The Swing to Science: Retrospects and Prospects

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About the author

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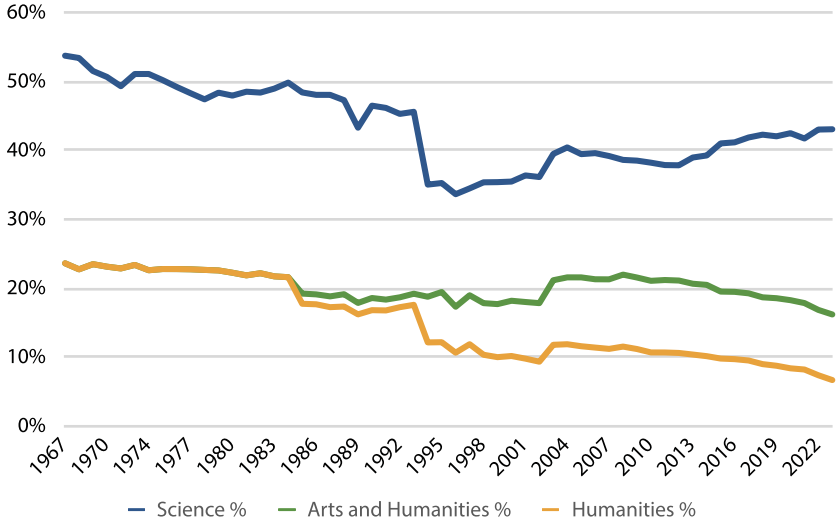
The Swing to Science: Retrospects and Prospects

A significant inflection in historical trends in higher education began about a decade ago but has been relatively little acknowledged or analysed.

After nearly 50 years of decline, the share of STEM (Science, Technology, Engineering and Mathematics) of all first degrees in the UK began to grow. Having declined from 54% in 1967 to 38% in 2012, the STEM share has risen to 43% in 2023 (about where it was in the mid-1990s (see Figure 1).

Figure 1 Share of all first degrees in the UK for STEM and Arts and Humanities, 1967 to 2023



Data from *Education Statistics for the UK* (1967 to 1978), *Statistics of Education*, Volume 6 (1979), *Universities' Statistical Record*, Volume 1 (1980 to 1992), HESA, *Higher Education Statistics for the UK* (1993-1997), HESA online statistics (1998 to 2023). For historical reasons, Architecture is classified as social studies, not STEM. The data for 1994 to 2003 are anomalous; after recategorisation of the polytechnics, statisticians classified more degrees as 'combined' (omitted from these data), but by 2004 classification had reverted more or less to its 1993 position, as suggested by the straight line that can be drawn between 1993 and 2004. Degrees in social studies have been omitted from the figure for clarity's sake; they account for most of (and a generally growing share of) the remainder. Arts and humanities maintain their level only because creative arts subjects enter the degree category, as seen in the gap that opens up between arts and humanities and humanities only.

If this major inflection has gone relatively acknowledged, that may be because pundits and politicians have been predicting it almost continuously since the 1960s.

If it has gone relatively unanalysed, that may be because of a set of ingrained assumptions about what determines subject choice:

i. that economists tend to assume that education provides the engine of economic growth (an assumption that Alison Wolf has called 'the great secular faith of our age')[1];
ii. that individuals (even 13-year-olds) make optimal decisions to maximise their future returns; and
iii. that, generally, STEM degrees maximise income (and where this does not happen, the problem lies in imperfect information).

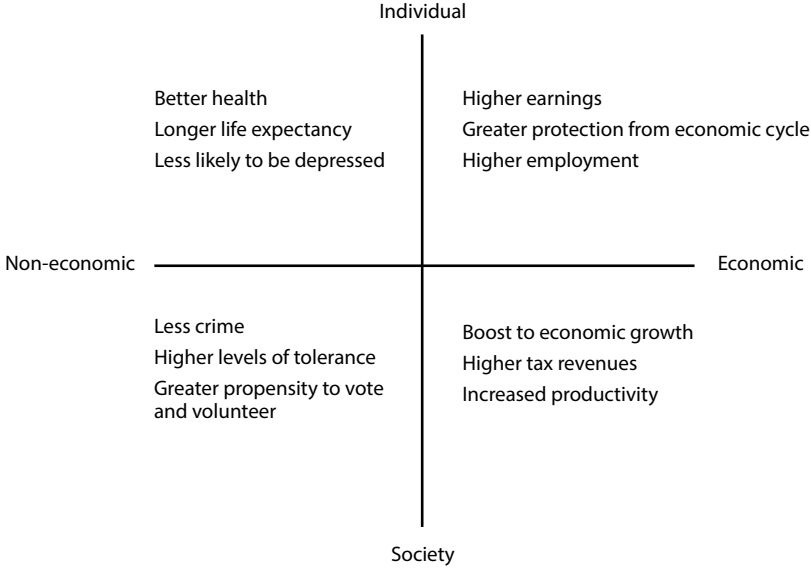
These views have become more or less hegemonic – how hegemonic may be seen in David Willetts' presentation in office and out of the benefits of higher education. In office, Willetts was very attracted to the idea that there were 'four quadrants' of benefit, pecuniary and non-pecuniary, social and individual, a scheme which appeared in a 2013 Business Department research paper and which he later reproduced in his book on higher education policy (see Figure 2).[2]

Yet in the discussion in the text, Willetts devotes four pages to non-pecuniary and 12 pages to pecuniary benefits, and most of the latter to individual pecuniary benefits. Fittingly, one of his lasting contributions to education policy will be the LEO [Longitudinal Employment Outcomes] database, designed to give young people precise information about the individual pecuniary benefits of choosing specific degrees in specific institutions in specific subjects (or at least about what benefits were available to the previous generation).[3]

Perhaps surprisingly, sociologists have often accepted the same set of assumptions, though their interests and values lie elsewhere. Taking as the measure of education its high individual pecuniary return, they are interested in explaining how individuals' returns stratify according to class or gender or ethnicity or some other ascribed characteristic productive

of inequality, in the tradition of the French sociologist Pierre Bourdieu. Sometimes they do ask students – relying not only as economists prefer on observed behaviour, but believing that reported behaviour can give insights into motivation and thus outcomes – what subjects they find 'interesting' or 'difficult' or 'useful'. The answers they glean are not often used to plumb the mechanisms of subject choice but more often to show how inequality is constructed via differential levels of taste or aptitude.

