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Data-Driven Career Advice

The Gallup-Amazon Careers of the Future Index

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Executive Summary

Gallup has partnered with Amazon Future Engineer, Amazon's global philanthropic computer science education program, to create the **Careers of the Future Index (CFI**). The public database aims to provide young adults and their advisers with transparent and useful data about the economic prospects of careers in the United States, and to inform industry and other stakeholders looking to invest in young adults' career pathways.

The CFI references U.S. Census Bureau occupational classifications to provide a summary measure of each career's economic prospects. The CFI combines the most recent career-level data on income, job growth, job vacancies per job seeker and automation risk to convey the economic strengths and weaknesses of various career paths. The goal is to highlight careers that both pay well and are likely to be available to applicants — now and in the future. The CFI provides scores ranging from 1 to 100 for all 529 occupations used by the Census Bureau to classify work. Higher scores on the CFI generally indicate higher pay, a high and growing level of job openings, and/or better prospects that the job will remain a viable option in the face of changes in technology.

This report summarizes the methods used to create the Gallup-Amazon CFI database and describes insights stemming from it. A more detailed description of the methods used to construct the index is provided in the background section of this report.

The findings section of this report highlights three important insights that emerge from the CFI data.

1. When comparing the CFI ranking for each occupation with that occupation's popularity with students, it becomes clear that **students overlook a number of high-opportunity careers**.

   For this report, students' career interests are determined by data from the Programme for International Student Assessment (PISA), part of the Organisation for Economic Cooperation and Development (OECD). The OECD periodically conducts a multicountry knowledge assessment that asks 15-year-olds, "What kind of job do you expect to have when you are about 30 years old?" Framed this way, the career question taps into not only students' personal interests, but also their beliefs about what is possible.

   The latest PISA survey from 2018 shows many U.S. 15-year-olds are missing the mark when it comes to envisioning their future selves working in a viable and financially rewarding career. Aside from medical occupations, many of the top-ranking careers are rarely chosen by students, including jobs in management, computers, math and science — suggesting a lack of familiarity with career paths, which this report and the accompanying database are meant to address. More generally, comparing the popularity of each occupation with those occupations' scores on the CFI reveals large opportunity gaps that students may want to be mindful of as they plan their futures.

   Furthermore, whether due to indecision, disinterest or lack of information, more than one in five 15-year-olds (22%) cannot name any job they foresee themselves doing when they turn 30. Stronger academic performance is associated with more definite career plans as students who score in the top quintile on the PISA exam are 10 percentage points more likely to name a career than those who score in the bottom quintile.[1]

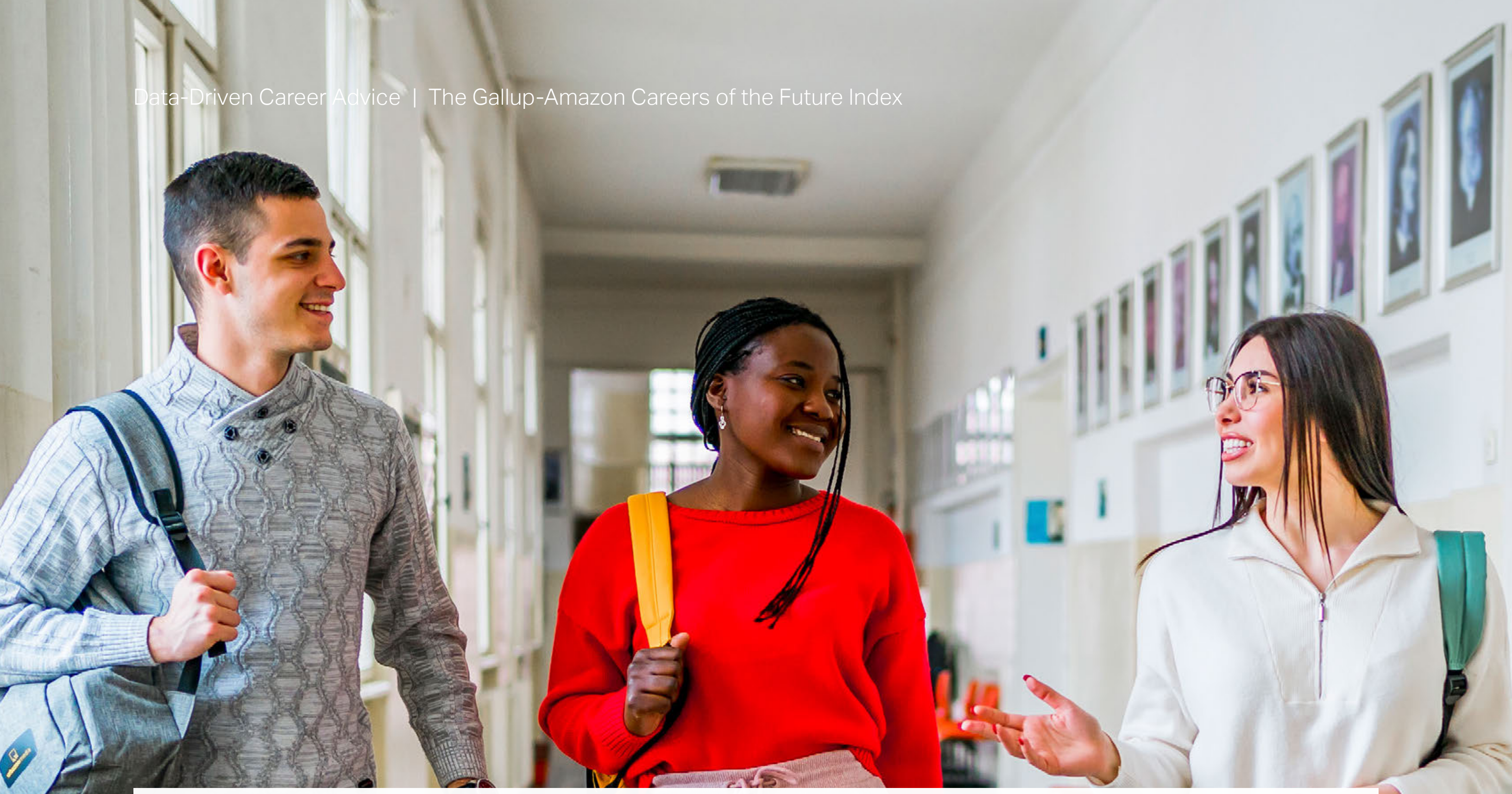
2. Comparing each job's CFI score with the academic background of the workforce currently doing that job reveals that, **while postsecondary education is extremely important to career success, it is not the whole story**. Many high-scoring CFI occupations — including cardiovascular technicians, chief firefighters, construction managers and industrial product managers — are accessible to students without a bachelor's degree. The majority of workers have less than a bachelor's degree education in 5.8 million jobs spanning 27 careers that score at or above the average career held by a bachelor's degree completer. Similarly, 34 top-scoring occupations are accessible without an advanced degree, such as careers as an actuary, engineer or software developer.

3. Comparing the CFI scores with the demographic makeup of the workforce in various occupations reveals **American Indian, Black, and Hispanic workers are underrepresented in high-scoring careers — those scoring 80 or above on the CFI — but Black, Hispanic and White workers moved closer to parity with their workforce shares from 2010 to 2021**. While diversification of the workforce parallels the increased diversity in the country as a whole over this period, the data reveal that high-scoring-CFI careers have generally diversified at a faster rate than low-scoring CFI careers. Men are slightly overrepresented among top-scoring jobs, whereas women are slightly underrepresented. Female representation increased among the top-scoring jobs that were consistently coded between 2010 and 2021.

The report also serves as a reference guide to an interactive tool for exploring highlighted features of the data and accessing the complete occupational-level database. While other career tools and lists explore some of the same themes as the CFI, none match this database's combination of high-quality data, rigorous methods, flexibility and transparency. Moreover, while scholars have previously ranked jobs by their capacity to withstand automation[2], this is the first career tool to include such a measure alongside other features, and the first to allow users to see context on racial and gender proportionality.

1 Test scores were standardized and averaged across the three domains of math, reading, and science. The gap is 30% vs 20% overall when comparing bottom quintile to top-quintile students, but it is especially large for boys. 39% of boys scoring in the bottom quintile did not name a career compared to 25% of boys scoring in the top quintile. Among top scoring girls, 15% named a career compared with 18% of those scoring in the bottom quintile.

2 Frey, Carl Benedikt, and Michael A. Osborne. "The future of employment: How susceptible are jobs to computerisation?." *Technological forecasting and social change* 114 (2017): 254-280; Nedelkoska, Ljubica, and Glenda Quintini. 2018. "Automation, Skills Use and Training." OECD Social, Employment, and Migration Working Papers 202;



Background

In collaboration with Amazon Future Engineer, Amazon's global philanthropic computer science education program, Gallup has created the Careers of the Future Index (CFI). The primary goal of this index is to provide young adults and their advisers with empirically supported guidance about the economic prospects of careers in the United States. A secondary goal is to provide useful insights to industry and other stakeholders looking to invest in young adults' career pathways. This document summarizes the CFI methods and findings at a high level, and in a concluding section, compares the CFI to other career guidance tools. The CFI is constructed with publicly available data using best-practice methods, reliable sources and full transparency, and allowing flexibility in how the data is used. See the appendix for more details about the CFI database construction.

Choosing a career is a complex decision. It involves, among other things, personal and cultural interests, a sense of alignment with one's abilities, and many practical considerations. These considerations may include whether the career pays well enough to sustain a family at a comfortable standard of living, whether jobs are readily available, whether job prospects are shrinking or expanding, and whether the tasks performed in the jobs are susceptible to displacement from automation in the coming years. Prospective entrants must also consider the educational requirements for the career, including the likely time and effort associated with pursuing the necessary acquisition of skills, academic degree, or related credentials. For policymakers and other interested parties, the database also provides context on the gender and racial diversity of the careers, which can be used to partially understand progress in overcoming historical barriers to people choosing the career that best matches their interests and abilities.

Amazon Future Engineer commissioned the CFI and will continue to develop future studies that further disaggregate data at the intersection of income, race and gender. A thorough understanding of racial, gender and educational requirements in students' access to career opportunities is especially important considering the current and future economic outlook.

Brief Methodology

The CFI is based on four characteristics relevant to the economic viability of a career:

1

SALARY
The median income* of all workers in each career or job category. (U.S. Census Bureau)

*median income from work

2

JOB GROWTH
The change in the number of workers in the career divided by the number of workers at the start of the period.

3

JOB VACANCIES PER JOB SEEKER
The number of job openings divided by the number of workers seeking employment in that field. This measures labor demand relative to supply. (Lightcast and U.S. Census Bureau, 2021 to 2022)

4

THE CAPACITY TO WITHSTAND AUTOMATION
Specifically, the difficulty of automating tasks performed on the job. (Gallup and O*NET)

	1	2	3	4
CFI CHARACTERISTIC WEIGHT	50.0%	16.7%	16.7%	16.7%

Note: For more information on weighting, see page 40.

The CFI reflects these four career elements for all 529 occupations included in the government database used for this analysis.[3] The careers are also evaluated on the basis of broader job categories that fall within the 2018 Standard Occupation Classification (SOC) system. The data reviewed for the CFI includes workers who are self-employed as well as those who earn a salary paid by an employer (i.e., W-2 workers). This is important because roughly 10% of U.S. workers identify as self-employed in government surveys.[4]

In constructing the CFI, the highest weight (50% of the total) is given to income. Income is in many ways the primary goal of work in urban or modern society.[5] It has been widely established that income is an important driver of job satisfaction.[6] It is also predictive of better physical health and subjective wellbeing, and achieving a high income is the most common stated goal of students who pursue higher education.[7]

3 The occupation titles and much of the linked data are from the 2010 and 2021 American Community Surveys (ACS). This is a 1% random sample of U.S. residents. Among other things, it collects data on the primary occupation and job duties of workers. These data were recoded and repacked by IPUMS USA, which organizes the Census data to approximate the occupation codes used in the government's Standard Occupational Classification system. The IPUMS variable is labeled "occsoc." See Steven Ruggles, Sarah Flood, Matthew Sobek, Danika Brockman, Grace Cooper, Stephanie Richards, and Megan Schouweiler. IPUMS USA: Version 13.0 [ACS 2010, 2021]. Minneapolis, MN: IPUMS, 2023. https://doi.org/10.18128/D010.V13.0.

4 Gallup Intuit, "Gig Economy and Self-Employment Report", https://quickbooks.intuit.com/content/dam/intuit/quickbooks/Gig-Economy-Self-Employment-Report-2019.pdf

5 In hunter-gatherer and subsistence farming societies, income would not be a relevant goal for work, and there were essentially no careers to choose from.

