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Only Ada?: dominance of entrepreneurial white men as the famous figures in computing and technology for young people

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ABSTRACT

Prominent public figures are important representatives of their fields, potentially becoming influential role models, especially for young people. The identities of these famous people can shape and stereotype their respective domains, impacting diversity and inclusion. This paper examines young people's awareness of the notable people in the computing and technology field, utilising data from a questionnaire with 4,112 entries from 1,788 young people aged 11–16 in England. Our study unveils two prominent groups of famous people: the *tech entrepreneurs* and the *historic academics*. The top 10 famous people identified are Bill Gates, Alan Turing, Steve Jobs, Elon Musk, Mark Zuckerberg, Jeff Bezos, Ada Lovelace, Stephen Hawking, Grace Hopper and Charles Babbage. We also analyse how young people's demographic background, such as gender and enrolment in computer science study, predicts their awareness of famous individuals. We discuss the possible meanings and implications of these famous individuals as the leading figures in young people's available discourses, especially the dominance of entrepreneurial white men and the fascination of wealth through technology. We consider famous individuals as potential role models for young people and discuss the challenges we face to broaden dominant discourses of who represents the computing and technology sector.

KEYWORDS
Famous people; role model; computing professionals; career aspiration

Introduction

Compared to traditional sciences, the history of computing and modern technology is relatively recent, with few notable figures of historic importance. In education and the workforce, boys and men tend to dominate the field of computing and technology (Europa, 2022; JCQ, 2023; OECD, 2018). While there are ongoing efforts for greater gender diversity, there has been limited representation of women as role models or pioneers in public discourse, aside from Ada Lovelace who is often attributed as the first computer programmer (Fuegi & Francis, 2003). A study into the famous people in computing for

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young people will shed light on the contemporary discourses available to them and how these discourses may shape or influence their future aspirations.

This paper explores young people's knowledge of famous people in the field of computing and technology. We unveil the most famous people amongst secondary school students in England, and how these vary by their backgrounds such as gender and computing career aspirations. We find two main groups of famous people: *tech entrepreneurs* and *historic academics*. We discuss the potential meanings and conclude with implications for equality, diversity and inclusion.

Influential figures and role models in computing and technology

As with most disciplines, computing and technology as a field has widely acknowledged pioneers and influential figures that have made significant contributions. Yet, for various reasons, certain individuals achieve greater recognition than others. This discrepancy may reflect popular culture, including the media, social media or public recognitions (e.g. commemorative naming). Using an online Google search (in the UK) with the keywords 'pioneers of computing', the popular websites and names that appeared included that of Charles Babbage – often referred to as the 'father of computing', Ada Lovelace, Alan Turing – 'father of theoretical computer science', Grace Hopper – 'pioneer in computer programming', John von Neumann – 'the electronic digital computer visionary' and Tim Berners-Lee – 'inventor of the World Wide Web' (e.g. see Cosker, 2023). Of course, there are additional figures, such as Al-Khwarizmi (algorithm), Blaise Pascal (mechanical calculator) and George Boole (Boolean algebra), amongst others. There were over 100 names under the Wikipedia website for a 'List of pioneers in computer science', with the vast majority of these individuals being of European descent and male. This raises questions concerning the availability of diverse and influential figures for young people to learn from and aspire towards.

Building on this concern about the lack of diversity amongst famous figures, it is important to recognise that for many young people the prevalence of men in computing and technology can render the field exclusive (Fang et al., 2019). This limits the range of potential aspirational figures or role models, especially for those whose identities differ from popular representations (Misa, 2011; Wong, 2017). In essence, role models are typically individuals who can serve as inspiration for others, especially young people, due to their personal or professional accomplishments that are deemed as exemplary, desirable or noteworthy. Their success can provide young people with viable, intelligible and imaginable futures, especially when students share similarities or backgrounds with their role models (Gladstone & Cimpian, 2021). The function of role models forms the foundations of *social learning theory* (Bandura & Walters, 1977), which emphasises the importance of learning by observation and imitation.

For example, young people can learn by modelling the behaviours and attitudes of others, from family members, to people in schools, to the media, including notable and famous figures. However, it is important to recognise that not all individuals who are famous qualify as role models and there exists a distinction between being famous and serving as an exemplar for others. Steinke et al. (2022), for example, found that role models with closer proximity to students can be particularly influential, reinforcing the importance of relatability. Abbasianchavari and Moritz (2021) noted in their review of entrepreneurial role model research that, whilst exposure to role models at an early age could increase young people's entrepreneurial intentions and behaviours, the longer-term impact of role models depends on 'whom, when and in which context' (p. 33) individuals are exposed to role models. Indeed, it is important that students think critically about who is celebrated in their field and why, questioning how certain individuals become famous or successful and how this shapes their understanding of the field (Obembe et al., 2014). In short, the presence of role models has the potential to profoundly influence students' self-efficacy and confidence (Shin et al., 2016) through the observation and demonstration provided by others.