Figure 2 The four quadrants



David Willetts, *A University Education*, 2017, p.123

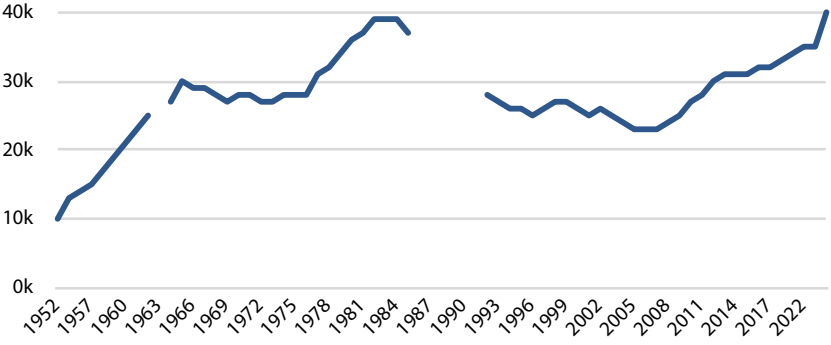
In this paper, I consider the years of STEM decline from the 1960s to the 2000s, a period in which contemporaries were aware early on of a 'swing away from science', but soon lost interest in explaining it. I then turn to the years of STEM growth (a 'swing to science') and to the particular circumstances that triggered this inflection. It will be seen that the drivers of decline were very different from the drivers of growth, as much depends not only on the stock determinants of economic rationality and structural

inequality but also on the social and cultural context and young people's perceptions of that context: in short, as the sociologist of education Diego Gambetta aptly put it, 'a dense combination of mechanisms', compounded 'of what one can do, of what one wants to do and, indirectly, of the conditions that shape one's preferences and intentions'.[4]

The 'swing away from science' was a major topic of public discussion in the late 1960s and still into the 1970s.[5] At a time when rapid educational expansion was expected to yield rapid economic growth, policymakers of all parties were disappointed to find that expansion was yielding a lower relative share of science qualifications: and in some cases, a lower absolute number.

In England, for example, the total number of Physics A Levels peaked in 1965, levelled off to 1977, grew for a time, and then fell, not reaching 1965 levels again until 2012 (Figure 3) – quite a feat given how many more A Levels were being taken overall.

Figure 3 Number of Physics A Levels



Data from *Statistics of Education*, Volume 2 (1961 to 1979, with historical statistics from 1952), *Statistics of School Leavers, CSE and GCE* (1980 to 1985), *Statistics of Education, Public Examinations GCSE and GCE* (1992-2000), online: GCE / Applied GCE A / AS and Equivalent Examination Results in England, 2009/10 (Revised) (2001-2010), Subject Time Series Tables 2014/15 (2011 to 2015), A Level and other 16-to-18 results (2016 to 2022), Joint Council for Qualifications: https://www.jcq.org.uk/examination-results/ (2023/24). Passes only to 2022; entries from 2023 (by which point very little difference)

A major government enquiry was set up to investigate the causes of the swing and what could be done to reverse it. This reported in 1966 and 1968, basing itself largely on the research of Celia Phillips, who played the role that Claus Moser had played for Lionel Robbins in his famous 1963 report on the expansion of higher education. Further enquiries ensued in government and academia through the 1970s.[6]

Among the explanations mooted for the 'swing', an early favourite was England's early-specialisation system, but this was soon discarded as it became clear first that Scotland's later-specialisation system and then that most of Europe's systems were subject to the same swing. A more durable explanation lay in the transformation of the labour market due to deindustrialisation and a shift to a 'knowledge economy', with a growing share of jobs in services and in the public sector, and a growing share of graduate jobs held by women, who were underrepresented in the sciences. But the clearest impact came from compositional and cohort effects. New entrants came from less traditional academic backgrounds; they were more attracted to degree-level subjects that were not taught in schools (less traditional and less dependent on prior attainment); they were from the 1980s increasingly likely to be women.

Behind many of these shifts lay other ones, harder to measure, but also observable to contemporaries: changes in the culture of young people away from 'doing' to 'feeling', critiques of the irresponsibility of science and technology (from heart transplants to nuclear weapons), ideals of social service and social responsibility (also linked to established gender roles and jobs in the public sector). Nicely, many of these explanations were cited in answers given to a question about the causes of the swing posed in a 1969 General Studies A Level examination: many candidates opined that the sciences were boring, had a bad public image and lacked opportunities for self-expression, whereas the arts, at least for girls, reflected 'their desire to help the community directly through social action'.[7]

As the swing continued to the end of the twentieth century, these motivations were reflected too in the new subjects – neither sciences nor arts – that more entrants were taking at degree level: generally, those subjects that tend to be grouped together as 'social studies', including

Business, Law, Media and Communications, and the social sciences (but not Psychology which is classified as a biological science for degree purposes). In 1967, sciences and arts between them accounted for over three-quarters of all degrees; by 1990, under two-thirds; since 2010, about 59%. Most of the rest were social studies.[8] Only one major new subject area came under the aegis of the sciences and the arts: 'subjects allied to medicine' (such as Nursing, Nutrition, Pharmacology, Ophthalmology) in the former case, 'creative arts' (Art, Design, Performing Arts) in the latter. These recruits did not avert either the swing away from science or the rise of social studies.

As Figure 1 shows – allowing for the statistical anomaly of many unclassified degrees between 1993 and 2003 – the swing away from science continued until 2012, when the share of science degrees reached its low point of 38%. If we do not count Psychology, the share was lower still at 34%, also at its lowest point in 2012. Since then it has crept up to 43% (38% without Psychology). Why has this happened?

The answers we have gleaned for the period of the swing away will not do for the swing to science. Participation has continued to grow year on year.[9] The proportion of first-degree recipients who are women has remained stable at around 57%. No major new subjects have been introduced.

