ICT was a primary reason for this. Common themes in criticisms of GCSE ICT included:

The content is repetitive: 'I did GCSE ICT and I never want to annotate another screen shot' was the view of one students. Others criticised the presence of multiple tasks including spreadsheets or other software items.

The content is uncreative or 'mundane'. Several students complained that the ICT curriculum included too many tasks in which they were required to use software to perform dull or limited operations. Where students were aware of media or internet applications, or of the 'exciting' potential of Computing, the absence of a chance of focus on these issues at GCSE was criticised.

ICT involves 'a lot of very easy work'. This view can be summed up by a quotation from one student in a focus group interview, who stated that 'It [GCSE ICT] is a lot of time but none of it's very difficult'. In a similar vein, numerous students stated that GCSE ICT was 'boring'.

The sense that ICT is 'not a proper subject'. Several students, in particular those taking a 'traditional' combination of A-levels or an all-science programme, wrote that they felt ICT was 'a waste of a GCSE'. Some focus group comments suggested that ICT was viewed as 'there to support other subjects'; it is possible that embedded ICT across the curriculum contributes to this view. Others stated that it is 'pointless' or 'Mickey-Mouse'. Some very interesting comments on this theme were made in the focus group interviews where post-GCSE students had *not* undertaken their GCSE ICT at the institution where the interview was taking place, i.e. where the enthusiastic CS/ICT teachers who had volunteered their institution to take part in the study had *not* been in charge of teaching this subject[3]. Several of these students stated that GCSE ICT had been a subject 'in which you could mess around'. Stories of students using time at the computer to 'message' with friends or to do homework for other subjects were told by several students.

ICT involves doing things 'that you can do already'. There were two strands to these comments. One was found among AS/A-level CS students, and also among some students who were not studying either CS or ICT at A-level. Most of the students who made comments of this sort appeared to be highly proficient in 'hobby' computing. They had found that where 'computing' tasks were involved in GCSE ICT, these were mostly operations which they had already learnt to perform themselves, and/or that the Computing elements of GCSE ICT had little to do with 'real computing'. 'Real computing' was equated with programming, writing software, and creative activities, as opposed to the use of software applications. One student stated that 'I couldn't really see what it had to do with computers – I mean, I spend all my spare time doing things with computers, and this was just spreadsheets and Office and stuff. You don't really learn anything about computers'. S/he had been dissuaded from taking AS/A-level *Computer Studies* by his/her experience of GCSE ICT, but planned on taking Computing in HE where 'you do the proper subject'.

Students who were not taking Computer Science/ICT who stated that GCSE ICT involved doing 'things you can do already' tended to be proficient in the use of particular software packages, and to feel that a school subject should not teach and reward 'everyday' skills. Again, embedded ICT may contribute to this attitude.

When the confusion between Computing and ICT which exists among many students who are not taking CS is considered, it is clear that the very negative attitudes towards GCSE ICT may colour students' perceptions of Computer Science/IT courses and careers. These may be viewed in a very negative light, and students may have an extremely inaccurate picture of what they involve.

2:3.4 Attitudes to AS/A-level Computer Science/ICT – by subject group

The attitudes of the subject groupings described in Section 2 above were examined in order to identify differences between students on the basis of the subject mix which they were studying alongside CS/ICT.

2:3.4.1 Attitudes to AS/A-level Computer Studies

Students studying AS/A-level Mathematics who were also taking CS were slightly more likely than students not taking Mathematics to state that an interest in the subject and the 'thrill factor' of CS had attracted them to this subject. For students taking Mathematics and/or at least one Physical Science subject, this trend was statistically significant. It appears that these factors are particularly important to students who take CS as part of a Mathematical or Scientific programme. Students taking Mathematics were also more likely to state that they were considering work or further study in Computing. Once again, these effects reached statistical significance for students taking *only* subjects in these areas at AS/A-level.

[3] This was, of course, the case for the sixth-form college, but in two of the secondary schools where focus group interviews were held there were several students in this position.

Students taking Mathematics and/or a Physical Science and students taking only mathematics and science subjects were significantly more likely than those not taking this combination of subjects to have chosen CS because they felt that they could achieve good grades in this subject. At least 60% in each of these categories stated that this factor had contributed to their choice of subject, compared to less than 50% who were taking other subject combinations. This does not necessarily indicate higher levels of confidence among students taking Mathematics and/or a Physical Science subject; it simply suggests that confidence about gaining high marks contributed to their choice of CS at AS/A-level. The fact that many of these students were taking four subjects at A-level or five subjects at AS may indicate that they had decided to add an 'extra' subject to the 'standard' number because of this confidence.

For this group, the enhancement of job prospects offered by CS was also important. Students taking Mathematics were slightly more likely to state that this was important than were other groups. However, among students taking Mathematics and/or a Physical Science subject this effect was significant, as was the case for students taking only Mathematics and Science subjects. These students may have identified the importance of Computing in a range of scientific disciplines and identified this as an important area of study to support their career plans in another area (e.g. Engineering or Physics).

The small number of students taking CS alongside Business Studies were *also* more likely than students not taking Business Studies to state that the enhancement of job prospects by this subject was important to them. However, subject interest and the 'thrill factor' do not appear to have been especially salient for this group.

Students taking a Humanities subject alongside CS were significantly *less* likely than those not taking a subject from this area to state that they were considering a career or further study in Computing. They were significantly *more* likely to state that subject interest had been important to them when choosing this subject; this factor may have been more salient for students who might not consider themselves to be 'scientific' in general.

Students taking Mathematics and/or a Physical Science and also a Humanities subject with CS *all* stated that subject interest had been important to them in choosing to take this subject. However, they were significantly *less* likely than other students to name the 'thrill factor' as having swayed them, and significantly *less* likely to have felt that their ability to get a good grade in CS was important in their decision.

Subject interest appears to draw students to CS in large numbers, especially scientists and those who appear to be seeking a 'balanced' portfolio of AS/A-level subjects. Job prospects are important both to Science students who are contemplating a career in Computing, and to Business Studies students (although the latter group are not particularly likely to view Computing as a likely career).

Overall, Science students seem to be having the most positive experiences on their CS course. Students taking Mathematics and students taking Mathematics and/or a Physical Science subject are significantly more likely to state that they are 'really enjoying' their CS studies, with two-thirds of students in these groups as opposed to one-third of students not taking Mathematics or Physical Sciences agree with this item. Students taking only Mathematics and Science subjects are slightly but not significantly more likely than students taking a mixture of subjects to agree with this item, and all three groups are significantly more likely to state that they find the course very interesting and would take it again if they had the choice.

Students in all of these groups are also *less* likely to state that they are enjoying the course less than expected, or that they are not enjoying the course. They are significantly more likely to state that the course is easier than they had expected, and significantly less likely to state that it is harder. By contrast, while Humanities and Business Studies students express average levels of enjoyment (or

lack of it), they are more likely than other groups of students to state that they find the course is harder than they had expected. This effect is statistically significant for Business Studies students. Students taking Mathematics and/or a Physical Science and also a Humanities subject show no notable differences from other groups in their experience of studying CS at AS/A-level.

From these findings, it seems that while overall satisfaction with AS/A-level CS is reasonably good, experiences of this subject are more positive among students whose overall interests are scientific or mathematical.

2:3.4.2 Attitudes to AS/A-level ICT: by subject group

Subject interest does not emerge as an especially salient reason for choosing AS/A-level ICT for any of the groups of students identified here. In fact, reasons for choosing this subject are remarkably uniform. Students taking only Mathematics and Science subjects are significantly *less* likely than other groups to name subject interest among their motivations for choosing it, but no other single reason emerges as especially important for this particular group. Students who are studying Mathematics are slightly more likely than those not taking this subject to state that the enhancement of job prospects was important to them, but this effect is not significant.

Humanities students are slightly les likely to state that they are considering a job or further study in ICT, but Business Studies students are significantly *more* likely to say that ICT is a possible area of work or further study for them. Business Studies students are also slightly more likely to have chosen ICT because their friends were also planning to take this subject. Students taking only Mathematics and Science subjects students taking ICT were slightly *less* likely to name this reason, and also slightly *less* likely to state that they chose ICT because they liked the staff who teach this subject at their school.

Experiences of studying ICT were less positive among Science students than experiences of CS. Students in all of the 'Science subject' categories were less likely to state that they were 'really enjoying' this subject, and more likely to state that they found it 'boring' or less enjoyable than expected, or that they were not enjoying it. Students in all categories were significantly more likely than students not taking Science subjects to *disagree* with the item 'I would take this subject again if I had the choice'. It appears that AS/A-level ICT does not generally satisfy students whose primary subject choices are scientific.

Students taking Business Studies, by contrast, were slightly more likely than those not taking a subject in this area to state that they were 'really enjoying' ICT at AS/A-level and that they would choose this subject again if given the option. They were also significantly likely to find their ICT course easier than they had expected.

Students taking at least one Humanities subject also tended to have reasonably positive experiences of ICT AS/A-level. They were significantly less likely than students not taking a subject from this group to state that they were not enjoying the course, and to state that they would take it again if making the decision a second time. In addition, they were slightly less likely than other groups to state that they found it boring.

2:3.4.3 Gender differences in attitudes to CS/ICT

Among students taking CS or ICT at AS/A-level, a small number of gender differences emerged.

Almost identical proportions of male and female students named subject interest as having been important in their decision to take CS. The 'thrill factor', plans to work in this field, and the enhancement of job prospects were also named by very percentages of male and female students.

However, more females than males stated that they believed CS to offer useful skills alongside other subjects. In addition, females were significantly less likely than males to state that they had chosen the subject because they believed they could gain good grades[4].

For ICT, however, females were slightly more likely than males to state that subject interest had guided their choice of subjects, and also that the 'thrill factor' of ICT had been important to them. Males, however, were significantly more likely to state that they were considering work in ICT. They were also significantly more likely to state that they had chosen ICT because their friends had also decided to take this subject[5]. It is difficult to identify any factors which are more important to females than to males in the decision to take ICT at AS/A-level.

The experience of male and female students taking ICT is very similar, although males are significantly more likely than females to state that they find the subject 'very interesting'. However, slightly fewer females than males state that they are 'really enjoying' CS, and slightly more state that they find it enjoyable, but less so than expected. Females are slightly less likely to state that they find CS easier than expected, but no more likely than males to find CS more difficult than they had anticipated.

Gender issues will be discussed in more detail below. However, it is worth noting that several of the female CS students who expressed lower levels of satisfaction in this section of the questionnaire also made comments about the male dominance and 'sexism' of Computing, as well as the need to encourage more women to take it. In focus groups, the small number of women who expressed some dissatisfaction with their course named 'social' rather than curriculum issues.

2:3.4.4 Differences between AS and A-level CS/ICT students

Very few significant differences between students at each of these stages emerged. In CS, AS students were significantly *more* likely than A-level students to state that they found their course 'very interesting'; 57.1% of AS student agreed with this item compared with 37.2% of A-level students. Only 7.1% of AS CS students stated that their course was boring, compared with 20.9% of A-level students. It appears that satisfaction with CS may dip slightly between these two stages.

In ICT, by contrast, opinions appear to become more polarised. Slightly more A-level than AS students state that they are 'really enjoying' ICT. However, A-level students are also significantly more likely agree that they are *not* enjoying ICT.

2:3.4.5 What went right? Attitudes among students planning to study CS/ICT in HE

The experience of AS/A-level CS/ICT among students who stated that they planned on studying one of these subjects in HE was examined, in order to identify the features of secondary education courses which had appealed especially to these students.

All of the students who definitely intended to study CS/ICT in HE stated that subject interest had guided their decision to study CS at AS/A-level. This was also the case for around 90% of students in this group who were taking AS/A-level ICT. However, the 'thrill factor' item ('I want to learn new

[4] This does not mean that the grades gained by female students are generally lower than those attained by men; in fact, a slightly higher proportion of female than male students gain the highest grades in A-level CS (BCS 2005, 29). It is likely that the responses to this item reflect a more general trend in surveys where what might loosely be termed 'confidence measures' are included. In such cases, female respondents tend to express lower confidence in their abilities than males, particularly when numerical or scientific skills are under discussion.
[5] This is consistent with the finding throughout this study that the choices and opinions of one's friends are *more* important to males than to females.

things and explore new areas') was named by only 69.4% of students taking CS and 57.5% of students taking ICT who definitely planned to study Computing/ICT in HE and by 86.4% of CS and 77.3% of ICT students who *may* study Computing/ICT in HE. This is surprising, but the relatively low number of students who agree with this statement may be due to the wording of the item rather than actual attitudes among students. If these students have an interest in Computing as a hobby, they may not regard the things that they will learn at AS or A-level, or even in HE, as 'new'. Alternatively, they may feel that their strong interest in the subject subsumes this item.

Students who plan on taking these subjects in HE are significantly more likely to be considering a career in Computing. Those taking ICT are significantly more likely to have chosen the AS/A-level course because they feel that it will enhance their job prospects, but this is not significant for CS students. It is more likely to be named by CS students who *might* take a related subject at university. This may occur because those who do not feel fully committed to taking this subject lack the level of subject interest of those who have made a firm decision about what to study. Besides or instead of subject interest, 'extrinsic' reasons such as job prospects may be more salient for them. The responses to the item 'Computing/ICT is a useful skill to have alongside other subjects' follow an almost identical pattern, with higher levels of agreement among those studying ICT rather than CS and among those who state that they *may* study Computing in HE than among those who state that they have definitely decided to do so.

For students taking AS or A-level ICT and planning on studying Computing/IT in HE, a significantly higher number took ICT because they were advised to do so, because they liked the staff in this subject at their school, or because their friends were doing the subject than is the case for other ICT students. However, none of these factors were more important among CS students who plan on studying Computing in HE.

While A/AS ICT students who plan to study Computing/IT in HE show different patterns in their reasons for choosing to study ICT after GCSE, their attitudes to their studies are similar to those of ICT students as a group. Among A/AS CS students, those who state that they definitely or possibly intend to study this subject at university are significantly more likely to state that they are enjoying their A/AS studies in CSS, and that they would still take the subject if they had to make the choice again. They are also significantly *less* likely to state that they find the A/AS course harder than they had expected.

Subject interest, therefore, appears to be of central importance to students whose involvement in IT is at the 'technical' or 'scientific' end of the spectrum represented by Computing. Job prospects are also important to this group, but they appear to be secondary to subject interest. Interest is also salient for students at the 'ICT end', but this group are also likely to focus on job prospects, career plans, and personal factors such as feeling at ease with staff and peers.

2:3.5 Reasons for not taking CS/ICT at AS/A-level – post-GCSE students

2:3.5.1 All students

Post-GCSE students were asked to reflect on their decisions about which subjects to study at AS (and later A-level). Chart 27a shows the pattern of responses to this item. Only around 8.5% of students who did not take CS or ICT had thought seriously about taking it, and a further 14.8% had considered it. Around 75% gave it no serious thought at all.

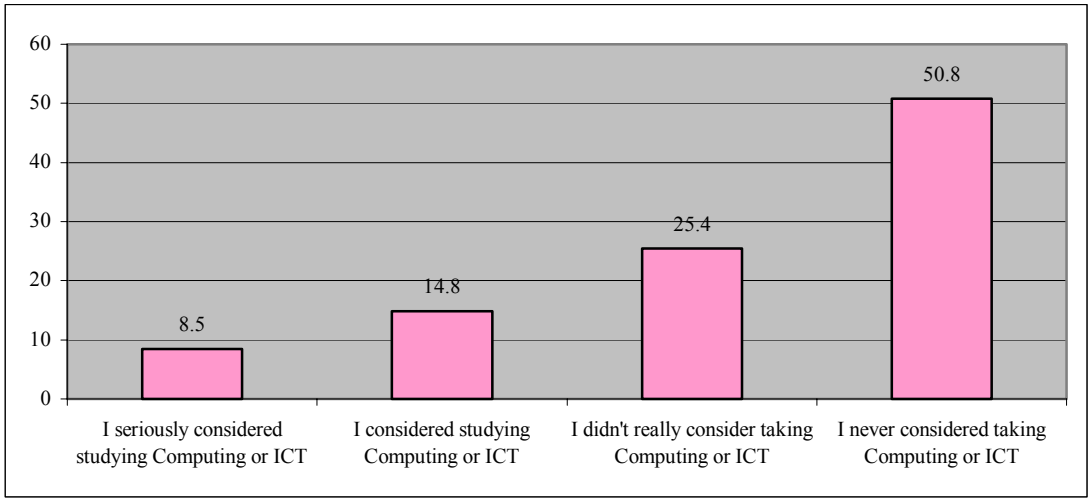

Chart 27a: Recalled intentions with regard to taking Computer Science/ICT at A/AS level, students not taking these subjects post-GCSE

Chart 27b shows the distribution of students between different subject areas in their *actual* A-level or AS studies.

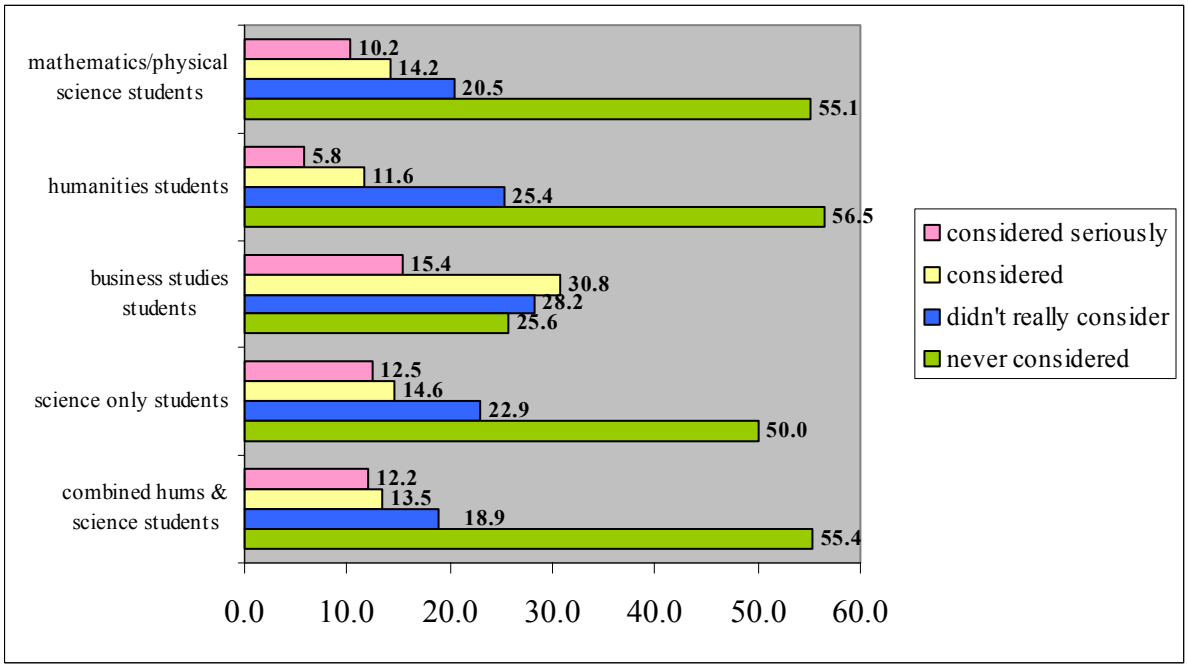

Chart 27b: Recalled intentions with regard to taking Computer Science/ICT at A/AS level, students not taking these subjects post-GCSE: by subjects taken at A/AS

It appears that there are very few differences between the patterns of choice for students studying different 'traditional' subjects. Perhaps surprisingly, only slightly fewer Humanities students gave the matter serious consideration and only slightly more students in this group did not. However, the greatest 'potential market' revealed by this item is among Business Studies students. This group are significantly more likely to have thought seriously or at least to have considered taking CS or ICT (in fact, it is likely that ICT was the subject considered by a large number of these students). Only just over 50% either 'didn't really consider' or 'never considered' taking either subject, and the proportion who 'never considered' CS or ICT is half that found in the other subject areas.

The reasons for this pattern of choice are unclear. It may be that students taking Business Studies are more interested in ICT (and possibly CS), or that they are generally *less* decided about which subjects to take after GCSE. Alternatively, students whose choices are in 'traditional' subject areas may simply not have CS and/or ICT 'on their radar' to the same extent as those who are taking at least one 'modern' or 'vocational' discipline.

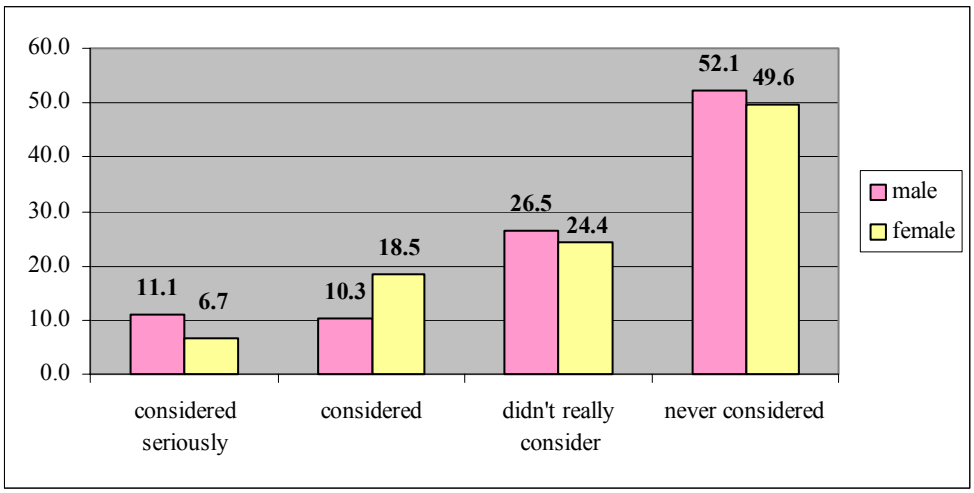

Chart 27c: Recalled intentions with regard to taking Computer Science/ICT at A/AS level, students not taking these subjects post-GCSE, split by gender

Chart 27c shows attitudes to taking CS or ICT by gender. Although figures are reasonably similar for both sexes, perhaps the most surprising finding here is that more *females* than males have considered taking one of these subjects. Women appear to be open to the idea of taking CS or ICT at AS/A-level, but something prevents a significant number of them from choosing these subjects.

Chart 28 shows the recalled reasons for considering taking AS/A-level CS or ICT. The most common is the belief that these subjects offer useful general skills (named by around two-thirds of students who gave the matter at least some consideration). Fewer name interest in the subject and/or in computers. Just 15% had changed their career plans since choosing their AS/A-level subjects, and for a smaller number of students, the image of the subject or peer influences were important.

However, among students who gave the matter *serious* consideration, subject interest and an interest in computers were far more important. Subject interest operated for 50% of students who considered CS/ICT seriously and 45.7% of students who considered it; interest in computers operated for 65% of those who seriously considered Computing and 31.4% of those who considered it. 16.5% of those who did not really consider CS or ICT also stated that interest in Computing was a factor for them.

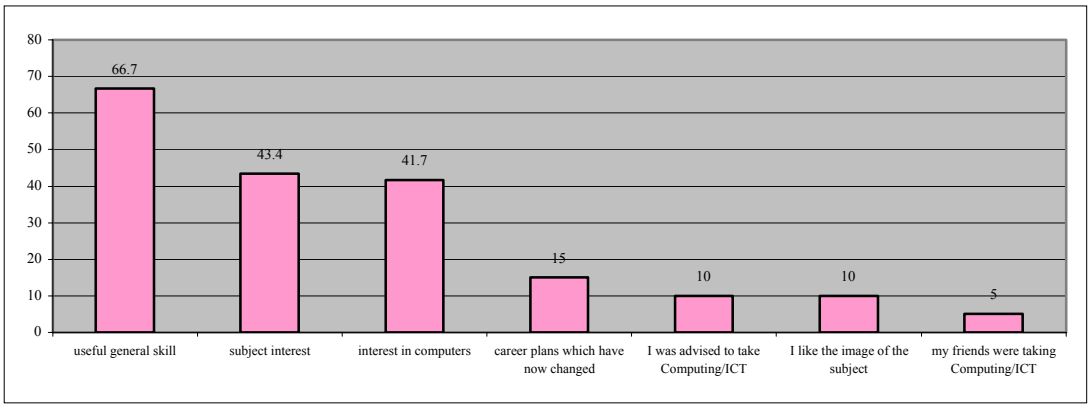

Chart 28: Recalled reasons for considering Computer Science/ICT at A/AS level, students not taking these subjects post-GCSE

For students who named subject interest or interest in computers as reasons for considering taking CS or ICT, the factors most likely to have dissuaded them were the desire to 'keep their options open' (26.9%), clear plans to work or study in another area (38.5%), a belief that it was easy to pick up skills in this area without taking the subject (30.4%)[6], and a belief that the environment in Computing would be too male-dominated.

Chart 29 shows the recalled reasons for deciding *against* taking CS or ICT at AS/A-level for all post-GCSE students who were not taking either of these subjects.