By the same token, the absence of relatable figures can equally challenge the thinkability of particular pathways, especially for careers, with the attribution that the lack of 'people like me' may reinforce the status quo or existing stereotypes. In Western countries, the dominance of men, especially white men, in particular Science, Technology, Engineering and Mathematics (STEM) fields, such as physics and computing, has created an established stereotype of who excels in these spaces. For example, DeWitt et al. (2013) found children and parents to construct scientists as clever and nerdy, but also special or unique, alluding to something innate about their ability to occupy the field. Existing STEM education research has long raised concerns about the dangers and consequences of a lack of representation, especially by gender, in how the field is perceived, aspired and experienced by young people (e.g. Blackburn, 2017; Kim et al., 2018; Wong & Kemp, 2018). Several barriers have been explored, for instance, 'chilly' environments or unfair treatments, including intersectional inequalities of gender *and* ethnicity (Ong et al., 2018). Here, the notion of science identity and STEM identities, more broadly, has also been used as a lens to interpret students' experiences and aspirations (e.g. Holmegaard & Archer, 2022), including the extent to which young people can envision themselves pursuing STEM in the future. Research from the industry, such as Microsoft (2018), also found a clear positive relationship amongst young people in Europe between the presence of role models and an increase in their STEM interest, confidence and career aspirations.

A common call for action from existing research is greater promotion and visibility of role models from underrepresented backgrounds for young people, especially in the media, including social media, and in schools and the computing curriculum (Cheryan, Plaut, et al., 2013; Lang et al., 2020). It is hoped that more diverse representations will help to challenge and reshape stereotypes and broaden perceptions of who can be successful in STEM (González-Pérez et al., 2020). Thus, diverse role models can serve as a catalyst for change by presenting young people with inspirational figures from various backgrounds to demonstrate their achievability across a range of pathways (Herrmann et al., 2016).

However, in the field of computing and technology, diversity amongst celebrated role models and famous figures is limited, with very few women. Their relative invisibility may both reflect and reinforce existing gender-related and wider structural inequalities (Bamberger, 2014). Computing has traditionally been dominated by men, especially those from privileged and white backgrounds (Cheryan et al., 2017). The dominance of men in computing can have long-term impacts on young people's perceptions of the field, as well as their future aspirations, through the presence of unchanging role models with specific identities and imageries that inadvertently present the field as highly exclusive (Fang et al., 2019; Main & Schimpf, 2017). Similarly, although access to computing and technology is arguably easier today than ever before, a digital divide exists in both skills and knowledge, especially hardware and equipment, between those from the highest and lowest socioeconomic groups (Ofcom, 2022; Parker & Guzdial, 2015), as well as racial and ethnic minority backgrounds (Margolis, 2002).

The lack of visible and relatable figures, especially women, can discourage young people, particularly girls, from considering careers in technology-related fields. For example, Cheryan, Plaut, et al. (2013) found undergraduate students to perceive people in computer science as highly determined but lacking in social skills, which were less attractive to women. However, when such stereotypes are disproved or contested in an experimental study that involved fabricated newspapers, Cheryan, Plaut, et al. (2013) reported that more women expressed an interest in computer science compared to those who read fabricated newspapers that reinforced the stereotype. Relatedly, Cheryan, Drury, et al. (2013) also reported that exposure to a computer science role model who fits the (male) stereotype of computer scientists seemed to have a lasting negative influence on women's interest in the field. In other words, if the popular stereotypes and representations of computer science are less male-centric, then women appear to be more interested in exploring the field. In short, representation matters, especially in public and popular discourses (González-Pérez et al., 2020). In the wider media, Kool et al. (2022) found positive improvements in how women scientists are portrayed in movies, especially as knowledgeable experts as to the rather unsavoury or nerdy stereotypes previously popular for male scientists. There are reasons for optimism with these positive representations.

In this paper, we explore the famous faces of computing and technology as a way to appreciate the types of available and known figures within the discourses of young people. Furthermore, we compare the differences, if any, between the famous people mentioned and the characteristics of young people themselves, such as by their gender and ethnicity, as well as their educational and career aspirations towards computing. These comparisons shed light on the extent to which existing representations of famous individuals align with the diverse backgrounds and interests of young people, contributing to our understanding of the potential impact of these famous people as possible role models on their aspirations and choices.

The study

The SCARI Computing project aims to explore the factors shaping English secondary schoolchildren's (ages 11–16) participation and performance in computer science study. In England, pupils tend to receive some computer science education between ages 11 and 14, as part of a broader curriculum, with the option to study computer science as a qualification (e.g. at GCSE, ages 14–16), if offered by the school. Whilst the study of computer science is not typically a prerequisite for further and higher education levels, enrolment at this stage would signify an interest in the discipline. An important aspect of that decision can include how students view and make sense of the wider computer science field, including the people within it and the seemingly successful people 'who made it'.