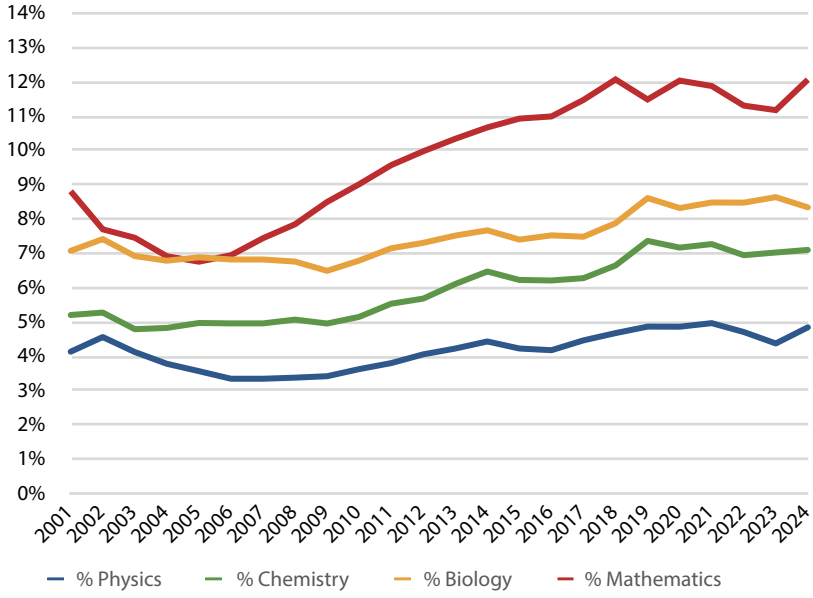
To come up with answers specific to our period, we can start by identifying more clearly when and where the swing to science began. If the first year of increase in STEM share of first degrees was 2013, then the relevant cohort is (except for Scotland) that which had chosen their A Levels in 2008/09. Figure 4 shows the performance of some key STEM subjects at A Level.

The most remarkable feature is the strong performance of Maths from as early as 2006.[10] A growing pool of Maths-ready university applicants has clearly already prepared them for some (if not all) STEM courses at university. Their number and share continued to grow strongly until 2018 at least: from 7% in 2005 to 12% today.

Other science subjects have enjoyed steady but much slower increases, starting a few years later, around 2010. As we have seen, this steady growth finally lifted absolute numbers of Physics students above their previous

historic high, though with a much smaller share as the total number of A Levels has grown considerably. Each of the major science subjects has gained a few percentage points in share.

Figure 4 Share of A Levels in selected STEM subjects



Data from Joint Council for Qualifications: https://www.jcq.org.uk/examination-results/. Note that these data differ from those in Figure 3: they are UK not England totals, and entries rather than passes throughout

One further wrinkle must be introduced before we move on to explaining this swing over the longer time frame now established. The upward inching of STEM A Level entries would not have been possible, at least at the beginning, if it were not for one key policy change that was applied between 2008 and 2012. From the late 1980s, when GCSE replaced O Levels in the UK outside of Scotland, an option became available to take not only the traditional 'triple science' (separate GCSEs in Physics, Chemistry and Biology) but also 'double' science, that is, exams that amalgamated the conventional disciplines. Most schools took up this offer even though double science was not widely viewed as good preparation for the separate

Physics, Chemistry and Biology A Levels, and thus for degree-level study of science. Although the shift from O Levels to GCSE led to many more entries overall, the move away from 'triple science' undoubtedly contributed to some continued decline in Physics and Chemistry, though it did not impede continued growth in Biology.[11]

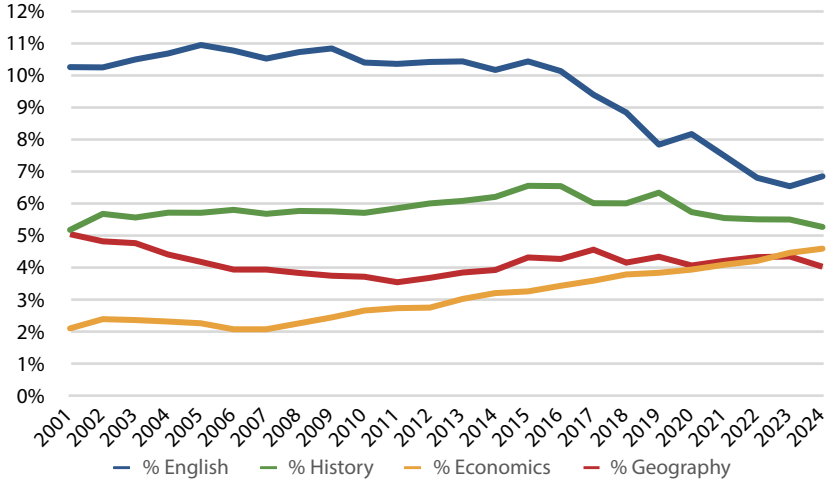
There were many many attempts to boost qualifications in science without success during the long decline, but at this point – around 2000 – one intervention did make a difference. Alerted to the diluting effects of 'double science', Gordon Brown began encouraging state schools to offer their students 'triple science', setting targets from 2004 and then from 2006 requiring all schools to offer triple science at least to their high attainers. The proportion of pupils offering triple science surged upwards from about 5% to about 25% between 2006 and 2014.[12] This is one policy that can be shown to have had a direct effect. From the late 2000s there was a larger pool of students whose GCSE attainment qualified them to progress to science A Levels and degrees. The New Labour Government also had schemes to encourage that greater take-up at these higher levels, but it is harder to discern with the data available if they had any similar direct effect.[13] And the boost provided by triple science was a one-off. The proportions of students offering triple science peaked around 2011 and have since levelled off, whereas as we have seen the proportions offering science subjects at A Level continued to rise until 2018 and the proportions taking science degrees continues to rise slowly to the present.[14]

Given these patterns and the available data, what explanations can we provide? One explanation that caused much consternation at the beginning was the introduction of 'Curriculum 2000', breaking up the two-year linear A Level course into a modular course divided into 'AS' qualifications in Year 12 and the full A Level in Year 13. There were high hopes for it (broadening the curriculum, delaying specialisation) and brooding misgivings (dumbing down, discouraging sustained and difficult work, seen as potentially damaging to Maths). As we have seen, however, the AS / A split did not make much difference to uptake, either for Mathematics (which began its rapid upswing a few years after the introduction of Curriculum 2000) or for other science subjects.[15] Broadening could be a good in its own right, as most students took four or five subjects at AS before narrowing down to

three at A Level; but delaying specialisation does not seem to have affected subject choice at A Level or degree level much.