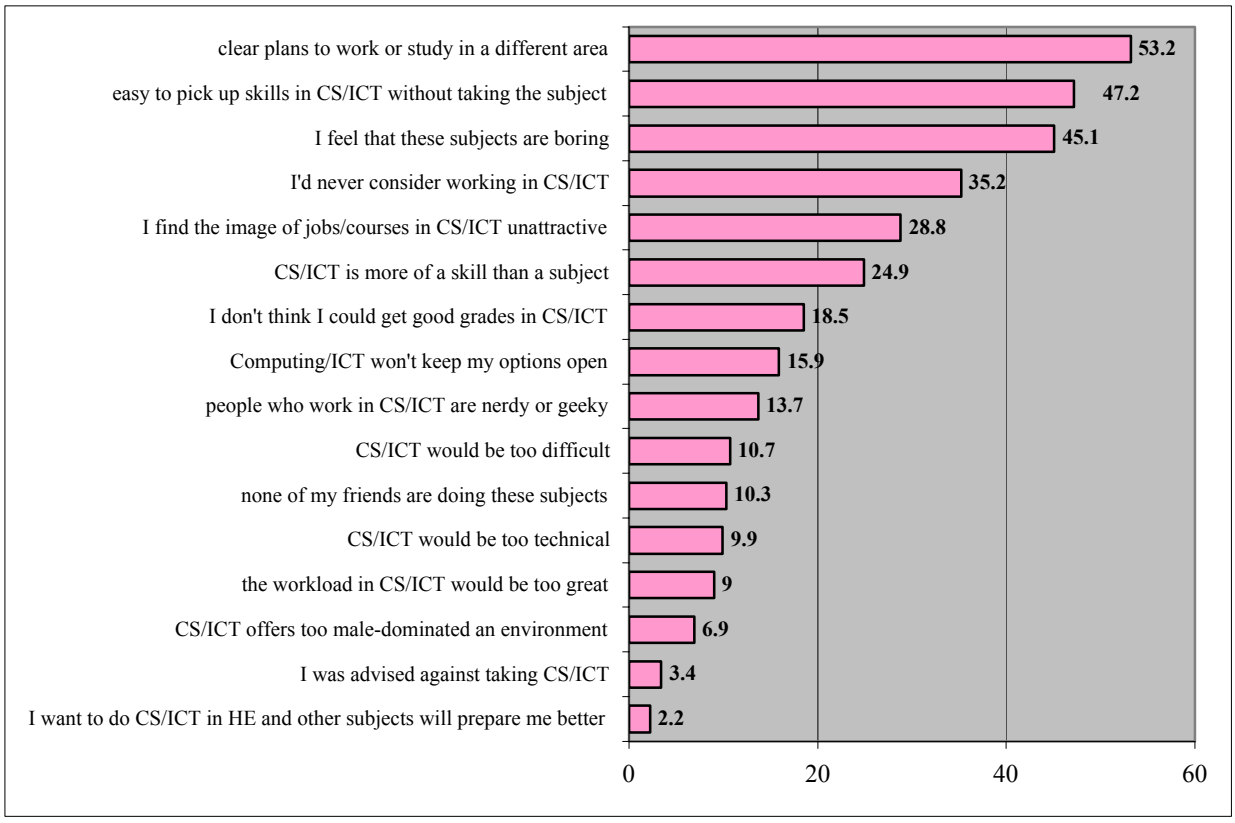

Chart 29: Recalled reasons for not taking Computer Science/ICT at A/AS level, students not taking these subjects post-GCSE

[6] It is possible that a high number of these students may be 'hobby computer' experts

The most common factor is a clear plan to work or study in a different area, followed by the belief that it is easy to pick up skills in CS or ICT without formal study. Almost 50% feel that these subjects would be 'boring', and just over one third state that they would 'never consider working' in CS or ICT. This figure is surprisingly small; can it really be taken to imply that two thirds of students *could* envisage themselves in an IT job? Only just over half currently have definite plans for work of a different sort.

An 'unattractive image' is important for 28%, although only 13.7% are put off by the 'nerd/geek' image. One quarter believe that CS/ICT is 'more of a skill than a subject', and 15.9% want to 'keep their options open'. The belief that CS and ICT are 'too specific' as subjects was raised by students in several of the focus group interviews. Students believed that these subjects would add little to a profile of generic skills, and would fit people only for work of a certain type. They therefore believed that it might be unwise to choose them over 'traditional' humanities or science disciplines if one was not yet certain about career choices, and especially if one was not certain whether or not to work in Computing.

Small numbers of students are concerned about the difficulty or 'technicality' of these subjects, or about the workload in CS/ICT. 6.9% of the students who had not taken either subject stated that the perceived male domination of courses and careers had dissuaded them.

Among students who had considered or seriously considered taking AS/A-level CS or ICT, certain factors had been especially influential. 9.5% of those who had seriously considered taking CS or ICT at AS/A-level intended to study Computing at university, and felt that other subjects would enhance their chances of obtaining a place. In the focus group interviews, a number of students explained their decision not to take CS or ICT on the basis of advice received from university Computing departments, and/or worried that their decision to study one of these subjects might have damaged their chances of a university place in Computing.

23.8% of students who had seriously considered CS/ICT and 40.6% who had considered these subjects stated that they had clear plans to work or study in a different field. However, these items applied to 58.3% of students who had not really considered Computer Science/ICT and to 60% of those who had never considered these subjects. Those who had given CS/ICT serious thought were significantly less likely to believe that these subjects would be 'boring'. They were significantly *less* likely to state that they 'would never consider working' in CS or ICT. An unattractive image of the subject was not important for any group except for those who had never considered taking CS or ICT, of whom 41.7% named this item.

Perhaps the most important finding from this section for recruitment into CS and ICT was the number of students who did not really consider or who never considered CS or ICT who stated that an important reason for this was that they 'didn't really know very much about CS/ICT'. This was named by around 25% of students who did not really consider CS or ICT or who never considered these subjects. It appears that a simple lack of accurate information is putting off a reasonable number of students.

2:3.5.2 Reasons for not taking CS/ICT at AS/A-level: by subject group

Students taking Mathematics and and/or a Physical Science subject were significantly more likely than other groups to state that they considered taking CS or ICT at AS or A-level because of an interest in the subject. Students taking Mathematics were slightly more likely to state that they considered these subjects because they were interested in Computers and/or because they were considering working in Computing/IT, but this item did not appear to be especially important for students taking Mathematics and/or a Physical Science subject or 'science only' students.

Students taking Mathematics, students taking Mathematics and/or a Physical Science subject and 'science only' students showed very similar patterns in naming their reasons for *not* taking CS/ICT at AS or A-level. All of these groups were significantly more likely to say that they had decided against studying CS/ICT because they believed that it is easy to pick up enough skills in this area without taking the subject, because they would never consider working in Computing/IT, and because they feel that the environment of the subject would be too male-dominated (male as well as female students named this reason).

Both students taking Mathematics and 'science only' students were significantly *less* likely than other groups to state that they had decided against taking CS/ICT because they felt that this subject would be 'too hard'. Students taking Mathematics and students taking Mathematics and/or a Physical Science subject are significantly more likely to state that they were put off because they felt that many CS/ICT students are 'nerdy' or 'geeky', and students taking Mathematics and/or a Physical Science subject were significantly *less* likely than other groups to state that they were initially attracted to CS/ICT because they 'liked the image of the subject'.

'Science only' students were significantly more likely than other students to state that they have clear plans to work or study in another area. However, they were significantly less likely to state that they wished to keep their options open and felt that CS/ICT would not allow this.

Business Studies students were significantly *less* likely than other groups to state that they had been dissuaded from taking CS/ICT because they felt that these subjects would be boring or because they would not consider working in these areas. They were also slightly *less* likely to state that they felt it would be easy to pick up enough skills in this area without formal study or that they felt it would be too male-dominated. They were *more* likely to state that they had been attracted to CS/ICT because they liked the image of the subject, or because their friends were studying CS/ICT. It was not possible to identify any factors which were particularly important in dissuading Business Studies students from taking these subjects, although all of the factors except the idea that it would be too male-dominated operated for some Business Studies students.

Humanities students, and students taking a mixture of Humanities and Sciences, were significantly more likely than other groups to state that they had decided against taking CS/ICT because they felt that these subjects would be boring and because they disliked the image of this subject and jobs in these areas.

2:3.5.3 Gender differences in reasons for *not* taking CS/ICT at AS or A-level

There were relatively few differences between males and females in the reasons stated for an initial interest in taking CS/ICT at AS or A-level. Females were more likely than males to state that subject interest had been a factor. Males, however, were more likely to state that an interest in computers had drawn them to these subjects. Neither of these trends is statistically significant.

When asked why they had *not* taken CS/ICT, males were significantly more likely than females to state that they felt that Computing was 'more of a skill than a subject', that they were afraid these subjects would entail too large a workload, that they thought many people working or studying in these areas were 'nerdy', or that they had been advised against taking these subjects. No items emerged as being especially important for female students; instead, each item listed was important for a relatively large minority of females.

2:3.5.4 Reasons for not taking CS/ICT: by HE subject choice

A handful of students not taking CS/ICT at AS or A-level stated that they would definitely or possibly study Computing/IT at university. Those who stated that they had made a definite decision to do so had been attracted to CS/ICT at AS or A-level because subject interest. This was also the case for 60% of those for whom Computing/IT at university was a possibility.

Various reasons had dissuaded these students from taking Computing/IT at AS or A-level. The most important was the belief that they could pick up enough skills in Computing without formal study. This response may have been chosen by students whose hobby is Computing and who feel that they learn enough through this experience to cope with a first year at university. Students who may study Computer Science/ICT at university are significantly *less* likely than other groups to be dissuaded from taking AS or A-level CS/ICT because of the image of the subject, or the belief that it is a skill rather than a subject; this is hardly surprising, given that they are making long-term plans to study Computing.

2:3.6 Reasons for not taking CS/ICT at AS/A-level – post-GCSE students

2:3.6.1 All students

Charts 30 and 31 show the stated intentions of pre-GCSE students when asked whether they might take CS or ICT at AS/A-level.

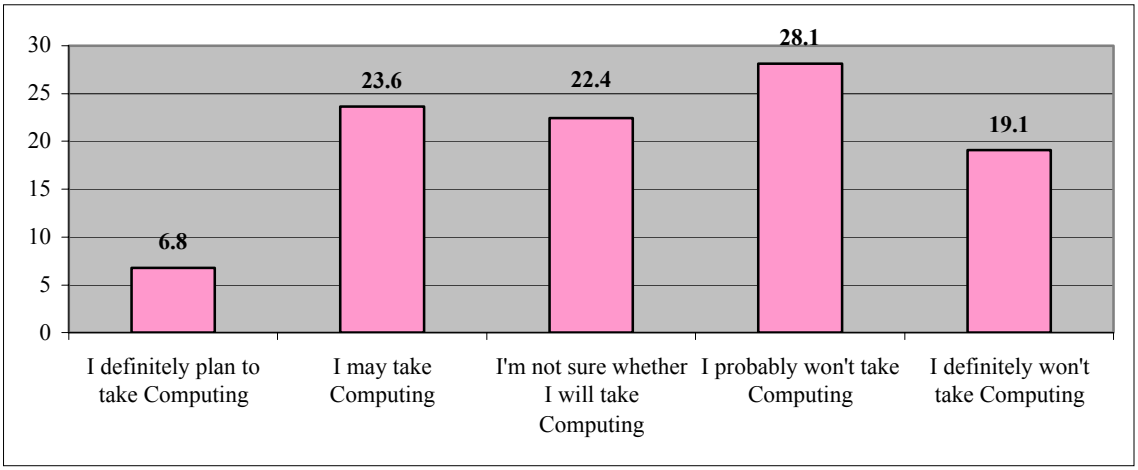

Chart 30: Intentions regarding taking Computer Science at A/AS level, pre-GCSE students

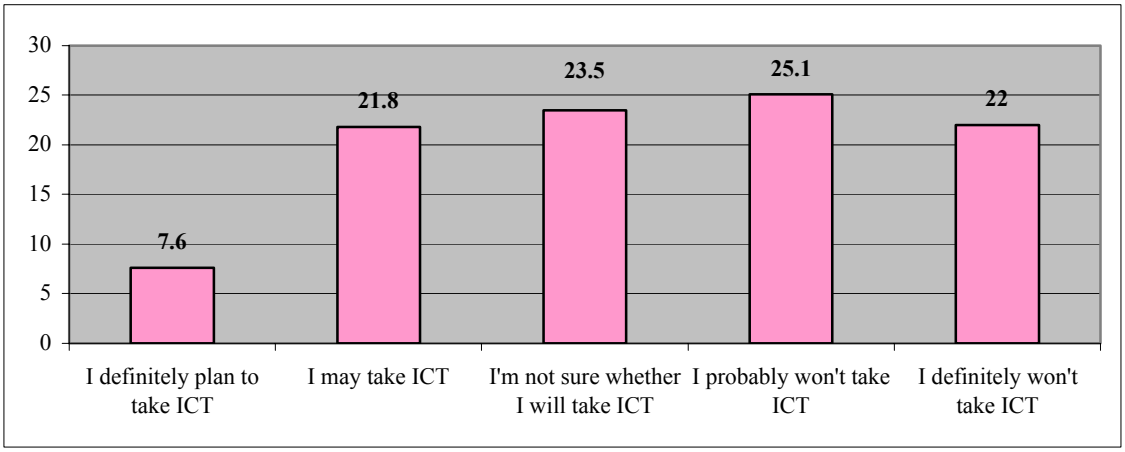

Chart 31: Intentions regarding taking ICT at A/AS level, pre-GCSE students

The pattern of response is very similar for both subjects. Only 6.8% of students to whom CS is available have already made a firm plan to study this subject, but it is a possibility for a further 23.6%. Around 25% are unsure about whether or not to take CS (and possibly about their choices in general). For almost 50%, CS is not really a possibility, and around 20% have decided firmly against it.

Just under 1% more students have firm plans to take ICT at AS or A-level, and almost the same number (21.8%) state that it is a possibility. 23.5% are unsure, and the subject has been definitely rejected by 22%, slightly more than in the case of CS. The total number for whom ICT is definitely not a possibility is again just under 50%.

Tables 34a and b show the reasons stated by students for considering or not considering CS at AS or A-level. Tables 35a and b show the reasons for stated for considering or not considering AS or A-level ICT.

subject interest	55.2
want to learn new things & explore new areas	51.7
considering studying or working in this area	36
improve job prospects	69
Useful skill alongside other subjects	65.5
my friends are doing Computing	9.9
I was advised to study Computing	4.9
I like the staff in Computing at my school/college	19.7
I believe I can achieve good grades	40.4

Table 34a: Reasons for considering taking A/AS Computing, pre-GCSE students only

it's easy to pick up enough skills in Computing without taking the subject	43
Computing is not relevant for my chosen further study/job	40.5
I don't think I could get good grades in Computing	34.7
I am not interested in Computing	32.9
I feel that Computing is boring	32.6
Computing would be too difficult	28.1
Computing would be too technical	23.1
workload in Computing would be too great	18.6
people who study/work in Computing are nerdy/geeky	18.6
none of my friends are doing Computing	10.7
Computing offers too male-dominated an environment	10.7
I was advised against taking Computing	2.1

Table 34b: Reasons for not considering taking A/AS Computing, pre-GCSE students only

I am interested in ICT	60.3
want to learn new things & explore new areas	51
considering studying or working in this area	38.7
improve job prospects	64.2
useful skill alongside other subjects	69.1
my friends are doing ICT	12.7
I was advised to study ICT	10.8
I like the staff in ICT at my school/college	22.1
I believe I can achieve good grades	38.2

Table 35a: Reasons for considering taking A/AS ICT, pre-GCSE students only

I am not interested in ICT	38.7
not relevant for my chosen further study/job	47.3
easy to pick up enough skills in Comptuing without taking the subject	46.6
ICT would be too difficult	31.1
ICT would be too technical	22.3
workload in ICT would be too great	26.5
none of my friends are doing ICT	10.5
people who study/work in ICT are nerdy/geeky	17.2
ICT offers too male-dominated an environment	10.1
I don't think I could get good grades in ICT	30.3
I was advised against taking ICT	2.1

Table 35b: Reasons for not considering taking A/AS ICT, pre-GCSE students only

Figures relating to the two subjects are placed side by side in Charts 32a and b. The most striking feature of these responses is the similarity between the patterns for CS and ICT. It is possible that these items may reveal more about the concerns of pre-GCSE students about their studies than about how they regard IT.

Among students who are definitely or possibly considering taking CS/ICT at AS or A-level, the most important reason in each case is the belief that this subject will provide them with useful skills alongside their other subjects. The idea that Computing and IT are primarily 'tools' seems to be strong among these students. The second most important issue, by a small margin, is the perceived improvement of job prospects which is offered by CS/ICT. Students in focus groups had a very clear idea of the 'hierarchy' of subjects as they relate to job prospects, and ICT – although not CS – was consistently listed as one of the most important. Others were English, Mathematics, and Business Studies.

Subject interest and the 'thrill factor' are named by smaller numbers of students. Given the very high importance accorded to subject interest by focus group participants, the *relative* unimportance of this item is very surprising. Among those considering the subjects, between 55% and 60% state that subject interest is important to them; this means that at least 40% are thinking of taking AS or A-level CS/ICT *without* a strong interest in the subject. This may imply that their commitment is a vulnerable one, and that something about their experience of the curriculum so far does not engage their interest particularly strongly. The 'thrill factor' of studying things which are new or exciting is important to just over 50% of students, and applies equally to CS and ICT, although given the confusion about the difference between these subjects, this may relate to inaccurate perceptions.

A career in IT is a possibility for around a third of students considering these subjects, and around two-fifths feel that they can achieve good grades. One fifth state that they like the staff in these subjects at their school, and around 10% are guided by the choices of their friends.

Students who are not interested in these subjects also focus on skills and career plans. Just over 40% feel that these subjects are not relevant to their chosen area of work and/or further study, and a similar number believe that they will be able to pick up enough relevant skills without formal study. A smaller number, between 32 and 38%, state that they are simply not interested in these subjects. The importance of grades to these students is shown by the fact that around one-third state that they are not considering the subject because they feel they could not achieve good grades in this area. Just under a third believe these subjects would be 'too difficult', and just over a fifth feel that they would be 'too technical'. The workload in ICT is a concern for just over 25%, but this does not seem to be as salient with regard to CS.

The 'geek image' is important in dissuading around 18% of students who are unlikely to take CS/ICT, and concerns about gender balance and the choices of friends matter for around 10%.

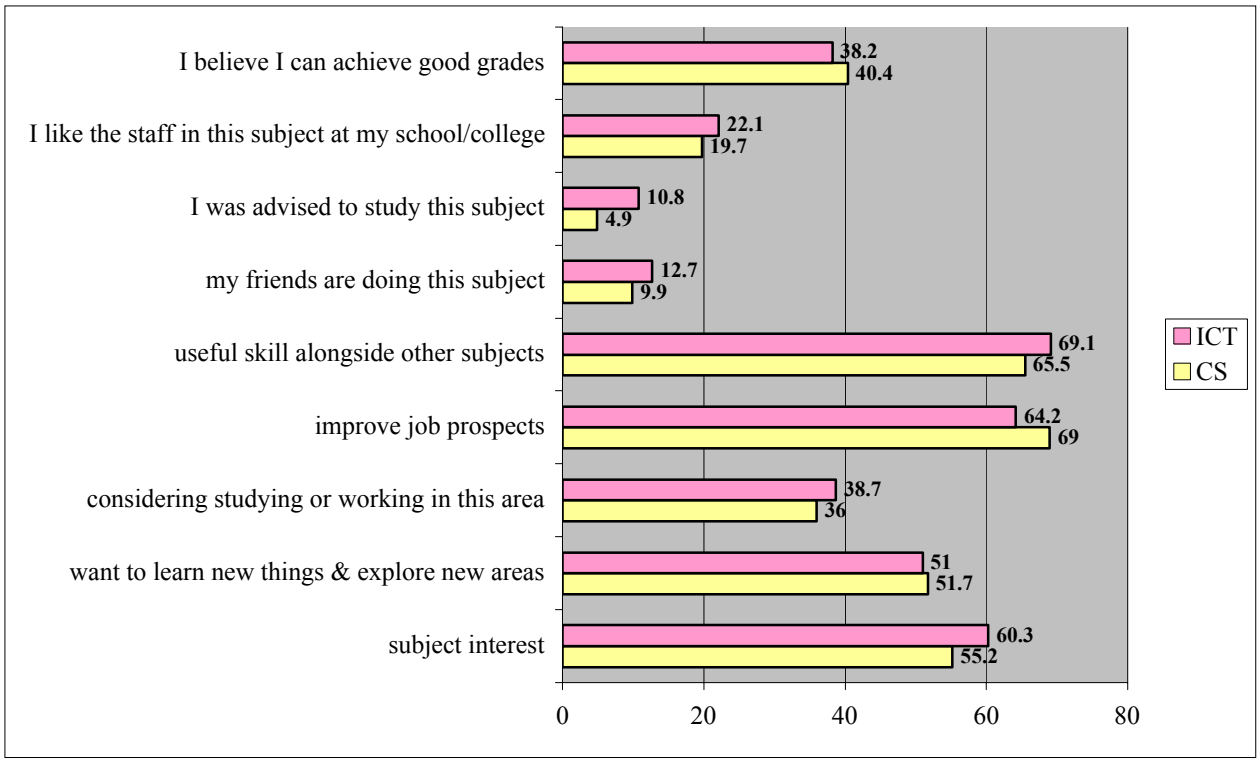

Chart 32a: Reasons for considering taking CS or ICT at A/AS, pre-GCSE students only

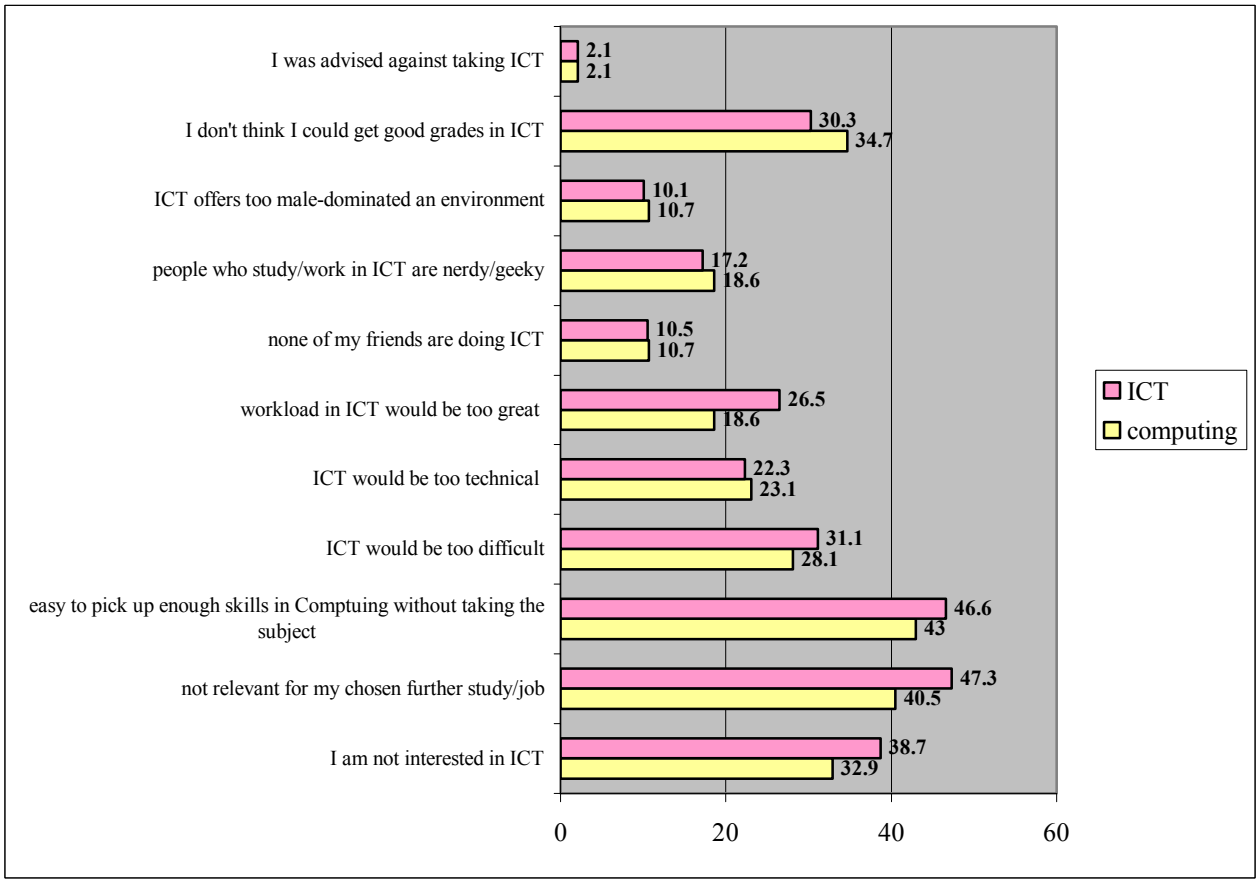

Chart 32b: Reasons for not considering taking CS or ICT at A/AS, pre-GCSE students only

2:3.6.2 Pre-GCSE students: gender differences in attitudes to AS/A-level CS/ICT

Perhaps surprisingly, female students are only very slightly less likely than male students to consider taking CS at AS/A-level, and gender was not a statistically significant factor in whether CS was considered seriously as a subject choice where it was available.

However, there are some significant differences in the factors which prompted pupils to consider taking CS. Subject interest was significantly more important for male students, with 63.1% naming this reason, compared to 43.2% of females. Even more strikingly, female students are extremely unlikely to believe that they might at some point work in Computing or IT. Only 24.7% of females who are considering taking CS name this factor, compared with 43.4% of males. By contrast, the perceived improvement in job prospects offered by taking CS is more important to females than to males. Males are more likely to state that they are considering taking CS because their friends are also planning to take this subject.

A lack of interest in CS is named by significantly more females (52.2%) than males (19.4%). This statistic is interesting in that it indicates that there is a large pool of subject interest which might be tapped here, especially among male students. Males are also less likely to state that they believe CS will be boring (26.6%, compared to 41.1% of females), or too technical (18.2% as opposed to 30.3%)[7]. Females, however, were more likely to reject CS because they felt that it would offer an environment which was 'too male-dominated', although this factor was named by only 15.2% of females who had decided against taking the subject. 7.7% of males stated that this had put them off CS.

Once again, responses from male and female students were very similar in response to the question about their intentions with regard to taking AS/A-level ICT. Subject interest was stronger among males who had decided to study ICT, being named by 67.2% of those who felt that they might take this subject compared to 51.1% of females. A lack of interest is named as a reason for avoiding ICT by 48.4% of males and 32.7% of females who have decided against the subject. Males are more likely than females to state that they are considering taking ICT because they believe that they might one day work in this area (43.1% compared to 33% of females). They are also more likely to state that the 'geeky' image has put them off.

No other significant differences emerge between male and female students, suggesting that attitudes to CS and ICT are broadly similar for both sexes.