In this paper, we focus on an open-ended response item of a questionnaire, namely, '*Can you name any famous people in computing?*'. The online questionnaire was administered during class time to ensure consistency. We are interested in students' knowledge of famous people in the computer science field, which can act as a proxy to illustrate the available discourses for young people in the context of the computing and technology field, providing insights into their available icons and role models, which can potentially shape their education and career aspirations in computer science. Students were offered up to three options for their input, and the question emphasised that these should be completed '*without talking to your friends or doing any searches!*'. Here, the primary goal is to provide a mapping of famous computing people as shared by young people, with further analyses of how different student groups, especially by gender, voiced their knowledge of these luminaries. We explore what these famous people might tell us about young people's aspirations towards computing and technology. The novelty of this approach lies in its combination of a large-scale student survey on computing education, alongside creative approaches to analysis, offering a unique contribution to the field of computing education research. For data collection, over 100 state co-educational English secondary schools were invited to participate, selected based on their above-average proportion of students, especially girls, who had studied GCSE Computer Science in recent years. The recruitment resulted in 15 schools, each with at least two classes of GCSE Computer Science as a criterion to ensure that sampled schools were relatively large but not specialists. Potential schools were identified using national databases and cross-checked with individual schools. These schools are not meant to be representative of the national population but represent the 'best scenario' of computer science uptake in state co-educational schools in England. With the Covid-19 pandemic and additional pressures on schools and teachers during different stages of national lockdowns and remote learning, our recruitment and data collection began in Summer 2021 before the school holidays, continued in Autumn 2021, and eventually rolled into Spring 2022 before our target was reached for the main study. The project received institutional approval on ethics, and consent was agreed with the schools, students and their families (King's College London, HR/DP-20/21-22,501).

A short introduction video was produced that explained the project and how to complete the survey, highlighting the project's aim to understand student views and perspectives, with neither right nor wrong answers. All questions were optional. The full questionnaire took around 20–30 minutes to complete, including demographic data, which was completed by 4,995 students (see Hamer et al., 2023). The data collected, to the best of our knowledge, form one of the largest student surveys in England specifically on computing education. The completion rate for the famous people open-ended question was 35.8%, with the majority (54.4%) providing three names (21.3% with two names and 24.4% with one name). In total, 4,112 entries were provided by 1,788 students. For context, the completion rate for other closed-ended Likert-scale questions was around 87–90%, whilst this open-ended question required textual input.

For further data cleaning, all entries were manually checked for spellings, with obvious typos corrected. Inputs that only included a first name (e.g. 'Bill' or 'Mark') were recoded as invalid, as were entries that were either unclear or descriptive. Typos for surnames were corrected when it was more obvious that a particular famous person was intended (e.g. 'Bill Gate', or 'Zukerberg'). Over 500 individual entries were recoded. Two notable excluded entries were 'I don't know' ($n = 480$) and the names of their schoolteachers ($n = 66$), and the potential meanings of these are revisited in the discussion.

We ended up with 4,115 eligible entries for further grouping, especially by their known field, such as from business/industry, gaming, social media, academic/research, or other. These are not mutually exclusive. Just over 200 names were mentioned in total, although less than 20 famous people had more than 10 mentions. In other words, more than 180 names were mentioned under 10 times, which do not constitute being widely known when looked at collectively. We mapped these names by students' gender and ethnicity, as well as by their computer science educational and career aspirations – using whether they were enrolled in the study of GCSE Computer Science or had expressed a career aspiration towards computing as proxies elsewhere in the survey. We report our frequency analysis below of the top 10 most popular mentions, and in doing so, we were also able to group these famous people into provisional categories for further analysis, namely as 'tech entrepreneurs' and 'historic academics', as well as an additional 'famous females' category that considered the whole dataset to explore their frequencies in more detail.

Informed by existing literature and available data, we created three multivariable logistic regression models that explored the key predictors of whether a student had mentioned any famous people meeting the criteria of being a *male tech entrepreneur*, a *female figure* or a *historic academic*. These three groups of famous people were found to be the most numerous responses in our dataset. The predictors chosen for the model were the gender of the student as there is strong evidence for differences between genders in computing interests or participations (Childs, 2021). This variable was self-identified, and for statistical reasons (e.g. smaller sample size) we only looked at those students who had selected 'boy' or 'girl', which made up 88% of the overall dataset (with 3.4% 'prefer not to say', 1.9% 'not listed', and 6.6% 'NA' – excluded); whether students self-identified as ethnically White British (50.3%) or from an ethnic minority (29.1%) background (with 12.5% 'Other', 1.7% 'prefer not to say', and 6.3% 'NA' – excluded); whether students had chosen to study the GCSE Computer Science qualification or had not yet chosen (i.e. they were younger students). Choosing whether to study the course would indicate an interest in the subject and a potential exposure to a wider range of famous computing people, as would the 'career aspiration' of a student, using a 5-point Likert scale registering their aspiration towards a computing career, with 1 being 'not at all interested' and 5 being 'very interested'. For analysis, this is recoded as a dichotomous option where ratings of 4 and 5 are considered to be 'yes', whilst 1, 2 and 3 are regrouped as 'no'. We anticipate that the higher the rating, the more knowledgeable students might be about famous computing people.