6 Rothwell, Jonathan and Steve Crabtree, "Not Just a Job: New Evidence on the Quality of Work in the United States", Gallup 2019, https://www.gallup.com/education/267590/great-jobs-lumina-gates-omidyar-gallup-report-2019.aspx;

7 Diego-Rosell, Pablo, Robert Tortora, and James Bird. "International determinants of subjective well-being: Living in a subjectively material world." *Journal of Happiness studies* 19 (2018): 123-143; Gallup "The State of Higher Education 2022 Report", https://www.gallup.com/analytics/391829/state-of-higher-education-2022.aspx; Chetty R, Stepner M, Abraham S, et al. The Association Between Income and Life Expectancy in the United States, 2001-2014. *JAMA.* 2016;315(16):1750–1766. doi:10.1001/jama.2016.4226

Yet, income does not get all the weight. A high-paying career with no vacancies cannot provide income, and a high-paying job for which there is no market demand may be eliminated, along with its income. The other index elements pertain more directly to the absence of layoff risk, risk of displacement or the steady erosion of demand — all of which are found to be undesirable characteristics of jobs, according to surveys of workers.[8]

There is no right or wrong way to determine the relative weights of each job characteristic, and the elements are somewhat overlapping. Jobs that are difficult to automate lower the risk of displacement and tend to be inherently engaging, in that they involve creative and non-routine work, both of which are associated with higher job evaluations. It is also important that there are job vacancies available, and positive job growth trends make it more likely that vacancies today will be followed by vacancies in the future. For these reasons, one-third of the 50% index weight (about 16.7%) was assigned to each of these three components. As discussed in the appendix, other weighting schemes for income produce results that are highly correlated with our preferred one, and users can rank careers by each component, assigning whichever weight they prefer.

Additionally, the database includes many other elements (not factoring into the CFI) that provide relevant context for understanding career trajectories. These include early and mid-career incomes and the percentage of workers in part-time and full-time jobs. The Gallup-Amazon CFI database also shows the percentage of workers in each career that are earning a family sustaining salary, which is defined as at least $70,000 a year, using data on the spending patterns of households with children (see methods appendix).

The database also presents information on the share of jobs held by women and men and by each major racial and ethnic group in 2010 and 2021. Additionally, the database includes an analysis of disproportionality, with respect to race and gender. This measures the degree to which workers are represented in an occupation in proportion to their share of the overall workforce. The inclusion of 2010 data allow users to consider how gender and racial/ethnic representation have shifted in recent years.

Finally, the database also considers how knowledge in a field can lead to related career opportunities across multiple types of jobs. For example, knowledge of human biology is important in medical and healthcare-related jobs, as well as scientific research and jobs in science education. Expertise in biology, when combined with the right credentials and experience, can branch into multiple high-paying career paths. To quantify these opportunities for each job, Gallup created a "career transition index" to assess the income and job growth opportunities of closely related fields, so that each job is ranked by opportunities adjacent to it.

Comparison With Other Sources

To understand how the CFI and the accompanying database compares with other resources for career advice, Gallup conducted internet research related to "careers of the future," "best careers" and "best careers for young adults." While some of the resources emerging from this search overlap with the CFI, the CFI approach has important methodological and practical advantages, both conceptually and in the ranking of top careers.

One of the top-ranked search results for career advice is a webpage from the U.S. Bureau of Labor Statistics (BLS) entitled "Fastest Growing Occupations." This ranks occupations by their forecasted job growth rate between 2021 and 2031,[9] taking into account estimated future demand for each job based on projections of U.S. demographic changes. Yet, the BLS list does not factor pay into its ranking and, because job growth (which it does consider) is only modestly correlated with pay, the BLS list of top 100 jobs includes several jobs with rapid growth but very modest pay.[10] For instance, "ushers, lobby attendants and ticket takers" ranks second on their list, but pays only $24,000 per year. Restaurant cooks is fifth on the BLS list, yet pays just $30,000.

8 Rothwell, Jonathan and Steve Crabtree, "Not Just a Job: New Evidence on the Quality of Work in the United States", Gallup 2019, https://www.gallup.com/education/267590/great-jobs-lumina-gates-omidyar-gallup-report-2019.aspx

9 U.S. Bureau of Labor Statistics, Fastest Growing Occupations, https://www.bls.gov/ooh/fastest-growing.htm (Accessed December 2, 2022).

10 Correlation between job growth and pay: r=0.29

Another prominent resource, by Kiplinger, uses methods more similar to the CFI to rate jobs, but does not disclose the formula.[11] Kiplinger lists what they call “the 30 best jobs for the future,” but merely says that forecasted job growth and pay were taken into account. App developer, nurse practitioner, health services manager, financial manager and market research analyst are their top five occupations. Physician, dentist and family practitioner are also listed in the top 30. These jobs tend to perform well on the CFI, and Kiplinger provides useful information about the jobs, but provides no data that would allow users to rank jobs by any single criteria. They also provide no measure of the ratio of demand to supply, so it would be difficult to know how competitive the job search process would be. For example, postsecondary teachers are listed by Kiplinger as one of the 30 best jobs, whereas this occupation ranks 107th in the CFI database. The main reason it scores lower in the CFI is that job growth is mediocre, and there are very few job vacancies per unemployed worker. As many recent graduates would confirm, the academic job market is highly competitive.

U.S. News and World Report also offers an in-depth, but static ranking of careers on its “100 Best Jobs” page.[12] Their analysis gives weight to median salary, the unemployment rate, forecasted growth volume, forecasted growth rate and openings per worker — all of which are based on BLS data — as well as workers’ perceived stress and feelings of work-life balance, based on proprietary surveys that they conducted. However, there are some important limitations to their approach.

The BLS projections used by *U.S. News* for income and job growth estimates exclude self-employed or independent contractor workers, which, as noted, cover about 10% of workers. Thus, their analysis of jobs is missing an important piece of the total employment picture. Secondly, the BLS forecasts for job vacancies and growth have historically tended to understate growth in fields closely linked to novel technologies. For example, BLS forecasts for software developers from 2010 to 2021 were 38 percentage points below the actual growth.[13] In retrospective analysis, one economist found that BLS growth projections were well correlated with actual growth from 2010 to 2019, but the projection only accounted for 26% of the actual variation in growth.[14] Third, *U.S. News* gives weight to jobs with large positive changes in employment, but this metric will tend to give high weight to fields with slow growth and many workers competing over few openings per worker. Moreover, *U.S. News* does not release their data, does not disclose their weighting formula, and relies on private survey data to measure somewhat vague constructs (stress and work-life balance) that they do not precisely define.

Another useful career resource is from the employment website, Indeed, which ranks the 25 “Best Jobs of 2023” based on metrics similar to the ones used in the CFI.[15] This includes salary, job vacancies (based on their own database), job postings per total job, hybrid work opportunities and annual growth in job postings, from January 2020 to January 2023. This report draws upon Indeed’s “Career Clusters,” which provide a useful categorization of fields of work or sectors. While this is a useful resource with helpful contextual discussion, it is limited by the small number of jobs disclosed, the focus on very recent changes in growth, and the reliance on Indeed data, which are not representative of the entire labor force. For example, jobs for doctors and lawyers, as well as many blue-collar roles, would not typically be advertised with Indeed.

11 Stacy Rapacon, “30 of the Best Jobs for the Future” Kiplinger, https://www.kiplinger.com/slideshow/business/t012-s001-best-jobs-for-the-future-2018/index.html (accessed December 2, 2022).

12 U.S. News and World Reports, “100 Best Jobs,” https://money.usnews.com/careers/best-jobs/rankings/the-100-best-jobs (accessed December 2, 2022)

13 Forecasted growth can be found here, Lockard, C. Brett, and Michael Wolf. "Occupational employment projections to 2021." *Monthly Lab. Rev.* 135 (2012): 84, available at https://www.bls.gov/opub/mlr/2012/01/art5full.pdf (Accessed December 2, 2022). Actual 2010 and 2021 software development jobs are available on the BLS OES website. Actual growth using these data was 68% for all software developers compared to a forecasted growth rate of 30% for 2010 to 2021.

14 Atalay, Enghin. "How Accurate Are Long-Run Employment Projections?." *Economic Insights* 5, no. 4 (2021): 12-18, available at https://enghinatalay.github.io/long_run_projections.pdf (accessed December 7, 2022)

15 Indeed, Top Jobs of 2023, available at Best Jobs of 2023 | Indeed.com (accessed April 18, 2023).

Findings

When Planning Their Future, U.S. High School Students Overlook Many Viable Career Pathways

Despite the ocean of data available on the internet, there are few if any resources available online to provide clear and compelling information about career pathways to young people. Yet, there are signs that young people could benefit from such information.

When asked what career they expect to have at age 30, one in five U.S. 15-year-olds (22%) could not name a career. These data come from the 2018 OECD PISA exam, and students who do well on the exam (scoring in the top quintile) are much more likely to name a career than those who do poorly, suggesting that career planning tends to be weaker among the students struggling the most academically.

Moreover, less than half (45%) of students name a career that scores in the top quintile (highest 20%) on the CFI, whereas the remaining 35% pick a career that falls below the top tier. This contrasts markedly with the distribution of today's workforce across these CFI tiers with only 29% working in the top quintile-rated jobs and more than one out of every three working in the bottom two quintiles.

The mismatch between what 15-year-olds think they will be doing and what workers actually do is indicative, in part, of students' lack of awareness of the types of jobs available. As is evident in the detailed results, students disproportionately name a handful of high-profile careers (doctors, lawyers, athletes, musicians) because these are what they are most familiar with, but aren't necessarily jobs that will continue to match their interests, opportunities or prospects as they progress through school.

Female students are especially likely to aim their sights at a top-quintile career — 53% of girls vs. 38% of boys expect to have a job in this sphere. Girls are also more likely than boys to have any career goal at all (85% vs. 72%).

Girls' career choices are led by medical professions, including doctors, veterinarians, and dentists. These are high-scoring careers, but their dominance suggests that many other paths may be overlooked. For instance, no computer or engineer-related careers are among the top 20 careers selected by girls, while beauticians, photographers, actors and musicians are among the popular but low-scoring jobs chosen.

FIGURE 1

Most Popular Expected Careers of U.S. Girls and the CFI of Those Careers

Top mentions of careers 15-year-old U.S. girls expect to have by age 30

% Mentions   Gallup-Amazon CFI Score: 1 - 19 | 20 - 39 | 40 - 59 | 60 - 79 | 80+

	% Mentions	Gallup-Amazon CFI score
Did not name career	15.0	
Specialist medical practitioners	13.1	91.9
Nursing professionals	7.9	88.0
Generalist medical practitioners	4.5	91.9
Lawyers	4.3	98.0
Veterinarians	4.0	96.0
Teaching professionals	2.3	56.0
Psychologists	2.2	90.7
Biologists, botanists, zoologists and related professionals	2.0	73.0
Physiotherapists	1.8	90.0
Graphic and multimedia designers	1.8	66.0
Nursing associate professionals	1.8	51.0
Police inspectors and detectives	1.7	82.8
Dentists	1.4	99.0
Beauticians and related workers	1.3	33.0
Social work and counseling professionals	1.2	65.0
Photographers	1.1	54.0
Actors	1.0	48.0
Musicians, singers and composers	1.0	61.0
Interior designers and decorators	1.0	69.0

Sources: Gallup-Amazon CFI Database and OECD PISA

The most popular career choice among boys is athlete (3.8%), which has a fairly low CFI score of 52. Boys' next most popular choices — mechanical engineer and specialist medical practitioners — are associated with high CFI scores, as are several other in their top 20, including lawyers, generalist medical practitioners, software developers and police officers. However, boys' top 20 list is rounded out by several occupations which, along with athletes, offer less opportunity, particularly armed forces careers, welders and actors. To be clear, military officers score highly on the CFI (81), but only a small number of boys stated the expectation of becoming an officer, whereas many more listed a low-ranking or more generic military career, with weaker economic prospects.

FIGURE 2

Most Popular Expected Careers of U.S. Boys and the CFI Score of Those Careers

Top mentions of careers 15-year-old U.S. boys expect to have by age 30

% Mentions   Gallup-Amazon CFI Score: 1 - 19 | 20 - 39 | 40 - 59 | 60 - 79 | 80+

	% Mentions	Gallup-Amazon CFI score
Did not name career	27.9	
Athletes and sports players	3.8	52.0
Mechanical engineers	3.2	94.0
Specialist medical practitioners	2.9	91.9
Motor vehicle mechanics and repairers	2.3	74.0
Graphic and multimedia designers	2.2	66.0
Software developers	2.1	87.9
Police officers	2.0	85.0
Lawyers	1.9	98.0
Generalist medical practitioners	1.9	91.9
Armed forces occupations, other ranks	1.6	16.0
Web and multimedia developers	1.5	87.9
Musicians, singers and composers	1.3	61.0
Engineering professionals (excluding electrotechnology)	1.2	82.5
Science and engineering professionals	1.2	82.5
Physiotherapists	1.2	90.0
Welders and flamecutters	1.1	26.0
Actors	1.1	48.0
Film, stage and related directors and producers	1.1	66.0
Managing directors and chief executives	1.1	90.5

Sources: Gallup-Amazon CFI Database and OECD PISA

The PISA survey also finds U.S. boys are on the worrisome end of a sizeable gender gap in students' ability to name a job they will be doing at age 30. Combined with the dearth of boys aiming for a top CFI-scoring career, it appears boys are either less familiar with viable career paths or less able to envision themselves holding a high-level job in their future work lives than girls. If these plans play out, the gender gap will further exacerbate a growing trend in which young men are increasingly less likely than young women to go to college or otherwise pursue a high-scoring career.[16]

Opportunity Gaps Quantify Mismatch Between Career Popularity and Quality

Gallup computed an opportunity gap for each major occupational group (or occupation family), which is the difference between the mean popularity of careers in that family and their mean CFI score. Each career is first ranked on a centile scale (1-100) based on its popularity, and that rank is subtracted from the CFI score (also on a 1-100 scale) using the detailed career. The theoretical range of the opportunity gaps is therefore +100 to -100, where positive scores indicate a career is overlooked by young people, and a negative number suggests more young people want to enter that career than would be expected based on its economic viability. In practice, the observed opportunity gaps in this research range from -39 to 38.