[7] The precise meaning of 'too technical', of course, is difficult to ascertain. During focus groups, it appeared that this term might be used as a proxy for 'too impersonal', implying that a strong focus on technical issues would make it 'dull' or 'dry'. By contrast, subjects such as the biological and medical sciences, which have a strong technical component, were not condemned in the same way.

2:4 University choices

2:4.1 Orientation to HE

Chart 33 shows the pattern of responses when students were asked about their intentions regarding university application. Almost two-thirds of all students definitely intend to apply to university, and this figure rises to almost three-quarters of students who have already made the commitment to staying in education after taking their GCSEs. Just 10.5% of all students have decided that they will definitely not go to university.

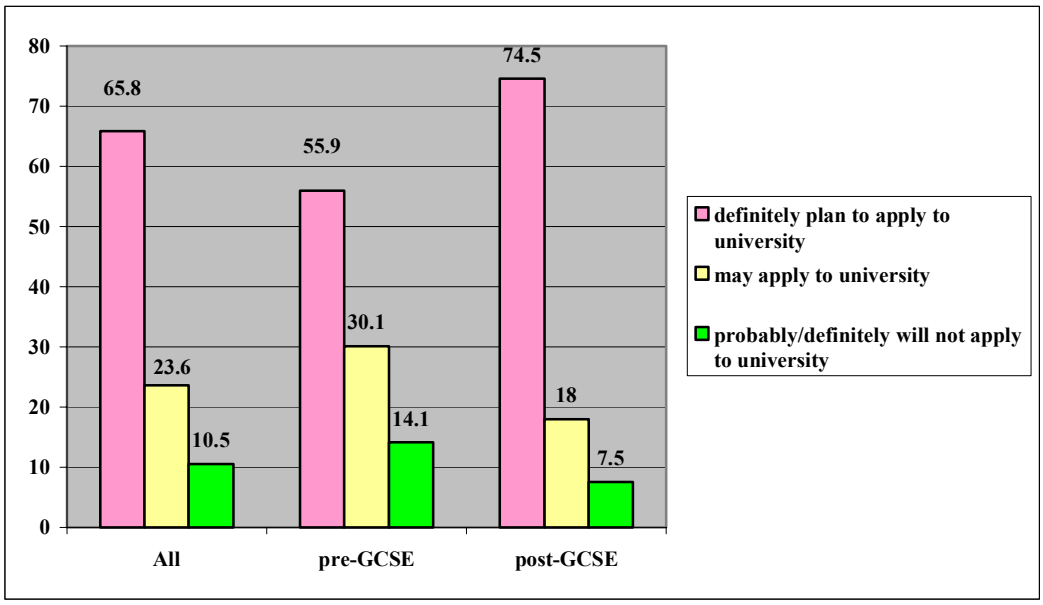

Chart 33: Expressed intentions about applying to university

These figures, it should be stressed, relate to students *in the institutions surveyed* and *not* to a representative sample of students in this age group. The statistics which follow should therefore be regarded as representative of students who have a generally favourable attitude towards entering HE, but *not* of all students at this education stage in the UK.

Perhaps surprisingly, no significant difference emerges between the orientation of male and female students towards HE, even among the less-inclined pre-GCSE students. This may indicate a shift away from the current trend for more female than male students to progress to university (see xxx above). However, it may also be an effect of the particular group of students surveyed here, which included a high number of science students whose classes tend to include higher numbers of males, and who tend (see below) to be more strongly oriented towards HE.

There were significant differences in orientation towards university according to the mixture of subjects which students were taking at A-level. These are presented in Charts 34a – d (these charts relate *only* to post-GCSE students). Among those who were studying at least one A-level from among the 'traditional academic' subjects, such as mathematics, the physical sciences, the humanities and modern languages, there appears to be a stronger orientation to university entrance, and this is even more pronounced among those who are taking only science and mathematics.

Students who are taking Business Studies in any combination, however, are significantly *less* likely to have a firm or slight inclination to apply to university than those whose choices at AS/A-level do not include a subject from this group.

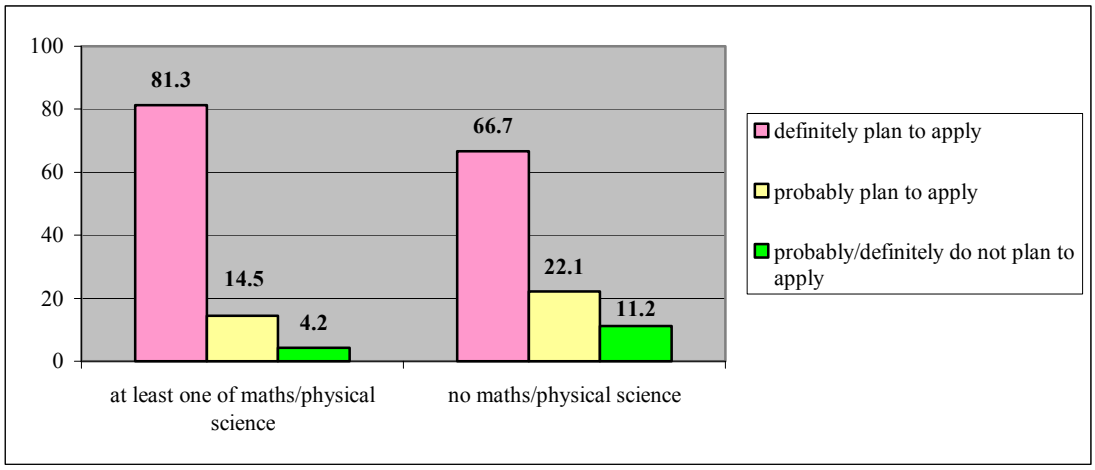

Chart 34a: Expressed intentions about applying to university: students taking mathematics and/or physical science

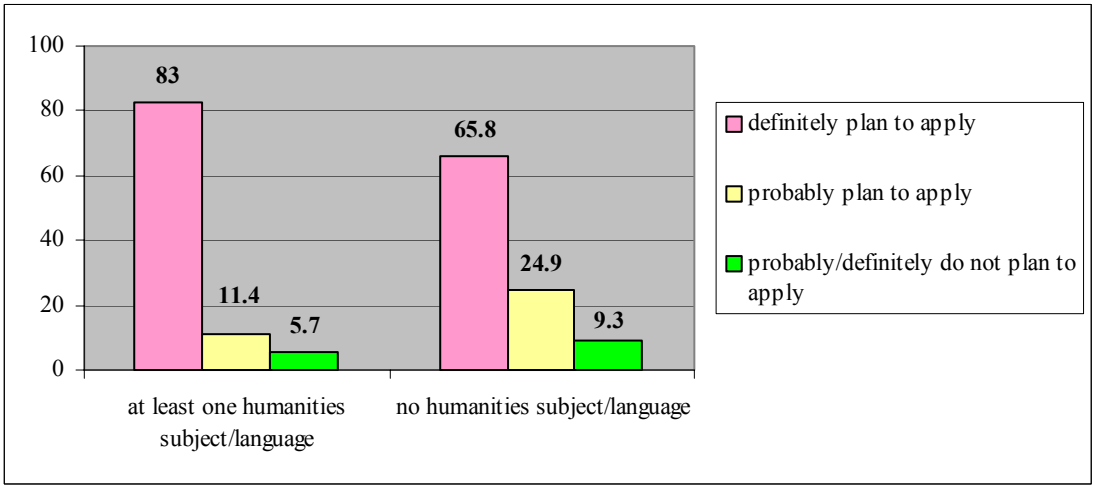

Chart 34b: Expressed intentions about applying to university: students taking humanities subjects and/or languages

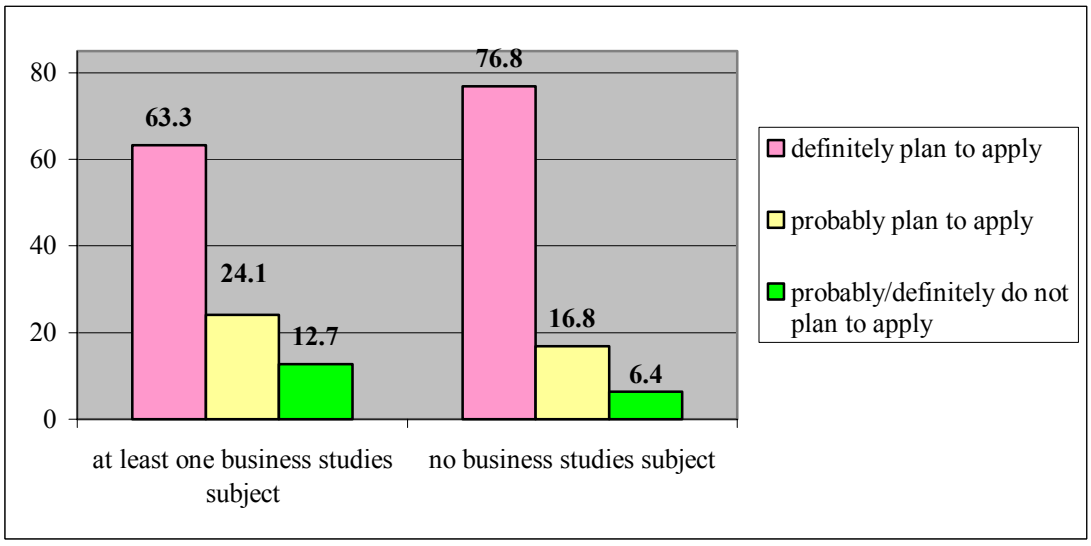

Chart 34c: Expressed intentions about applying to university: students taking business studies

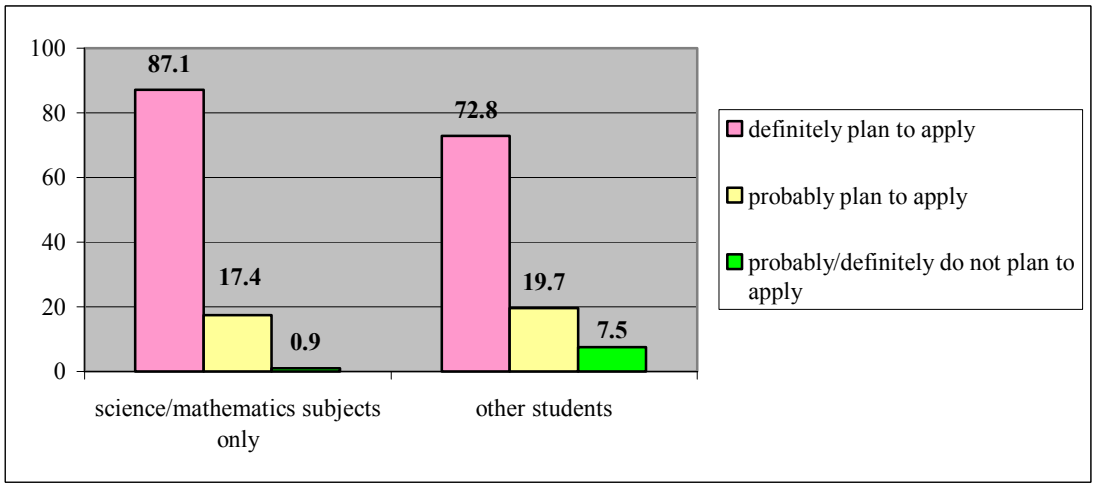

Chart 34d: Expressed intentions about applying to university: students taking only science subjects and/or mathematics

These findings have some implications for Computer Science/ICT, because as was demonstrated above, one 'constituency' for potential students in this area is among those with an interest in taking business studies. If this group are less inclined than others to consider going to university, then it may be necessary to find additional ways of informing them about the courses and opportunities which are available, or of enthusing them about continuing their education once they have left school or college.

All students in the study were asked to indicate the factors which had influenced their decisions about whether to sit AS/A-level and about which subjects to study at this stage, about whether or not to apply to university, and about which subject to study at university. Charts 35a – 35c shows the proportion of students who named each factor.

In each case, the vast majority of students believed that their own choices and preferences had played a part in the decision. Only around 10% of students felt that these had not had any influence on their decisions. The factor named by the second highest number of students was the student's parents; they appear most influential in the decision about whether to go to university, and least influential on the selection of the subject of study.

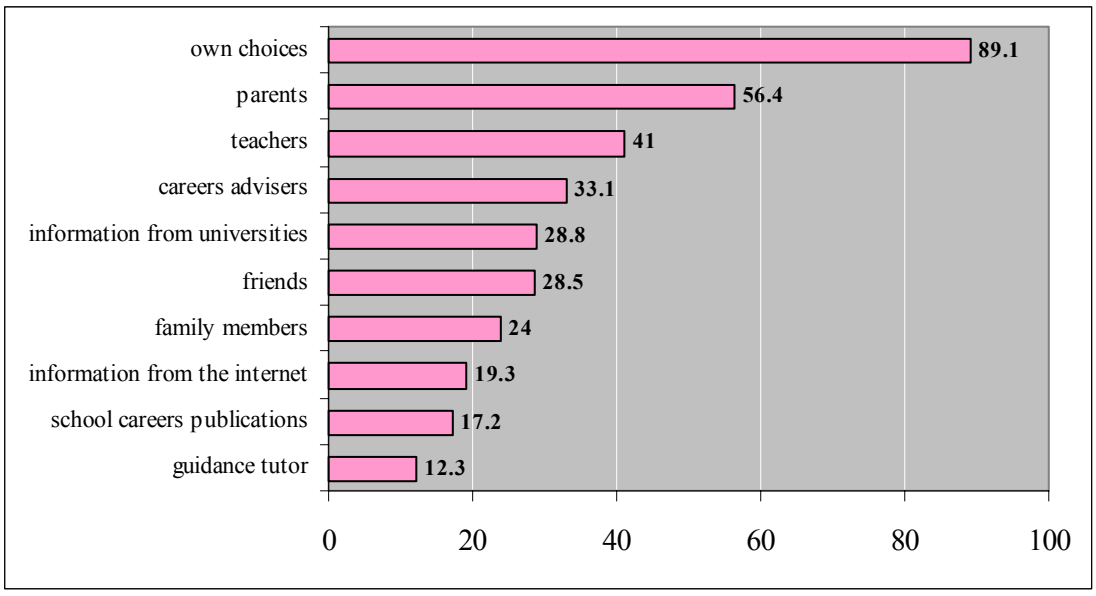

Chart 35a: Influences on post-GCSE study

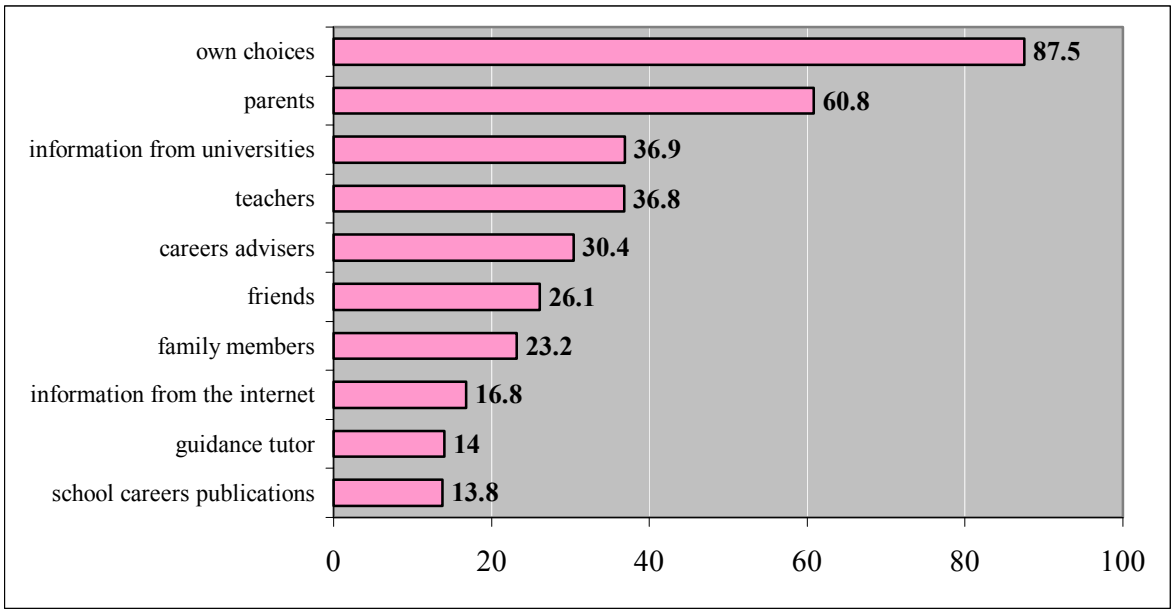

Chart 35b: Influences on the decision about whether to go to university

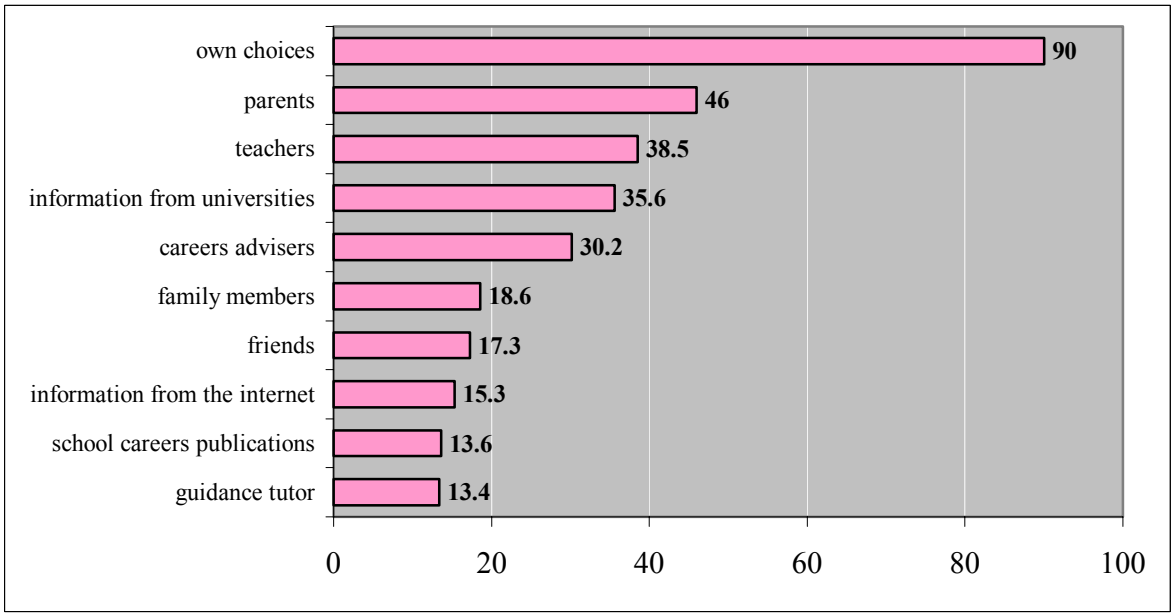

Chart 35c: Influences on choice of subject for university study

Teachers also appear to wield a considerable influence in all of these areas, and information from universities is also important in deciding whether to go to university at all, and in choosing a subject to study. However, it seems remarkable that only just over one-third of students state that information from universities has helped them to select a university course. This figure does not rise even among post-GCSE students, who might be expected to have given the subject more thought and to have examined university publications in more detail.

Careers advisers are consulted by around one third of students; in general, pre-GCSE students are more likely to name this source of information than post-GCSE students. The influence of friends and family members in decisions about whether to stay on at school and whether to go to university is remarkably strong, and these two also play a part in a reasonable number of decisions about subject of study. Information from the internet, school careers publications and guidance tutors (as opposed to subject teachers) are relatively minor influences.

A handful of gender differences emerged in the sources of information which were named has having been influential. At all stages, males were more likely to name guidance tutors as having been influential, and they were also more likely to name careers advisers as having been important in their decision about whether to go to university. When choosing their subject, they were significantly more likely than females to state that a school careers publication had been influential. It appears that male students are more likely than females to be influenced by advice offered on a local and/or 'personal' basis.

Female students, by contrast, were more likely than males to name information provided by universities as having been important in their decisions about whether to go to university and about what to study. They were also more likely than males to state that their parents had been influential at all stages.

There were also some differences between students according to the mixture of subjects which they were studying at AS/A-level. Students who were taking CS were more likely to state that they had been influenced in their decisions about post-GCSE study by careers advisers and information from universities, as well as information gleaned from the internet. This latter factor had also been significantly more important for this group than for others in their choice of subject for university study. At all stages of decision making, the influence of the student's friends had been more important for CS students than for other groups in guiding their choices, and this effect was strongly significant when their choice of subject for university study was in question. It appears that peer-group and social issues are particularly important for CS students, perhaps because of some of the social stigmatisation from which their subject suffers.

Students who were taking ICT were significantly more likely than other groups to state that information from universities and the influence of their parents had guided their decisions about post-GCSE study. However, the only factor which emerged as significantly different for this group at all three stages was the weight which they allocated to their 'own choices'. These were named by significantly *fewer* students taking AS/A-level ICT than by students who had not chosen this subject.

Students who were taking mathematics at AS/A-level were more likely to have been influenced by information from universities in their decision about whether to stay on at secondary school, but their choice of university subject was significantly more likely to have been guided by their teachers. Overall, students taking mathematics and physical sciences named a smaller range of influences other than their 'own choice' at all stages.

2:4.2 Orientation to Computing or IT in HE

2:4.2.1 Numbers of student considering Computing or IT in HE

All students in the study were asked to indicate, if they were definitely or possibly considering going to university, whether they would consider taking Computer Science/ICT in HE. The responses to this item are shown in Chart 35.

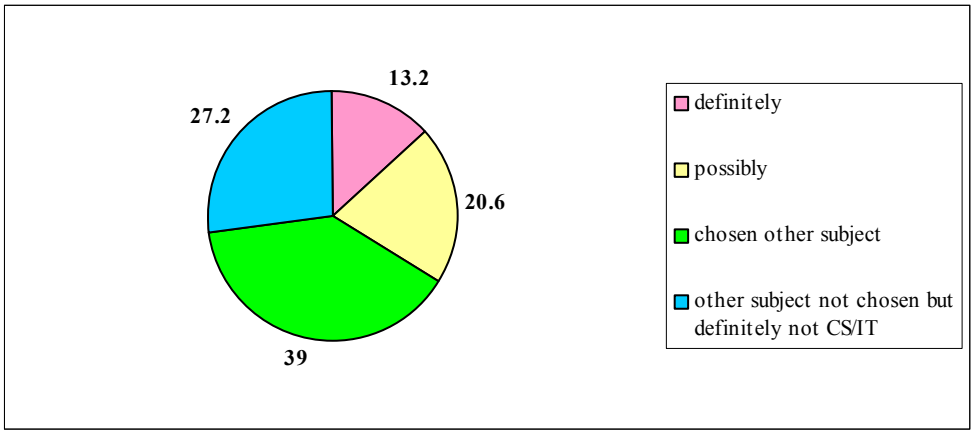

Chart 35: Orientation to Computing or IT in HE, all students

Even given that the students surveyed included a high number who had chosen to study CS or ICT at AS/A-level, the finding that around one-third feel that they at least *might* take one of these subjects as a university course indicates that there is a reasonably large pool of 'possible' students.

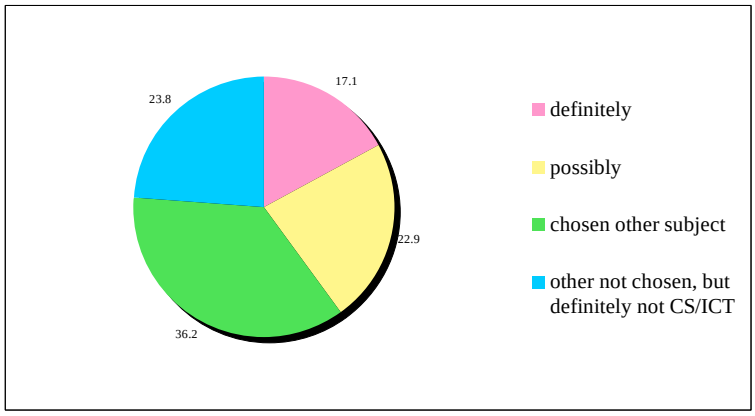

Chart 36a: Orientation to Computing or IT in HE, male students

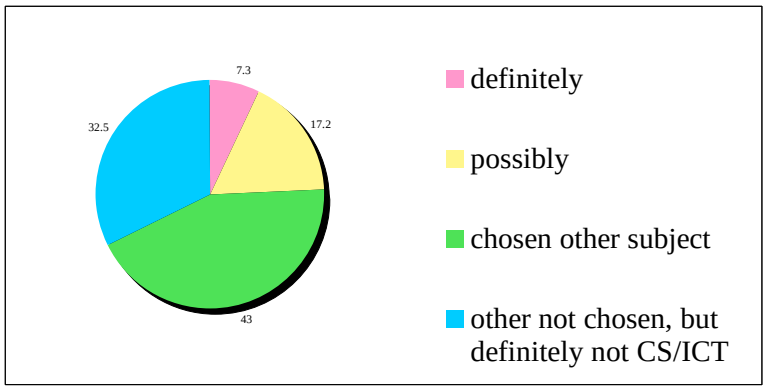

Chart 36b: Orientation to Computing or IT in HE, female students

As shown in Charts 36a and b, Computing or IT is substantially more popular among male than female students. Both the number of students who have already chosen other subjects and the number for whom these subjects are not even under consideration is greater than for male students. This confirms the gender trends noted in the first part of this report.

Charts 37a and 37b show the orientation of pre-GCSE students towards Computing or IT in HE, among male and female students. Before taking their GCSEs, ICT or CS is regarded as a possibility

by only *slightly* fewer female than male students, and almost identical proportions state that they have definitely decided to study one of these subjects at university. However, the proportion of female students who make a definite decision in favour of Computing or IT rises only slightly at post-GCSE stage, and the proportion for whom it is a possibility drops dramatically. By contrast, more than a quarter of male post-GCSE students state that they will *definitely* study one of these subjects, and the proportion who might still consider them remains slightly higher than it is among female students.