Model 1: Male tech entrepreneur ~ gender + ethnicity + qualification + career aspiration

Model 2: Female figure ~ gender + ethnicity + qualification + career aspiration

Model 3: Historic academic ~ gender + ethnicity + qualification + career aspiration

The second and third models used the same predictors but changed the outcome variable to indicate whether amongst their (up to three) possible responses, a student had mentioned a famous female figure or a historic academic (see Appendix).

The data also allow us to study the clusters of names mentioned through a frequent itemset analysis using the Apriori algorithm implemented using the R arules and arulesViz packages. The results were filtered to show only those related items that appear 10 times or more.

Famous people in computing and technology

We begin with a descriptive overview of the famous peoples as articulated by young people in our study, including a 'top 10' summary of these individuals, as well as how these varied according to student backgrounds and aspirations. We then grouped these figures into two types: *tech entrepreneurs* and *historic academics* (with a separate analysis for 'famous females' across all categories to ensure clarity) to highlight any notable patterns by student background as we illustrate the narrow and specific developments of computing and technology as a field that are interlinked with commerce and wealth in wider discourses.

The top 10

Perhaps unsurprisingly, Microsoft co-founder Bill Gates topped the list of famous people with 20.2% (831 mentions) of all mentions from our students, regardless of their demographic backgrounds or aspirations. Widely regarded as the world's richest person for at least two decades since the mid-1990s, the dominance of Microsoft with the rise in computers and technology has provided Gates with worldwide fame and wealth.

Alan Turing is ranked second (12.6%, 517 mentions), a renowned British academic in mathematics and computer science, especially during World War II. Turing is often attributed as the 'father' of computer science and artificial intelligence and was posthumously pardoned for his conviction under historical UK laws against homosexuality. In third place was Apple co-founder Steve Jobs (11.6%, 477 mentions), a figure often seen to be influential in the rise of Apple as a technology company that produces premium products.

In fourth place is Elon Musk (10.0%, 413 mentions), one of the world's richest entrepreneurs with a portfolio of technology-based or inspired companies, notably Tesla, SpaceX and X (formerly Twitter). Mark Zuckerberg is in fifth place (9.6%, 395 mentions), a social media entrepreneur who co-founded Facebook, who also owns, via Meta, popular apps such as Instagram and WhatsApp. The sixth most famous person is Amazon founder Jeff Bezos (6.3%, 258 mentions), an ecommerce and technology company that began with online book delivery.

Ada Lovelace is ranked seventh (4.2%, 173 mentions), arguably the most well-known woman related to computing, often attributed as the world's first programmer (Fuegi & Francis, 2003). In eighth place is the renowned physicist and academic Stephen Hawking (2.6%, 113 mentions), which was an interesting entry given the question was for a famous computer (rather than physics) person. Grace Hopper is in ninth place (1.9%, 77 mentions), the second woman on the list and a pioneering computer scientist. It is noted that besides Lovelace and Hopper, there were 17 mentions in total for eight females, including Barbara Liskov (computer scientist, 5 mentions), Katherine Johnson (mathematician, 4 mentions) and Lisa Su (tech entrepreneur, 3 mentions). Five other women had one mention.

Charles Babbage is tenth (1.6%, 67 mentions), a mathematician who has been credited for the invention of the first mechanical computer (Britannica.com, 2023). For information, just outside the top 10 included Tim Berners-Lee (1.6%, 65 mentions), Larry Page (1.2%, 58 mentions), and John von Neumann (0.98%, 40 mentions). Several other names were mentioned, especially in the field of social media and online tech influencers or presenters, although these are often in low single-digit numbers. Famed scientist Albert Einstein (0.5%, 21 mentions) and Isaac Newton (0.1%, 3 mentions) were also part of this diverse longlist.

Notable patterns and differences: tech entrepreneurs and historic academics

The famous people as articulated by young people were analysed for patterns, which included our grouping of these top 10 famous individuals into two groups: *tech entrepreneurs* and *historic academics*. Whilst limited differences were found by students' ethnicity, there were some differences by gender, whether students are studying GCSE Computer Science, and their computer science career aspirations.

The top 10 for girls and boys are similar, with minor differences in their order and the personnel in the lower spots (see also Figure 1). For girls, Larry Page was the 10th most popular (and 13th for boys), ahead of Babbage and Berners Lee at 11th and 12th. For boys, Berners Lee was 9th, Babbage 10th and Hopper 11th – meaning only Lovelace as the sole woman in the boy's top 10. Von Neumann was 13th for girls and 12th for boys.