Conversely, when AS Levels were virtually abolished in 2015 and the linear two-year A Level essentially restored, little obvious change registered: as Figure 4 showed, the share of science subjects continued to rise until 2019 though it has since levelled off; as Figure 5 suggests, not many non-STEM subjects seem much affected either. Again, the loss of some breadth may be regretted for its own sake: now that they have reverted from four or five subjects to three, more students are studying only subjects from one major group, and given the swing more are studying only STEM. But it is not evident that the reduction in number of subjects has affected much the general picture of subject choice at A Level or degree level.[16] Much the same could be said about the English Baccalaureate (EBacc), introduced in 2010: though it may well have had other beneficial effects, the EBacc itself does not seem to have influenced subject choice across the major subject groupings.[17]

Figure 5 Share of all A Levels of selected non-STEM subjects



Data as in Figure 4. 'English' combines English Language, English Literature, and English Language & Literature.

Before moving on to other more plausible explanations for the swing, it is worth considering briefly one subject which did show a sudden drop-off from 2015: English. Two enquiries by English subject specialists acknowledged that the end of AS Levels had concentrated minds but also that this necessarily affected all subjects, and the question remained why English alone had suffered a dramatic fall in A Level take up. The factors they considered significant were a growing emphasis on STEM subjects in school and the changed nature of the GCSE English exams that had also been introduced in 2015, seen to have become 'narrow and dull' and 'terribly boring'.[18] These surveys arise from talking to teachers and students and they tell us things that even the most sophisticated manipulation of official statistics cannot. At the least, conclusions based on the latter should be paired with plausible mechanisms that explain how teachers and students (and parents) might have registered the changes around them and translated these into subject choices.

From the data we have looked at so far, we can sketch out a rough scenario. Before 2000, there had been a long slow decline of both 'traditional' subject groups at degree level – science and humanities – but the latter's overall share had been buoyed up by the addition of creative arts; the sciences continued to decline at degree level until 2012. The chief beneficiary had been a range of social studies. Something began to change in the 2000s. Maths became much more popular as a school exam subject. The Government encouraged students not to foreclose their options to take up science after GCSE. Then around 2009/10 most of the A Level indicators for STEM took an upturn – even for the longtime laggard, Physics – and most of the A Level indicators for arts and humanities took a downturn. The inevitable knock-on effect was the upward inflection point for STEM degrees from 2013.

What changed minds and choices? One obvious answer is, after decades of public discussion and worry, belatedly changing gender roles. Girls who had long felt excluded from science and Maths were finally taking them up in numbers commensurate with boys.[19] Girls who formed only about 40% of the cohort taking triple science at GCSE in 2001 had reached parity by 2021. There was a parallel but smaller shift at A Level: Biology up from 62% to 64% female, Chemistry up from 50% to 55% female, but Maths still

lagging behind, up from 37% to 39% female, and Physics hardly budging from 22% to 23% female.[20] By the time we get up to degree level, where the proportions of women science graduates notched up only 1 percentage point to 53% during the swing to science in the 2010s – a majority owing mostly to Psychology and subjects allied to medicine – we can see that the shift in gendered take up of STEM made only some contribution to the swing.

This part of the swing is evidently a compositional effect, but not the much bigger compositional effects registered in the swing away from the 1960s to the 2000s, which were shaped by the dramatic expansion of A Levels and degrees over that period. Nor is it a change in the gender composition of the whole cohort – which has remained fairly stable – but rather a change in the gender composition of the STEM portion of the cohort. There have been other compositional changes since 2000 – as noted, participation in A Levels and degrees continues to grow, slowly – but none of these has had much effect on subject choice except for a change in the ethnic composition of the cohort.

At A Level, the proportions of the cohort made up of three large ethnic-minority groups – South Asian, Black and 'mixed ethnicity' – has swelled from 15% in 2008 to 25% in 2022 (15% Asian, 6% Black, 4% mixed), and their share of STEM A Levels has risen from 16% to 32%. In other words, the growing proportions of ethnic-minority A Level takers has contributed to the swing. If we break their subject choices down further, we find that Asian students take 28% of Chemistry, 23% of Economics and 22% of Biology A Levels; Black students take 10% of Sociology and 9% of Economics A Levels. So Asian students are contributing more to the swing to science, Black students to the swing to social studies.[21] At degree level, these concentrations can be larger still: today, when 13% of undergraduates are Asian and 8% Black, Asian students provide 44% of Pharmacy, 41% of Dentistry, 33% of Medicine, 23% of Computer Science and 18% of Engineering and Law, while Black students comprise 32% of Mental Health Nursing students, 18% of Adult Nursing and 15% of Social Work and Pharmacy.[22]

These compositional effects, it should be noted, are not static but reflect social change: women are now more likely to study science, Asian and

Black students are more likely to study science or social studies and are now more numerous. As sociological studies have shown for gender difference, these groups may have different ideas about their likely 'self-efficacy' in specific subjects, they come under different parental pressures, they have different ideas about the intrinsic and extrinsic value of subjects and different capacities and aspirations. But these differences are constantly in flux under the pressure of wider social and economic changes, which may affect all students, albeit different groups in different ways.

Around 2009/10, two major disruptions do seem to have shifted attitudes for all students: the global financial crisis of 2007 to 2009 and the trebling of the undergraduate tuition fee cap in England to £9,000 a year announced for 2012. It is difficult to decompose these two effects and perhaps not necessary.[23] Undoubtedly they made young people – and their parents, and probably their teachers – more sensitive to future income prospects. People worried about taking on debt during education and getting remunerative employment. Perhaps more important than specific worries (worries about debt, for example, did not slow the continued growth of higher education participation in the 2010s) was the way in which the 'double shock' of these two effects in general sharpened anxieties about economic wellbeing.