To understand which broad categories of jobs have the largest and smallest gaps in opportunity (meaning they are the most or least overlooked by students relative to their economic prospects), the detailed differences in ranks were averaged at the major job-family level. Note, the broad titles listed below reflect average scores across potentially many detailed careers.[17]

- The greatest career opportunities, by far, involve **management occupations** (i.e., high-level leaders or managers across all industries and a range of company divisions), **computer and mathematical occupations**, and **business and financial operations** (e.g., buyers, adjusters, accountants, trainers, etc.). Because of their high pay and promising career prospects, jobs that fall into these categories score highly on the CFI but are mentioned by relatively small percentages of U.S. 15-year-olds as what they foresee doing at age 30 (just 11%). This yields opportunity gap scores ranging from 34 to 38.
- **Life, physical and social science** occupations, as well as **architecture and engineering** both attract fairly high percentages of students naming them as their expected careers (14%); nevertheless, these categories' high CFI scores means they are still good choices for students, with relatively high opportunity gaps of 32 and 22, respectively.
- **Healthcare practitioners** and **technical occupations** (doctors, nurses, veterinarians, various health technicians, etc.) are the most often cited future careers, comprising 33% of all mentions. Still, with a CFI score of 75, this category has a positive opportunity gap of +10.
- On the other hand, the **arts, design, entertainment, sports and media** category has a negative opportunity gap of -19. This reflects this group's lower CFI rank (60) relative to the high percentage of students (14%) who plan to be working in one of these fields.
- Several other occupational categories have negative opportunity gap scores, of between -1 (transportation) and -39 (food preparation), reflecting low or somewhat low CFI scores and moderately high popularity.

16 Reeves, Richard. Of Boys and Men: Why the Modern Male Is Struggling, Why It Matters, and What to Do about It (Brookings Institution Press, 2022)

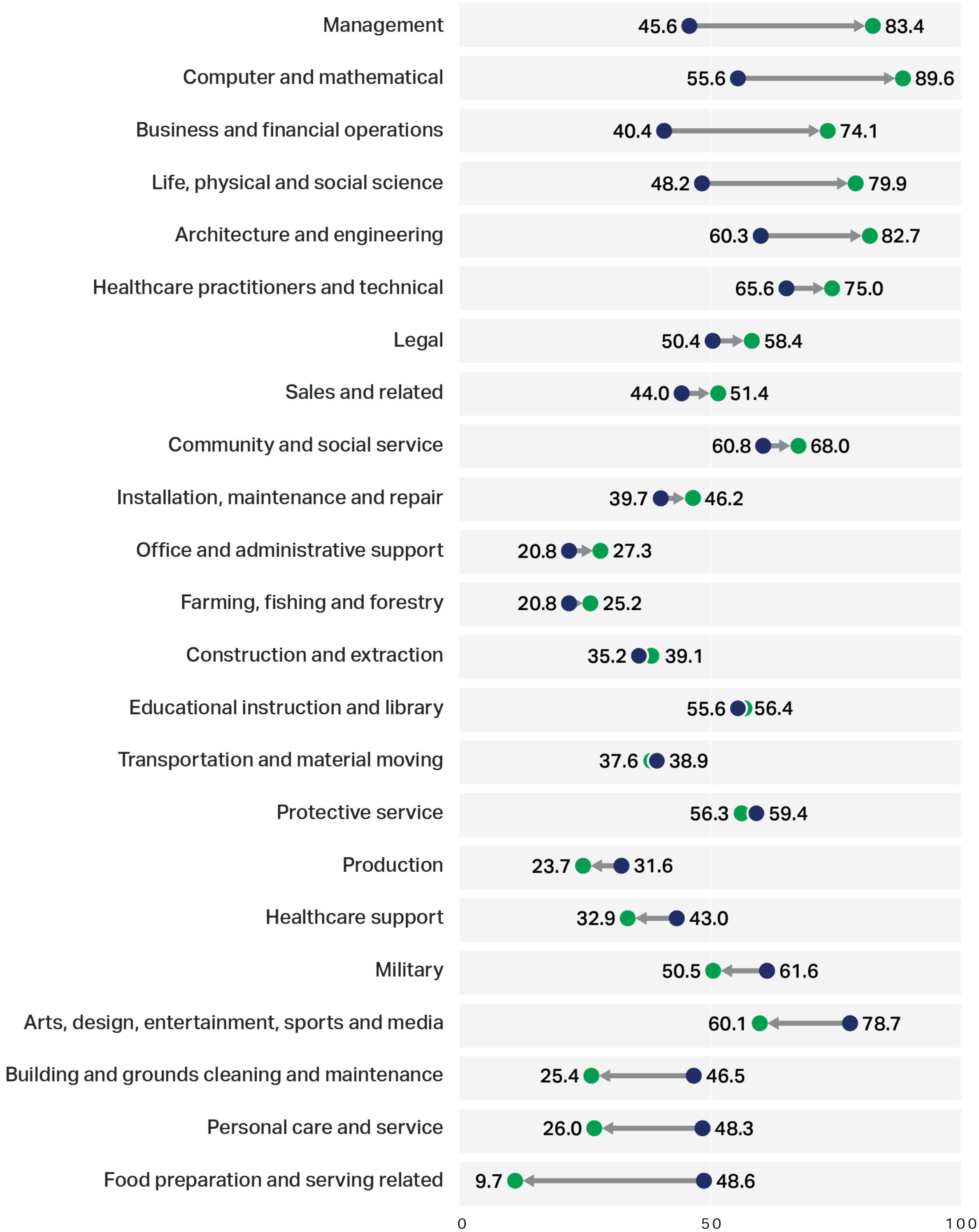
17 The possible scores could range from -99 to +99, since the calculation subtracts a score of 1-100 from another score that could range from 1 to 100. In practice, no occupational groups have careers that are only at the extreme ends of economic viability or popularity, so that actual range goes from -39 to +38. All scores would be zero if 15-year-olds expressed career expectations that aligned perfectly with CFI scores. A positive number suggests the career is overlooked by young people, and a negative number suggest more young people want to enter that career than would be expected based on its economic viability.

FIGURE 3

Popularity of Broad Careers Compared With Economic Viability

Plots popularity rank of career (1-100 scale) among U.S. 15-years-olds against Careers of the Future Index

● PISA mean centile rank for student popularity ● Mean Gallup-Amazon Careers of the Future Index score



Values represents means rank of detailed occupations within the major job category listed
Sources: Gallup-Amazon CFI Database and OECD PISA

Workers' Level of Education Is Highly Correlated With the CFI, But Many Fairly High-Scoring Careers Do Not Require a Bachelor's Degree

Having more postsecondary education is strongly associated with working in higher-scoring careers. The mean CFI score for workers with a professional graduate degree (such as an M.D. or law degree) is 88.8, and it is 84.6 for those with a non-medical doctorate (Ph.D.). It falls slightly to 76.8 for a master's degree and 69.8 for a bachelor's degree. Meanwhile, those with a high school diploma or lower levels of education are in jobs that average just 35.9 on the index.

Even one to two years of postsecondary education predicts a substantial increase in the CFI score for one's job.

FIGURE 4

CFI and Its Components, by Workers' Level of Education

Gallup-Amazon CFI Score: 1 - 19 | 20 - 39 | 40 - 59 | 60 - 79 | 80+

	CENTILE RANK				
Education Level	**Gallup-Amazon CFI score**	**Income**	**Job growth**	**Ads per seeker**	**Resistance to automation**
Professional degree	**88.8**	87.7	68.6	73.2	80.8
Doctorate	**84.6**	83.1	68.4	58.3	80.5
Master's	**76.8**	72.5	66.2	63.8	78.6
Bachelor's	**69.8**	66.8	62.4	62.4	69.1
Associate degree	**53.7**	50.7	55.9	56.6	54.6
One or more years of college credit	**47.5**	45.2	53.0	50.6	49.4
Less than one year of college	**45.4**	43.5	51.9	49.0	47.1
High school or less	**35.9**	34.3	50.3	40.8	37.8

Yet, even at each level of education there is wide variation in the CFI score of the average bachelor's degree holder, depending on one's major. Workers with a bachelor's degree in the fields of science, medicine and health services, engineering, math, and computer science work in careers scoring 78 or above. Construction or architecture majors also score highly. Workers with college degrees in psychology, communications, English, and business have jobs that score between 70 and 72, and those with majors in liberal arts or fine arts work in careers scoring 67 and 66, respectively.

Many careers accessible to workers without a bachelor's degree score at least as high as the mean bachelor's degree-holding worker. In 27 careers — comprising 5.8 million jobs (5.2% of all) — many workers have less than a bachelor's degree, but the career still scores in the top 70th percentile.[18]

The best-scoring careers that don't require a bachelor's degree include managers of fire fighters, cardiovascular technicians, industrial production managers, construction managers, and power-plant operators.

Another 16 high-scoring careers often do not require a college degree (between 40% and 49% of workers in these fields have less than a bachelor's degree). These represent an additional 4 million jobs (4% of all) and include computer network architects, emergency management directors, MRI technologists, occupational health and safety specialists, and computer systems administrators.

Finally, many high-scoring careers are commonly held by people with a bachelor's degree but not a graduate degree. Among these careers, 34 score in the top 80th percentile, representing 9.4 million jobs (8% of all). They include actuaries, sales engineers, financial analysts, software developers and chemical engineers.

18 The career 'Occupational therapy assistances and aides' has a score of 76 despite a low salary because of its very high performance on non-income dimensions.

The following table shows the 20 highest-scoring careers in which the majority of workers have less than a bachelor's degree. In many of these careers — including those not listed but available in the complete database, more than three-quarters of workers have no bachelor's degree, and yet the jobs score between 71 and 89 on the CFI.

FIGURE 5

Best Careers in Which 50% or More Workers Have Less Education Than a Bachelor's Degree

	Percentage of workers with less than a bachelor's degree	Gallup-Amazon CFI score	Percentage with incomes that are family sustaining ($69,740)
Cardiovascular technologists and technicians	56%	89.0	43%
First-line supervisors of fire fighting and prevention workers	68%	89.0	74%
Construction managers	63%	87.0	62%
Industrial production managers	52%	87.0	68%
Power plant operators, distributors and dispatchers	76%	85.0	76%
Elevator installers and repairers	94%	85.0	74%
First-line supervisors of police and detectives	54%	85.0	64%
General and operations managers	54%	82.0	57%
Air traffic controllers and airfield operations specialists	59%	81.0	65%
Entertainment and recreation managers	51%	81.0	33%
Facilities managers	63%	80.0	50%
Fire inspectors	79%	77.0	48%
Cost estimators	59%	77.0	54%
Occupational therapy assistants and aides	75%	76.0	12%
Other rail transportation workers	86%	75.0	60%
Police officers	61%	75.0	50%
Electrical power-line installers and repairers	91%	75.0	61%
Logisticians	52%	75.0	37%
First-line supervisors of mechanics, installers and repairers	85%	74.0	45%
Firefighters	77%	73.0	52%
All careers	**58%**	**56.0**	**35%**

Even greater economic opportunity is available to workers without a bachelor's degree in the following 16 occupations, in which between 40% and 50% of the workers have less than a bachelor's degree. Many of these are highly technical positions with CFI scores above 80.

FIGURE 6

Best Careers in Which 40% to Less Than 50% of Workers Have Less Education Than a Bachelor's Degree

	Percentage of workers with less than a bachelor's degree	Gallup-Amazon CFI score	Percentage with family-sustaining incomes ($69,740+)
Computer network architects	44%	97.0	81%
Emergency management directors	42%	94.0	56%
Magnetic resonance imaging technologists	48%	91.0	60%
Occupational health and safety specialists and technicians	49%	87.0	47%
Training and development managers	40%	86.0	60%
Computer occupations, all other	45%	84.0	54%
Network and computer systems administrators	47%	83.0	62%
Radiation therapists	44%	81.0	73%
Diagnostic medical sonographers	48%	79.0	57%
Administrative services managers	45%	79.0	48%
Sales representatives, wholesale and manufacturing	50%	77.0	53%
Training and development specialists	47%	76.0	41%
Sales representatives of services, except advertising, insurance, financial services and travel	44%	74.0	55%
Real estate brokers and sales agents	44%	73.0	48%
Purchasing agents, except wholesale, retail and farm products	50%	72.0	40%
Credit counselors and loan officers	48%	72.0	51%
All careers	**58%**	**56.0**	**35%**

Another set of jobs offers extremely high CFI scores to workers with only a bachelor's degree, despite being associated with workers with graduate or professional degrees. Large percentages of actuaries, sales engineers, financial and investment analysts, software developers and chemical engineers — the top five on the list — have no advanced education, yet their jobs score 96 or higher.