Using the odds ratios from our multivariable logistic regression, girls have more than three times greater odds than boys to name a famous female person (OR = 3.13, 95% CI [2.26, 4.34], $p < 0.001$). No other differences were statistically significant (e.g. statistically insignificant by ethnicity, qualification and career aspiration). There is limited diversity in young people's knowledge of famous computing people. The

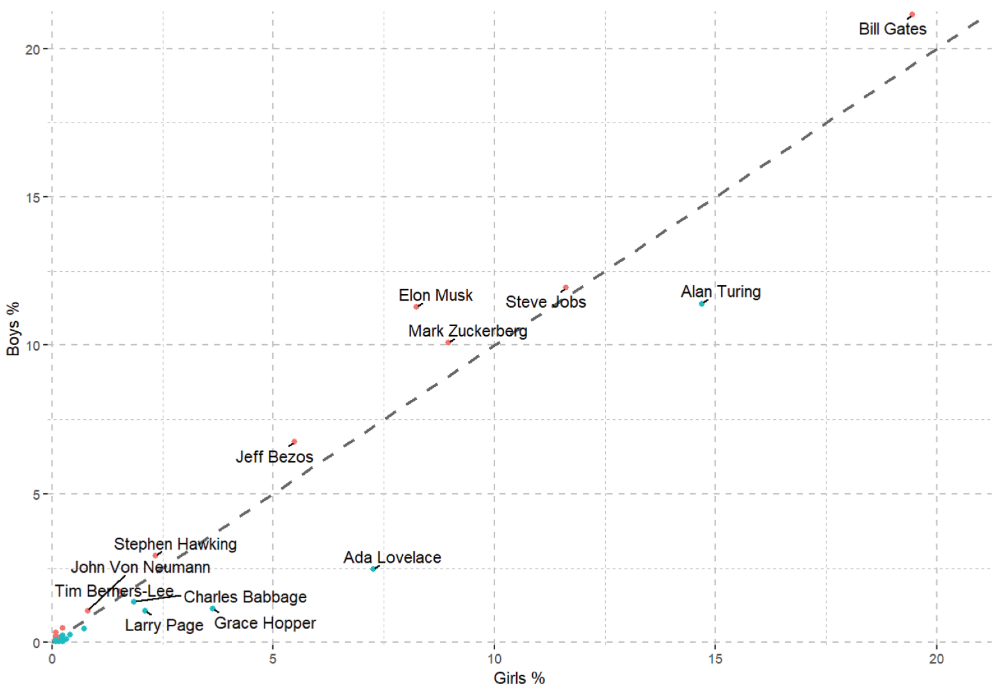

Figure 1. The top 10 famous people students mentioned by gender.

Table 1. Frequent itemset analysis of student entries (count ≥10).

Name(s)	with	Name	Support	Confidence	Coverage	Lift	Count
Jeff Bezos	=>	Elon Musk	0.0621	0.4319	0.1437	1.8699	111
Ada Lovelace	=>	Alan Turing	0.0615	0.6358	0.0968	2.1990	110
Grace Hopper	=>	Alan Turing	0.0319	0.7403	0.0431	2.5601	57
Grace Hopper	=>	Ada Lovelace	0.0268	0.6234	0.0431	6.4428	48
Alan Turing, Ada Lovelace	=>	Grace Hopper	0.0224	0.3636	0.0615	8.4439	40
Alan Turing, Grace Hopper	=>	Ada Lovelace	0.0224	0.7018	0.0319	7.2528	40
Ada Lovelace, Grace Hopper	=>	Alan Turing	0.0224	0.8333	0.0268	2.8820	40
George Boole	=>	Charles Babbage	0.0056	0.7692	0.0073	20.5281	10

majority of responses would fit what we call the *tech entrepreneurs*, comprising wealthy founders of technology-related global enterprises. Within our top 10 famous list, these are represented by five individuals, all white men (Gates, Jobs, Musk, Zuckerberg, Bezos constituting 58.7% of all responses). We find that girls have lower odds than boys to name these individuals [OR = 0.59, 95% CI [0.46, 0.75], $p < 0.001$], whilst ethnic minority students have higher odds than white British students [OR = 1.32, 95% CI [1.05, 1.67], $p = 0.017$]. Students with an interest in computer science careers are more also likely than those without [OR = 1.22, 95% CI [1.07, 1.40], $p = 0.004$] to mention *tech entrepreneurs*.

The smaller group of famous computing people would be the *historic academics*, whose prominence and fame are predominately driven by their landmark contributions to academic research or knowledge advancement. This group is more demographically diverse but also mostly historic, with two women (Lovelace and Hopper) as well as men with disclosed characteristics that have attracted discrimination or stigmatisation, such as sexuality (Turing) and physical disability (Hawking). Together with Babbage, these five individuals accounted for 23.0% of responses, with the remaining 200 other names outside the top 10 responsible for 18.3% of all mentions. Girls have a greater odds than boys to mention *historic academics* [OR = 1.69, 95% CI [1.36, 2.10], $p < 0.001$], as do those studying GCSE Computer Science [OR = 1.84, 95% CI [1.29, 2.64], $p < 0.001$] when compared to those who are not.

An interesting observation from the names mentioned by students is the likelihood that students will submit the same cluster of names. From the frequent itemset analysis (see Table 1), we found the trio of Turing, Lovelace and Hopper to be a popular combination, submitted by 40 students. Students who included Hopper, for instance, were 6.4 times more likely to also include Lovelace (with 48 pairings, 31 of which were from girls), and 2.5 times more likely to include Turing (with 57 pairings, 34 of which were from girls). Likewise, entries with Lovelace are 2.2 times more likely to include Turing (with 110 pairings, 52 of which were from girls) within their submissions. The other popular groupings included Bezos and Musk, who were 1.9 times more likely to include each other, and this pairing was particularly popular amongst boys (83 out of 111 pairings from boys), as well as Gates and Jobs, which was popular for both boys (207 pairings) and girls (84 pairings). Whilst these patterns may have limited implications, it is interesting to note the group of famous people that students include when probed.