Surveys have shown that 'Millennials', those born between 1980 and 1995 and typically entering higher education between 1998 and 2013, were more pessimistic about economic prospects than the cohorts before or after them; the latter, 'Generation Z', who were born from 1996 onwards and entered higher education from 2014, are less directly scarred by the effects of the 2007 to 2009 crisis but seem to have inherited some of the Millennials' anxieties about insecurity.[24] Studies before and after the crisis, though not strictly comparable, suggest a distinct sharpening of focus on employment prospects among students and their parents at the point when school subject choices are made.[25]

These anxieties do not necessarily have to translate into choices for science.[26] As we have seen, Asian, Black and female students have all responded in different ways, some favouring specific science subjects, other specific social studies subjects. Psychology – which at least stands on the borderlands of science and social studies – has been the fastest growing subject this century, its share of A Levels more than doubling

to 9%, but it has been growing steadily at A Level and degree level since the late 1960s, mostly among girls and women. It has thus been capable of expressing a wide variety of aspirations: for 'feeling' over 'doing'; for better understanding of self and society[27]; for girls' traditional aspirations to social service; for girls' newer career aspirations; and latterly for girls' greater concentration on vocationalism and security of employment.[28] But prevailing discourses in society – going back well before the current century – tend to push them in the direction of science, which is always uppermost in the minds of policymakers.

Attentive readers of Figure 1 will have noticed that the only previous spell of enhanced science degree uptake occurred in 1979 to 1984, a period of heightened anxiety about employment prospects.[29] Observers of the Mathematics upswing from 2005 certainly credited deteriorating economic prospects after 2008.[30] Some 'social studies' subjects associated with high returns in the public mind – such as Business and Law – have also enjoyed rapid absolute growth at degree level since 2010 (40% to 50%, like science), and Economics has nearly doubled. The real outlier is the humanities, which have shrunk by 20%. Note in contrast that creative arts, which are thought to carry the lowest income return, have grown by 17%.

The Futuretrack study, which followed a cohort applying to university in 2005, and was caught unawares by the global financial crisis, found that arts and humanities graduates in 2012 were least satisfied with their degree choice as preparation for employment; those with the most vocational goals and those with high-level skills in subjects like Engineering and Technology, subjects allied to medicine, Maths, Computer Science and Education were the most satisfied. As it happens STEM graduates experienced more post-2008 disillusionment about their degree subject than others; they had made their subject choices with higher expectations that they would be useful for their careers and only about a quarter of them entered jobs that had any discernible need for STEM skills. Arts and humanities graduates had gone into the job market with fewer illusions to lose. But this retrospective view is not the prospective view of teenagers making their subject choices at 16 and 18.[31] Since 2012, entrants may be more focused on employment but they may also encounter greater disillusionment subsequently: we need qualitative studies to follow up on Futuretrack for post-2008 cohorts.

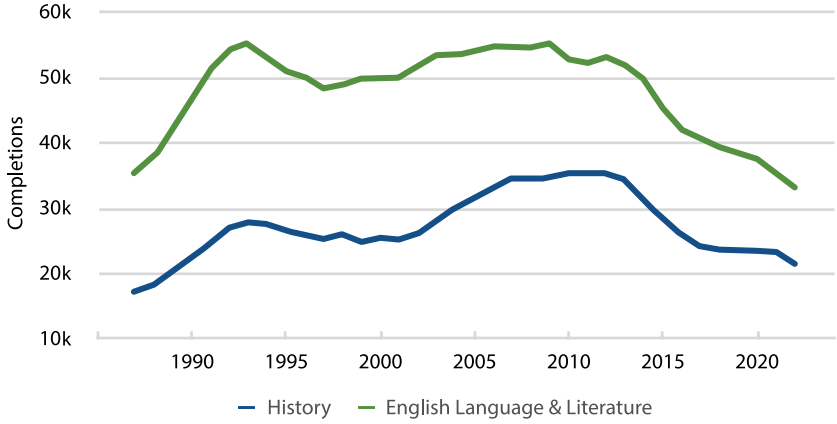
Much more speculatively, we might consider the impact of the digital world which began to impinge ever more persistently on young people's lives especially in the 2000s. It is not implausible – though no evidence has been cited in the literature on Maths education or indeed on subject choice – that the surge in Maths in the mid-2000s stemmed from a growing sense that Maths was of greater use in the digital world, perhaps the exam accompaniment to the fads for teaching coding (not itself an examined subject) in schools. Similarly, it is not implausible that the sharp decline in English from the mid-2010s stemmed from a growing preference for digital products over longer-form texts. But note the different timings of these two trends and their surprisingly sharp onsets. Although these factors are difficult to connect closely to subject choice, there is probably survey evidence to be had from elsewhere about young people's changing attitudes in this period to literacy and numeracy which further work might apply to explanations of the examination trends.

Some of these effects came directly from 'policy' – certainly the one-off bump from triple science, possibly the impact of tuition fees (but see the final section) – but mostly they came from changes only loosely related to policy if at all: changes in gender roles and ethnic-group behaviours, perceptions of economic insecurity and of subject choices that might address insecurity, perceptions of utility in the digital world, generational effects and also peer-group effects (which might cumulate once the ball gets rolling: for example, if the number of Maths students starts to grow, subsequent cohorts might model themselves on their elders). These are all hard to measure or even to detect, but just as the cultural 'weather' accelerated the swing away from science in the late 1960s, so the swing to science is surely being influenced by today's weather in ways that we are only just finding a vocabulary to fathom. It is understandable that social scientists prefer to assess policy – that is what policymakers pay them to do – but if they only assess policy they are missing important things.[32]

Finally, as an epilogue, a brief comparative note that might shed some further light. The swing to science is an international phenomenon, just as the swing away was in the 1960s.[33] The global financial crisis affected everyone. Government policies everywhere also tend to promote STEM – though that has been true since the 1960s at least, and the questions I

raise here aim to focus on why these policies did not work before 2010 but seem to be working now. In the United States, humanities degree numbers have been dropping even more rapidly than in the UK, and History quite as rapidly as English (Figure 6).