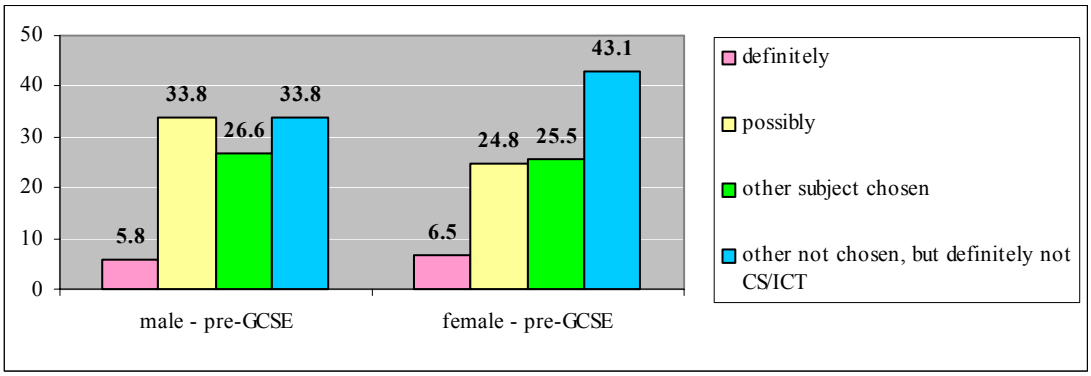

Chart 37a: Orientation to Computing or IT in HE, pre-GCSE students – by gender

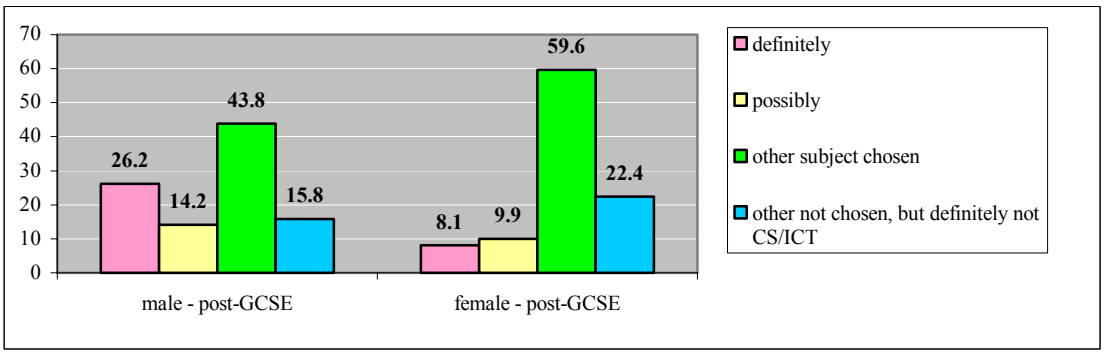

Chart 37b: Orientation to Computing or IT in HE, post-GCSE students – by gender

Chart 38a and 38b show the orientation of AS/A-level CS/ICT students towards studying a Computing/IT-related discipline at university. Once again, a gender split emerges, with just over a fifth of the female students who are studying these subjects after GCSE having made a firm decision to continue with them in HE, compared with more than two-fifths of the male students. Around one-fifth of students of each sex is still considering CS or ICT at university. These findings may reflect the tendency (noted above) for female students to consider Computing or IT as useful 'additional' subjects to support their other interests or enhance e their job prospects, rather than possible areas of primary study in which they have a strong personal interest.

Within the group of students who stated that they possibly or definitely intended to apply to university, the intentions with regard to Computing or IT of students taking AS/A-level CS were compared with those of students taking AS/A-level ICT. No significant differences emerged between these two groups.

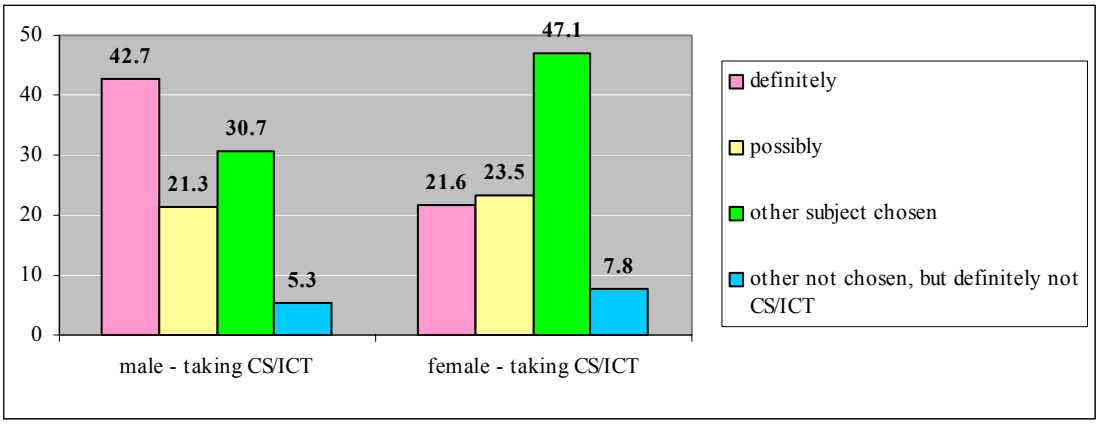

Chart 38a: Orientation to Computing or IT in HE: AS/A-level CS/ICT students, by gender

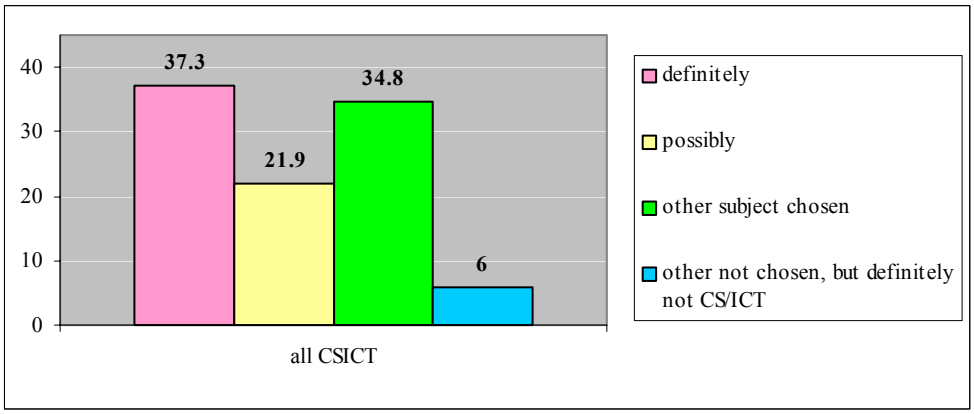

Chart 38b: Orientation to Computing or IT in HE: AS/A-level CS/ICT students

Chart 39 shows the disciplines named by students who stated that they had selected a subject other than Computing or IT for university study, along with the percentage of these students who named each discipline. The most popular area is the humanities, followed by the social sciences and psychology. Medicine was also a popular choice. Perhaps surprisingly, subjects such as media and forensic science (counted with biological sciences), were named by relatively few students despite their growing popularity.

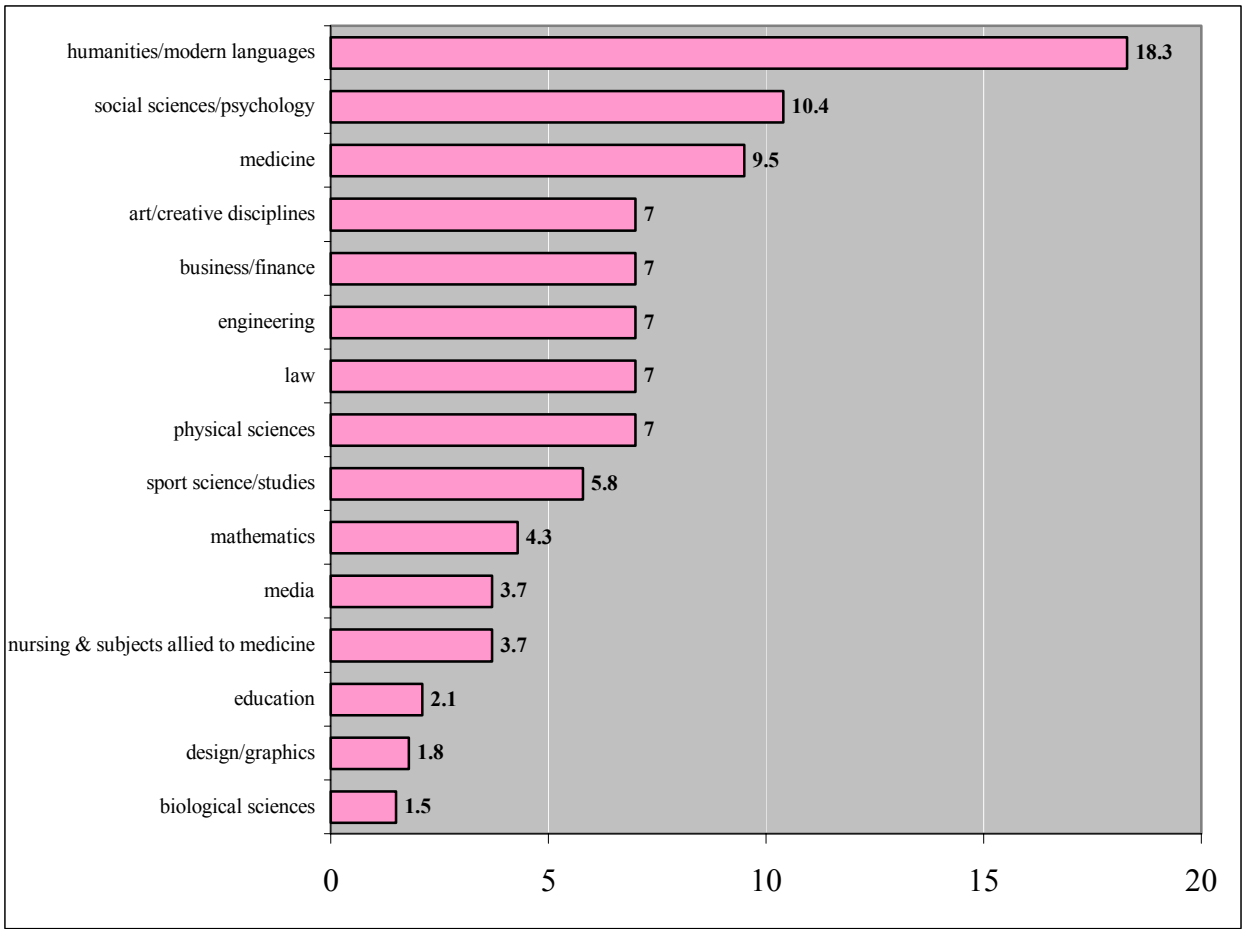

Chart 39: other subjects chosen for study in HE and percentage of all students naming each

2:4.2.2 Attitudes to Computing or IT in HE: all students

Students who had stated that they 'definitely' or 'probably' intended to study CS or ICT were asked to report their reasons for making this decision.

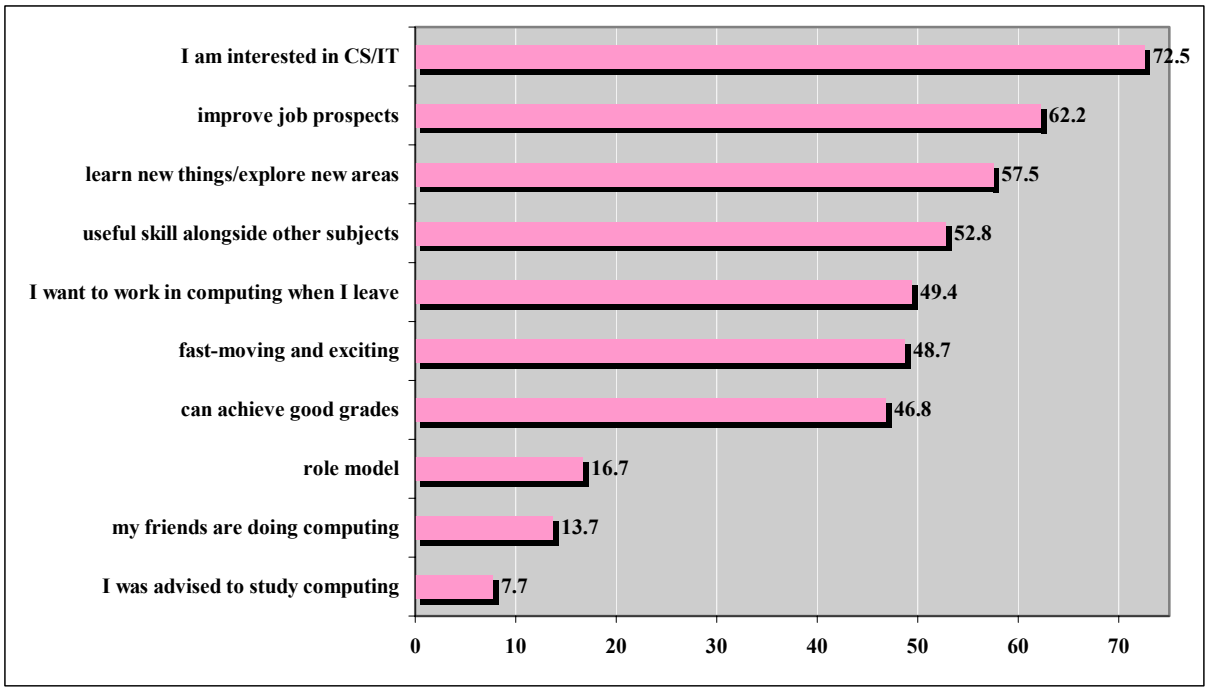

Chart 40: Reasons named by students intending to study CS/IT at university

The most frequently named reason is interest in the subject. This reflects the feeling in focus groups that choice of university course would be guided in most cases by subject interest. Students in these interviews tended to take a somewhat deterministic view of interest; when asked *what* might cause someone to be interested in a particular field or subject, the most common response was to say that one 'just is' or 'just isn't' interested in certain things. Some students even expressed a distrust of attempts to engage people with subjects which did not fall within their 'natural' range of interest. For many students, interest was tied to ability, and a 'natural aptitude' and a 'natural interest' were used almost interchangeably; the statement that 'of course you'll be more interested in things you're good at' was a typical comment.

Alongside this – and sometimes in contradiction to it – the idea that people would choose certain university courses because they would enhance job prospects was also strong, and this is clearly a motivator for many of the students who have chosen this field. Around 50% of those who intend to study CS at university also plan to work in this field on graduation. Students who stated that Computing was a useful skill to have alongside other subjects were significantly less likely to state that they wanted to work in Computing when they left university than students who did not name this reason for choosing an HE course in Computer Science/IT. It appears that a reasonable number of students elect to follow a *degree* programme in this area in order to support a different choice of career.

The 'thrill factor' appears to operate for around half of prospective CS/IT students, and this group are significantly more likely to state that they are interested in the subject. There is also a significant association between agreement with the 'thrill factor' items and the belief that studying Computing or IT will enhance job prospects; however, there is *no* association between the 'job prospects' item and an expressed interest in Computing. It is possible that this reflects the 'self-image' of students who have a strong vocational motivation in their choice of degree programme. They feel that they want to

be in a 'fast moving' or 'exciting' area, but do not see themselves as the potentially stigmatised 'computing people'.

For just under half of the students who have chosen this subject, the feeling that they can achieve good grades in Computing or IT is a factor. It is probable that the group for whom this is *actually* relevant is rather greater, but that only those who are to some extent nervous about their grades (possibly those whose overall achievement has been lower at school) feel that it is salient enough to mention. The importance of grades to students of this age emerged in several sections of the questionnaire; many students named the grades which they had received or would receive while at school as important in their choice of whether to proceed to HE and of their choice of HE subject. In the focus groups, students spoke frequently of grades as guiding their options, and also as indicators of ability. Once again attitudes were deterministic, with students feeling that 'intelligence' or 'capacity' were clearly shown by grades. Some students spoke disparagingly of others on the basis of their marks, and disclosure of one's marks to fellow pupils appeared to be the norm.

Rather less important reasons for choosing these subjects were the influence of role models, and of one's friends. The low number of students who named the former was surprising given the relatively frequent mention of role models as important in career and subject choices during the focus group interviews. This may indicate that role models are relevant to these decisions, but that pupils are not always conscious of this. Explicit advice was mentioned very rarely.

Chart 41 shows the reasons named by students who had decided *not* to study either Computing or IT at university, along with the percentage of students who named each of these.

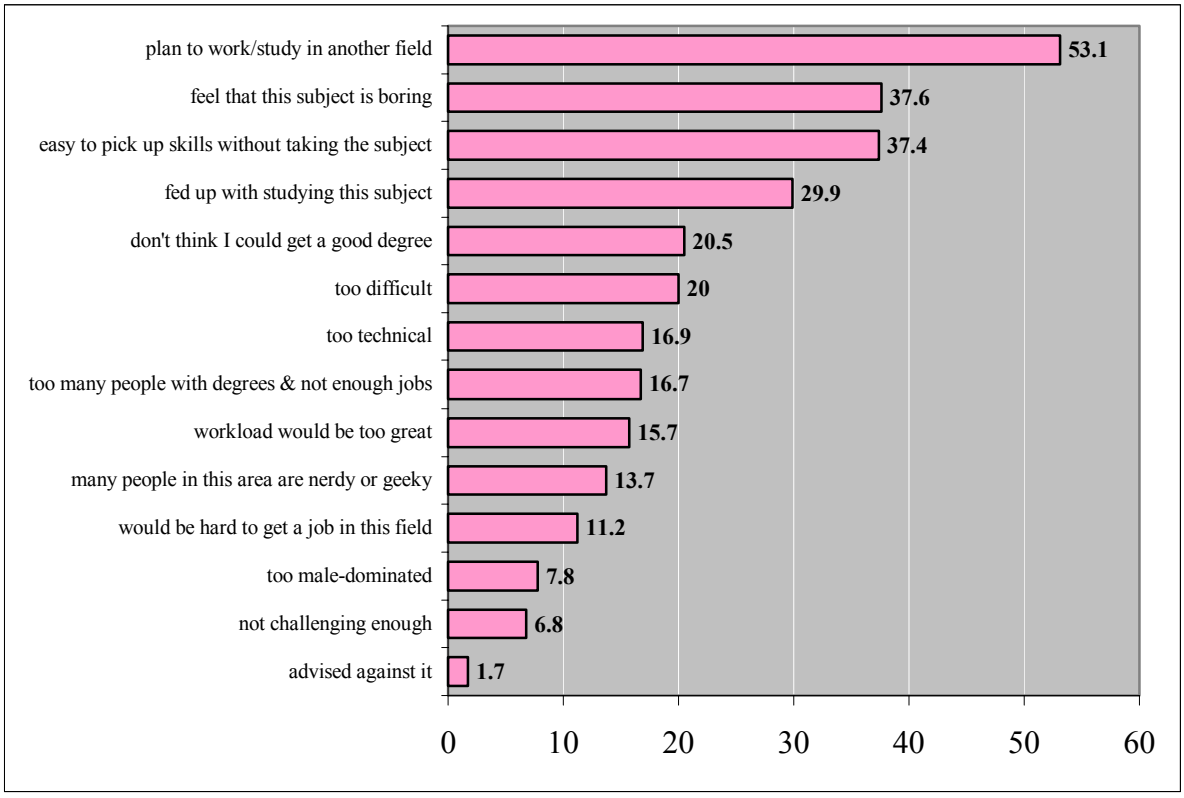

Chart 41: Reasons named by students <u>not</u> intending to take CS/IT at university

The most common reason named was an intention to work or study in a different area. Decisions about future educational careers and jobs appear to be made very early; one Year 12 student wrote on the questionnaire that 'This should have been given to year ten students. We have already made all our decisions'. A *relatively* small number of students named only this option, indicating that they

were willing to think briefly at least about their reasons for choosing another field over Computing or IT.

A simple lack of interest was expressed by 37.6% of students who had made other university choices, and 29.9% (all of whom were taking AS/A-level CS/ICT) stated that they were fed up with studying these subjects. Only one-third of those with plans to work or study in a different area felt that Computing or IT would be dull, but around two-thirds of those who were tired of their AS/A-level studies in this field stated that it was 'boring'.

37.4% feel that it is easy enough to pick up skills in Computing or IT without formal study; of these, just over 40% state that the subject is 'boring' in their opinion. This group are significantly more likely than others to feel that a Computing or IT degree would not be challenging enough for them.

Grades issues put off around one-fifth of students. The group who feel that they would not be able to get a good degree in Computing or IT are significantly more likely than others to feel that the subject would be too difficult and/or too technical. However, they are *also* significantly more likely than others to believe that it would be difficult to get a job in this area, and that the market is flooded with Computing graduates. In addition, they are significantly more likely to be put off because none of their friends are doing Computing or IT, and because of the 'geek' image. This suggests that the statement that one might not be 'good at' a particular subject actually operates as a proxy for a wider range of issues.

This may relate to the rather unanalysed views among students about what one is or is not 'good at'. Encouraging students to look more closely at their views about their natural inclinations and abilities, and to learn more about subjects which they have not previously investigated, may be an important part of increasing the number of potential students.

Worries about image, job prospects, and the nature of Computing or IT courses operate for just under a fifth of students. Despite the generally favourable view of the employment market in Computing or IT, a reasonably large minority are sceptical. In the focus group interviews, this view was voiced by a small but vocal number of students. Several of them were aware of the outsourcing issue, with comments such as 'all the jobs are going to India' being made. It should be noted that the students who made this point were contradicted by their peers, who countered by stating that it would only be 'low grade' work that was outsourced and that computers would become so ubiquitous that there would be plenty of work in all countries. Other students stated that they were sceptical about job prospects because they knew someone who had lost a job in Computing or IT, or who had been unable to obtain work after a period of unemployment, often because their skills required upgrading. Some students were also aware that large numbers of people graduate with Computing or IT degrees, and deduced from this that it *must* be hard to get a job, therefore.

2:4.2.3 Attitudes to Computing or IT in HE: by subject group

Among students who are taking AS/A-level CS and who also planned to study Computing or IT at university, subject interest was higher than for other students intending to do so, and students in this group were significantly more likely to state that they planned to work in Computing or IT after graduation. They were also significantly more likely to state that they had chosen this subject because they wanted to learn new things and explore new areas.

By contrast, subject interest was significantly *less* important for AS/A-level ICT students who planned to go on to study Computing or IT in HE. This group were significantly more likely to name an enhancement of job prospects as having been important to them. 'External' factors, such as the influence of friends who had made similar subject choices, advice, and 'role models', had also been significantly more important for ICT students who intended to undertake further study in Computing or IT.

AS/A-level CS and ICT students who had decided *against* further study in this area were significantly less likely than other groups to state that they had made this decision because they felt that the subjects were boring. AS/A-level ICT students were also significantly less likely to state that they felt it would be possible to pick up 'enough' skills without formal study. However, no other reasons emerged as especially important or unimportant for those who had studied ICT after GCSE.

AS/A-level CS students who had decided not to take Computing or IT in HE were significantly more likely than others to state that they felt that the subject would be too difficult and would involve too high a workload. They were also significantly more likely to state that they were concerned that they might not be able to obtain a 'good degree' in this field. However, they were significantly less likely than other groups to feel that the subject might not be sufficiently challenging, or that it would be too technical. This may reflect an accurate awareness on the part of these students of the nature of study in CS; those who are prepared to put in the work are presumably among the ones who have decided to study it at university. AS/A-level CS students were also significantly more likely to state that they would avoid this subject in HE because they believed it was too male-dominated, with female CS students being especially likely to name this item.

Chart 42 shows the other subjects chosen by AS/A-level CS/ICT students who have made a reasonably firm decision to study in an area other than Computing or IT.

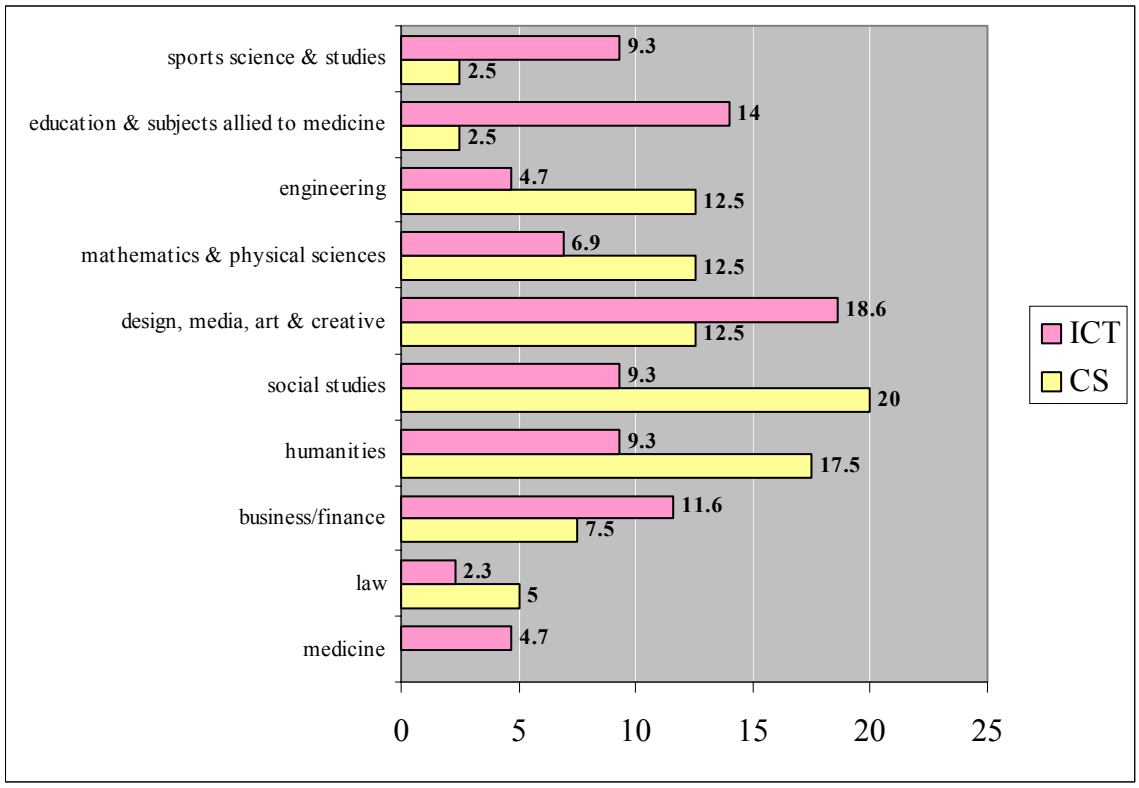

Chart 42: Other subjects chosen for university study by AS/A-level CS/ICT students

This chart illustrates, once again, the very different 'constituency' of students reached by each of these school subjects. Students taking ICT at AS/A-level are more likely to choose vocational or creative disciplines, veering towards what might be called 'new' university courses. CS students, on the other hand, are more likely to consider 'traditional' subjects in the Humanities and Social Sciences, or in the physical sciences, Mathematics and Engineering. It is possible that options for combining elements of CS/ICT with these might attract a higher number of students to continue with Computing or IT in HE. However, it might be difficult to identify courses which would attract high numbers of students from both A-level CS and A-level ICT.