FIGURE 7

Best Careers in Which Most Workers Have a Bachelor's Degree But Not a Graduate Degree

	Percentage of workers with a bachelor's degree but no higher education	Gallup-Amazon CFI score
Actuaries	68%	99.0
Sales engineers	57%	98.0
Financial and investment analysts	54%	98.0
Software developers	53%	97.0
Chemical engineers	57%	96.0
Petroleum, mining and geological engineers, including mining safety engineers	59%	95.0
Aerospace engineers	50%	94.0
Public relations and fundraising managers	54%	94.0
Other engineers	51%	94.0
Electrical and electronics engineers	51%	94.0
Mechanical engineers	60%	93.0
Personal financial advisers	54%	92.0
Marketing managers	59%	92.0
Aircraft pilots and flight engineers	58%	91.0
Civil engineers	60%	91.0
Materials engineers	55%	90.0
Securities, commodities and financial services sales agents	55%	90.0
Atmospheric and space scientists	55%	89.0
Industrial engineers, including health and safety	52%	88.0
Registered nurses	54%	88.0

American Indian, Black and Hispanic Workers Are Underrepresented in High-Scoring Careers — Those Scoring 80 or Above on the CFI — But Have Moved Closer to Parity With Their Workforce Shares Since 2010

WHY THE RACE AND GENDER OF WORKERS IS INCLUDED IN THE ANALYSIS

The Careers of the Future database includes information on the racial and gender composition of each career, including summary measures of diversity and proportionality. Stakeholders, leaders, policymakers and even prospective students may be interested in these data for a variety of reasons.

The primary motivation for providing diversity data is to facilitate additional research on specific careers. For example, careers in which worker demographic characteristics diverge sharply from the composition of the workforce may have informal or formal practices in place that impede more balanced representation. This was the case for many professional jobs during the middle of the 20th century, as research on gender and racial discrimination has shown.[19] While formalized discrimination in labor markets has been outlawed and has likely fallen, structural obstacles — such as licensing requirements or professional norms — may affect some groups more than others. When employees face discrimination or other unnecessary obstacles to career development, it also impedes engagement.[20] Further research could clarify these dynamics.

19 For discussion of gender discrimination in the workplace in the 20th and 21st centuries, see Goldin, Claudia. "Career and family." In *Career and Family*. (Princeton University Press, 2021); For discussions of labor market and other forms of racial discrimination against Black Americans, see Packard, Jerrold M. *American nightmare: the history of Jim Crow*. Macmillan, 2003; Jonathan Rothwell, A Republic of Equals: A Manifesto for a Just Society (Princeton University Press, Princeton NJ, 2019). For discussion of how policy and ethnic bias has affected the social status of Hispanic Americans, see Massey, Douglas S., and Karen A. Pren. "Origins of the new Latino underclass." *Race and Social Problems* 4 (2012): 5-17.

20 Gallup, "What Is Employee Engagement and How Do You Improve It?," available at https://www.gallup.com/workplace/285674/improve-employee-engagement-workplace.aspx (Accessed May 2, 2023)

The CFI database measures both the proportionality of each career — by race/ethnicity and gender — and its diversity. See the methodological appendix for details. Both measures consider the percentage of workers in a career that are in each group.

PROPORTIONALITY

Measures how closely group occupation shares match group workforce shares. Disproportionality is the occupation's percentage deviation from equal representation relative to each group's workforce composition.

DIVERSITY

Measures how equally the groups are represented relative to one another. The diversity index measures the probability that two randomly chosen workers in an occupation represent different groups.

The two measures are distinct in important ways. A career may be highly diverse when the largest group (White Americans) is somewhat underrepresented relative to its share of the workforce and smaller groups are overrepresented. When considering the fairness of how desirable careers are distributed, proportionality provides a more compelling target than diversity, since maximum diversity is impossible when groups differ in population size.

While the database includes detailed information on race and gender for context, neither diversity nor proportionality are included in the CFI. Diversity and proportionality will mean different things to different workers, and neither is a perfect measure of fairness or justice. Even when careers are equally open to all, differences in groups' characteristics such as age, experience and education are likely to lead to differences in occupational pathways. Moreover, the demographic representation of a career is likely to vary by city or organization, and different organizations and even managers will vary in their ability to inspire engagement across groups. Nonetheless, given concerns about the subjective nature of hiring and promotion, and the importance of respect and opinion to employee engagement, it is expected that representational issues will continue to matter for many workers, especially for those in groups that have been historically discriminated against.

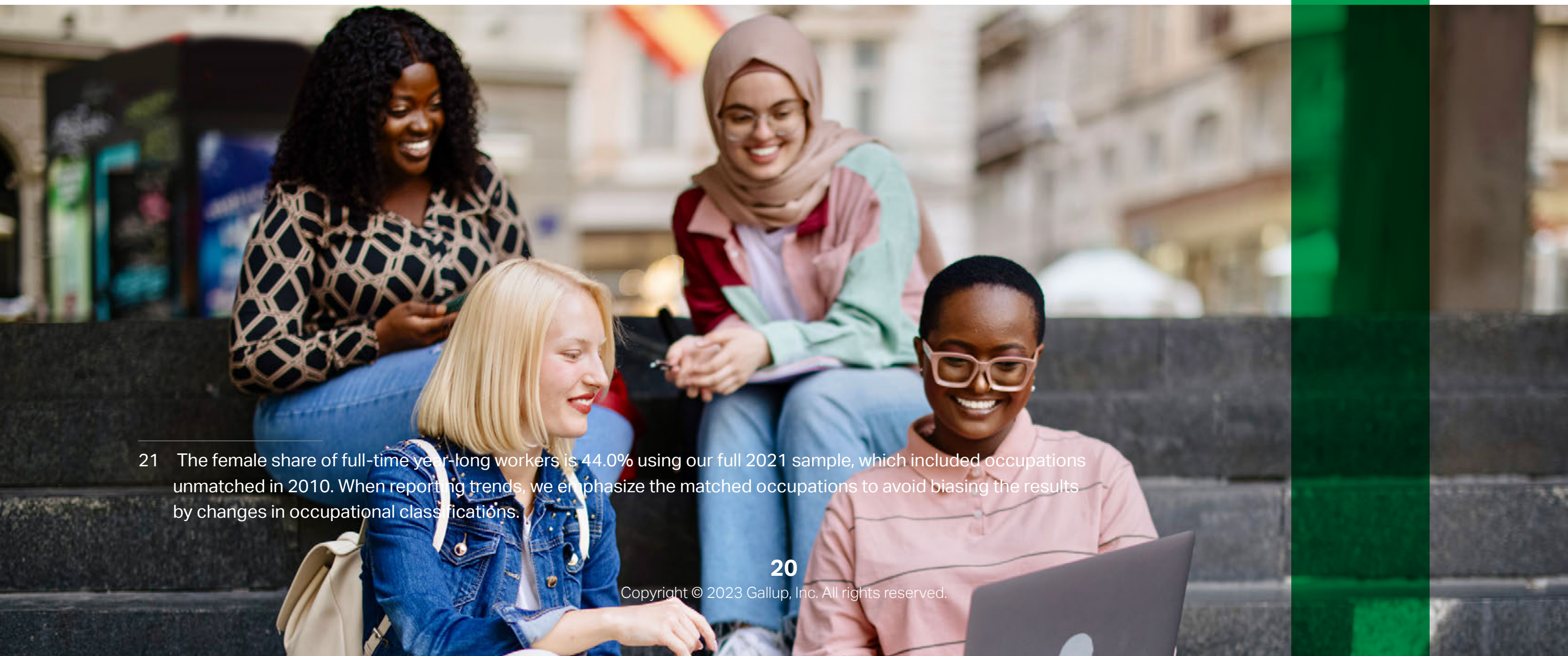
TRENDS BY RACE/ETHNICITY AND GENDER

Before considering more complex measures of group proportionality, the analysis begins with an overview of workforce characteristics by race/ethnicity and gender for all occupations and top-scoring occupations, meaning those scoring 80 or above on the CFI. For these calculations — as well as for the CFI generally, we analyze salary, job growth and demographic data for the subset of workers who are employed full time. The share of workers who are part time is provided in the complete database for reference. Two values for 2021 are reported, because only a subset of occupations have available data for 2010 and 2021, due to inconsistencies in occupational classifications. The 2021 results are, therefore, broken out into the full set of all occupations and the subset, which is directly comparable to the 2010 data, which is limited to the subset, since a CFI could not be created for the occupations that no longer existed in 2021 or were otherwise merged with other occupations.

The largest change between 2010 and 2021 was in the share of non-Hispanic White workers, which fell from 68% to 61%. Hispanic and multiracial workers saw the largest increase, by about three percentage points each, whereas Black and Asian workers saw small increases and American Indian/Alaskan Natives saw a very small decrease. The female share of full-time workers inched up from 42.9% to 43.%.[21]

This report defines top-scoring jobs as those in the top quintile of the CFI, which is 80 or above. For those top-scoring jobs, American Indian/Alaskan Native and especially White workers saw a decline in their share of workers in these categories, where Asian, Hispanic and multiracial workers saw substantial increases. Black workers saw a small increase. These trends occur regardless of whether the analysis is restricted to the occupations that are matched between 2010 and 2021, or whether all occupations in 2021 are included.

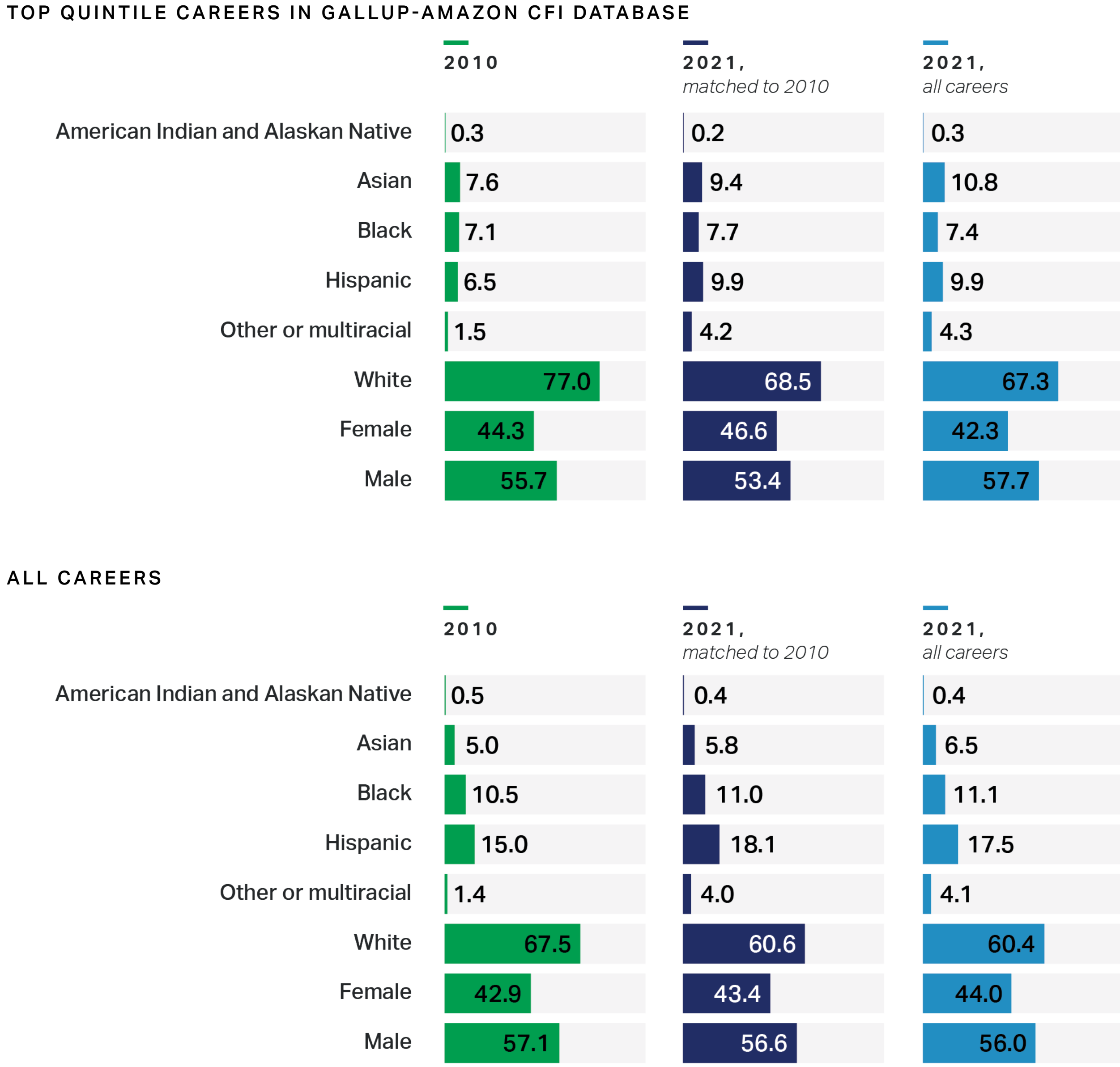
The trend is more complicated for gender. Women saw an increase in top-scoring jobs when considering the occupations that are matched between periods, but an apparent decrease if all occupations in the top quintile are included, regardless of whether they existed in 2010. This may be the result of newer occupations — such as those in information technology — being more heavily represented by men.