Figure 6 Number of first degrees in the Humanities (USA), 1987 to 2022

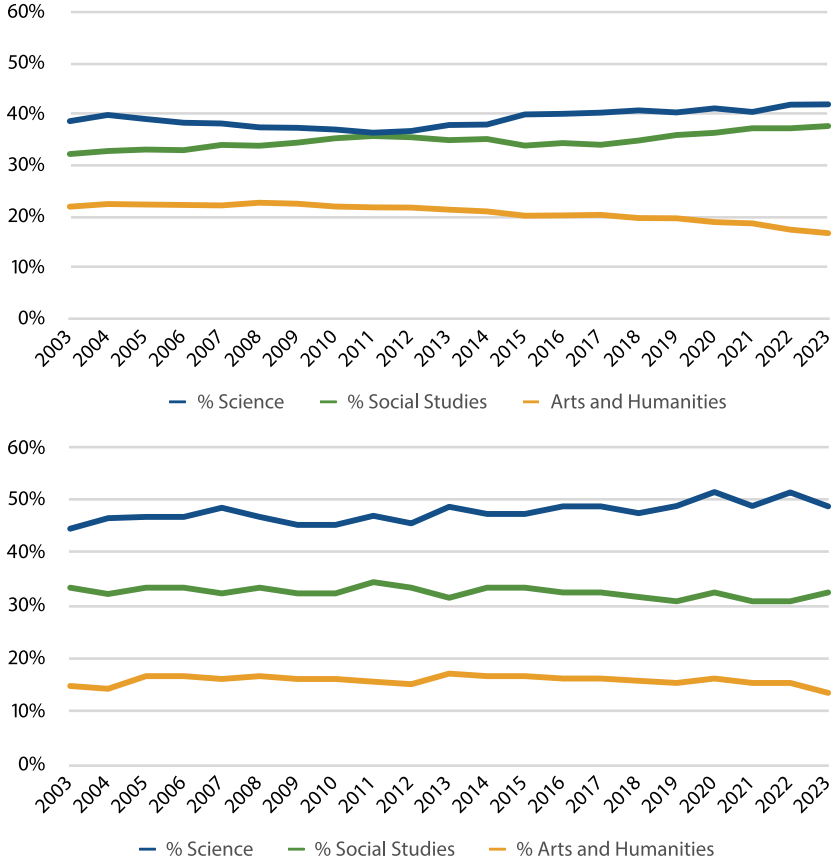


Data from Humanities Indicators, https://www.amacad.org/humanities-indicators/figure/ii-03d-humanities-bachelors-degree-completions-discipline-1987-2022, with History and English isolated to show the steepest declines

No doubt in both the US and the UK the sharper consideration of income returns since the global financial crisis have disadvantaged both these major humanities disciplines. But why has English suffered so much more in the UK? Or would it be more accurate to ask why has History not suffered as much as in the US? The observed effects of curricular change on English A Levels may well be the culprit. But in neither case was a sudden tuition fee hike – not relevant in the US – a factor.

And then there is Scotland. All of the above data for degree subjects apply to the entire UK; the A Level data necessarily are confined either to England or to the UK excluding Scotland, which has a different, somewhat less specialised school exam system. Figure 7 decomposes English and Scottish degree subjects to see whether the swing to science occurred in both places at the same time or to the same extent. The answer is no.

Figure 7 Shares of the major subject groups in England (above) and Scotland (below), 2003 to 2023



Data from HESA online statistics: 'Students in Higher Education Institutions', Table 14 (2003 to 2019), Table 18d (2010 to 2016), extracted from Heidi+ by University of Cambridge (2017/18), https://www.hesa.ac.uk/data-and-analysis/students/outcomes (2019 to 2023)

The trends in Scotland are flatter. The humanities start out at lower levels but do not show much change over time. The sciences start out at higher levels and benefit from a similar swing over the whole of the period, but without a clear inflection in 2013, and social studies do not show any

benefit at all. Scotland did not experience 'Curriculum 2000' or high tuition fees; its subject choice patterns seem less amenable to change, and even the changing economic climate does not seem to have had the same effect as in England.[34] Still, there has been a perceptible swing to science. These national differences remind us that while the swing to science is international, its timing, drivers and scale are not.

What overall lessons are there in these trends for education policy?

First, policymakers should be (this does not mean they will be) more modest about their ability to avert or even alter changes in subject choice driven by strong demographic and cultural forces beyond their control, even indirectly. That lesson applies so long as the UK persists in its long tradition of liberalism in curricular policy: decentralising curricular control and maximising subject choice. Before the age of 16, England's National Curriculum and its equivalents in the other three nations have been loose and permissive (and at the time of writing not even compulsory for most English secondary schools). Post-16, multiple exam boards and a rich palette of subjects offered at GCSE, A Level and degree level have maximised choice with few restrictions. French educational policy which is more centralised and less permissive has given France's policymakers more tools than the UK's liberal traditions have allowed.

Secondly, policy changes work best when they are aligned with, or work within, those powerful demographic and cultural changes (which therefore need better specification than some of the standard class, gender and ethnicity categories afford). For example, a government initiative from 2005 to promote 'Strategically Important and Vulnerable Subjects' (SIVS) – which included both sciences and modern languages – seems to have had little impact on either until the swing to science helped the former although not the latter. As one report on this initiative granted in 2011, it was difficult – to say the least – to disaggregate changes on the demand and supply sides, especially when the initiative's supply-side interventions were so modest in scale (eschewing, as it said, 'heavy-handed market interference').[35]

Finally, quite apart from the doubts that might arise about the effects of over-promoting STEM (doubts about labour-market demand and value, and about steering students away from subjects where they are happiest

and do best), policymakers who do wish to promote STEM would be well advised to acknowledge that at present student demand is doing their work for them. That might leave more headspace for problems which are going in the wrong direction and are more amenable to policy solutions.