Students who were taking AS/A-level Mathematics and/or Physical Sciences, who intended to study Computing or IT in HE, were significantly more likely to name subject interest, the desire to learn 'new things', an intention to work in the field and a belief that they could gain good grades in these subjects as reasons for their choice. They were also significantly more likely to state that they believed that Computing or IT would provide them with 'useful skills alongside other subjects', suggesting that at least some of these students see Computing or IT as a preparation for a scientific career *of some sort.*

Students with a Mathematics/Physical Science background who had decided *against* Computing or IT were also likely to name their career plans as a reason for this. In other words, this group of students are very likely to have a reasonably clear idea about the kind of work they would like to do *before* they have left school. Mathematics/Physical Science students who did not intend to study Computing or IT at university were also slightly more likely to state that they felt the subject was 'boring' and that they believed they could pick up enough skills without studying the subject. They were significantly less likely than other groups to state that they felt it would be too 'technical', or that they felt that the workload would be too high.

This group were less likely than others to state that they believed it would be hard to get a job. However, students who planned to study Medicine, Mathematics or Physical Science at university were significantly more likely than other groups to state that they believed that there are 'too many [CS] graduates and not enough jobs'. Students who had chosen one of these subjects, or who were taking only science subjects at AS/A-level were significantly *less* likely than others to state that they felt Computing or IT at university would be 'too difficult' or that they believed they would not be able to gain good grades in this area. They were significantly *more* likely than other groups to state that hey felt it would not be challenging enough. This suggests that CS is to some extent stigmatised among some students who feel that they are 'proper scientists', an issue discussed at greater length below.

Students who were studying at least one Business or Finance subject at AS/A-level, and who planned to take Computing or IT in HE, were slightly less likely than other students to state that this decision had been prompted by subject interest or by plans to work in this field after graduation. However, they were more likely to state that enhanced job prospects had attracted them to this subject, and that they felt that Computing or IT would offer them a useful skill alongside other subjects. They were significantly more likely to state that the subject choices made by their friends had influenced their decisions.

AS/A-level Business/Finance students who had decided against Computing or IT in HE were also *less* likely to state that they had done so because they had definite plans to work in another area. This suggests that, just as students with a strong science bias in their AS/A-level subject mixture may be quite clear about their employment plans during their last two years of secondary education, those taking Business and Finance subjects may have rather less firm plans than other groups. Despite some of the comments on school ICT, those taking it at AS/A-level are significantly less likely than other groups to state that they have decided against studying it at university because they feel that it is boring. They are also less likely to state that they have made this decision because they feel it would be easy to 'pick up' the skills, or because they feel that people who work in Computing or IT are 'geeky'.

Just as job prospects are an important factor for AS/A-level ICT students who decide to take Computing or IT in HE, they are also important to those who have decide against doing so. Students studying AS/A-level ICT who have made other HE choices are more likely than other groups to state that they believe it would be hard to get a job in this area, and/or that they believe that there are too many Computing or IT graduates and not enough jobs. The issue remains the same in each case, but it appears that different students have received different specific information about the employment market.

2:4.2.4 Attitudes to Computing or IT in HE: gender differences

Male and female students who plan to take Computing or IT in HE are equally likely to state that they want to 'learn new things and explore new areas', and that they are attracted by the good job prospects offered by this subject. They are also equally likely to state that a role model has played an important part in their choice. Among those taking Computer Science/ICT at AS/A-level, however, female students are slightly *more* likely than males to state that job prospects were important in their decision to continue with one of these subjects at university.

However, male students are slightly *more* likely to state that they believe Computing or IT is a 'useful general skill' to have. They are also more likely to state that they believe they can achieve good grades in this subject, and also that the choices of their friends were important in their decision about which subject to study at university. While females and males showed similar responses to the item relating to learning *new* things, males were notably more likely to state that they had chosen Computing or IT because it was a 'fast moving area and studying it will be exciting'.

Similarly, subject interest was named by significantly more male (76.5%) than female (59.3%) students. This may relate once again to whether a student sees him or herself as a 'computing person'. Male students are also significantly more likely to name an interest in working in Computing or IT on graduation; 57% of males planning to study these subjects in HE name this item, compared with just 27.9% of potential female Computing or IT undergraduates. Males are also significantly more likely than females to have been advised in favour of studying Computing or IT at university. It is possible that this reflects some lingering gender stereotyping in careers advising.

Male students were more likely than female students to have been discouraged from taking Computing or IT in HE because of a worry that the subject would involve a workload at university which was 'too high'. They were also more likely to have decided against Computing or IT because their friends were not doing this subject and because of the 'geek' image. Males were significantly more likely than females to worry that there would be 'too many graduates and not enough jobs' in Computing or IT.

Female students, by contrast, were more likely to feel that Computing or IT would not be sufficiently challenging as a university subject. Alongside this, females were significantly more likely to feel that it would be 'too technical'. The focus group discussions shed some light on this potentially contradictory finding. The students (mostly, it must be said, female) who stated that the 'technical' aspects of Computing or IT had put them off did not equate a 'technical' subject with one which was mathematical or abstract. Instead, they used this term to indicate the performance of repetitive and 'fiddly' tasks, of the sort which many disliked in GCSE ICT. The danger of a lack of challenge seemed to be regarded as resulting from the lack of a problem-solving and/or 'human interest' aspect of the subject. Thus it is possible that female students are put off, *not* by the idea of a highly 'scientific' discipline, but by one which does not involve enough analytical activity or applications.

Although 5.7% of male students who had chosen not to take Computing or IT in HE stated that this was because it would offer an atmosphere which was too male-dominated, 10.1% of women named this item. Gender issues will be discussed at greater length below.

2:5 Beliefs about Computing or IT at university

2:5.1 What would be taught on a university computing course?

Students were asked to indicate which subjects they would expect to encounter on a Computing or IT course at university. Chart 43 shows the percentage of students who named each of the elements listed. The list is derived from Alison Mitchell's work with secondary school students in Scotland, and reflects the free text responses of her subjects when asked to list the topics which they thought would feature on a course of this type.

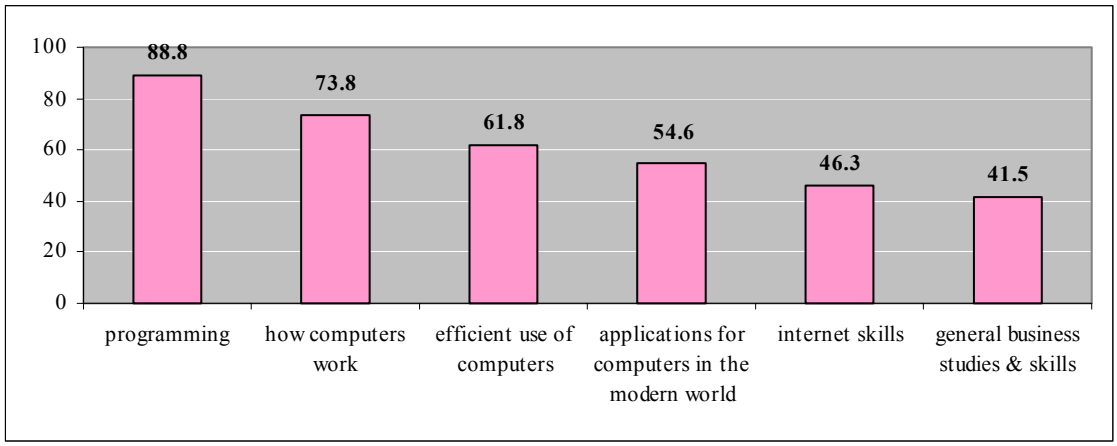

Chart 43: Percentage of students who believed that each of these elements would feature on a university Computing or IT course

Not surprisingly, the vast majority of students believe that programming would be part of a university course in Computing or IT. 'How computers work', when explored further in the focus group interviews, appeared to relate to computer hardware for a high number of students. A surprising feature of the focus group discussions was the extent to which students felt that computer hardware was a very interesting subject. They believed that it was interesting to know what actually happens in a computer 'behind the screen', and also thought that they and other people would be interested to learn more about miniaturisation and pervasive computing (of which the majority of interviewees had only the scantiest knowledge). Several 'hobby computer scientists' stated that they had first become interested in the subject as a result of 'taking computers to bits', or because they had helped an adult to build a computer themselves.

The 'efficient use' of computers was also named by just under two-thirds of the students in the sample. This reflects a widespread belief that software packages and their use would be important on Computing or IT courses. By contrast, the application of computers was named by just over half of the students. It is likely that the Computing/ICT confusion discussed above is again at work here. It is possible that students were unsure of what was meant by 'internet skills' (i.e. user or 'builder' skills), and that this accounts for the low number who named this item.

41.5% of students felt that 'general business studies and skills' would feature on a Computing or IT course. Once again, some students may have named this item because they are aware of courses in which the scientific/technical aspects of the subject are combined with modules on information systems or business practice. Those who disagreed may have aligned Computing or IT more strongly with science disciplines where such combinations are rarely found. Another possibility is that some students feel that Computing or – more likely – IT is actually a 'sub-discipline of business studies, and that elements of this latter area would therefore be found on a Computing or IT course.
Responses to this item from different groups of students revealed a split between those who aligned Computing or IT at university with ICT and Business Studies, and those who assumed that these courses would have more in common with Mathematics.

Students whose responses indicate an equation of Computing or IT with ICT were similarly or only *slightly* less likely to state that programming would feature on an HE course in Computing or IT, but they were significantly more likely to believe that ICT skills, Internet skills, the efficient use of computers, and general Business Studies and skills would be taught. They were significantly less likely to believe that such courses would include modules on 'how computers work' or on the applications of computers.

Students who align Computing or IT with Mathematics tended to be *slightly* more likely to state that Programming would be taught, and also significantly more likely to believe that courses would feature the study of applications and of 'how computers work' (possibly meaning computer hardware). They were significantly less likely to believe that ICT, Internet and general business skills would be taught, and also less likely to expect that the use of computers would be encountered.

Male and female students showed similar responses when naming the items which would indicate that Computing or IT would be like Mathematics. However, female students were significantly more likely to name ICT, internet and Business studies and skills, suggesting that females are more likely to believe that Computing or IT is like ICT.

Pre-GCSE students were also significantly more likely to align university Computing or IT with ICT rather than Mathematics. This may reflect the high proportion of AS/A-level CS/ICT students in the study, whose knowledge of the subject is better than that of pre-GCSE students in general. Post-GCSE students were significantly more likely to state that they believed that programming and applications would be taught, and less likely to name the efficient use of computers, ICT, internet and business skills.

Students who were taking AS/A-level CS, not surprisingly, fell strongly into the 'Computing or IT is like mathematics' camp. They were significantly more likely to state that they believed Programming would be taught, along with 'how computers work' and applications. They were significantly less likely to name ICT, internet and business studies skills. Their responses on 'the efficient use of computers' were less clear-cut, possibly indicating that they have interpreted this item rather differently from other students. For example, they may have read it as a variation on the notion of applications rather than a suggestion that software packages are involved.

AS/A-level ICT students, however, show responses which are only slightly different from those of students not taking AS/A-level CS/ICT. They are equally likely to state that Programming would feature on a university course, and their response relating to the use of computers, Business Studies and Skills, and applications are also very similar. Unlike students *not* taking ICT, who are likely to equate university Computing or IT with this subject, they are significantly *less* likely to state that ICT and Internet skills would be taught on an HE course, although they are also significantly less likely to believe that 'how computers work' would be taught. This suggests that AS/A-level ICT students are generally quite unclear about the content of HE courses, a factor which may be related to their relatively low level of firm decisions about further study and/or work.

Business Studies students are also slightly less likely to name Programming and Applications, but overall their pattern of response indicates a fairly average level of knowledge about university Computing or IT courses.

Students taking neither CS nor ICT at AS/A-level, however, align university Computing or IT firmly with ICT. They are slightly less likely than students taking one or both of CS/ICT to believe programming would be taught, and significantly less likely to believe that a course would include the study of applications and 'how computers work'. However, they are significantly more likely to name ICT, Internet and Business Studies and skills.

An interesting variation emerges among students who are taking Mathematics and Physical Science subjects. This group align Computing or IT firmly with Mathematics. They are significantly more likely to name Programming and 'how computers work' as elements of the courses, and significantly less likely to name ICT, Internet and Business Studies skills. Once again, 'efficient use' does not show any significant pattern of naming for these students, possibly because of the differences in interpretation mentioned above.

Students who plan on taking Computing or IT in HE in generally show a pattern of responses which is closer to that of the 'Computing or IT is like mathematics' group, although there are some differences. Prospective HE students in Computing or IT are slightly *less* likely to name Programming (86.7% compared to 90.6%), and also slightly less likely to name ICT skills (55.3% compared to 64.8%) and Business Studies and skills (37.1% compared to more than 50%). This suggests that these students are aware that Computing or IT at university be a rather different subject from what they have encountered thus far. These students show similar patterns to the whole sample when naming the efficient use of computers, internet skills and how computers work, but they are slightly less likely (48.1% compared to 59.8%) to name applications.

It is possible that this group of students have a higher awareness of the actual content of HE Computing or IT courses because they have undertaken some research to support their decisions. This would mean that they are aware of the full range of Computing or IT courses which are available, and also that different students may have chosen very different courses for themselves. The spread of responses would therefore be explained by the variety of courses which students can study in HE; all of the items named, of course, really *do* feature on some Computing or IT courses in the UK university system.

2:5.2 Similarity to secondary education subjects

Charts 44 and 45 show responses to two further questions about the relationship between university Computing or IT and AS/A-level subjects. Students were asked to name the 'school' subject which they believed Computing or IT in HE was most similar, and also to state whether particular AS/A-level subjects would be 'useful' to students planning on studying Computing or IT at university.

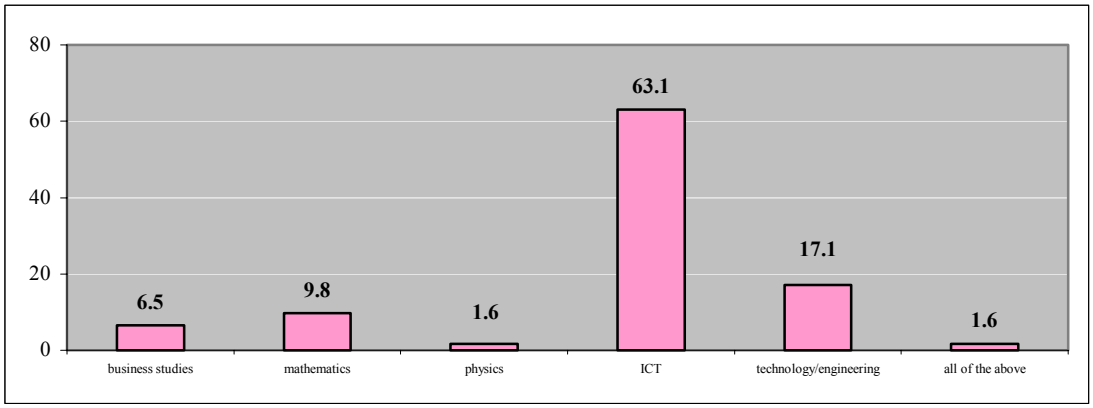

Chart 44: Which school subject do you think is most like Computing or IT at university?

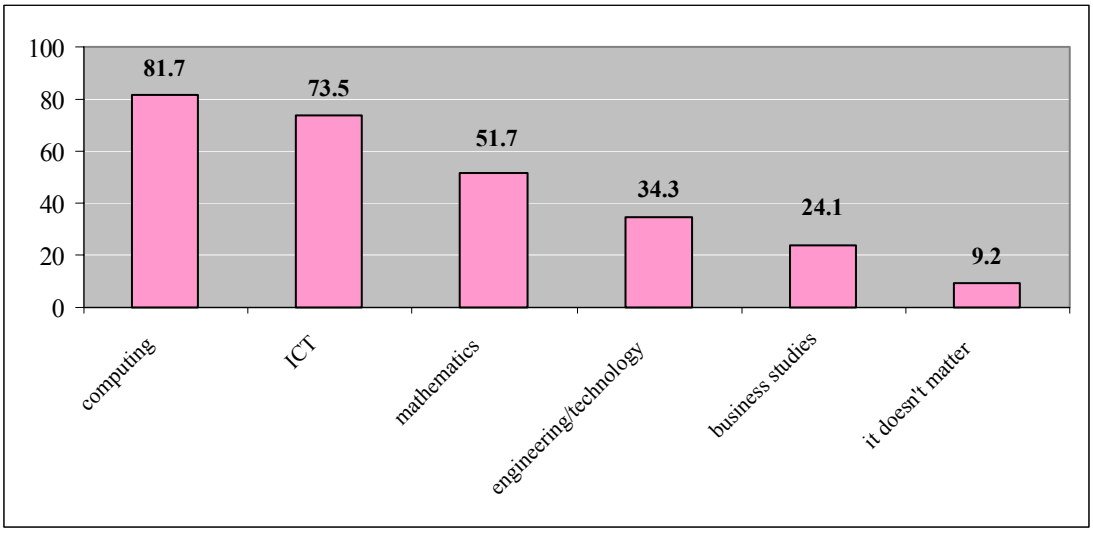

Chart 45: Do you think that this AS/A-level subject would be useful to people planning to study Computing or IT at university?

The majority of students believe that ICT is the 'closest' subject to Computing or IT in HE, with a smaller number equating it with Technology/Engineering, and a handful naming each of the other subjects. Not surprisingly, students name CS and ICT as the most 'useful' subjects for those planning to go on to further study in Computing or IT. The focus group interviews revealed a very strong feeling that it was essential to study a subject at school if one planned to go on to a course in the same area in higher education; there was some general nervousness about subjects in which this was not possible[8].

Only half of the students surveyed named mathematics, and around one third named engineering and technology, suggesting that many students do not make the connection between Computing or IT and these disciplines. Just a quarter named Business Studies, and very few students felt that it would be possible to do well in a Computing or IT course no matter what had been studied at AS/A-level.

The responses to these questions revealed a similar 'split' between groups of students according to where they 'placed' university Computing or IT. Male students were significantly more likely than female students to state that it would be 'like' mathematics', and that mathematics would be useful. Female students were significantly more likely to state that it would be 'like' technology or engineering. However, they were *not* more likely to state that these subjects would be useful to prospective Computing or IT students. Instead, they were significantly more likely to name ICT and Business Studies.

Pre-GCSE students were more likely to equate university Computing or IT with either Business Studies or ICT, and to state that these, as well as Computing, would be useful as prior studies. Post-GCSE students, however, were more likely to equate university Computing or IT with Mathematics and to name Mathematics and Engineering or Technology as the most useful A-levels.

Students who were actually taking AS/A-level CS were significantly more likely to state that Computing or IT in HE would be like either Mathematics (36% named this subject, compared to 8.8% of other students) or Engineering/Technology (28.8% named this, compared to 16.4%). They were

[8] Of course, two of the most popular and respected subjects for HE study are *not* generally available in the secondary school curriculum; A-level Law is a very new innovation, and health-related A-levels are not generally taken by prospective medical students. However, the routes into Medicine and Law are so well-established that these subjects were not even considered during the relevant discussion. Similarly the fashionable forensic science was omitted. Subjects such as physiotherapy, linguistics and artificial intelligence were all mentioned.

significantly less likely to state that it would be like ICT (25.2% named ICT, compared to 66.6% of other students). They were also more likely to state that CS would be a useful A-level for prospective Computing or IT students, and significantly *less* likely to name either ICT or Business Studies as useful precursors.

Those taking ICT, however, did not generally equate their own subject with HE Computing or IT. Only 42.9% stated that it would be the most similar, compared with 59.7% of students who were not taking ICT at AS/A-level, a significant difference. They were also significantly less likely to equate university Computing or IT with Mathematics. Instead, they tended to believe that Engineering or Technology would be the closest match, with 30.6% naming this subject (compared with 16.4% of other students). AS/A-level ICT students were, however, significantly more likely than others to believe that their subject would be useful to those taking Computing or IT in HE. They were also significantly more likely to name Engineering and Technology and Business Studies, and significantly less likely to name Mathematics. Their naming of CS was similar to that of other students.

Students taking Business Studies at A-level were very slightly less likely to state that Computing or IT in HE would be like mathematics or ICT than were other groups. They were slightly more likely to name ICT and Business Studies as useful A-level subjects for those planning to take Computing or IT in HE, and less likely to name Mathematics.

Students who were taking neither CS nor ICT were generally non-committal in their responses to these questions. Several wrote comments indicating that they felt it was unfair to require them to answer, because they had 'no knowledge' of the subjects concerned. They were significantly more likely than other groups to name CS and ICT as being the most like HE Computing or IT, and as being the most useful A-levels to support further study in this area. They were also slightly more likely to state that it did not matter what one studied at school in preparation for an HE Computing or IT course.

Among students taking AS/A-level Mathematics and/or Physical Science subjects were significantly more likely to name Mathematics as the most similar subject to Computing or IT in HE. They were *slightly* less likely to name either ICT or Engineering/Technology, but this effect was nowhere near as marked as it was for AS/A-level CS students. They were more likely to state that A-level mathematics would be useful, and less likely to state that ICT, Engineering and Technology, or Business Studies would.

Students who planned to take Computing or IT in HE were significantly more likely than those who did not to state that it would be like Mathematics, and significantly less likely to state that it would be like ICT. The appeal of university Computing or IT courses appears to rest, for the students in this survey at least, to its similarity to Mathematics and *not* to ICT. These students are, however, *less* likely than those not planning on further study in Computing or IT to state that A-level CS would be useful to them in this plan. They were significantly more likely to state that the would be sensible to take AS/A-level Mathematics.

These findings once again underline the 'two views' of Computing or IT which can be held, and the gap between groups of students who hold these.

2:6 Attitudes to Computing or IT courses and careers

2:6.1 Introduction

Students were asked to respond to a list of statements about Computing/IT in HE, and about Computing/IT jobs and professionals. Because the pattern of response to these items was similar, they will be considered together in the analysis which follows. These items were presented in a list where the various themes identified below appeared in a random order.

One caveat to the discussion which follows relates to the use by a high number of students of the 'not sure' category. Overall, responses in this category to all items were relatively high. Some students added notes to the effect that it was unreasonable to ask them to answer questions about university courses which they had not followed or jobs of which they had no experience. These notes were interesting because of their tone; they not only indicated that students had found it *hard* to respond to these items, but that they felt that they had been unfairly treated. This was despite the fact that all of the questionnaires were anonymous, and the teachers who administered them had been asked to stress that students would not be assessed on the basis of their answers.

The tendency for current students to assume that they are always being 'tested', even when they have been assured that they are not, has been noted by several writers working with this age group, as has the attractiveness of 'non-committal' responses. Some of the problems with the discussion of statements which appear to express an opinion are noted below. Overall, however, it appears that many students feel that their knowledge of university Computing/IT courses and of careers in Computing/IT is poor. This may relate to a lack of up-to-date careers information and also to the lack of representation for Computing/IT in the general media.

2:6.2 The 'thrill factor'

Two sets of questionnaire items related to the 'thrill factor', the first addressing the issue of challenge and the second the nature of jobs. Charts 46 and 47 show the pattern of response to these items.