Discussion

We now discuss the potential meanings and implications of who these famous people are for young people's computing and technology aspirations. It is important to distinguish between famous individuals and role models. While many of the figures mentioned are famous, not all may serve as positive role models for young people. The dominance of white entrepreneurial men as part of the discourse suggests a narrow view of role models available to young people. We reflect on the longstanding challenge to unsettle dominant gendered discourses of computer science and conclude with recommendations underpinned by our aspirations to promote greater diversity and inclusion.

The dominance of entrepreneurial white men in tech

The *tech entrepreneurs* share many background characteristics, notably being men, ethnically white and having financially stable or well-off families; they are among the world's richest people, as billionaires. The association between computing, technology and entrepreneurial wealth is arguably quite recent (c. 1960s with more personal computing hardware). Global enterprises underpinned by STEM had previously been dominated by engineering, which drove advancements in manufacturing capabilities, products and services (Horváth & Szabó, 2019). The rise of the digital age alongside ease of internet access and smartphones alike has rapidly broadened the information and content available to young people, especially on social media (Ofcom, 2023).

The visibility of wealthy individuals, with yearly rankings by the media, has undoubtedly raised the profiles of rich tech entrepreneurs, especially as they tend to command the position of the richest person in the world (Forbes.com, 2023). However, not all wealthy individuals or leaders of global technology companies are equally famous, according to young people at least. For example, the current Apple CEO Tim Cook was mentioned seven times and the current CEO of Alphabet (who owns Google) Sundar Pichai six times, whilst former Microsoft CEO Steve Ballmer was not mentioned at all. It is acknowledged that even in this unmentioned list of notable names in the computing and technology sector, these people are all men, mostly white, and they mostly come from relatively privileged families.

Outside of the top 10, it is interesting to note that there are 'newer' forms of *tech entrepreneurs*, stretching to the domains of gaming (Markus Persson, 18 mentions) and social media ('Linus Tech Tips', by Linus Sebastian, 10 mentions), which potentially indicate a broadening of perception of the computing and technology field.

The dominance of these tech entrepreneurs can be a double-edged sword. On the one hand, these figures are often associated with wealth, power and success, but on the other hand, they highlight the dominance of white privileged men as the leading figures in computing, reinforcing a view of computing amongst young people that tends to be patriarchal and dominated by capitalist-driven discourses. Research by Zuboff (2009) and others (e.g. Conley & Bilimoria, 2022 highlight how large technology companies (*Big Tech*) and their predominantly white male entrepreneurs can create a cycle of perception that reinforces their dominance in the field. Furthermore, other media mechanisms such as films can also play a role in perpetuating these narratives. For example, films such as *The Social Network* (in 2010) about Mark Zuckerberg and *Jobs* (in 2013) and *Steve Jobs* (in 2015) about the Apple co-founder, can contribute to their larger-than-life status amongst young people. Yet, films such as *Hidden Figures* (in 2016) have the potential to highlight the contributions of African American women like Katherine Johnson, who was mentioned just four times by our students. Likewise, a large following or presence on social media (e.g. Elon Musk on X, formerly Twitter) including those which are popular amongst young people, can serve a similar effect. It is important to note that familiarity with these figures does not necessarily equate to endorsement, which merits further research. Furthermore, it is possible for students to admire these individuals for their entrepreneurial success, but be critical of their other views or practices (e.g. Obembe et al., 2014).

Computing education can often be perceived and marketed as a means of advancing career opportunities, especially in business, which reflects a broader trend of neoliberalism in education that tends to focus on economic and commercial interests (Ball & Grimaldi, 2022). For instance, the emphasis on coding in the English computing curriculum aligns with the political vision of preparing a future workforce that can meet the demands of the technology industry. However, this neoliberal approach can overlook other critical aspects of computing, including issues of digital literacy, data privacy and surveillance, and the related social, political and ethical consequences (Williamson, 2017). Moreover, the dominance of tech entrepreneurs as potential role models for students may also draw attention away from the underlying links between the technology industry and its main beneficiaries with current, albeit less well-known, global inequalities, such as the exploitation of labour, energy resources and raw materials in the Global South to produce computing equipment for the Global North (e.g. Democratic Republic of Congo; see Kara, 2023). The popularity of business-focused technology figures has also somewhat overshadowed young people's awareness of other key contributors in computing, for example, Linus Torvalds (with eight mentions, including one girl) as the creator of the open-source Linux operating system and the Git version control system; and Jimmy Wales, the founder of Wikipedia, not appearing in any responses.

Although there have been greater movements to broaden gender and ethnic representations in the tech industry, especially at the top, their successes are not yet widely recognised or celebrated by young people, nor prominent enough to alter the overall picture (Poggesi et al., 2020). Faces of white men continue to dominate young people's knowledge, which is a concern because such status quo can feed and reinforce the persistent stereotype and identity of computing and technology, where rich and famous tech entrepreneurs are overly male, white and privileged. Additionally, the dominant narrative around computing being focused on commercial business is at risk of missing out on the countercultural discourse of computer hackers and the free and open-source software movement.