Endnotes

1 Alison Wolf, *Does Education Matter? Myths about Education and Economic Growth*, May 2002, p.x.

2 Janette King and Charles Ritchie, *The Benefits of Higher Education Participation for Individuals and Society: key findings and reports, "The Quadrants",* BIS Research Paper No. 146, October 2013 https://www.gov.uk/government/publications/benefits-of-participating-in-higher-education-key-findings-and-reports-quadrants

3 David Willetts, *A University Education*, 2017, p.38, and cf. pp.39-40 for his subsequent criticisms

4 Diego Gambetta, *Were They Pushed Or Did They Jump? Individual Decision Mechanisms in Education*, 1987, pp.168-69. This exemplary study of educational motivations (in Italy) has not been as influential as it should have been. See also Ross Finnie, 'Does culture affect post-secondary education choices?', *Higher Education Management and Policy,* Volume 24, Issue 3, February 2014, pp.57-85 https://www.researchgate.net/publication/270461452_Does_culture_affect_post-secondary_education_choices

5 This section draws on my previous work on subject choice: 'The Two Cultures Revisited: The Humanities in British Universities Since 1945', *Twentieth-Century British History*, Volume 26, Issue 3, 2015, pp.400-423 https://www.repository.cam.ac.uk/items/70d041df-cc51-4df8-8c21-a3ca10164d95; 'Educating the Nation: IV. Subject Choice', *Transactions of the Royal Historical Society*, Volume 27, December 2017, pp.1-27; *The Crisis of the Meritocracy: Britain's Transition to Mass Education Since the Second World War*, 2020, Chapter 8; 'STEM Subjects and the "market" in education since the 1960s', *History & Policy* Opinion Article, 3 September 2020 http://www.historyandpolicy.org/opinion-articles/articles/stem-subjects-and-the-market-in-education-since-the-1960s

6 The Dainton Reports, i.e. Council for Scientific Policy, *Enquiry into the Flow of Candidates in Science and Technology into Higher Education* (1965-1966 Cmnd. 2893) and (1967-1968 Cmnd. 3541); Celia M. Phillips, *Changes in Subject Choice at School and University*, 1969; the last major study in this tradition was Derek Duckworth, *The Continuing Swing? Pupils' Reluctance to Study Science,* 1978. After this the issue attracted little or no attention until sociologists and educationalists began to query the underrepresentation of girls and women in science, in a Bourdieusian tradition, from the 1980s. But see also Andrew Stables, *Subjects of Choice: The Process and Management of Pupil and Student Choice*, 1996, and Cristina Iannelli and Emer Smyth, 'Curriculum Choices and School-to-Work Transitions Among Upper-Secondary School Leavers in Scotland and Ireland', *Journal of Education and Work,* Volume 30, 2017, pp.731-740

7 Derek Duckworth, *The Continuing Swing? Pupils' Reluctance to Study Science*, 1978, p.32

8 Excepting only Education (which could conceivably count in any of the three main subject groups) and, outside of the 1993-2003 anomaly discussed above, a small number of uncategorized 'combined' degrees

9 It is difficult to document this from government statistics, which have changed the measure they use from HEIPR to CHEP, but the latest release (only from 2022) asserts that 'the 18-year-old participation rate has increased for every cohort since 2010/11': https://explore-education-statistics.service.gov.uk/find-statistics/participation-measures-in-higher-education

10 The data here are for 'single' Maths, which is taken by everyone who also takes 'Further Maths'. Nearly all the commentary on the uptake of maths in upper-secondary education has focused on how far it lags behind other countries (many of which make it compulsory to 18), and very little attention has been paid to the growth in share from 7% to 12%.

11 Unlike the decline in entries for Physics and Chemistry A Level, the number of entries for Biology increased 50% between 1985 and 2000. Alan Smithers, *GCSE Trends 1988-2016*,

2015, pp.11-12, exaggerates the scale of the decline by not counting 'double science' as a science entry at all and thus also misses the fact that 'double science' did not prove a barrier to A Level Biology. See further Becky Francis et al, 'An exploration of the impact of science stratification in the English school curriculum: the relationship between "Double" and "Triple" Science pathways and pupils' further study of science', *Research Papers in Education*, Volume 40, Issue 1, November 2023, p.14 https://www.tandfonline.com/doi/full/10.1080/02671522.2023.2283417

12 Louise Archer et al, 'Stratifying Science: A Bourdieusian analysis of student views and experiences of school selective practices in relation to "Triple Science" at KS4 in England', *Research Papers in Education,* Volume 32, Issue 3, August 2016, pp.296-315 https://www.tandfonline.com/doi/full/10.1080/02671522.2016.1219382; Stijn Broecke, 'Does offering more science at school increase the supply of scientists?', *Education Economics,* Volume 21, Issue 4, September 2011, pp.325-342 https://www.tandfonline.com/doi/full/10.1080/09645292.2011.585044; Matt Homer et al, 'Sources of differential participation rates in school science: the impact of curriculum reform', *British Educational Research Journal,* Volume 39, Issue 2, January 2013, pp.248-265 https://bera-journals.onlinelibrary.wiley.com/doi/10.1080/01411926.2011.635783

13 See the Roberts Report, *SET for Success: the Report of Sir Gareth Roberts' Review – The supply of people with science, technology, engineering and mathematics skills,* HM Treasury, March 2002, especially. p.2, pp.7-9, pp.23-24, p.73 https://www.employment-studies.co.uk/resource/set-success-report-sir-gareth-roberts-review

14 The share of all GCSEs done as single sciences trebled from 1% each to 3% each and remains today at about 3% each, with Biology edging up to 3.3%

15 It could be that greater exposure to Maths at AS Level eventually showed more young people that they could tackle Maths at A Level, but the years of Maths' upswing – 2007 to 2018 – do not match up very well with this possibility, and the gentler upswings for the sciences match up even less well

16 This is the main thrust of a recent report (on whose advisory board I sat), Michael Scott et al, *Subject choice trends in post-16 education in England: Investigating subject choice over the past 20 years,* National Foundation for Educational Research for British Academy, August 2024 https://www.nfer.ac.uk/publications/subject-choice-trends-in-post-16-education-in-england-investigating-subject-choice-over-the-past-20-years/. Note in Figure 11 that the proportion taking only science starts to rise as one would expect from 2008/09, though naturally accelerates from 2015 when students start taking fewer subjects overall (dropping their 'extra' or enrichment subjects from other groups). The proportions taking individual subjects generally follow the trends as the slightly different data I assemble here

17 James Lloyd and Evie Matthews, 'Stepping Stone: the future of the EBacc and student progression', March 2022 https://www.aqi.org.uk/publications/stepping-stone-the-future-of-the-ebacc-and-student-progression/