21 The female share of full-time year-long workers is 44.0% using our full 2021 sample, which included occupations unmatched in 2010. When reporting trends, we emphasize the matched occupations to avoid biasing the results by changes in occupational classifications.

FIGURE 8

How Shares of Top-Scoring Careers and All Careers Changed by Gender and Race/Ethnicity from 2010 to 2021



First two columns are limited to 387 occupations with consistent titles from 2010 to 2021. Third column includes all 529 occupations.
Sources: U.S. Census Bureau 2010 and 2021 American Community Survey, via IPUMS USA

FINDINGS ON PROPORTIONALITY

Gallup evaluates the proportionality of jobs with respect to race/ethnicity and gender using a disproportionality index (see methods for details of the calculation). It measures the relative distance between a group's share of the national labor force and a group's share of workers in a given career. A value of 33% means that the average group is 33% away from its share of the national labor force. A value of zero means that each group matches its labor force share. Thus, occupations with low values on the occupational disproportionality index are well represented by race/ethnicity or gender. A score of 100% means that at least some groups are represented at a rate that is more than double their share of the workforce — and other groups are underrepresented by large proportions.

When summarizing trends by race, the index is modified slightly to measure group overrepresentation — taking a positive value when a group's occupation share exceeds it workforce share — and underrepresentation, when a group's occupation share falls below its share of national workers. Again, a score of zero means the group (a specific race or gender) is at parity with its share of the workforce for a given occupation (or set of occupations).

For top-scoring careers on the CFI, Black, American Indian and Hispanic workers are underrepresented by 33%, 38% and 43%, respectively. To illustrate this more directly, the number of Black workers in top-scoring jobs would need to increase by 1.5 (1/(1-.33)) to reach proportionality. On the other hand, Asian and White workers are overrepresented in top-scoring occupations, by 67% and 12%, respectively. Multiracial workers are only slightly overrepresented (5.4%)

Comparing 2010 with 2021 measures is complicated by the fact that 142 occupations (such as web developers) were not specifically classified in 2010, so there is no way to measure how their demographic composition has changed. Thus, the figure below reports 2010 values for all 387 occupations with a 2021 CFI score, 2021 values for the same 387 and 2021 values for all occupations, including the newly created classifications.

Within top-scoring jobs, Black, Hispanic and White workers have moved closer to parity, meaning their share of jobs in top-scoring careers more closely matches their share of all jobs in 2021 than it did in 2010. This is especially pronounced for Hispanic workers, who gained 12 percentage points. By contrast, American Indian, Asian and multiracial/other racial groups have moved further from parity.

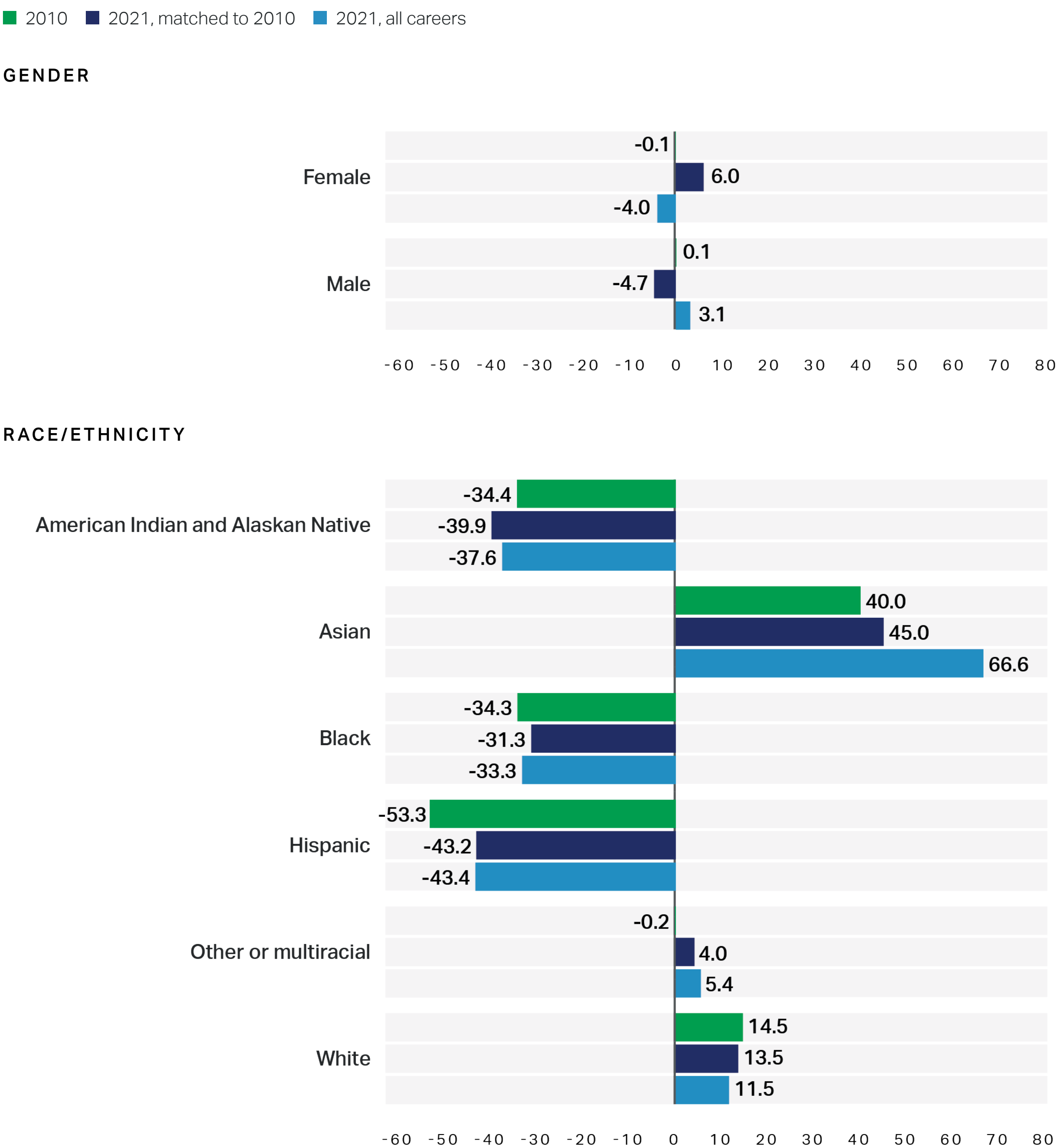
When it comes to gender, men are slightly overrepresented among top-scoring jobs (3.1%), whereas women are slightly underrepresented (-4%). This is driven entirely by the newly created jobs or the ones that did not have an equivalent category in 2010. This is clear by comparing the 2021 value when jobs are matched with the 2021 value for all jobs.

For just the jobs that were consistently classified, women went from parity to overrepresentation (6%), but this falls to underrepresentation when the unmatched jobs are included. The unmatched jobs include many in computer-related roles, where women tend to be underrepresented.

FIGURE 9

How Over/Underrepresentation By Gender and Race/Ethnicty Changed From 2010 to 2021 Across U.S. Occupations for Top-Quintile-Scoring Careers on the CFI

Values show percentage difference from exact representation.



Values calculated as the mean difference between the share of workers in each occupation and the national group share, with that gap divided by the national group share. Negative values indicate underrepresentation. Mean is a weighted average, using the national share of workers in the occupation as the weight.

Sources: U.S. Census Bureau 2010 and 2021 American Community Survey, via IPUMS USA

When compared with the average occupation, top-scoring occupations on the CFI (those scoring 80 or above), tend to be somewhat less representative by race/ethnicity, but more representative by gender.

First, looking at race/ethnicity, several of the highest scoring jobs are highly uneven in their racial distributions, such as surgeons, astronomers/physicists, physicians and other mathematical science occupations (which includes data scientists). Dentists, optometrists and software developers are also highly skewed by race/ethnicity.

Yet, several top-scoring jobs are relatively proportional by race/ethnicity, including chief executives, nurse practitioners, lawyers, project management specialists and miscellaneous managers. Where data is available, these jobs have also been moving closer to proportionality, especially nurse practitioners.

Turning to gender, the degree of proportionality varies widely by role. Some top-scoring jobs in healthcare — such as nurse anesthetists, physicians and optometrists — are relatively balanced, but surgeons and nurse practitioners are highly imbalanced. Dentists fall in between. Several jobs in management roles tend to have high proportionality (low disproportionality), including project management specialists and other managers. Chief executives are moderately disproportionate, whereas jobs in software development and sales engineering are highly disproportionate.

FIGURE 10

Racial and Gender Disproportionality in Top 20 Careers by the CFI (Sorted by CFI)

	Race/ethnicity disproportionality		Gender disproportionality	
Career	**2021**	**Change since 2010, percentage points**	**2021**	**Change since 2010, percentage points**
Surgeons	59%	N/A	52%	N/A
Astronomers and physicists	58%	-35	44%	-8
Nurse anesthetists	52%	-10	22%	-11
Physicians	62%	N/A	14%	N/A
Project management specialists	29%	N/A	0%	N/A
Other mathematical science occupations	77%	21	1%	-9
Chief executives and legislators	30%	-7	33%	-13
Architectural and engineering managers	52%	2	65%	-9
Dentists	65%	-5	24%	-16
Actuaries	71%	-8	39%	8
Nurse practitioners and nurse midwives	24%	-31	86%	-8
Lawyers, judges, magistrates and other judicial workers	33%	-6	6%	-14
Other managers	17%	N/A	11%	N/A
Financial and investment analysts	60%	5	2%	-18
Sales engineers	63%	16	76%	4
Optometrists	78%	26	16%	10
Economists	46%	-5	18%	-8
Software developers	104%	N/A	54%	N/A
All careers	**36%**	**-2**	**48%**	**-1**

Note: Missing values indicate that data is not available in 2010 due to inconsistencies in occupational classifications. Disproportionality measures the absolute value difference between group occupation shares and group workforce shares in proportion to each group workforce share. Values show the average percentage distance from the representational share. Lower numbers are closer to proportionality. For example, using gender, if the disproportionality index is 50% and favors men, then women would need to double their share of workers to reach parity. A value of 100% for gender disproportionality would mean that the underrepresented group would need to double in size.

FIGURE 11

Racial and Gender Disproportionality in Top-Scoring Careers in Which Most Workers Have Less Education Than a Bachelor's Degree (Sorted by CFI)

	Race/ethnicity disproportionality		Gender disproportionality	
Career	**2021**	**Change since 2010, percentage points**	**2021**	**Change since 2010, percentage points**
Computer network architects	38%	N/A	77%	N/A
Emergency management directors	39%	-37	30%	2
Magnetic resonance imaging technologists	41%	N/A	29%	N/A
First-line supervisors of fire fighting and prevention workers	37%	-7	82%	3
Cardiovascular technologists and technicians	80%	N/A	20%	N/A
Construction managers	34%	-6	72%	-3
Occupational health and safety specialists and technicians	35%	N/A	32%	N/A
Industrial production managers	25%	-4	41%	-15
Training and development managers	28%	-13	16%	4
Power plant operators, distributors and dispatchers	47%	6	77%	4
Elevator installers and repairers	49%	15	86%	-2
First-line supervisors of police and detectives	39%	8	55%	-1
Computer occupations, all other	31%	N/A	39%	N/A
Network and computer systems administrators	29%	N/A	57%	N/A
General and operations managers	23%	-4	21%	-10
Air traffic controllers and airfield operations specialists	43%	2	50%	-2
Entertainment and recreation managers	119%	N/A	13%	N/A
Radiation therapists	62%	16	44%	-24
Facilities managers	33%	N/A	45%	N/A
All careers	**36%**	**-2**	**48%**	**-1**

Note: Missing values indicate that data is not available in 2010 due to inconsistencies in occupational classifications.