Concerted efforts are thus required from the computing and technology sector, as well as the media, to ensure that existing efforts and progress that broaden the pool of potential role models for diverse young people are at the very least sustained, if not further strengthened. For example, this could include the campaign led by Dr Jess Wade at Imperial College London to raise the profiles of scientists and engineers from under-represented groups on the popular web-based information platform, Wikipedia (The Guardian, 2023). Initiatives such as the *Digital Good Network*, *Code Club*, *Girls Who Code* and *Black Girls Code* can help to promote diversity and ethical practices in technology, and provide alternative perspectives, role models and opportunities for young people. In schools, teachers may also wish to consider concepts such as copyleft and the Creative

Commons licences, whilst at the same time highlighting luminaries such as Torvalds and Wales, who have created open-source products for the betterment of the world.

The roles and values of historic academics

It is perhaps not surprising that *historic academics* command a much smaller share of mentions, especially since some of these names, for most young people, may only arise during school lessons, revision, or in fairly specific contexts – such as having a building named after the said person. These historic references can also be made in other STEM subjects, reinforcing the need for a concerted effort across all STEM disciplines to highlight diverse figures with a holistic view of their contributions to science and technology. As our data show, students studying GCSE Computer Science have an 85% greater odds than those not studying the subject to mention a historic academic, as have girls, with a 71% greater odds than boys.

Tech entrepreneurs, on the other hand, are often in world news, on issues related and unrelated to computing due to their ever-diverse portfolio of modern interests, investments and media exposures. The definition of fame has evolved and is now arguably dominated by social media, especially for young people as it is their main source of information (Ofcom, 2023). There is a risk and danger that *historic academics* and their contributions to the field will be annexed, or worse, overwritten by contemporary and more modern advancements, leaving only a handful of diverse and aspirational figures for young people.

As such, schools may wish to review the extent to which key *historic academics* are documented or discussed in their computing curriculum to ensure that the contributions of more diverse figures are acknowledged. That said, the historic nature of these individuals may also mean that their relevance or relatability to young people is more limited. As such, it is also important that more recent figures of computing are considered to showcase the breadth and diversity of the field, including current leaders, developers and researchers, as well as local alumni and figures from the community, in recognition of viable role models (Copsey-Blake et al., 2021). Indeed, teachers themselves are regularly mentioned by students, and so their experiences and trajectories could be of interest to or inspire young people's perception of computing and technology.

The inclusion of Hawking is noted, as is Einstein, who are world-renowned theoretical physicists. Yet, their fame appears to transcend their disciplinary expertise and their names may have been included here by students who are unsure or unaware of any other famous computing people and therefore resorted to the wider STEM field. After all, one in 10 entries (10.1%) wrote, 'I don't know' and it is conceivable that some of those who did not respond to this particular question – 3,029 students (61.6%) – may also share this view and thus did not complete. This potentially highlights a wider lack of knowledge about or interest in famous computing people.

Our *historic academics*, arguably Turing and Lovelace in particular, are also notable figures beyond computing, such as in mathematics, but also as namesakes for research organisations (i.e. Alan Turing Institute in 2015 and Ada Lovelace Institute in 2018). Whilst these institutes are relatively recent, such recognitions are important and play a role in diversifying the visible representation of public and educational discourses of those who have excelled in computing and technology (González-Pérez et al., 2020). The caveat to this seemingly positive development is that their popularity and knowability are probably less prominent when compared to their tech entrepreneur counterparts who dominate young people's points of reference on famous computing figures. Moreover, teachers could engage students in more explicit discussions about the forces of exclusion that can lead to certain individuals entering the profession, or not, highlighting concepts such as the *Matilda Effect*. This approach can help students critically understand why certain figures are celebrated while others remain overlooked.

Diversity and inclusion

For young people, the dominance of *tech entrepreneurs* as the famous faces of computing and technology is not inherently problematic, but their shared characteristics, as mainly wealthy white men, pose a risk to reinforcing a homogeneous representation of the field.

Whilst the visibilities of women and minority ethnicities in positions of leadership in tech may be growing, their popularity has yet to reach young people. Only two women featured in the top 10, Lovelace and Hopper, which accounted for 94% of all mentions ($n = 250/267$) across 10 women in total. Our analysis showed that girls are 319% more likely than boys to mention a famous female person in computing and technology. For boys, only Lovelace made their top 10, at eighth place (compared to girls, at sixth). Similarly, our frequent itemset analysis highlights the popular combinations of Lovelace and Hopper, with Turing – the historic academics – amongst girls, whilst boys were more likely to mention only tech entrepreneurs.

Some prominent figures were not mentioned at all, such as Kathleen Booth, a British computer scientist who invented assembly language. We note that there are websites and resources which celebrate the contributions of women in computing (e.g. Computerscience.org, 2023), and perhaps in time their influence will replace some of the existing famous figures in our top 10. Yet, for now, more concerted efforts are likely required to ensure that diverse talents are supported in lieu of limited or absent role models from more diverse backgrounds.