18 English Media Centre, *EMC Survey: Significant drop in numbers taking A Level English subjects*, November 2017 https://www.englishandmedia.co.uk/blog/emc-survey-significant-drop-in-numbers-taking-A-Level-english-subjects/; English Association, *Working Group on GCSE English Reform*, July 2024 https://englishassociation.ac.uk/working-group-on-gcse-english-reform/. See also Mary Curnock Cook and Christoffer Fogtdal, *A Level Analysis 2019: Blood Pressure Alert for English and Mathematics*, HEPI Blog, 21 August 2019 https://www.hepi.ac.uk/2019/08/21/A-Level-analysis-2019-blood-pressure-alert-for-english-and-mathematics/

19 A similar effect has been observed by Ben Schmidt for the United States, but much earlier in the 1970s and 1980s and to the benefit of social studies rather than sciences: Ben Schmidt, 'A Crisis in the Humanities?', *The Chronicle of Higher Education,* 10 June 2013 www.chronicle.com/blognetwork/edgeofthewest/2013/06/10/the-humanities-crisis/

20 See further Jennifer DeWitt et al, '15/16-Year-Old Students' Reasons for Choosing and Not Choosing Physics at A Level', *International Journal of Science and Mathematics Education,* Volume 17, June 2018, pp.1071-1087 https://link.springer.com/article/10.1007/s10763-018-9900-4

21 This data derives from online appendices to the NFER report, *Subject choice trends in post-16 education in England*, in Dashboard 1, available at https://www.thebritishacademy.ac.uk/publications/subject-choice-trends-post-16-education-england/

22 This data derives from HESA statistics on current undergraduate numbers in 2022/23 broken down by subject and ethnicity, available at https://www.hesa.ac.uk/data-and-analysis/students/what-study/characteristics

23 Economists have tended to focus on the tuition fee hike, partly because it is a policy, partly because it can be costed; they less often take into account the contemporaneous shock to attitudes caused by the economic crisis

24 Ipsos, 'Generation Z - do they exist and what influences them?', January 2023 https://www.ipsos.com/en-uk/generation-z-do-they-exist-and-what-influences-them

25 Cf. the enjoyment and interest emphasized by the Futuretrack project before 2008, for example Kate Purcell et al, *Applying for Higher Education: the diversity career choices, plans and expectations: Findings from the First Futuretrack Survey of the 'Class of 2006' applicants for Higher Education*, March 2008 https://warwick.ac.uk/fac/soc/ier/news/wfreport0408.pdf, with the 'consistent picture of subject choice as overwhelmingly driven by future plans related to jobs or university' found by the Aspires project afterwards, for example Jennifer DeWitt et al, '15/16-Year-Old Students' Reasons for Choosing and Not Choosing Physics at a Level', *International Journal of Science and Mathematics Education,* Volume 17, June 2018, pp.1071-1087 https://link.springer.com/article/10.1007/s10763-018-9900-4

26 For a gloomy view of the impact of the financial crisis on STEM recruitment, as late as 2011, see Maria Vetleseter Bøe et al, 'Participation in science and technology: Young people's achievement-related choices in late-modern societies', *Studies in Science Education,* Volume 47, Issue 1, March 2011, pp.37-72 https://www.tandfonline.com/doi/abs/10.1080/03057267.2011.549621; cf. Ellen Karoline Henriksen et al (eds.), *Understanding Student Participation and Choice in Science and Technology Education*, September 2014, not much more optimistic

27 If science in general might be benefiting from generational concerns about climate change, Psychology more specifically – but also other social studies subjects – is surely benefiting from similar concerns about mental health, sexuality and identity: more factors that would really only become evident from wide-ranging qualitative surveys

28 But note that even after controlling for gender and prior attainment Psychology degrees give a fairly low return in income by age 30: Jack Britton et al, 'How much does degree choice matter?', *Labour Economics,* Volume 79, December 2022, 102268: p.7 https://www.sciencedirect.com/science/article/pii/S0927537122001580

29 This was also a period of stagnation in HE participation rates, which would also have increased science share, but both stagnating participation and a mild preference for science may have stemmed from the same economic anxieties. In any case, as argued above, stagnating participation has not been a feature of the post-2012 swing

30 Andrew Noyes and Michael Adkins, 'Reconsidering the rise in A-Level Mathematics participation', *Teaching Mathematics and its Applications,* Volume 35, Issue 1, March 2016, pp.1-13, see p.4

31 Kate Purcell et al, *The Futuretrack Stage 4 Report: Transitions into employment, further study and other outcomes,* March 2013, see p,xv, p,xxvi, pp,68-69, p.98, pp,133-136, p,140, p,194 https://warwick.ac.uk/fac/soc/ier/futuretrack/findings/stage_4_report_final_06_03_2013.pdf

32 Other policies that have come under closer inspection than the attitudinal changes I discuss here include Curriculum 2000 (that is, the introduction of the AS Level), the English Baccalaureate, the Russell Group's promotion of 'facilitating subjects' and the many government initiatives over the last 50 or more years to promote STEM take up at all levels of the education system

33 Brigid Freeman et al (eds), *The Age of STEM: Educational Policy and Practice Across the World in Science, Technology, Engineering and Mathematics*, June 2016; Humanities Indicators, 'Humanities Degree Completions: An International Comparison' https://www.amacad.org/humanities-indicators/higher-education/humanities-degree-completions-international-comparison

34 Though there was a lesser trend to greater specialisation at National 5 (equivalent to GCSE) as an unanticipated outcome of the 'Curriculum for Excellence': Marina Shapira et al, *Choice, attainment and positive destinations: exploring the impact of curriculum policy changes on young people*, 2023

35 HEFCE, *Strategically Important and Vulnerable Subjects: The HEFCE advisory group's 2010-11 report*, September 2011/24, see p.9, p.24, and compare subsequent movements in these subjects since 2011 https://dera.ioe.ac.uk/id/eprint/10338/1/11_24.pdf

In recent years, there has been a swing to science and away from the arts and humanities in the subjects students study at school and university. Why? A careful look at the data suggests policy and even schools may not be quite as influential on these choices as we think.

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