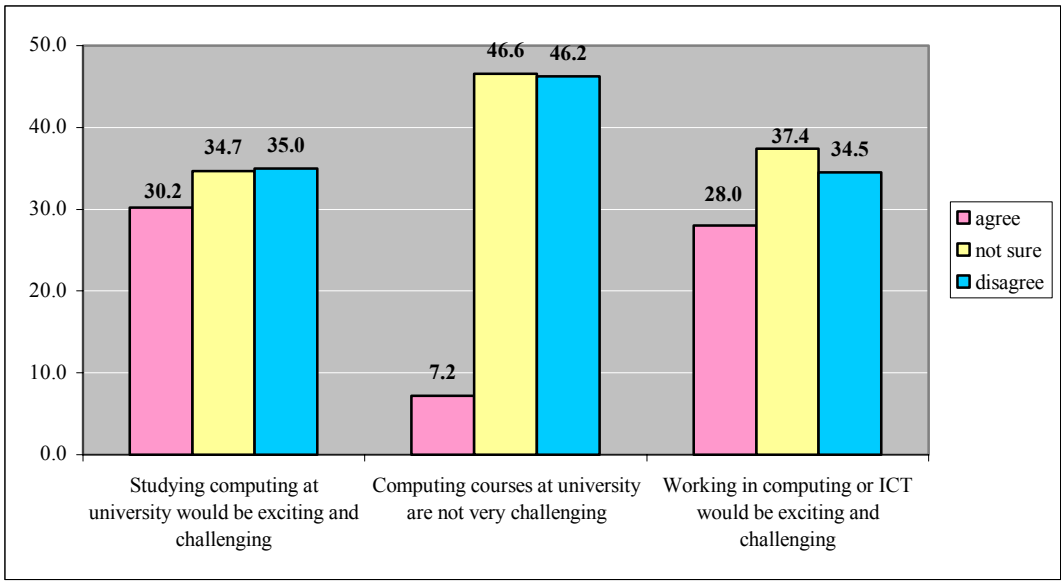

Chart 46: Responses to the 'thrill factor – challenge' questionnaire items

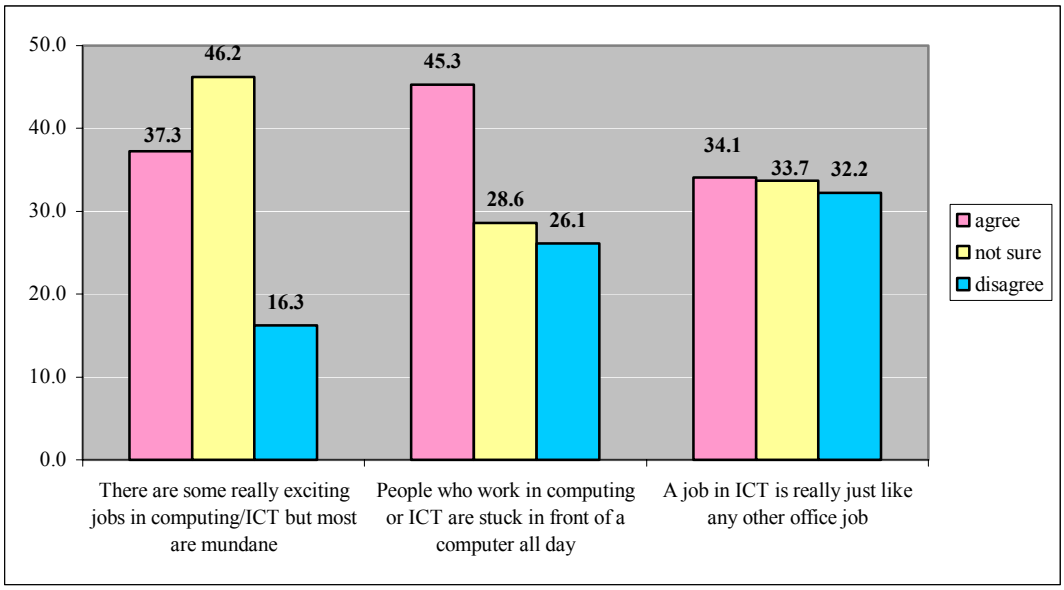

Chart 47: Responses to the 'thrill factor – jobs' questionnaire items

The first of these contains an apparent contradiction. Very similar numbers of students agree, appear non-committal, and disagree with the statement 'studying computing at university would be exciting and challenging'. However, when asked to evaluate *university courses* in Computing/IT, the non-committal group is considerably larger and so is the group who, presumably, feel that these courses *would* be 'exciting and challenging'. A very small minority is prepared to commit to the statement that these courses would *not* be challenging.

This contrast may arise because of the wording of the questionnaire item. Students may contrast the idea of 'a university course' in the abstract – which presumably involves a high level of difficulty and assessment, commensurate with the achievement of a degree – with the idea of an actual student, possibly themselves, studying this course. It is possible that students have read the first of these items as '[I would find] studying computing at university exciting and challenging', and responded according to their personal choices and preferences.

The fact that nearly half of the student surveyed believe that Computing/IT courses *themselves* are 'exciting and challenging' is encouraging. However, a disparity emerges between students' views of courses and careers in Computing/IT. Just over a quarter feel that working in Computing/IT would be 'exciting and challenging', and while the group who are not sure is still the largest, almost one-third of students disagree with this statement. This may relate to the stereotype of a Computing/IT job as anti-social, repetitive and desk-bound, reflecting a lack of accurate information not only among those students who state that they are unsure about what is involved, but also among those who have committed themselves to a particular view.

Both the lack of information and the disenchantment with the stereotype of Computing/IT jobs are further illustrated by the responses to the items reported in Chart 47. The most popular response in the first case is 'not sure', indicating once again that students have little information about Computing/IT jobs on which to base an opinion. However, just over a third appear to agree with a statement implying that 'most' Computing/IT jobs are 'mundane'[9], while fewer than one-fifth disagree.

The responses discussed in 6:3, however, suggest that the 'just programming' stereotype is *not* to blame here. It appears instead that the idea of repetitive and/or anti-social jobs is rmoe likely to lie at

[9] The wording of this item was poor, making it difficult to evaluate responses. The term 'mundane' was taken from a student comment on ICT, and it appeared to be a 'buzz word' for a number of students both in the questionnaire responses and the focus group interviews.

the root of these attitudes. The idea that one is doing something 'dull and repetitive' or 'just like any other office job' appears to be widespread. Students do not seem to think in terms of innovation, problem-solving or applications, but may instead assume that an IT professional does similar work to administrative or clerical staff. This may reflect the equation made by many students between Computing and the use of software packages, and/or the school subject of ICT rather than more science-based disciplines.

Similarly the anti-social aspect of Computing/IT work may make it unpopular with many students. The highest level of commitment is found in responses agreeing to the item suggesting that Computing/IT professionals find themselves 'stuck in front of a computer all day'. This phrase was used by several students in different focus groups to contrast an essentially 'anti-social' job with more interesting options.

Some differences between groups of students emerge in the responses to the 'thrill factor' items. Male students are more likely than women to give answers indicating that they believe that working or studying in CS/IT will be exciting and challenging, although women are more positive about the *jobs* which are available than they are about the courses. However, men are more likely than women to indicate that they believe that a job in Computing/IT will be 'just like any other office job', and *less* likely than women to disagree with this item. It is possible that different groups of male students are providing the 'pro-Computing/IT' items in each case. More male than female students strongly agree that people who work in Computing/IT are 'stuck in front of a computer all day', but overall women are more likely to agree with this item than to disagree, while men are more likely to disagree. All of the correlations with gender described here are statistically significant.

Pre- and post-GCSE students give very similar responses, although post-GCSE students are more likely to agree that there while some jobs in Computing/IT are exciting, most are mundane. They are also significantly less likely to state that they are 'not sure' about the answers to this item. However, it is probably that this relates to a difference in the extent to which post-GCSE students possess information about jobs and careers, rather than to an actual difference in attitudes between the two groups.

The subjects which a student is taking at AS/A-level correlate strongly with different attitudes. Those who are taking CS are significantly more likely to agree and less likely to disagree with items implying that they believe that studying or working in Computing/IT will be exciting and challenging. However, even among these students a high proportion select the 'not sure' item, indicating that even those who have elected to take CS beyond GCSE know relatively little about courses and careers in this area, or do not trust the information which they have. Overall, these students are more positive about the excitement and challenge of *courses* than of *careers*, indicating that while the image of Computing/IT at university may be fairly healthy among those studying a related subject in secondary education, the image of jobs in the field is poor.

More than 50% of CS students agree with the statement that 'there are some exciting jobs in Computing/IT but most are mundane', compared with 37.9% of students not taking this subject. CS students are significantly less likely to state that they are not sure about this item (25.3% select this option, compared with 46.9%), but only 20.7% disagree. 44.1% of CS students agree with the item 'people who work in Computing/IT are stuck in front of a computer all day', compared to 48.4% of other students; 36% disagree, compared to 23.1% of other students. CS students give very similar answers to the sample as a whole to the item 'a job in Computing/IT is really just like any other office job'. These students do not appear to have a good understanding of Computing/IT professions.

AS/A-level ICT students provide answers which indicate that they are more likely than other students to agree that working or studying in Computing/IT will be exciting and challenging. However, they are also significantly more likely to indicate that they are 'not sure' about this issue. Their responses on the items relating to the nature of Computing/IT jobs ('stuck in front of a computer'/'just like any

other office job') indicate a slightly more positive view than students who are not taking ICT, but the differences are small and not statistically significant.

Students who are taking neither CS nor ICT either indicate that they know very little about jobs in these areas, or that they view them as unchallenging, mundane, or 'just like any other office job'. It appears that students who have elected to study neither CS nor ICT at AS/A-level have a negative image of both courses and careers in these areas.

Among students taking Mathematics, students are generally less likely to indicate that they are uncertain about the 'thrill factor' of Computing/IT degrees and jobs. Students taking Mathematics and/or Physical Science subjects, and those taking *only* science subjects at AS/A-level, are slightly more likely than others to agree with items indicating that university courses in Computing/IT will be exciting and challenging. However, this effect is substantially less pronounced in relation to *jobs* in Computing/IT.

These students are slightly more likely to agree that 'there are some exciting jobs in Computing/IT' but most are mundane, and also that 'people who work in Computing/IT are stuck in front of a computer all day'. They appear to have a positive view of courses but a negative view of work. However, their responses to the item 'a job in Computing/IT is really just like any other office job' are similar to those for the whole sample.

Humanities students, in general, provide responses which indicate a belief that both courses and careers in Computing/IT would lack excitement and challenge. However, their responses to the items relating to Computing/IT careers are similar to those for the whole sample, perhaps reflecting the overall lack of information. This may be more pronounced for students who have made 'non-science' choices after GCSE, and who therefore have not bothered to find out much about working in Computing/IT.

Students taking a Business or Finance subject at AS/A-level provide responses which are quite similar to those of ICT students. They are significantly more likely than other students to agree that they believe both working and studying in Computing/IT will be exciting and challenging, but also to state that they are not sure about this matter. Their responses to the items on jobs indicate that they are *slightly* more likely to view these positively, but this effect is only significant when they are asked to compare Computing/IT jobs to other office jobs. This may reflect their better knowledge of the range of business and office jobs in general.

2:6.3 What do Computing/IT professionals do?

Five items relating to the nature of Computing/IT courses and careers were included in the questionnaire. These are reported in Chart 48 below.

In general, students are very uncertain about what Computing/IT students and professionals actually do, with over 50% stating that they are unsure about the importance of programming. Where students do express a positive opinion, their answers indicate that they feel that a university course would involve a great deal of programming, but that *working* in Computing/IT might be rather different. This may reflect the view expressed above that Computing/IT jobs are similar to 'any other office job'.

Students are also non-committal about the workload on Computing/IT courses, although the majority of those who do have a view feel that it would be high. The majority of students appear to believe that Computing/IT is a 'proper subject' for university study, but only a minority disagree with the item 'Computing/IT is more of a skill than a career'. Again, this implies a more positive image of Computing/IT courses than careers. It may also reflect a lack of [accurate] information about what Computing/IT professionals actually do.

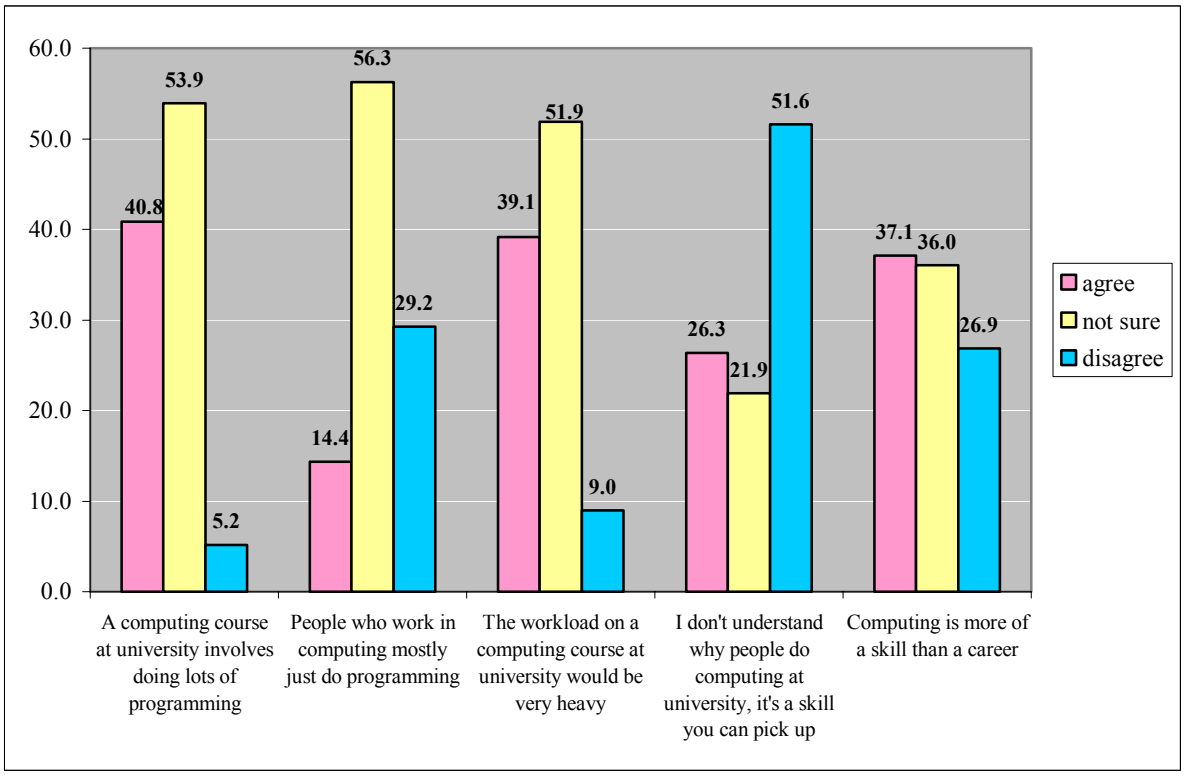

Chart 48: Responses to 'what do Computing/IT students & professionals do?' items

Male students are significantly less likely than female students to state that they are 'not sure' about the importance of programming to Computing/IT students and professionals. However, they are also more likely to *agree* that these people do a great deal of programming (which is not necessarily a 'bad' thing). Males are more likely to feel that the workload on Computing/IT courses would be very heavy, while females are more likely to disagree with this item. Responses from both sexes to the 'skills' items are very similar.

The only significant difference between pre- and post-GCSE students is that the latter are more likely to *disagree* with the items implying that Computing/IT is a 'skill' rather than a 'subject' or a 'career'. This may reflect the high number of students studying CS or ICT in the post-GCSE sample, rather than a difference between general attitudes at each educational stage.

Students who are taking CS are significantly less likely to indicate that they are 'not sure' about all of the items in this section *with the exception* of the item 'Computing/IT is more of a skill than a career'. In this latter case their responses are similar to those of other students.

CS students are significantly more likely to agree that a university CS course will involve a lot of programming, but significantly *less* likely to agree and more likely to disagree that this will be the main activity of a Computing/IT professional. They are more likely to agree and less likely to disagree that workloads on Computing/IT courses will be heavy, and significantly less likely to agree and more likely to disagree that Computing/IT is a 'skill rather than a subject'. Once again, courses appear to be viewed more positively than jobs.

This is one of the few sections in which the responses of CS and ICT students are very much alike. Their responses to the 'skills' and 'workload' items show an almost identical pattern, and their responses to the item on programming in HE are also similar. However, they are also more likely to believe strongly that programming will constitute the main activity of a Computing/IT professional.

Students taking neither CS nor ICT at AS/A-level are significantly more likely than those taking one of these subjects to state that they are 'not sure' about the importance of programming. They are also more likely to state that they are 'not sure' about the workload on Computing/IT courses, although this group are slightly more likely to feel that it would be low than are students taking CS or ICT. However, students who have dropped both CS and ICT are significantly more likely to agree that Computing/IT is a 'skill not a subject'; this factor may, of course, provide a clue as to why at least some of them have elected not to study in this area after GCSE.

The responses of students taking Mathematics and/or Physical Science subjects, Humanities and Business Studies are very similar to those of the whole sample. Overall, the most important finding from this section is that there is a general lack of information about both courses and careers in this area. Students studying CS or ICT at AS/A-level may be more confident about their knowledge of university courses in Computing/IT, but even they are uncertain about the nature of careers.

2:6.4 Job prospects

Chart 49 shows the pattern of responses to items relating to job prospects in Computing/IT.

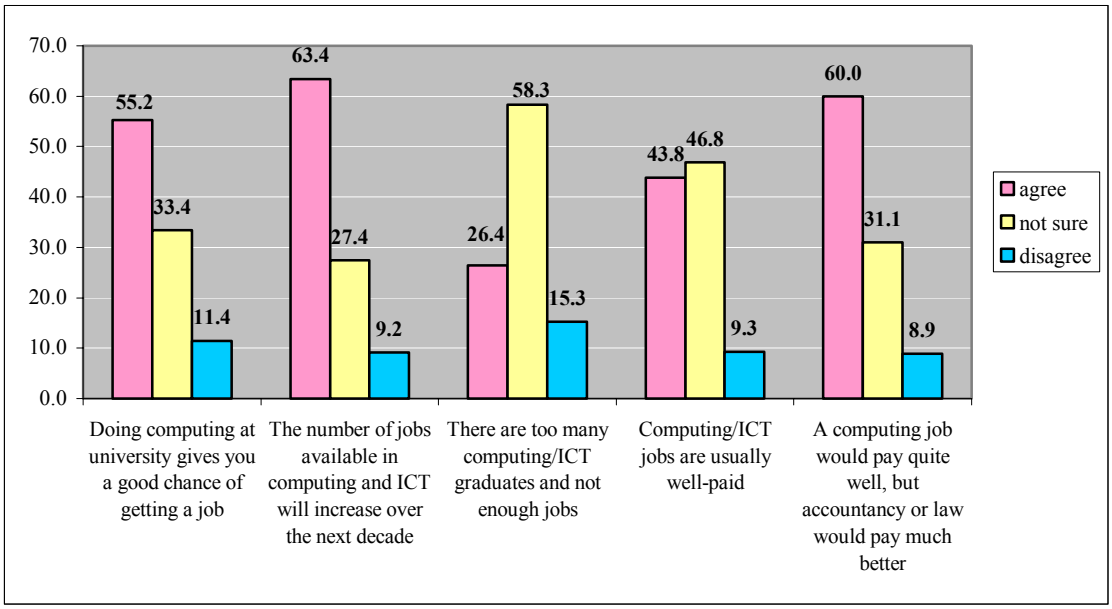

Chart 49: Responses to the 'job prospects' items

Overall, Computing/IT appears to be seen as a degree course which offers good job prospects, and a large majority of students believe that the number of jobs in this area will increase in the near future. This is confirmed by the tone of most of the focus group interviews; as one student stated, 'it's the way everything's going'.

However, when asked about the ratio of graduates to jobs[10] was considered, the majority of students were non-committal. A slightly higher number agreed than disagreed. Once again, these responses reflect a somewhat contradictory characteristic of some of the focus group discussions. Unprompted, many students expressed strong and often sweepingly general beliefs about the job market; for example, many were 'sure' that Law would always offer good job prospects, while others were adamant that there were 'too many' Media graduates. However, when these opinions were probed a little further, students retreated swiftly and decisively, stating that 'we can't be expected to know'.

[10] This item was included because it was an issue about which some of Alison Mitchell's subjects expressed concern.

There was a curious mixture of a strong 'folklore' and a professed lack of information which sounded, at its most pronounced, almost like a cry for help.

A similar contradiction operated around beliefs about which jobs would pay well. Of course, students may operate different scales of 'good pay'. Once again, although more students believe that Computing/IT will be well-paid than do not, the most popular answer is to state that one is 'not sure'. However, the majority believe that other 'traditional' professions would be more remunerative.

In general, female students are significantly more likely than males to state that they are uncertain about the job prospects offered by Computing/IT. This may reflect the lower interest in Computing/IT among females, and a consequently lower number who have investigated, or taken an interest in, the relevant employment options. Males are significantly more likely than females to state that they believe that studying Computing/IT will provide a good chance of a job. However, males are significantly more likely to agree *and* to disagree with the item relating to the increase in the number of jobs available. They are more likely to *agree* that there are too many Computing/IT graduates and not enough graduates, perhaps because their greater interest in these subjects means that they are more aware of the high numbers of university students in this area. Whatever is putting women off Computing/IT courses, it is unlikely to be a lack of confidence in the prospects of finding work.

Male and female students provide very similar responses to the items relating to pay.

Students who are taking CS are slightly, but not more significantly, more likely to feel positive about the job prospects offered by a Computing/IT degree. They are also significantly more likely to disagree with the item stating that there are 'too many' Computing/IT graduates and not enough jobs, perhaps suggesting a better level of information. In addition, they are significantly more likely to agree that Computing/IT jobs will pay well, although they are equally likely to agree that other professions will pay better.

ICT students are also significantly more likely to agree that a Computing/IT degree offers good job prospects, although they are also more likely than other students to state that they are unsure. Perhaps surprisingly, they are *also* significantly more likely to agree that there are 'too many graduates and not enough jobs' in this area. These patterns of response may come from different ICT students, or they may reflect a general lack of knowledge about the relevant job market. It is also possible that some of these students feel that there is a problem with *graduate* level employment in this field.

Students taking neither CS nor ICT are significantly less likely to feel positive about the job prospects offered by a Computing/IT degree. They are slightly more likely to disagree with the item relating to an increase in the number of jobs available in this area, and also with the item suggesting that a Computing/IT job will pay well. Both job prospects and wage prospects in Computing/IT are viewed negatively by students studying neither subject at AS/A-level.

Students studying Mathematics and/or Physical Sciences at AS/A-level provide very similar responses to the general sample on the items on job prospects and an increase in the number of jobs. They are slightly but not significantly more likely to disagree, and less likely to agree, with the items suggesting that there are 'too many Computing/IT graduates and not enough jobs', suggesting a good knowledge of the general scientific job market. Students taking only science/Mathematics at AS/A-level, and those planning on studying Medicine, Mathematics or the Physical Sciences at university, are significantly more likely than others to agree that other professions would pay better than Computing/IT; this factor may, of course, have guided AS/A-level subject choices for this group of students.

The responses of humanities students are similar to those for the sample as a whole. The only item on which Business Studies students show a different pattern of responses is the one relating to the ratio of graduates to jobs. Although no significant difference emerged, Business Studies students were slightly more likely to agree with this item, and less likely to disagree or state that they were uncertain.

2:6:5 Status

Chart 50 shows responses to the items reflecting the 'status' of Computing/IT as a degree subject and a career path among these students.

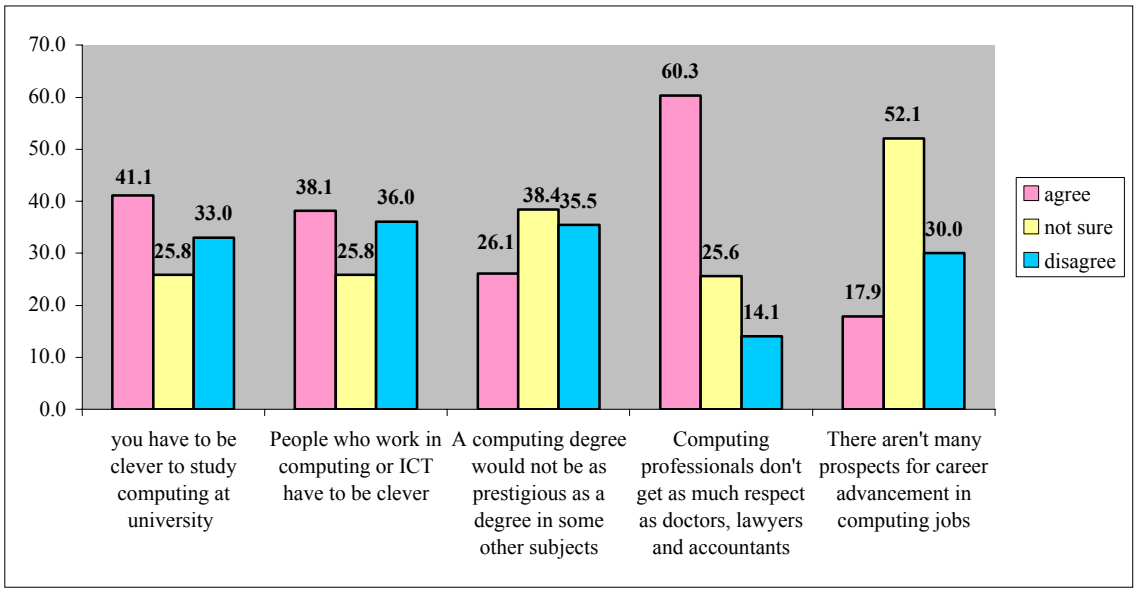

Chart 50: Responses to the 'status' items

These items were included because there was some anecdotal evidence that Computing/IT is seen as a 'low prestige' subject compared with more 'traditional' academic disciplines such as Mathematics and Physical sciences, or the 'high prestige' subjects such as Medicine and Law. One Computing/IT academic suggested many people believe that 'we're "down with engineering" rather than "up with medicine"'. The focus group discussions to some extent confirmed this, with some students suggesting that 'people who do computing' are 'not as clever' as other students – where a concrete contrast was expressed, it was with those taking traditional disciplines. Among some CS students, ICT students were viewed with a measure of contempt. Several suggested that they did 'glorified Business Studies' instead of 'proper computing'. Where this was probed further, the contrast appeared to be between a subject in which the focus was on the *use* rather than the *workings/building* of computers.

Unfortunately, time did not permit a comparison in the questionnaire between Computing/IT and other subjects/professions, but it is probably safe to speculate that the pattern of response would have been different had 'Maths/English/Physics/Medicine' been substituted in the first of the items in Chart 50, and 'Law/Medicine/the arts' in the second. The prestige of degrees was an area in which many students were unsure (with a high number of students in the state schools suggesting that *any* degree would be prestigious), but the prestige of different professions was very clear. Once again, students are unwilling to commit to a firm response when asked directly about the professional world.

Female and male students had similar views on the importance of 'cleverness' for students and professionals in Computing/IT, but males were significantly more confident about the prestige of a Computing/IT degree. However, males and females had similar views on the prestige of Computing/IT employment. Males were also more significantly likely than females to express either a positive *or* a negative response to the item on career prospects, while females were significantly more likely to state that they were uncertain. Again, it may be that fewer female than male students have investigated careers in Computing/IT.