Otherwise, the risk of inaction is that these popular discourses and famous figures will reinforce an exclusive stereotype that can result in inequalities of experiences for those in computing and technology who do not share these advertised identities and characteristics. Women in computer science degrees, for example, have reported 'chilly climates' and experiences of misogyny or microaggression from male peers, reflecting the dominant discourse of computing as 'for men' (Wong & Copsey-Blake, 2023). In education, from compulsory to post-compulsory schools, there is perhaps a role and a responsibility for educators to challenge and disrupt these dominant but seemingly narrow perspectives. We ought to question whether there is a greater or conscious need in the computing curriculum to place an emphasis on learning about different computing pioneers and contributors to the field, especially with a focus on their diverse backgrounds, values and social characteristics. In practice, this could be group or individual projects or activities where students research and present to each other about the lives and contributions of different key figures in computing and technology, including those who may share some similarities with students themselves to promote relatability.

Limitations

It is acknowledged that the data in this paper are simple and from a selective study of young people in schools with above-average participation in computer science study. In theory, their knowledge of prominent figures in the field should, overall, be on the stronger side. Yet, the data suggest there is limited knowledge of key people in computing, with little variation between student demographics and profiles. We recognise that our data do not capture the reasons or nuances for students' inclusion of famous individuals beyond students' knowledge of their existence. We are wary that, despite explicit instructions not to, students may have also consulted others or the internet before submission. In the questionnaire, students were limited to three entries, and so there may have been a preferential decision for students with more than three names. Recalling the names of famous people on the spot can also be challenging. Different faces of famous people may have also appeared in students' teaching or home environments, which can vary by classrooms, schools and families, alongside many other factors of influence and circumstances. It was thus not possible to isolate or 'control' the variables that may shape how students come to submit their famous people's names. As such, this paper's aim was to map the popular names amongst young people when asked about their knowledge of famous people in computing and technology, which in itself is an important finding.

Conclusion

Young people's knowledge of famous computing people may play a limited role in their future career trajectories. However, it is evident that the most popular figures are rather homogeneous, dominated by white male tech entrepreneurs, which highlights a narrow representation of the field and available role models for young people.

To address these inequities, educators should integrate more diverse role models into the curriculum and highlight the contributions of women and minorities in computing and technology. Practical steps include incorporating the biographies of diverse figures in teaching materials, organising talks and events with speakers from underrepresented backgrounds, and promoting initiatives that celebrate diversity in tech. Schools should also foster environments where students can critically engage with the historical and social contexts of technological developments, understanding the broader implications of who is represented and why.

Future work should strive to identify and promote diverse role models as we continue to challenge existing stereotypes and broaden young people's perceptions of who can succeed in computing and technology.

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Appendix

Model 1. Male tech entrepreneur ~ gender + ethnicity + qualification + career aspiration.

Characteristic	OR[a]	95% CI[a]	*p*-value
Gender			
Boy	–	–	
Girl	0.59	0.46, 0.75	**<0.001**
Ethnicity			
White – British	–	–	
Minority ethnic	1.32	1.05, 1.67	**0.017**
Qualification			
No	–	–	
Pre	1.05	0.73, 1.48	0.8
Yes	1.14	0.76, 1.70	0.5
Career aspiration			
No	–	–	
Yes	1.22	1.07, 1.40	**0.004**
No. Obs.	**1,685**		

[a]OR = Odds Ratio, CI = Confidence Interval.
Bolded values are statistically significant ($p < 0.05$)

Model 2. Female figure ~ gender + ethnicity + qualification + career aspiration.

Characteristic	OR[a]	95% CI[a]	*p*-value
Gender			
Boy	–	–	
Girl	3.13	2.26, 4.34	**<0.001**
Ethnicity			
White – British	–	–	
Minority ethnic	1.17	0.86, 1.60	0.3
Qualification			
No	–	–	
Pre	0.76	0.48, 1.24	0.3
Yes	1.04	0.62, 1.78	0.9
Career aspiration			
No	–	–	
Yes	1.18	0.98, 1.42	0.086
No. Obs.	**1,685**		

[a]OR = Odds Ratio, CI = Confidence Interval.
Bolded values are statistically significant ($p < 0.05$)

Model 3. Historic academic ~ gender + ethnicity + qualification + career aspiration.

Characteristic	OR[a]	95% CI[a]	*p*-value
Gender			
Boy	–	–	
Girl	1.69	1.36, 2.10	**<0.001**
Ethnicity			
White – British	–	–	
Minority ethnic	1.13	0.93, 1.38	0.2
Qualification			
No	–	–	
Pre	1.09	0.79, 1.51	0.6
Yes	1.84	1.29, 2.64	**<0.001**
Career aspiration			
No	–	–	
Yes	1.09	0.97, 1.22	0.2
No. Obs.	**1,685**		

[a]OR = Odds Ratio, CI = Confidence Interval.
Bolded values are statistically significant ($p < 0.05$)