FIGURE 12

Racial and Gender Disproportionality in Top-Scoring Careers in Which Most Workers Have a Bachelor's Degree But No Graduate Degree (Sorted by CFI)

	Race/ethnicity disproportionality		Gender disproportionality	
Career	**2021**	**Change since 2010, percentage points**	**2021**	**Change since 2010, percentage points**
Actuaries	71%	-8	39%	8
Financial and investment analysts	60%	5	2%	-18
Sales engineers	63%	16	76%	4
Software developers	104%	N/A	54%	N/A
Chemical engineers	52%	0	49%	-12
Petroleum, mining and geological engineers, including mining safety engineers	35%	-10	72%	4
Other engineers	62%	6	60%	-8
Aerospace engineers	47%	-17	64%	-3
Electrical and electronics engineers	56%	-11	69%	-4
Public relations and fundraising managers	28%	N/A	50%	N/A
Mechanical engineers	52%	-3	71%	-3
Personal financial advisers	35%	-5	25%	-4
Marketing managers	37%	N/A	37%	N/A
Aircraft pilots and flight engineers	57%	6	77%	-4
Civil engineers	39%	-10	55%	-9
Materials engineers	60%	-31	66%	-3
Securities, commodities and financial services sales agents	40%	2	37%	7
Atmospheric and space scientists	67%	8	12%	-30
Industrial engineers, including health and safety	38%	-13	40%	-13
Registered nurses	26%	-3	87%	-5
All careers	**36%**	**-2**	**48%**	**-1**

Note: Missing values indicate that data is not available in 2010 due to inconsistencies in occupational classifications. Disproportionality measures the absolute value difference between group occupation shares and group workforce shares in proportion to each group workforce share. Values show the average percentage distance from the representational number. For example, using gender, if the disproportionality index is 50% and favors men, then women would need to double their share of workers to reach parity. Values above 100% indicate that the mean group's gap between national and occupational shares is more than double the group's national representation.

TOP-SCORING CAREERS WITH GROWING PERCENTAGES OF BLACK AND HISPANIC WORKERS

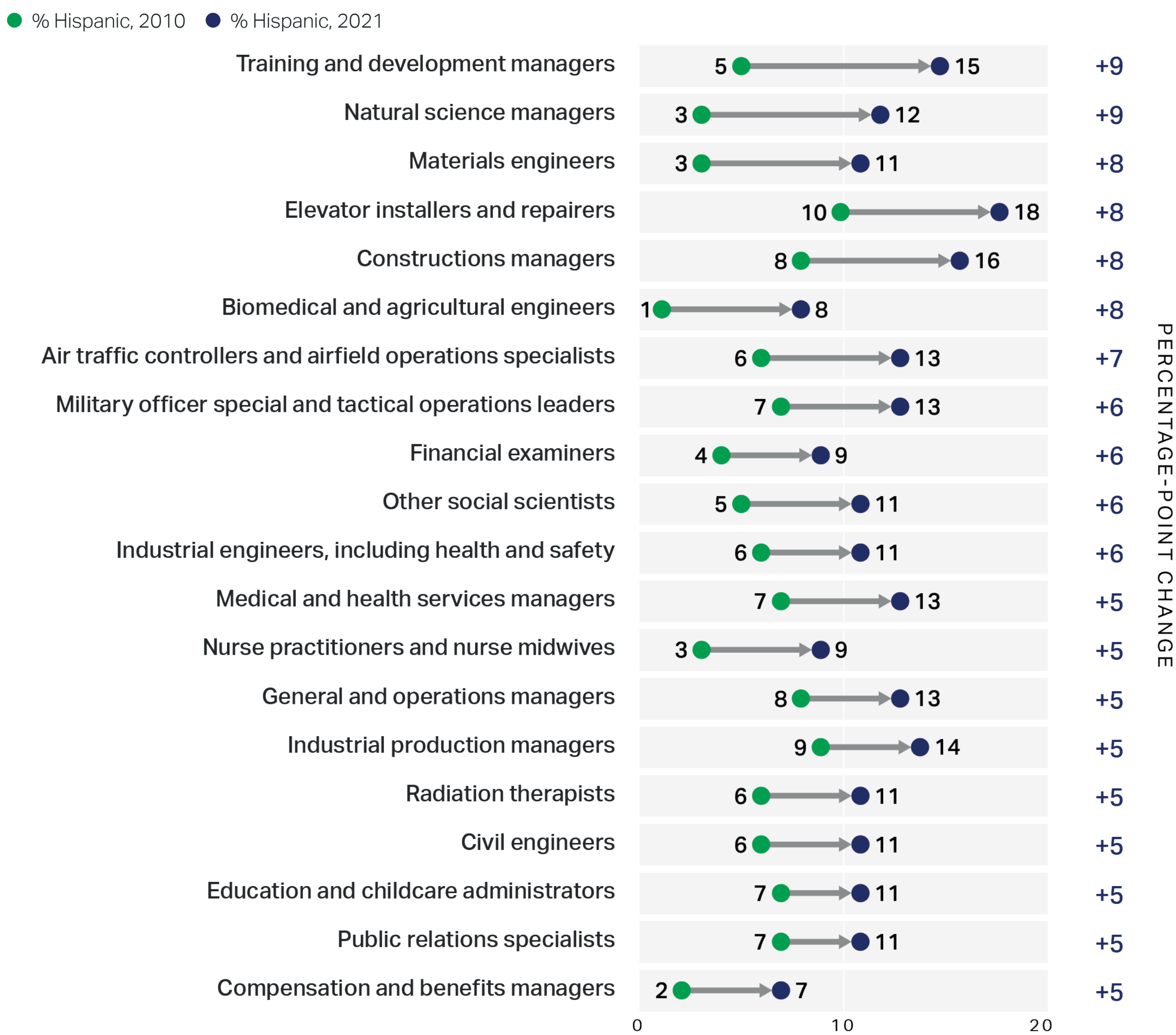
Of the 78 careers scoring 80 or higher with continuous data, the Hispanic share of workers increased in 74 of them. These span a variety of occupations, ranging from management to skilled workers to medical workers and social scientists, among others. The largest increases were for careers in training and development managers, natural science managers, materials engineers, elevator installers and construction managers, which all saw increases of eight percentage points (without rounding) or higher in the Hispanic share of workers.

Despite the growing share of Hispanic workers in these roles, Hispanic workers remain underrepresented in all but one of the 74 top-scoring careers with an increasing share. The Hispanic share of all workers is 18%, and only elevator installers and repairers matches that.

FIGURE 13

Top-Scoring Careers With the Largest Increases in Hispanic Share of Workers From 2010 to 2021

The 20 careers with the largest change that score 80 or above on the CFI. In 2021, Hispanic workers comprise 18.1% of all full-time workers in careers with matching 2010 titles.



Due to rounding, percentage-point changes may equal the difference of the numbers shown, +/-1.

The share of Black workers among full-time U.S. workers changed only slightly from 2010 to 2021 (increasing half a percentage point, from 10.6% to 11.1%), and the share of Black workers in the top quintile increased by a similar margin, going up from 7.1% to 7.7%. This includes much larger increases in a handful of top-tier occupations, with increases of one to nearly seven percentage points between 2010 and 2021. Overall, 47 top-scoring careers saw an increase in Black representation, though only eight of them see rates of Black employment at or above their share of the full-time labor force.

The largest increases in the share of Black workers has occurred in emergency management directors (up 6.8 percentage points, operations research analysts (up 4.5 percentage points) and actuaries (up 3.4 percentage points). Of the top 10 high CFI careers seeing increased representation of Black workers, many are in engineering fields, including marine engineering, aerospace engineering and chemical engineering.

FIGURE 14

Top-Scoring Careers With the Largest Increases in Black Share of Workers From 2010 to 2021

The 20 careers with the largest change that score 80 or above on the CFI. In 2021, Black workers comprise 11.0% of all full-time workers in careers with matching 2010 titles.

Due to rounding, percentage-point changes may equal the difference of the numbers shown, +/-1.

TOP-SCORING CAREERS WITH GROWING GENDER DIVERSITY

Of the 78 careers in the top quintile with data in 2010 and 2021, 46 became more proportionate by gender, though they took different paths to get there. Fifty-five top-scoring careers increased their share of women, with only 35 of those becoming more proportionate by gender. Whether a career becomes more representative by gender depends on its baseline representation. Eleven top-quintile careers became more gender diverse by expanding their share of men. This is true for radiation therapists, compensation and benefits managers, nurse practitioner and midwives, registered nurses, nurse anesthetists and physical therapists, all of which were heavily dominated by women in 2010, but became less so by 2021.

Of top-scoring jobs, those with the largest increases in gender proportionality are shown below. Atmospheric and space scientists saw the largest change, a 30% fall in disproportionality. Women went from just 23.6% of workers in this career in 2010 to 38.2% in 2021. Other notable gains in proportionality through greater female representation include environmental engineers, financial analysists, dentists, biomedical engineers, lawyers, chief executives and chemical engineers.

Other mathematical science occupations (which includes data scientists) became somewhat more proportionate, as the female share went from 44.7% to 49.3%. It is now slightly disproportionate in favor of women, given the labor force breakdown.

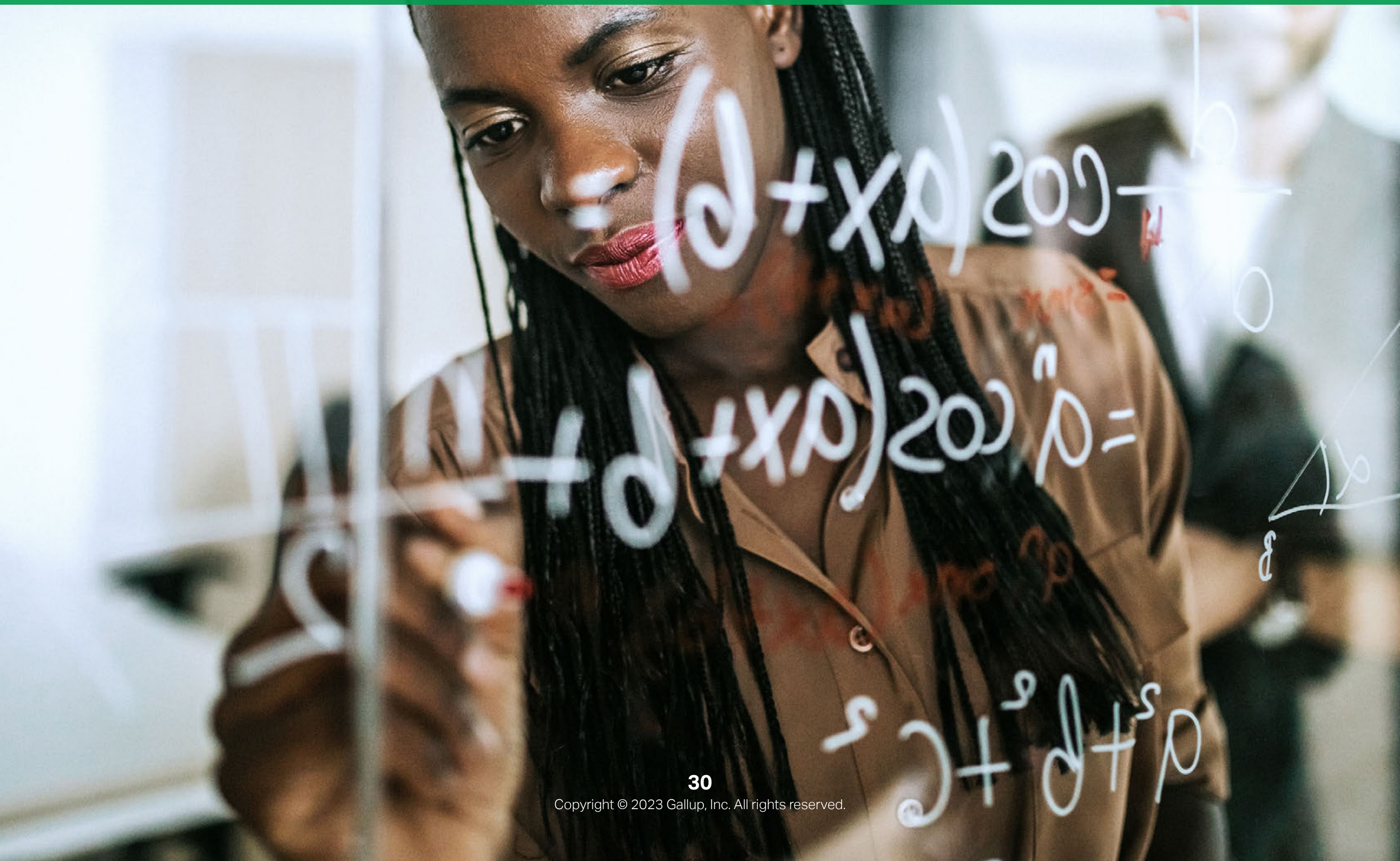


FIGURE 15

Top-Scoring Occupations That Are Increasingly Proportional by Gender (Sorted by Change in Disproportionality)

The 20 careers with the largest change that score 80 or above on the CFI. In 2021, female workers comprise 43.4% of all full-time workers in careers with matching 2010 titles.

Careers	Change in disproportionality since 2010	Disproportionality, 2021	Change in female share since 2010, percentage points
Atmospheric and space scientists	-30%	12%	15
Environmental engineers	-24%	26%	12
Radiation therapists	-24%	44%	-12
Financial and investment analysts	-18%	2%	9
Compensation and benefits managers	-16%	55%	-8
Dentists	-16%	24%	8
Biomedical and agricultural engineers	-16%	39%	8
Industrial production managers	-15%	41%	7
Lawyers, judges, magistrates and other judicial workers	-14%	6%	7
Physical scientists, all other	-14%	0%	7
Chief executives and legislators	-13%	33%	6
Industrial engineers, including health and safety	-13%	40%	6
Chemical engineers	-12%	49%	6
Other social scientists	-12%	1%	-6
Urban and regional planners	-11%	3%	5
Nurse anesthetists	-11%	22%	-6
General and operations managers	-10%	21%	5
Civil engineers	-9%	55%	4
Other mathematical science occupations	-9%	1%	-5
Architectural and engineering managers	-9%	65%	4

Some top-scoring jobs, 32 in all, became less proportionate by gender. Of these, 20 became less proportionate despite seeing an increase in female representation. This applies to natural science managers, pharmacists and veterinarians. The first two went from majority male to majority female, but so much so that they became more homogeneous (further away from proportionality). Veterinarians went from slightly majority female (53% in 2010) to strongly majority female (65% in 2021), resulting in lower diversity.