Students who were studying CS at AS/A-level are significantly more likely to agree, and significantly less likely to disagree, that university Computing/IT students need to be 'clever'. However, around a quarter of AS/A-level CS students are 'not sure' about this item. Once again, the image of *jobs*

appears to be less positive than that of courses; a similar pattern of responses is found for the corresponding item relating to Computing/IT professionals, but it is much less clear-cut and does not reach statistical significance. Similarly, while CS students are significantly less likely to agree and more likely to disagree with the item about the prestige of Computing/IT degrees, their response on the prestige of Computing/IT careers are similar to those for the sample as a whole. They are, however, significantly more likely to believe that Computing/IT careers offer good prospects for advancement.

Students studying ICT respond to all of these items in ways that are similar to the rest of the sample, with one exception; they are significantly *less* likely to feel that Computing/IT professionals will be respected less than those in other jobs. They are *slightly* more likely to believe in the 'cleverness' of Computing/IT students and workers, the prestige of Computing/IT degrees and the prospects for career advancement, but none of these response rates is statistically significant.

However, among students who have dropped both CS and ICT are significantly more likely to *disagree* with the items suggesting that Computing/IT students and professionals need to be clever, and significantly more likely to believe that degrees and careers in Computing/IT are less prestigious than those in other areas. They are also significantly more likely to agree that the prospects for career advancement are limited. Among those who are taking neither CS or ICT at AS/A-level, the status of Computing/IT seems to be fairly low.

Mathematics and Physical Science students appear to hold Computing/IT courses in reasonably high esteem. They are significantly more likely than students not taking these subjects to agree that Computing/IT students need to be clever, although their response on the items relating to *jobs* in these areas are similar to those of other students. The more positive view of degree courses than of careers in Computing/IT is seen once again. Students taking *only* science subjects are significantly more likely than others to *disagree* with the item suggesting that Computing/IT degrees are held in low esteem, but they are the only group who show a differing response to this item. However, students taking Mathematics and Physical Sciences, students taking only Mathematics and Science subjects, and those planning on studying Mathematics, Physical Science or Medicine at university are all significantly more likely to agree that Computing/IT professionals are less respected than those in other areas. These students are, however, confident about prospects for career advancement in Computing/IT.

2:6:6 Image

Chart 51 shows response to items relating to the 'image' of Computing/IT courses and careers. All of these issues are discussed at greater length in Section Three, below.

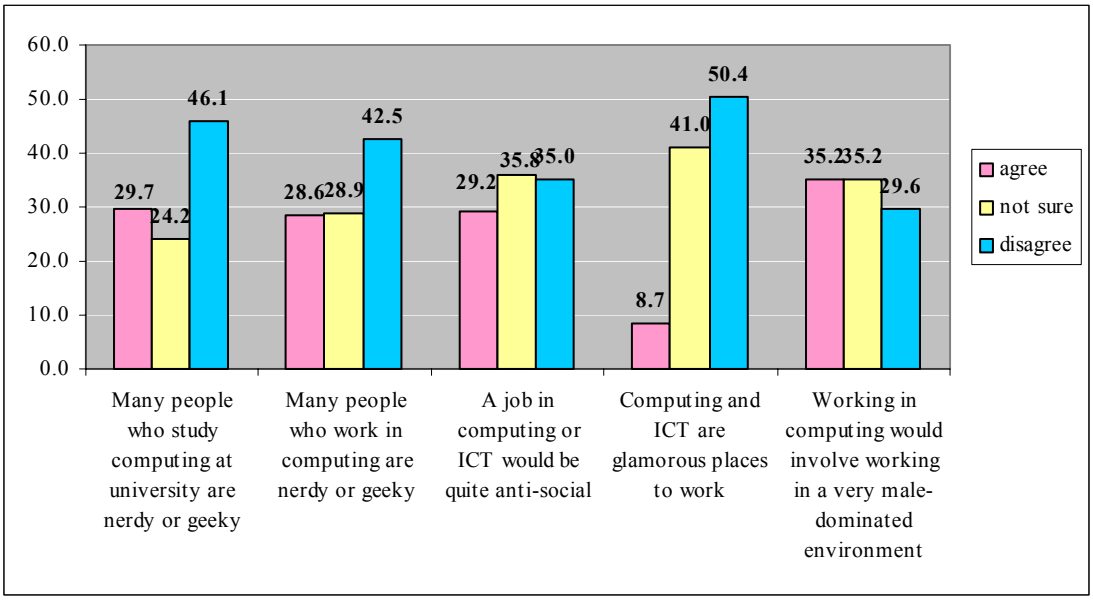

Chart 51: Responses to the 'image and gender' items

At first reading, responses to the first two items are both surprising and encouraging. It would be easy to assume that these indicate that the 'geek image' no longer operates for the majority of students (and thus, possibly, of the wider population). Instead, it has been rejected as an unrealistic and stereotyped view, which few people would assume to reflect the truth.

Unfortunately, the focus group interviews told a rather different story. Many of the students interviewed were contemptuous of the 'geek image' and of anyone who held it, stating that they were aware that 'some people' thought like that but that they themselves knew that it was untrue. Several took the interviewer to task for *mentioning* something which was 'just a stereotype', suggesting that it should not have been raised as an issue in the first place. However, during discussions many students used other words to describe 'what people in computing are like'. The descriptions thus given conformed closely to the 'geek image', even when they were offered by the same students who had previously rejected this, and had even argued with the use of the terms 'nerd' and 'geek'.

It appears that while students know that 'stereotypes are bad', they nevertheless may *believe in* these stereotypes while expressing them through other words.

The definition of 'anti-social' may vary for different students, and with hindsight this may not have been a particularly helpful item to include in the questionnaire. Several students stated that they believed there was a 'camaraderie' between people working in Computing/IT (even if, with further questioning, this turned out to be based on 'nerdy' activities which the students themselves would reject). However, social interaction with 'the rest of the world' might be more limited. The item discussed above on whether Computing/IT professionals are 'stuck in front of a computer all day' may be a better guide to attitudes in this area.

Given media depictions of Computing/IT workplaces, and also the composition of many of the AS/A-level CS/ICT classes in the schools surveyed, responses to the item on gender balance were very surprising. Once again, however, there appears to have been a problem in this case with what students in the age group surveyed as a 'reasonable' issue for discussion.

The ‘gender’ items provoked more negative – and passionate – responses than anything else in the questionnaire. Several students wrote a note in the margin stating that they had ‘refused’ to provide a response to these. In several cases they stated that this was because the issue was ‘not relevant’. Another stated that his decision not to reply was a protest at the fact that the inclusion of this item implied that male domination was ‘a bad thing’, while others stated that it was ‘old fashioned’ to refer to gender balance. Others agreed that Computing/IT *would* offer a very male-dominated environment, but stated that this was not a cause for worry, or that it was ‘neutral. All of the responses of this type came from male students.

By contrast, a number of female students wrote at length and with some feeling about their experience of male-dominated classes and social activities in computing. Several had experienced behaviours which they believed constituted sexism from fellow students, although one woman wrote of a supportive male teacher. Others had received negative responses from people outside school because they were female and interested in computers. Some female students wrote in strong terms about the need to increase the number of women in this area, and about the fact that females are both good at computing and able to offer a different perspective on the subject. All of the prose answers described in this paragraph came from female students.

Not surprisingly, male students were significantly less likely than females to agree and more likely to disagree with the ‘gender’ item, while more women agreed and fewer disagreed. Males were significantly more likely to believe that Computing/IT workplaces might be ‘glamorous, but also significantly more likely to agree and less likely to disagree that Computing/IT students and professionals included many ‘geeks’. It is likely that this latter pattern emerges because male students are less worried than females about agreeing with stereotypes. Female students in the focus groups were just as likely to present a stereotyped portrait of the Computing/IT ‘nerd’, while stating that they did not subscribe to a belief in this image. One woman wrote on a questionnaire ‘I don’t think that all people who do computing are geeks but I wouldn’t want to do it myself’.

Post-GCSE students tended to subscribe more strongly than pre-GCSE students to both the ‘geek’ image and the view of the Computing/IT workplace as male-dominated. This may simply reflect the higher salience to this group of the nature of workplaces of any sort.

Students taking CS at AS/A-level were significantly *more* likely than the general sample to state that they believed in the ‘geek’. This is perhaps surprising, as it implies that a group who have chosen this subject hold a negative view of those who are interested in it. A number of possible explanations emerged from the questionnaires and the focus group interviews. Many CS students who were interviewed stated cheerfully that they had *encountered* a disproportionate number of ‘nerds’ and ‘geeks’ while studying the subject; ‘oh yes, they’re out there’, as one student put it. However, these students were often clear that *they* were the ones who bucked the stereotype, and would continue to do so.

Other male students were ‘geeky and proud of it’. ‘I like computers and I’m pretty nerdy’, wrote one questionnaire respondent. Others, in a focus group which contained five confident self-proclaimed ‘geeks’, cheerfully explained the various characteristics which provided them with their badges of ‘geekiness’; these included an interest in online gaming, a fondness for dismantling computers, and wearing glasses. This group had perhaps found ‘strength in numbers’ in their class. A quieter group of students were aware that they had the ‘outer’ characteristics of geeks, and felt that they would be happy among people who appeared like this to the rest of the world; they knew that the stereotype would only be held by people who are themselves ‘shallow’, but they also knew that it could hide more interesting depths.

ICT students, however, were significantly *less* likely than students in the sample as a whole to believe that Computing/IT students and professionals are ‘geeky’. This may be because their experience of the subject is situated in a ‘business’ context rather than a ‘scientific’ one. One AS/A-level ICT student referred in a focus group to ‘science geeks’. Similarly, they are less likely to believe that

Computing/IT would offer a 'male dominated' work environment, perhaps because they think in terms of the more 'feminised' office. They are also significantly less likely than other students to feel that Computing/IT might be 'anti-social' as a place to work. The responses of Business Studies students are very similar.

Students taking Mathematics and/or Physical Sciences once again provide responses which are similar to those of CS rather than ICT students. They are significantly more likely than other students to agree that Computing/IT people may be 'geeky', although this effect is slightly less strong among students taking *only* Mathematics and Science subjects, and those planning to take Medicine, Physical Science or Mathematics at University. For these students, the 'geek' image is stronger for people *working* in Computing/IT than for Computing/IT *students*. Students taking Mathematics and Physical Sciences are significantly more likely than others to believe that the Computing/IT workplace will be male-dominated, but no such effect is found for students taking only Mathematics and Science subjects or potential university students in Medicine, Mathematics and the Physical Sciences.

PART THREE: FOCUS GROUP FEEDBACK

3:1 The focus group interviews

A total of 166 students were interviewed at focus group sessions in four of the participating institutions. All of the focus group participants were post-GCSE students, and the majority were taking either CS or ICT at AS or A-level. Because of this, more of the focus group participants were male than female.

The smallest group interviewed contained two students, although one student who was unable to attend a group session but wanted to take part was interviewed alone. The largest group contained twenty-one students. School staff were told that the focus group interviews would last around twenty minutes, but in most cases students had a great deal to say and wanted to spend longer than this. It was usually possible to accommodate a slightly longer session, with the result that in the end most focus group interviews lasted between twenty minutes and half an hour.

Students were asked to discuss a number of statements or questions which were presented to them on 'flashcards'. However, the discussion in these groups was fairly free, and where students appeared to be interested in a particular 'tangent', they were left to discuss this for some time.

School/college teachers were absent from all but one of the focus group interviews; however, the member of staff who sat in on an interview was not a CS or ICT teacher.

The context of the focus group interviews varied because different arrangements were convenient for different institutions. In some cases students were asked to attend a session outside class time. Elsewhere the interview was integrated into the CS/ICT curriculum or some other aspect of the students' timetable.

Most students seemed happy to take part, and in the majority of cases the discussion was lively. Only one suffered from long silences. It was generally possible to manage situations in which the occasional student was aggressive or dominant, and most of the interviews were reasonably good-natured.

As noted above, the CS/ICT students who took part were not necessarily representative of students in these subjects. This was because institutions participated at the instigation of their senior CS/ICT staff, most of whom had a connection with the BCS and/or a strong personal interest in the teaching of these subjects over and above their day-to-day duties. These students, therefore, had mostly experienced CS/ICT with a highly motivated and committed teacher, who had often made efforts to enhance the curriculum as far as possible.

A fairly high number of students happened to have done their GCSE ICT at a different school from the one in which they were interviewed, and several made comments about the difference between their previous experience of the subjects and the way in which they were presented at their current institution. One student stated that she would have taken A-level Computing had she known how good the teaching would be at her new institution, and how *different* it would be from her experience of GCSE ICT. Another, who was arguing with a classmate about whether GCSE ICT was 'boring' and 'pointless', finished the discussion by saying 'Well, it was alright for *you* – you had [teacher's name]'.

3:2 Attitudes to Computing/IT at university

3:2:1 Reasons why people might want to study Computing/IT at university

Students were asked to talk about the reasons why they thought that people might choose to study Computing/IT in HE. They were *not* asked to give their own reasons for choosing to do so, if they had already made a decision, but several clearly spoke from personal experience. All of the institutions whose students took part in the focus group interviews expect a high proportion of their pupils to progress to university, and most of the students interviewed assumed that university was the 'normal' path. One confidently told the interviewer that 'everybody goes to university'.

The first reason named by all of the groups interviewed was 'personal interest in the subject'. Students believed very strongly that personal interest was the most important reason for choosing a university subject. Several stated that it would be 'pointless' to study a subject which one did not find interesting, and it appeared that this issue was seen in some isolation from the issue of job prospects. Many of the students appeared to take a rather 'traditional' view in which a degree was taken for its own sake, or for the value in the job market of a qualification at this level, rather than in a specific area or to accredit a particular type of training. This was almost certainly a consequence of the social and educational backgrounds of the majority of the participants, and possibly also of the values of some of the educational institutions involved.

In the groups which included CS/ICT students, several mentioned or betrayed their own interest. 'Some people are very interested in computers', said one CS student, who went on to illustrate all the reasons for his own interest. Another said, 'It's just really, really interesting'. A ICT student stated that 'It's fun. You can do lots of different things, like music and pictures and everything.'

Subject interest, as noted above, was regarded in a distinctly deterministic way. The idea that one might *gain* an interest in a subject was often viewed with a certain suspicion, as if this would involve being 'untrue' to one's innate nature. There was some conflation of interest with ability ('well, of course you'll be more interested in the things you're good at' was how one student put it), and students talked about 'computing people', 'languages people', 'English people' [referring to the subject not the nationality] in most of the institutions visited. This suggests that they are inclined to 'type' themselves and their peers according to their aptitudes and interests. As a result, it may be difficult for a student to 'get interested in' a different area from their original one. Nevertheless, several students *did* describe changes in their own interests, although this had almost always occurred within the same general subject field; for example, one had shifted his interests from Chemistry to Mathematics, while another was choosing between Drama and Politics.

One student wrote on his/her questionnaire, with regard to choosing a subject: 'Everything has to be my own decision or I wont be happy[11]… I want the best for my education… my own opinion is the on that counts… my own opinion is best'. Others betrayed a suspicion about attempts to influence their subject choices. The following three comments illustrate this view:

- Does this have anything to do with careers talks? Are you trying to persuade people to take ICT?
- They should let people choose what they want to do and not attempt to make people do what they want
- Don't waste pupils time trying to persuade them to do Computing/ICT

Several interviewees suggested that it would be 'pointless' to study a subject in which one did not have an 'inherent interest'.

Alongside the strong belief in subject interest, however, all of the groups named good job prospects as a reason for choosing Computing/IT. 'Lots of jobs' was a common response, and the majority

[11] Free text responses from questionnaires are reproduced here exactly as they were written by the students.

appeared to believe that a Computing/IT degree would offer excellent employment opportunities. High wages were also mentioned favourably in most cases. One student, however, who had decided against taking the subject at AS or A-level or at university, said that Computing/IT offered 'lots of money at a young age for not doing that much', which did not appear to be a favourable characteristic in her eyes.

Several students mentioned particular aspects of the subject which they themselves enjoyed and wanted to do more of. Programming was mentioned by a high number of CS students, and networking, hardware, analytical work and creative applications were also named. The popularity of programming among these students who have been well-taught was one of the more surprising findings from this study. A student who had investigated university prospectuses in some detail stated that 'there are good courses and loads of variety'.

The *general* usefulness of Computing/IT skills was mentioned, although this tended to occur more to students who were not taking CS/ICT. 'You can use it in any desk job… mmm, maybe that's a reason why not,' said one female student. Another student took a more positive approach: 'You can use the skills in any sort of job'. His group went on to list financial professions and 'any sort of job involving analytical skills'. Also important was the perceived 'practicality' of Computing/IT.

Its novelty was also seen as a 'draw' by many students. Computing/IT was described – positively – as 'new', 'up to date', 'modern' and 'with it'. The phrase 'it's the way the world's going' was used in three different groups (at different institutions!). This appeared to relate both to the idea of Computing/IT as a fast-moving and exciting area, and also to the excellent job prospects offered in this field.

Rather less positively, a small number of students referred to a perception that Computing/IT courses would offer a light workload. The following comments are typical:

- It's not much work.
- Not much reading.
- There's the idea that the first year is a doss… it's like a catch up easy year if you've done computing at school

It must be said that where these opinions were voiced (or quoted, being attributed to other, 'lazy' students who were not in the group), they were vigorously contradicted by other group members. 'There's no subject that's a doss at university… anyone who believes that is stupid' was the response to the last item on the list above. However in one group this opinion went unchallenged by the other students.

3:2:2 Reasons why people might <u>not</u> want to study Computing/IT at university

Some of the reasons offered to explain why Computing/IT might *not* be chosen as a university subject also related to the actual content of courses. One student stated that 'it's really frustrating, with all the different languages', while another said that 'Courses are too broad. Most people are just interested in one bit of it'. Both of these students, it appeared, had read several prospectuses but had not yet attended an open day.

There were rather more answers which referred more broadly to skills. One student felt that university Computing/IT courses were not sufficiently broad ('the skills in university courses aren't the ones you use for normal jobs'). The idea that it is possible to 'pick up enough' knowledge for a job in Computing/IT was also voiced in several groups, but it was rare among CS students and more common among those taking ICT or taking neither CS nor ICT. Typical comments included the following:

- You can pick up a whole lot of it by yourself.

- You don't want to spend three years doing what you can do for yourself.

The questionnaires also yielded a rich vein of comments to this effect, the majority of them from non-CS/ICT students. The following is typical: 'I think that ICT is important at GCSE so that you can learn the basic skills, but it is not needed at A level or university, because you can pick up skills easily.' At the root of this view is the confusion between Computing and IT which was discussed above. The following student, who appears to be a keen 'hobby' computer enthusiast, appears to equate the subject at all levels of education with ICT, despite his obvious knowledge of CS: 'It's too ICT-related. I prefer web designing, development and programming. I know HTML, PHP, CSS, Javascript and plan also to learn ASP and JSP. They don't focus enough on programming at school, college or university. I am more interested in these than in learning Office applications'. Rather less knowledgeable, but similar in tone, was the following: 'I am not going to study Computing/ICT at university because the subject becomes mundane using standard software'.

Content was also named by a few students as a reason for people's decision not to take Computing/IT, with a 'lack of creativity' and 'no human interest' contributing. Several students who were taking AS or A-level CS/ICT disliked the theoretical aspects of their school studies. '[there are] too many definitions, and too many words all ending in the same three letters… learning loads of definitions you'll never use', complained one student. When asked to give examples of 'irritating words', he and his classmates came up with 'polymorphism', 'time multiplexing' and 'multitasking'.

Students, especially those taking CS, were aware that there exists a large gap in the public understanding of Computing/IT: 'People don't know what it is,' said one, to explain why some do not even consider this field for university study. Another suggested that it is necessary to have some prior knowledge or interest in order to select Computing/IT: 'it's not obvious – you don't think of it if you don't have a special interest'. One explanation which was offered was that 'there aren't many high-profile jobs [in Computing/IT]'.

The image of Computing/IT and of computer scientists was felt by at least some students in all of the groups to be an important factor. 'It isn't fashionable' was offered as an explanation by several students. A lack of knowledge about what is actually involved in Computing/IT jobs was also mentioned; the following comments illustrate this view:

- People can't see themselves sitting in front of a computer for the rest of their lives
- People think they'll be stuck in an office typing 10 hours a day

The 'geek' image was also felt, by CS/ICT students, to put people off. 'The image is awful and you can't improve it!' said one, while another felt that Computing/IT is 'not charismatic'. It was suggested that the uninitiated are likely to believe that computing students are 'people who go home and do 5 hours online gaming' or 'a bunch of geeks'. Perhaps not surprisingly, in the light of the questionnaire responses discussed above, several students expressed the opinion that 'the [geek] image is actually quite true'. A few female students stated that the gender balance, and possibly sexism, would put women off studying Computing/IT.

Factors which were mentioned by smaller numbers of students, or in only one or two groups, were the following:

Prestige. 'Well, it's not the best subject, is it?' said one student, while several others agreed with the notion that it is 'not a standard academic subject'. These issues, it was felt, would put off potential students because they would feel that applying for a Computing/IT course would imply their inferiority.

Job prospects. Despite the overwhelmingly positive view of these, a some students felt that the graduate job market in Computing/IT is 'flooded' ('There are too many people doing it and not enough jobs. Everyone is doing ICT'), and a handful were aware of offshoring as a potential threat.

Several thought that a computing degree might be 'too specialised' and would result in closing down one's job options too early: 'it doesn't give you much career flexibility'.

An issue which was mentioned by only a couple of students (in different groups), but which their peers then felt was extremely important, was the fact that 'people are a bit afraid of computers'. The idea that computers are somehow threatening, insidious, or even dangerous was felt to be common among people whose knowledge and understanding of Computing/IT was generally poor. Focus group participants, especially those who were taking AS or A-level CS/ICT, did not share these feelings, but once this notion had been raised other group members felt that they were very much aware of it, and that it might put people off Computing/IT.

Their views were confirmed by a handful of responses in the free text sections of the questionnaires, where students expressed their distrust and almost superstitious dislike of computers. One GCSE student wrote that he '[did] not feel [his] workload should increase tenfold because [his] teacher thinks in the future computers will control us not the other way round', while another, in a longish paragraph, stated that 'computing is yet another jargon based subject devised by New Labour to further control this nation and its citizens'. There was also a lengthy and strongly-argued response expressing the writer's anxiety about the breakdown of social relations as a result of increasing computerisation. A few students simply wrote 'I hate computers'.

One student was keen to explain why he had opted against A-level CS while planning on studying the subject at university. His argument was as follows:
'I have always had a passion for computing and computers in general, but found the prospect of A-level chemistry relatively more demanding than A-level computing. I have never found Computing/ICT difficult and found the AS level unchallenging. After consulting universities as to whether this would affect my chances of getting on their course, most said it would have no bearing on their decision and X University said it would even be beneficial. They indicated that degree courses are taught from a different approach to that of A-level courses, and some 'unlearning' and reteaching may be necessary, whereas without the A-level you wouldn't have any preconceptions to break.'

3:3 Attitudes to AS or A-level Computing/IT disciplines

3:3:1 Attitudes to ICT

A decision was taken *not* to ask the focus group participants about their enjoyment of or attitudes to their own experience of studying CS/ICT in secondary education. This was because of the danger that a particular institution or teacher might be named, and/or that conclusions about the provision offered at a one of the participating institutions might be subject to unjust criticism.

Both in the focus group interviews and in the questionnaire responses, though, students offered unsolicited opinions on both subjects. These views will be discussed briefly in this section. As noted above, it is likely that most of the participants had received excellent CS/ICT *teaching*, and not surprisingly therefore, *none* of the negative responses referred to poor-quality teaching at the current institution (although previous institutions were criticised by a handful of focus group participants). Students did, however, draw attention to aspects of the curriculum.

GCSE ICT was somewhat harshly criticised by a great many students who were not taking this subject at AS or A-level. The following are some characteristic comments:

- ICT coursework is boring and repetitive
- Everything about my ICT course was very boring
- [ICT] isn't at all difficult, but it is time consuming.

- I have not met anyone who finds 'exciting' or fun. Lessons are boring and pointless and I strongly believe it's a waste of a GCSE.
- I did ICT GCSE and it put me off A-level Computing
- I did ICT GNVQ at secondary school, I found it patronising and a big mistake so I decided I'd rather not continue
- ICT involves, To much pointless work, Not enough work using compters, To much boring theroy
- ICT is far too repetitive
- IT has a lot of work thats why people may not want choose it
- That you do not have to be very cleaver to go into ict you just need an understanding and need commitment
- I believe that ICT should not be a subject compulsory for GCSE as it can be self-taught.
- Reasons for not taking A-level: 'ICT coursework – shudder!'

These comments are terribly similar to those made by some of the ICT teachers who find the curriculum frustrating. Students in the focus groups were generally rather politer, but they expressed a similar range of opinions.

Students who had got beyond GCSE ICT and were taking the AS or A-level were, by contrast, often favourably surprised at how much they were enjoying the subject, although several suspected that this was due more to their teachers than to the curriculum itself. Very few echoed the negative views on the GCSE, or suggested that they applied to the AS or A-level. A number of students confessed that they had been very nervous about taking ICT and had not expected to enjoy it at all, let alone as much as they in fact were doing.

One student's questionnaire response suggested again that a 'fear' of computers might underlie some of the unpopularity of ICT. She wrote that: 'ICT is a useful subject to learn and do. People who don't take ICT are either computer shy or thought of things that they enjoy more'. Another ICT student wrote that 'Technology is always changing and I want to do it always'.

3:3:2 Attitudes to CS

Like AS or A-level ICT, AS or A-level CS was viewed favourably by students who had chosen this subject. Once again, several were aware that they were being very well taught, and that the curriculum was being to some extent enhanced for them. Some listed elements of their experiene which they had especially enjoyed:

- Computing Olympiad was good.
- I like team projects [at A level]. It is rare to be working alone in a computing job.

Other enjoyable elements are listed in 3:2:1 above. As with ICT students, those taking CS at AS or A-level were overwhelmingly enthusiastic about their studies.

A number of CS students were keen to demonstrate the difference between their subject and their perceptions of ICT (probably based on their GCSE studies). The following quotations from some of the questionnaires are typical:

- Computing is interesting but ICT is more like any old office job
- I don't see the reason for ICT. Its a weak base to learning how to use some certain programs. New update and programe replace these each year usually making what they learnt fairly but not completely useless. It should be adapted to a 6 month 'basic computer skills' course. Have a week explaining how to keep yourself up to date
- Computing isn't a skill you can just pick up – that would be ICT.
- ICT is boring, computing is interesting. ICT jobs are mundane, jobs in computing are interesting and challenging.
- I chose A-level computing because I wanted something that was different from ICT

And the following was received from a student who was taking neither subject:

- I don't know much about Computing but I think it's just ICT which I don't enjoy

There were a few complaints about the content of the Computing syllabus. Several students felt that there was *still* too much ICT-related work, with databases and spreadsheets attracting particular opprobrium. Instead, they stated that they would prefer to do more programming and to have more opportunities for creative and problem-solving work based on this. Teachers who had offered extra-curricular or off-syllabus options of this type were highly praised.

A few CS students also felt that they would prefer to learn more general principles of the subject rather than specific languages or packages. The following questionnaire comment expressed this view: 'I think giving schools an option of languages for A level is a bad idea. If they did what universitys do and teach us programming fundimentals rather than a language then we would be able to adapt better to programming in other languages. Personally I would have prefered to learn either C+ or Java as these seem to be alot more useful than Delphi.'

Other students were aware that computing moves faster in the outside world than in the A-level syllabus; they knew this both because of their personal interests in computing and because of initiatives by their teachers to enhance the curriculum. A student who had had this experience wrothe: 'Computing… the subject matter is very interesting but it seems to be an inherantly fast moving subject and the sylabus tends to leave this out leading to obsolete concepts sometimes frustratingly being taught.'

A criticism which arose in one focus group related to the subject culture of Computing. This was raised by a single student in the first interest, but his peers recognised the phenomenon that he was talking about. His view was as follows: 'There's this competitive thing in the class, a stigma of being crap at computing… it's more competitive than other subjects. I love computing, just not as a subject – because of all that competition.'

3:4 Career choice

3:4:1 Issues influencing career choice

Students were asked to consider a range of factors which might influence one's choice of a university subject and/or a job, and to state how important they felt each of these would be to people of their age group. Each factor was represented by a brief statement written on a flashcard; the cards were presented in a way which attempted to avoid imposing any ranking order on them (they are numbered here for convenience, but this was not done in the interviews).

The statements shown to students were as follows:

1) A degree course which doesn't have a *huge* workload
2) Not having to do the same thing day after day after day
3) A well-paid job
4) A job that is respected in society
5) Doing something that I personally find interesting
6) Having time for a life outside work
7) Ethics/doing something that helps people/making a difference in the world
8) … anything else?

In all of the groups, students focussed first and most vehemently on statement 5. Just as they had agreed that subject interest was paramount in selecting a university course, they also felt that this was key in their choice of career. They generally felt that it would be difficult to go to work every day and do something that one did *not* find interesting.

However, the second statement which drew interest in all groups was number 3. The way in which this item was introduced into the discussion was very similar in each case – one student would pick it out with a slight air of embarrassment, which was reinforced by rather sheepish laughter from other group members. As the discussion progressed, the students defended the importance of this item increasingly confidently, and eventually this item was almost aggressively championed. Students who, shortly before, had been arguing for the paramount importance of subject interest would make statements such as 'Well, that's the whole reason for going to university anyway, isn't it? – to make more money after.'

Most of the groups examined the balance between statements 3 and 5. The majority felt that what was needed was a balance between the two; they would not be prepared to sacrifice 'high' earnings altogether to do something they loved, but they felt contempt for someone who 'did a really, really boring job just for the money'. A minority, however, *did* feel that they would be prepared to do a job which they found boring or unpleasant for very high pay, or that they would at least be prepared to do this for part of their working life. 'Six hours a day of hell and then you can buy a yacht… yeah, I'd go for that', was how one student put it. A gender difference was apparent here; while students of both sexes expressed the former view (wanting a balance), *none* of the female interviewees expressed the latter, and several were very contemptuous of it.

One characteristic of a 'boring' job was 'doing the same thing day after day', as suggested in statement 2. Almost all of the students wanted to avoid jobs of this sort. They wanted to do things which involve problem-solving, learning new things, challenge, meeting different people and finding themselves in new situations. 'Routine' and 'mundane' jobs were regarded with a dislike bordering on horror by many students. However, a small number suggested that they would *like* a job which was fairly repetitive because it would absorb less of their mental and emotional energy, leaving these available for 'a life outside work'.

There was general agreement that *some* people might select their degree subject because they thought the course would offer a low workload. 'I can see how a certain sort of person would say that, yes,' said one student. Another characterised this view as follows: 'Well, yes, it's appealing, isn't it – get a degree and then some money for doing nothing – but that's Disneyland, really.' The general consensus was that any degree course would involve hard work, although in two of the non-CS/ICT groups an argument broke out over whether science or humanities courses were 'harder work' (with the students on each side claiming that *their* preferred area was 'harder').

Work/life balance was important to almost all of the students surveyed; if anyone disagreed with item 6, s/he was too intimidated to speak up. Students wanted jobs which would give them enough leisure (and disposable income) to have 'a good time' as well as a career structure. Several felt that this should be facilitated by a workplace which was 'sociable', 'friendly', populated by 'people like [us]', and which gave its employees opportunities to meet and socialise. After a little discussion, some students also agreed that 'when they were older' they would perhaps want jobs which allowed them to have time with a family of their own, although most felt that this 'wouldn't be until we're quite a bit older – at least thirty'. Both men and women were equally keen on having a good social life alongside work, and the comments about family time were also equally likely to come from members of *either* sex. This topic, in fact, was usually introduced by males rather than females, perhaps because women were anxious not to fall into the 'stereotype' of the 'homemaker'. When one male student suggested that 'having a family would be more important to girls', several of the female students turned on him in disagreement.

The two items which provoked the fiercest disagreement were 4 and 7. At first, statement 4 was greeted with surprise. 'People don't care about status any more' was a common comment; most groups appeared happy to leave it at that. However, with some probing they *did*, in fact, list jobs that they would be likely to respect; doctors and medical professionals appeared on the list, as did lawyers, teachers, and (among comments from male students), firefighters, police officers and builders. Interestingly, some of the 'celebrity' jobs that might have been expected – TV presenters, journalists,

sports professionals – were not mentioned. Despite this, students in several groups suggested that for their generation status had not been abandoned but merely redefined. 'It's more about image than status – people want cool jobs' was how one female student put it. In two groups, students pointed out that certain jobs would *not* be acceptable both because of the activities which they involved and their perception within society. The comment that 'people just will *not* do low status jobs, especially at the lower end' summed up this position.

Statement 7 also provoked a similar pattern of argument. At first students would laugh at this item and even make disparaging comments. 'Fluffy dog,' said one male participant. 'It's like that story at the end of the news that's meant to make you feel all warm and happy.' Students stated that they could not imagine this item directing anyone's choice of job. Money, personal interest and the work-life balance would all be more important. A number said that while making a social contribution was important to them, they would expect to do this through voluntary activities and not within the workplace.

As the discussion progressed, however, it became clear that considerations of this sort actually *were* important to many of the students. Several said that they would expect their employer to *support* them in voluntary and charitable activities, perhaps because they were used to these being supported by their schools and colleges. In the majority of groups one student would state that it was important to him/her to work for a company whose ethics were sound and whose values s/he agreed with, and following this first comment, the majority of the speaker's peers chimed in. At this stage, students who continued to treat the issue with contempt were themselves the the subject of disagreement. In particular, students felt that they wanted to work in professions and for organisations whose ethical and environmental record was respectable. One male student said that '[it's] definitely a factor for me, I don't want to screw up the environment or anything…'. Another stated that, although statement 7 would not be a primary factor for him, he 'wouldn't want to work for a company which was, like, doing *bad* things'.

Once again, a gender split operated for this item. The initial disparagement always came from a male student, but some of the first defenders of the 'ethical' position were almost always female. However, when the positive context for comments on this item had been established, statements from both genders were very similar.

3:4:2 Careers advice

The issue of careers advice was not explicitly included in the focus group interviews. However, students raised this issue themselves both in the interviews and in their comments on the questionnaires.

Many of the focus group participants stated that they felt it was difficult to obtain useful and comprehensive information from school careers materials on Computing/IT jobs. They had benefited most from talking to their subject teachers (who were unusually well-informed in these schools), and from getting in touch directly with the Computing/IT departments of universities. Several felt that Computing/IT was not 'on the radar' of a standard student's career awareness, which they thought included 'standard' office jobs, the traditional professions, and careers which are often shown in the media.

Some of the comments on the questionnaires revealed a lack of information, and a dissatisfaction with careers provision in secondary education

- The subjects that are available at university are not explain enough at school. I had to research from the internet about the possible options, this may discourage people [a student who has decided to study Computing/IT at university]
- I will need a lot of information to decide what to study at university

- Careers advisers don't help enough
- Computing is not advertised enough at school. If it was it would be more popular
- I don't know anything about computing/ICT careers but after doing this [questionnaire] I feel I want to

There was also some evidence of friends and relatives who had offered careers advice on the basis of personal, and possibly unrepresentative, experience. The following comment came from a female student who also mentioned that her mother is a computing graduate and that she herself planned to study engineering: 'Computing does not offer great job prospects without studying to a PhD, therefore it would be more beneficial to do a short course (e.g. CISCO) at a college for a year as opposed to a three-year degree.' Another student quoted his father, who felt that 'All degrees are under-rated at present'.

Two students who had relatives who had lost jobs in Computing/IT were worried about following their own desires to study these subjects because they believed that they too might become unemployed. Others, however, knew people with Computing/IT jobs and had been encouraged to enter the field because of them; this personal contact made them aware of the range of work which is available, and of the diversity of people who work in the area. 'My brother works with computers and he is really cool' wrote one student who planned to take Computing/IT in HE.

3:5 Image issues

3:5:1 Is Computing/IT a skill or a subject?

A fairly high number of the participants in Alison Mitchell's Scottish survey felt that Computing/IT was 'more of a skill than a subject'. This question was posed both in the questionnaire (see the discussion above) and also in the focus groups.

No consensus emerged on this issue; in fact, many of the students who were actually studying CS/ICT appeared not to be terribly bothered. They regarded it as something they enjoyed doing, and for which they could get a qualification. There was some interesting discussion about what might constitute the difference between a skill and a subject, but this rarely led to a conclusion in the case of Computing/IT.

One definition of a subject was 'something that you have to learn' rather than 'something you can *just do*'. A CS student stated that '[computing] is a subject. You don't know it if you don't study it.' Speaking at greater length, another argued that, 'it's a proper subject. If you compare it with art… art is like something you can just do or not, that's what a skill is, computing is something you have to learn about before you can do it.' CS students were, in general, the most likely to argue for 'subject status'. Some were aware that the Computing/ICT confusion might be at the root of this discussion. One student suggested that 'people think it's not a subject because of the course. You don't need to learn a lot for ICT.' Another read the statement and said, 'people only say that cause they think it's high school ICT'.

However, a few CS students were less adamant on this issue. One suggested that it did not matter whether Computing was a skill or a subject as long as one learnt enough to do it well, because 'it's a way of thinking.' Another stated that 'it depends how you like it and how you feel about it.' Another disputed the idea that a skill was something that did not have to be learnt, stating that in computing, 'you need to learn the really basic skills to do the exciting stuff'. The relatively poor skills of those who had 'picked it up as they went along' were also disparaged: 'if you just pick it up,' according to one CS student, 'you never learn it properly'.

ICT students, and those taking neither CS nor ICT, were more likely to align Computing with 'everyday' computer usage, and to suggest that it was a skill rather than a subject. One non-CS/ICT student stated that 'it's a skill… it's just what you do every day. It's like a subject trying to teach daily life.' Another made an explicit comparison with 'proper' subjects as follows: 'it's a skill. You can't just pick up Physics, because that's a subject'. Another student said that '[Computing] hasn't been around long enough to be a proper subject.'

Others, however, were less committed to one side of the argument or the other. An ICT student suggested that 'programming is a skill, but learning about programming is a subject', but then pointed out that you needed skills for most subjects. The distinction between 'traditional academic' subjects and 'new' ones such as Computing/IT was challenged. On presentation of the statement 'Computing is more of a skill than a subject,' one non-CS/ICT student said, 'OK, but you could say that about English.'. 'Everything's a skill,' agreed one of his classmates.

3:5:2 Status

The status of Computing/IT was also examined in the focus groups. Students were asked whether they thought that 'clever people' would work or study in Computing/IT, and also whether they thought a Computing/IT degree or job would command respect. This issue arose again during discussions of stereotypes and media images (see below).

At this point, students did not generally feel that *the majority* of students and professionals would have to be clever. As noted below, there is a distinction here between what students regarded as 'the very top people' in Computing/IT – generally inventors and developers – and most of those who have 'ordinary' jobs in the area, or places on the bulk of university courses. This was expressed as follows: 'some people think it's a dropout subject, anyone can do it. There are some very, very clever people and others who are just… [gesture]. There's no middle ground.'

More concisely, another suggested that 'some computing people are really clever but some are not.' The comparison with other sciences – especially medicine, and the 'traditional academic disciplines – was made by several students. One said that 'a doctor of computing wouldn't be as good as a doctor of science – I wouldn't bother doing my PhD in it.'

One student, in response to the item on Computing/IT students, said that 'they're fairly [clever]… but to get into a lot of Computing/IT courses the entry grades are lower, so there's an impression of, 'do they have to be clever?'. 'I'm not sure you have to be clever,' said a student from another group. As noted above, within the 'folklore' of some schools the students who are taking Computing/IT may be regarded as 'the sort of people' who aren't 'very clever' or who do not get the highest marks which would win them a place on a course in one of the 'more prestigious' subjects such as Medicine or Chemistry. A few were aware that the 'standard offer' of UCAS tariff points is lower for Computing/IT than for other science subjects at certain universities.

Several students had clearly thought about the issue of respect, and had formulated some interesting explanations. A frequent suggestion was that the ubiquity and familiarity of computers had led to a lack of understanding of their true complexity, and consequently to a lack of respect. Computing/IT will enjoy a high status among some people, but only by those who actually know something about the subject. Students felt that people are unlikely to gain this knowledge on the basis of day-to-day exposure to the UK media and culture. The following comments illustrate the position taken by these students:

- It won't be respected. Loads of people don't know about IT technology. They don't know what a difficult job it is, so they don't respect it.
- It doesn't get respected because there's such a wide number of businesses which just use computers all the time.

- To an extent, but only by people who know.

Students in three groups also felt that the low status of Computing/IT was a peculiarly British phenomenon. ‘It’s not [respected] by students, not in Britain,’ said one. Another suggested that the status accorded to Computing/IT varies by region: ‘it depends where you are in the world. If you’re in Asia or Russia or Hong Kong or somewhere it will be respected, yes, but not if you’re in England.’

3:5:3 The 'thrill factor'

When students were asked whether they felt that Computing/IT was 'exciting', the consensus was that it is, but that many people do not appreciate this. Even the majority students who were not taking CS/ICT appeared to agree with this, although it is possible that some of this was due to politeness to the interviewer, who was assumed to be a computer scientist.

Several students identified the novelty and modernity of Computing/IT as characteristics which contributed to the 'thrill factor':

- It's more exciting than the old science subjects [defined as Mathematics, Physics and Chemistry]… in the science area Computing has moved faster.
- It's the rate of change that makes it exciting.
- It's gone from nothing to now in a very short time.

In addition, the fact that computing is 'fundamental' to a number of aspects of modern life was seen as making it exciting. In response to a student who said that it was dull, one non-CS/ICT student exclaimed, 'look around you! There's progress all the time. Computers are in everything.' In a different group, someone stated that, 'it's in a lot of things, it's at the base.'

When students were asked what could be introduced into Computing/IT courses to make them more appealing or 'thrilling' to people who did not at present believe that there was excitement to be had in this area, the following suggestions were made. Perhaps surprisingly, computer *hardware* was regarded as a potential area for these activities:

- High-tech equipment would make it more exciting.
- Hardware is the really exciting bit
- Hardware is the really thrilling bit… people are building better hardware, that's what's really changing now. People aren't actually writing better programmes [female student]
- They should have a documentary on how you build computers. People don't understand what's inside that box.

Creativity was also mentioned in several groups:

- More creative aspects.
- Both letting you do more creative stuff and showing people how computing itself is quite a creative thing

The CS students in particular were keen to point out that programming can be interesting and should not be seen as a 'problem' with the appeal of the subject:

- More programming, but also more opportunities to work out what to programme.
- Programming is the best bit of the lessons – when you find out that you can *do* it.
- Problem solving – that's the bit of it I really enjoy

Specific applications were listed by students who had learned about these either through their private interests or enhanced teaching:

- Robotics is really exciting
- Modelling… how you can model things like diseases… climate change
- Yeah, but what's really exciting is that it changes things in your life when the data can get handled that much faster… that's the link

3:5:4 General public understanding of Computing/IT

A small number of the non-CS/ICT students interviewed betrayed a lack of general understanding of the extent to which computers are important in daily life. For example, some did not realise that an MP3 player is based on computing, that there are medical computing applications beyond record-keeping, or that computing has any relevance to films and cinema apart from ticket booking systems. It is possible that this results from a lack of information on these issues in the general media, or that it is evidence of a refusal among some younger people to take an interest in things which are, as one student put it, 'not relevant to my own life'[12].

However, some of the non-CS/ICT students had a general appreciation of the extent of Computing/IT applications in most areas of modern society. Some definitely felt that this was a positive and exciting thing; medical and scientific breakthroughs, improved consumer goods and services, and – most frequently – new opportunities for communications and social life were all mentioned as positive developments. Others seemed apprehensive or anxious about issues such as possible IT failures, over-reliance on computers, and the security of personal privacy and data.

All of the CS/ICT students had a good knowledge of the extent to which modern life relies on computers, and were able to provide and discuss multiple examples. One or two disagreed with the term 'fundamental' drawing a distinction between sciences which investigate the way in which the world works (such as biology, physics or chemistry) and those which are 'imposed' on it, as has happened with Computing/IT. However, there was no disagreement as to the extent and importance of Computing/IT technology in modern life. 'I can't imagine the world without computers' is how one student expressed this.

Most CS/ICT students were aware of the kind of information gaps described in the first paragraph of this section, both among people of their own age and older people (although a number were proud of their computer-enthusiast grandparents). A few felt that some people think 'it's clever' to dislike or know nothing about computers, and thought that this attitude was rather contemptible. However, others believed that it was a simple lack of knowledge and understanding which led to a failure to appreciate how important and widespread computers are. 'You have to be at quite a high level of knowledge to understand that. It *is* quite high, it's not obvious to people who are just doing ICT,' said one student. Many felt that it would be difficult to gain a good understanding from exposure to the general media.

Several students were somewhat proud of the extent to which other scientific disciplines have come to rely on a high level of Computing/IT technology, and the dependence of more 'fashionable' disciplines, such as forensic science, earth and climate science, physics and medicine, on 'their' subject. They were aware of applications such as modelling and simulation.

However, an issue which excited many students, even those with the most 'technical' interests in programming, was human/computer interaction. Many were excited about the new possibilities for communicating with their friends, and the opportunities they had to 'meet' people online, including people of their own age from other regions and companies. 'it *is* fundamental, it's changing social life', said one student, while another argued that 'now that people work much more on their own in their jobs, people have these whole lives online, with chatrooms and gaming and everything'. Students are keen both to learn about and participate in the social aspects of Computing and IT.

[12] The student's definition of 'relevant' appeared to be extremely narrow, but it would have been inappropriate to pursue this discussion further in the focus group.

3:4:5 Media representations of computer science

Students were aware that media coverage of Computing/IT is generally low compared to the attention given to other scientific areas. This is true both of drama and of documentaries on TV and radio, and also of newspaper and magazine reporting. Areas which they felt were highly represented were forensic science and medicine (in drama), and medicine and health, space exploration, climate science, engineering and 'technology' (in documentaries).

The few news stories which are written on Computing/IT tend to focus on the consumer or business aspects. It was noted that Bill Gates is more famous for being a rich and successful businessman than a talented scientist: 'he's more about money and power than computing'. One student complained that in documentaries and news stories, 'when they get onto computing they take out the science'. Alternatively, Computing/IT is too often portrayed as the site of failures, incompetence, or crime. Students listed scandals, failures, bugs and 'scares' as examples of the former, and hackers, criminals, the 'underground', pornography, spam, spyware, identity theft terrorism and viruses as examples of the second. Students could not think of any examples of positive Computing/IT stories or documentaries, when they could think of any stories at all.

A couple of students identified language issues which contributed to this. 'Part of the problem is the jargon [in Computing/IT]' said one. 'We all understand medical terminology.' Another suggested that the availability of an easy and contemptuous language for computing made things problematic, and might encourage readers to 'switch off'. '[It's] he words the papers use. "And then the geeks/the boffins/t he eggheads"…' he said. Another student suggested that the subtlety of Computing/IT's involvement in daily lives meant that it would be difficult to make viewers or readers engage, initially, with a documentary on this subject: 'It's not obvious when there are computers involved in your life… but we all get ill'.

When CS/ICT students were asked to list ideas for a documentary which might raise general interest in Computing/IT, the following were proposed:

- how computers are involved in a pregnancy
- robotics
- modelling – in various contexts, e.g. climate change, medical contexts
- medical imaging
- artificial intelligence
- computer forensics
- building a computer
- grid technology
- the history of computers
- 'someone who's like Jeremy Clarkson is about cars but about computers'
- how they develop a game
- 'how they actually stopped the Millennium Bug
- social lives online
- "Big Brother" [how computers are used in surveillance and tracking individuals]

It was agreed that the image of Computing/IT which is presented in dramas and films was 'appalling'. Students stated that the focus was rarely on what is actually involved in *doing* Computing/IT, or what Computing/IT can itself offer, but instead on negative and 'lazy' stereotypes of computer scientists. '*The IT Crowd*… it wasn't really about IT, just admin and the stereotypes again' was a comment on the Channel 4 comedy programme which had just aired.

Students felt that the 'geek image' was very strong in media portrayals of computer scientists. 'People like Homer Simpson's college friends or inventor guy' [stereotypical geeks] are the standard portrayals. Comments such as the following illustrate the 'content' of this image in programmes and films which they had seen.

- It's like in every programme you have to have a fat geeky nerd
- Man with a beard
- Someone with really pale skin and huge glasses
- Someone with very low social skills
- Maybe very clever but totally inarticulate
- Someone who never gets a girlfriend or has sex

It was noted that the only 'cool' Computing/IT experts who are shown in drama are the criminals, such as 'hackers… they are cooler because they get drunk and have sex'.

In general, the private lives of Computing/IT professionals are not portrayed as sympathetic or desirable. One perceptive comment was that 'when you see IT people on TV they're not as mainstream as doctors and nurses'.

Several students pointed out that where computer experts are shown in heroic roles, their computing expertise is very much secondary. It was pointed out that the Tom Cruise character in *Minority Report* is an IT professional, but that most people who did not have some sympathy with the subject themselves would fail to spot this. 'He's doing IT but he's not like an IT person,' was how this was expressed by one student.

Student suggested that it would be useful if more of the *process* of computing could be seen in TV and film dramas, giving a more realistic view of processes which are 'miraculously' but tacitly attained through Computing/IT. 'The IT person could… stop the plane crash, decode the bomb device' said one student. Another suggested that 'you could have Bond knowing about computers'. Students were also aware that it was possible to have sensitive and likeable characters who had some of the 'nerdy' characteristics but who were also brave and attractive. 'We need more film heroes, like the guy in *Jurassic Park*… sort of a cute nerd,' was one suggestion. The Jeff Goldblum character from *Independence Day* was also mentioned as a character who bridged this divide.

The content of computing was mentioned as a problem with some media representations. The following comment on a movie which was discussed in most of the groups was typical: 'in something like *The Matrix* it's very futuristic and exciting and the computer people are really clever and all that, but it's also the downside… humans are being ruled by computers'. This kind of storyline may well feed into the 'fear' of computers discussed above.

In addition, many CS/ICT students had noticed that which Computing/IT is fundamental to many storylines, this is often hidden because of the tendency for the 'interesting' characters to leave something to 'the techies' who go away and do the most important work without which the central problem could not be solved. However, these 'techies' are on the screen for very little time – if they appear at all – and may be heavily stereotyped. One student said, rather sadly, 'It's always secondary, IT is always under someone. The interesting people, like the detectives in *The X-Files*, they go and give a load of stuff to the geeks and it's the geeks who do all the work, they provide the information, but it's not them who the focus is on.'

Bibliography

Archer, L. and Hutchings, M. (2000) 'Bettering Yourself'? Discourse of risk, cost and benefit in ethnically diverse, young working-class non-participants' constructions of higher education. *British Journal of Sociology of Education,* 21 (4) 555-574.

BCS (2005). *Final Report from the Women in IT Working Group*. Report presented to the BCS, London

Conner H, Tyers C, Modood T & Hillage J. (2004) *Why the Difference? A Closer Look at Higher Education Minority Ethnic Students and Graduates* DfES Research Report 552

Dwyer, C., Modood, T., Sanghera, G., Shah, B. and Thapar-Bjorkert, S. (2006). Ethnicity as social capital? Exploring the differential educational achievements of young British Pakistani men and women. Paper presented at the 'Ethnicity, Mobility and Society' Leverhulme Programme Conference, Bristol, March 2006. Available at: www.bristol.ac.uk/sociology/leverhulme/conference/conferencepapers/dwyer.pdf

Elias, P., Jones, P. (2004) *SET and UK Ethnic Minorities* Report presented to the Royal Society

ETB/National Foundation for Educational Research (2005). *Factors Influencing Year 9 Career Choices.* Engineering and Technology Board, London

Reay, D., David, M. and Ball, S. (2005). *Degrees of Choice: Social Class, Race and Gender in Higher Education*. London: Trentham Books

Turner, E. (1999). Gender and Ethnicity of Computing - Perceptions of the Future Generation. Paper presented at Ethicomp 1999 (Rome). Abstract available at: http://www.ccsr.cse.dmu.ac.uk/conferences/ethicomp/ethicomp99/abstracts/turner.html