Meanwhile, 12 job titles with CFI scores of 80 or above saw increased male representation and a drop in gender proportionality. These careers include marine engineers and naval architects, computer hardware engineers, actuaries, securities, commodities and financial services agencies and sales engineers.

Conclusion

Finding a career can involve many twists, turns and false starts over a decade or more as people discover what interests them, what jobs are available, and what their options are for higher education or job training. In many cases, careers find people before people consciously decide for themselves how they want to spend their working lives. And while this can work out, a better way would be if, early on in the process, students have access to key information about the full range of available career opportunities in the United States. This could unlock the door to a wide range of possibilities most students would otherwise never consider.

Presently, however, there is no clear user-friendly resource to compare a wide range of careers or learn about new ones, based on their economic viability and educational requirements. The CFI attempts to fill this gap in the existing career resources answering the questions: Is this job hard to get? What does it pay? And, will it survive the AI revolution?

While many existing career lists identify the best paying jobs or the best paying jobs with promising futures, none provide the same comprehensive coverage and depth of information, or the same level of transparency about how jobs are scored and flexibility in analyzing various jobs as the CFI. Beyond the ranking of careers and the interactive tool to explore the CFI, this report provides useful insights about the many great jobs that exist that are largely overlooked and what career paths are most promising for those not interested in or able to pursue higher education. At the same time, the information ought to reinforce the broader message that higher education is an accelerator of success, thereby motivating students to act early on to set themselves up for academic and professional accomplishments.

We hope these resources empower young people in the U.S. to embark on a mindful journey that leads to a fulfilling and rewarding career.

Appendix

SUPPLEMENTAL TABLE

How shares of careers changed by gender and race/ethnicity from 2010 to 2021

Restricted to adults who are employed full-time and worked at least 40 weeks during the year prior year.

American Indian and Alaskan Native: 2010	2021, *matched to 2010*	2021, *all careers*		Asian: 2010	2021, *matched to 2010*	2021, *all careers*
0.6	0.6	0.6	BOTTOM QUINTILE	5.3	5.3	5.8
0.6	0.5	0.5	2ND QUINTILE	3.8	4.0	4.2
0.5	0.5	0.5	3RD QUINTILE	4.5	4.8	4.6
0.4	0.4	0.4	4TH QUINTILE	3.9	4.5	4.7
0.3	0.2	0.3	TOP QUINTILE	7.6	9.4	10.8
0.5	0.4	0.4	ALL CAREERS	5.0	5.8	6.5

Black: 2010	2021, *matched to 2010*	2021, *all careers*		Hispanic: 2010	2021, *matched to 2010*	2021, *all careers*
14.2	15.1	14.7	BOTTOM QUINTILE	26.8	29.4	30.0
12.6	13.7	15.0	2ND QUINTILE	19.2	24.4	23.1
10.3	10.8	10.8	3RD QUINTILE	13.4	17.9	17.9
8.3	9.2	9.9	4TH QUINTILE	9.4	13.2	13.3
7.1	7.7	7.4	TOP QUINTILE	6.5	9.9	9.9
10.5	11.0	11.1	ALL CAREERS	15.0	18.1	17.5

Other or multiracial: 2010	2021, *matched to 2010*	2021, *all careers*		White: 2010	2021, *matched to 2010*	2021, *all careers*
1.5	3.8	3.7	BOTTOM QUINTILE	51.5	45.8	45.2
1.5	4.0	4.0	2ND QUINTILE	62.3	53.5	53.2
1.4	4.2	4.1	3RD QUINTILE	69.8	61.8	62.1
1.3	3.9	4.0	4TH QUINTILE	76.7	68.9	67.8
1.5	4.2	4.3	TOP QUINTILE	77.0	68.5	67.3
1.4	4.0	4.1	ALL CAREERS	67.5	60.6	60.4

Female: 2010	2021, *matched to 2010*	2021, *all careers*		Male: 2010	2021, *matched to 2010*	2021, *all careers*
52.6	51.0	47.5	BOTTOM QUINTILE	47.4	49.0	52.5
34.1	33.4	43.8	2ND QUINTILE	65.9	66.6	56.2
40.3	40.9	39.7	3RD QUINTILE	59.7	59.1	60.3
43.8	45.7	47.5	4TH QUINTILE	56.2	54.3	52.5
44.3	46.6	42.3	TOP QUINTILE	55.7	53.4	57.7
42.9	43.4	44.0	ALL CAREERS	57.1	56.6	56.0

First two columns are limited to 387 occupations with consistent titles from 2010 to 2021. Third column includes all 529 occupations.

Sources: U.S. Census Bureau 2010 and 2021 American Community Survey, via IPUMS USA

Concepts, Data Sources and Methods

OCCUPATION AS THE UNIT OF ANALYSIS

A career refers to a job or series of jobs performed by an individual over time within a field of work. All jobs are classified by government statistical agencies into occupations based on the task requirements of that job. An occupation is therefore a group of closely related jobs and can be thought of as a career. As described by the U.S. Bureau of Labor Statistics (BLS), "Occupations are classified based on work performed and, in some cases, on the skills, education and/or training needed to perform the work."[22] For these reasons, an occupation is a rigorous and useful way to organize and analyze careers. All Careers of the Future data are reported at the level of an occupation, unless otherwise noted. The data are reported using the Standard Occupational Classification (SOC) system, which was developed by BLS.

University of Minnesota's IPUMS-USA provides the Census data used in our analysis.[23] They created the variable occsoc, which translates Census occupational coding into the SOC system and harmonizes across years. This is the fundamental unit of analysis for our database. Like the SOC system, the occsoc code consists of six digits (usually) and each adds more detail to the occupational category. The first two digits describe the major category, and each subsequent digit narrows the group.

We further restrict the analysis to people currently employed, who usually work full time (i.e., 35 hours or more per week), with income above zero, who worked at least 40 out of 52 weeks in the reference year. We control for hourly schedules and other structural factors that may differ between occupations, making the income data more readily comparable. The result is a database with 529 occupations, drawn from 1,034,063 survey respondents, representing 111.6 million workers in 2021.

22 Office of Management and Budget, 2018 "Standard Occupational Classification Manual," https://www.bls.gov/soc/2018/soc_2018_manual.pdf

23 Steven Ruggles, Sarah Flood, Ronald Goeken, Megan Schouweiler and Matthew Sobek. IPUMS USA: Version 12.0 2010 and 2021 American Community Survey. Minneapolis, MN: IPUMS, 2022. https://doi.org/10.18128/D010.V12.0

INCOME AND FAMILY-SUSTAINING SALARY

Income data come from the 2010 and 2021 American Community Surveys (ACS) and refer to wage and salary income earned from work as an employee.[24] Values are cumulative over the previous 12 months ending on the date of the survey.

Data are reported at the 25th, 50th (median) and 75th percentiles. The lower and upper ranges could be used to approximate workers at the lower and upper ends of the experience distribution, but the within-salary range is also affected by worker differences in skill, industry and employer.

A family-sustaining salary is defined as the amount of money a typical family would need to afford annual expenses. The average family consists of just over three people, according to Census data,[25] so we used consumption data from the 2021 BLS Consumer Expenditure Survey.[26] The average three-person household spends $69,740 per year. We used this as our definition of a family-sustaining income.

The amount of money needed to sustain a family varies widely by geography, mostly because of sharp differences in housing prices between large metropolitan areas, like San Francisco and New York, and smaller metropolitan areas and towns. While these differences could be accounted for, this tool is designed to be applicable across the U.S., and the national BLS data provide a weighted average of differences in expenditures according to where people currently reside. For those who intend to live in lower-cost areas of the country, they should realize that the family-sustaining income will provide a more generous standard of living, whereas those who move to the higher-cost areas may find they need additional income to afford their desired standard of living.

For these and other reasons, the family-sustaining income level should be thought of as a proxy measure with significant limitations when applied to individuals. The cost of living required to support a family will vary not only by metropolitan area housing prices and other regional factors, but also the spending habits and specific composition of household members, based on their age, health needs and labor force participation status.

JOB GROWTH

The number of jobs is defined as the number of individuals working in the reference occupation. This is calculated using ACS data for 2010 and 2021, and the rate of growth is calculated over the entire 11-year period. For some occupations, Census coding prevents direct comparisons from 2010 to 2021. In these cases, the number of jobs was calculated at a higher level of aggregation (3, 4, or 5 digits) and growth was calculated at this higher level, instead of the 6-digit level. In this way, job growth data was provided using closely related occupations including the reference occupation. A flag is added to indicate this imputation in the growth section of the database.

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24 Steven Ruggles, Sarah Flood, Ronald Goeken, Megan Schouweiler and Matthew Sobek. IPUMS USA: Version 12.0 2010 and 2021 American Community Survey. Minneapolis, MN: IPUMS, 2022. https://doi.org/10.18128/D010.V12.0

25 Statista, https://www.statista.com/statistics/183657/average-size-of-a-family-in-the-us/#:~:text=Families%20in%20the%20United%20States&text=The%20average%20family%20consisted%20of,about%2040%20percent%20in%202120

26 U.S. Bureau of Labor Statistics, "Table 1400. Size of consumer unit: Annual expenditure means, shares, standard errors, and coefficients of variation, Consumer Expenditure Surveys, 2021," https://www.bls.gov/cex/tables/calendar-year/mean-item-share-average-standard-error/cu-size-2021.pdf

JOB VACANCIES AND DEMAND VS. SUPPLY

Some high-paying jobs may, nonetheless, have few vacancies, and some fast-growing fields may have even faster growth in labor supply, through immigration or new entry from training programs. One indicator of whether demand growth has outpaced supply growth is income growth. As with commodities, economic theory predicts that the price rises as the demand curve shifts outwards relative to supply, and prices fall as the supply curve shifts out, with constant demand. Thus, a rise in relative income (growth of the reference occupation compared with others) should indicate an increase in the demand-supply ratio. These data are included in the database; 2010 incomes are adjusted for inflation using the Consumer Price Index and reported in 2021 dollars.

In addition to demand-supply dynamics, income is also strongly influenced by factors such as the underlying productivity, changes in the task and training requirements of a job, public policy (e.g., minimum wage laws), potential competition (e.g., if the price of food produced outside of home rises, more people will cook at home). Thus, income growth is, at best, a noisy measure of relative demand.

For these and other reasons, our preferred measure of demand-supply dynamics compares the number of job vacancies with the number of job candidates. At any given time, this ratio measures the degree of competition workers face when seeking a job. When demand is much higher than supply, workers have many potential employers or jobs to choose from, improving their chances of finding a match as well as their bargaining power. This was evident in 2021 when job vacancies per worker reached record highs, according to BLS data, after the recovery from the pandemic, and wages and benefits rose sharply as companies struggled to attract candidates for open positions.

The demand-supply ratio is defined as the number of advertised vacancies per month in a given occupation between June 2021 and May 2022, divided by the number of workers who are actively seeking employment in that field.

The numerator is derived from the database that Gallup purchased from the labor market intelligence firm Lightcast (formerly known as Burning Glass). The company collects, harmonizes and sells the data for all vacancies advertised online in the U.S. The validity of the data has been established in empirical research, though an obvious limitation is that some blue-collar occupations are less likely to be advertised online. The denominator is the number of unemployed workers based on data from IPUMS-USA. Unemployment is defined as someone not working for pay who is actively looking for work and able to accept a new job. Occupation is identified by the last occupation that the respondent worked. A limitation is that the respondent may be looking for work in a new occupation, despite previous experience in the target occupation. Despite these limitations, previous work establishes this measure as empirically valid and consistent with the labor economic theory of matching.[27] Some of the occupations could not be directly linked between occsoc and the Lightcast occupational code. In these cases, the next closest match was used (e.g., five-digit ads per unemployed worker instead of six-digit). In such cases, both the numerator and denominator were aggregated to the same level to maintain accuracy.

27 Rothwell, Jonathan. "Still searching: Job vacancies and STEM skills." *Metropolitan Policy Program at Brookings Institution* (2014).

RESISTANCE TO AUTOMATION

We measure *automation resistance* as an index that summarizes the level and importance of non-automatable tasks to each career. Economists have long been concerned about the potential for machines to displace humans and lower the demand for labor for specific tasks and careers. The automation of manufacturing plants is well known, but the effects extend much wider. To list some examples, bank ATMs, self-checkout kiosks at grocery stores, vending machines, and automated customer service chatbots are among the tools that have specifically replaced tasks that were previously only performed by humans. With the recent release of open-source artificial intelligence tools like ChatGPT and DALL-E, the domain of jobs subject to competition from automation was expanded still further.

A career of the future should be able to withstand this trend and either perform tasks that cannot be automated or use these new technologies to make themselves more productive, as many workers did through the introduction of computers.

To measure resistance to automation, Gallup took two steps. First, we identified a set of 24 constructs, related to the tasks, skills, abilities and work context of occupations. These constructs are associated with resistance to automation in the economics literature, and the Department of Labor's O*NET database collects and reports these data for every occupation.[28]

28 Influential scholarly work and papers include the following: Frey, Carl Benedikt, and Michael A. Osborne. 2017. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" Technological Forecasting and Social Change 114: 254-80. Arntz, Melanie, Terry Gregory, and Ulrich Zierahn. 2016. "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis." OECD Social, Employment, and Migration Working Paper 189; Nedelkoska, Ljubica, and Glenda Quintini. 2018. "Automation, Skills Use and Training." OECD Social, Employment, and Migration Working Papers 202; Acemoglu, Daron, and David Autor. 2011. "Skills, Tasks and Technologies: Implications for employment and earnings." In Handbook of Labor Economics: Volume 4B, edited by David Card and Orley Ashenfelter, 1043-171. Elsevier, North-Holland; Brynjolfsson, Erik, and Andrew McAfee. 2014. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. New York and London: WW Norton & Company

Second, we needed a way to validate and weight the importance of these constructs in determining whether and how they predict resistance to automation. To do this, we relied on the 2019 Gallup Great Jobs Survey. In the survey, Gallup directly asked workers about whether they could lose their job to automation. The sample includes 6,231 workers who were randomly contacted through mail, and they were asked to agree or disagree on a 1-5 scale with the statement "A machine, robot, computer, could do my job" (Appendix Table 1). Overall, 8.5% of workers agree or strongly agree with this statement. That is a plausible number considering that other economists have estimated that 9% of jobs are at high risk of displacement from automation.[29] As expected by economic theory, the automation risk item is highly correlated with the sorts of tasks that workers perform, as recorded by other survey items. Specifically, it is strongly and negatively correlated with whether they are expected to be creative and whether their work requires frequent face-to-face interactions, and it is positively related to whether their work involves short, repetitive tasks.

To test the O*NET items for validity and assign them weights, we run models that take the following form, where automation risk is measured at the individual level for worker i in occupation o, occupation-specific task scores are merged to individual records using the occupation:

$$\textit{Automation risk}_{o,i} = \beta(\textit{ONET task}_o) + \textit{Controls}_i$$

Individual-level demographic controls include binary variables for age group, educational attainment and sex, to attempt to identify the relationship between task content and automation risk. Some O*NET task items include a level and importance score, and we tested them separately. For each model, we captured the T-statistic, defined as the regression coefficient divided by standard error. Appendix Table 2 shows the mean t-statistic for each O*NET element. If a construct included an importance and level score, we averaged over the two.

This exercise serves two purposes. First, it shows the validity of many O*NET constructs identified in the literature. As expected, most of these constructs are strongly and significantly related to automation risk. Second, it provides a non-arbitrary way of weighting these items and aggregating the underlying construct to a single metric at the occupational level. Focusing on the predictive power of automation risk (e.g., could a robot do your job), we remove all items with a T-statistic that falls between -1.96 and 1.96, and would thus be statistically insignificant at 95% confidence intervals. We then standardize the underlying scores, multiply the standardized score by negative one if the T-statistic is negative, and take the weighted average by occupation, using the absolute value of the T-statistic as the weight. This gives us a resistance to automation index that is negatively correlated with the perception that a robot could do your job, positively correlated with social perceptiveness, creativity, originality and other constructs, and negatively correlated with automation of tasks and repetition, among other constructs. In other words, we define automation resistance as a summary measure of the level and importance of non-automatable tasks to each occupation.

29 Arntz, Melanie, Terry Gregory, and Ulrich Zierahn. 2016. "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis." OECD Social, Employment, and Migration Working Paper 189

APPENDIX TABLE 1

ONET Task-Related Item Ranked by Association With Automation Risk

ONET element	T-stat when regressed on risk of automation
Social perceptiveness	-6.21
Thinking creatively	-6.07
Originality	-5.88
Scheduling work and activities	-5.02
Negotiation	-4.97
Persuasion	-4.77
Coordinate or lead others	-4.72
Freedom to make decisions	-4.69
Deductive reasoning	-4.5
Structured versus unstructured work	-4.06
Inductive reasoning	-4.04
Deal with physically aggressive people	-3.87
Cramped workspace, awkward positions	-3.53
Face-to-face discussions	-3.06
Controlling machines and processes	-0.27
Finger dexterity	0.14
Manual dexterity	0.34
Mathematical reasoning	0.38
Working with computers	0.42
Pace determined by speed of equipment	2.34
Importance of being exact or accurate	3.39
Spend time making repetitive motions	5.11
Importance of repeating same tasks	5.83
Degree of automation	7.6

CAREERS OF THE FUTURE INDEX

The CFI summarizes the income and job prospects of each career (or occupation). As explained above, we give higher weight to income, given Gallup's research on the importance of income to overall job satisfaction and other subjective job and life evaluations.[30] The precise weighting is described below with 50% given to income (I) and the remainder evenly divided between job growth (G), the demand-supply ratio (D) and automation resistance (AR), each at the occupational level. Each variable is first standardized.

$$CFI = (0.5 \times I_o) + (0.17 \times D_o) + (0.17 \times G_o) + (0.17 \times AR_o)$$ [31]

Thus, a score of "0" would mean that the income and other characteristics of the job are near the average occupation. A score of "1" indicates that the job characteristics are one standard deviation above the mean, on average. To ease interpretation, we convert all standardized scores into a centile rank, which is a 1 to 100 scale.[32]

There is no natural law that would provide a weight of 50% for income in deciding which occupations are best suited for the future. Users of the data can, of course, choose to rank occupations by any of the components (which would give the component 100% weight) or consider alternative weighting schemes. To provide a sense of the robustness of the various schemes, we report correlations between our preferred weighting scheme and two alternatives: one in which income is given a 66% weight and one in which it is given a 25% weight (Appendix Table 2), while the other three components are equally weighted. The correlations are very high with our original scheme (0.99 and 0.95, respectively). Income is also moderately correlated with job growth and openings per job seeker (0.22, 0.29), and more strongly correlated with resistance to automation (0.50). As expected, resistance to automation is correlated with job growth (0.23) and openings per job seeker (0.21), and removing cases in which growth is imputed using higher aggregation increases its correlation with resistance to automation slightly (to 0.27).

30 Rothwell, Jonathan and Steve Crabtree, "Not Just a Job: New Evidence on the Quality of Work in the United States", Gallup 2019, https://www.gallup.com/education/267590/great-jobs-lumina-gates-omidyar-gallup-report-2019.aspx

31 In actually carrying out this calculation, we use 0.502 and 0.166 instead of the abbreviated values, so that the sum totals 100, exactly.

32 In the rare cases in which a data element is missing for an occupation, we adjust the weights accordingly so they continue to add up to 100. Specifically, we make income 66% of the weight.

APPENDIX TABLE 2

Correlation Matrix Between Index Components and Different Versions of the Index

	Gallup-Amazon CFI score (income=.50)	Income	Job growth	Job openings per seeker	Resistance index	Gallup-Amazon CFI score (income=.66)	Gallup-Amazon CFI score (income=.25)
Gallup-Amazon CFI score (income=.50)	1.00						
Income	0.92	1.00					
Job growth	0.45	0.22	1.00				
Job openings per seeker	0.50	0.29	0.08	1.00			
Resistance index	0.67	0.50	0.23	0.21	1.00		
Gallup-Amazon CFI score (income=.66)	0.99	0.97	0.36	0.42	0.61	1.00	
Gallup-Amazon CFI score (income=.25)	0.95	0.76	0.57	0.60	0.73	0.89	1.00

GENDER AND RACIAL PROPORTIONALITY

Using data from the 2010 and 2021 ACS, we calculate the percentage of workers in each occupation who self-identify as male and female. While the ACS collects information on a respondent's sex, we use the term "gender" to describe this diversity index.[33] We also calculate the percentage of workers who fall into one of six mutually exclusive race-ethnicity categories: American Indian/Alaskan Native; Asian; Black; Hispanic; Multiracial; White. Each group, except Hispanic, includes only people who are non-Hispanic. If one or more races are selected and the person is non-Hispanic, they are classified as "multiracial." Those who selected a non-specified "other" race were also considered multiracial when non-Hispanic. Those who describe themselves as Hispanic are classified as such, regardless of their racial classification(s).

In addition to measures of gender and racial diversity, we include a measure of occupational proportionality. Disproportionality and diversity are distinct concepts, which is why both are included. Proportionality measures how closely an occupation's racial representation matches the representation of the labor force, whereas diversity measures how closely each group's proportions are to one another, regardless of their presence in the labor force.

The proportionality index is defined as the gap between group shares in an occupation and group shares of the labor force. Define ***Pg,o*** as the number of workers of a given group ***g*** working in occupation o divided by the total number of workers in that occupation. Define ***Pg*** as the number of U.S. workers of a given race divided by the total number of U.S. workers. For n number of groups (e.g., racial groups or genders), disproportionality is the mean absolute value difference in these two values, relative to the group's share of the national workforce, as represented below in the occupation-level disproportionality index.

$$1.\ Di_o = \frac{\sum_{g=1}^{n} \frac{|p_{g,o} - p_g|}{p_g}}{n}$$

33 Other Census surveys suggest that transgender-identified adults are 0.6% of the population, and the ACS questionnaire does not explicitly ask about sex at birth. https://www.census.gov/library/stories/2021/11/census-bureau-survey-explores-sexual-orientation-and-gender-identity.html

The numerator of the index has a simple interpretation: the gap between equal and actual representation for a given group. This component has a maximum of one, when all groups are represented in an occupation in proportion to their share of the labor force, and it has a minimum of zero, when each group works entirely in one occupation with no overlap between groups. The absolute value is used because disproportionality means that some groups will be above and some below their national share, and for a random occupation, it is unclear which position is preferred. Dividing by the national group share (p_r) normalizes the size of the groups, so that the gap can be interpreted in proportion to their size. Thus, *Occupation-level Disproportionality* index (Di_o) signifies the *mean proportional distance from parity for each group,* and the average distance across groups conveys occupational disproportionality for any number of groups.

When considering a given group, it is convenient to drop the absolute value and mean operation and re-formulate (Di_o) as $Group - Occupation\ Disproportionality$ or $Di_{g,o}$ in equation 2:[34]

$$2.\ Di_{g,o} = \left(\frac{p_{g,o}}{p_g}\right) - 1$$

This value corresponds to the degree of overrepresentation (if positive) or underrepresentation (if negative). The analysis above uses this formula for group level disproportionality by level of CFI, because taking the absolute value would hide whether the group is above or below its parity level. An intuitive way to connect Di to the target proportionality is to see the relationship in equation 3.

$$3.\ \left(\frac{1}{1 + Di_{g,o}}\right) p_{g,o} = p_g$$

For example, when Di is zero, $p_{g,o} = p_g$. When Di is 1, the workers in that group would need to be halved (multiplied by ½) to equal their national share. When Di is +0.33, then a group's number of workers in the occupation would need to be multiplied by 0.75 to reach parity, but if Di is -.33, then it needs to be multiplied by 1.49.

To calculate a group Di for all occupations, one only needs to multiply $\left(\frac{p_{g,o}}{p_g}\right) - 1$ by T_o/T where T is the total number of national workers, and sum across all occupations. This weights each occupation-group level disproportionality measure by the occupation's share of total U.S. workers. This procedure is used for the group level summary data presented above. It is calculated for race/ethnicity and separately for gender.

34 Replace 1 with Pg/Pg to check the algebra.

To provide a concrete illustration, consider the occupation surgeons. Column 1 from Appendix Table 3 shows the group share of each occupation by race and gender. Column 2 shows the group share of all workers. The ratio (column 1/column 2) -1 yields column 3 for the group-specific values. Asian workers, for example, are heavily overrepresented as surgeons, yielding a group level overrepresentation of 1.03 or 103%. Column 4 shows what value the groups share would need to be multiplied by to obtain parity with the group share of the workforce. This would be 0.49 for Asians, suggesting that the total number of Asian workers would need to be halved. For Black workers, the number would need to be multiplied by 13 to reach parity. The category or occupational level disproportionality index (59%) reflects the average absolute-value deviation from parity for each group relative to that group's share of the workforce. Fifty-nine percent suggests that, for the average group, the absolute gap is more than half of the group's share of the workforce, which is true for four of the six racial groups. When it comes to gender, the number of men would need to be multiplied by 0.69 and the number of women more than doubled (2.38) to reach parity. 52% is the average absolute value difference from parity for men and women.

APPENDIX TABLE 3

Example Disproportionality Calculations for the Surgeon Occupation by Race and Gender

	Group share of occupation (Pg.o)	Group share of workforce (Pg)	Disproportionality index (Di g,o for each group and Di o for occupation)	Value needed to multiply group share (Pg,o) to reach parity, 1/(1+Di g,o)
American Indian or Alaskan Native	0.2%	0.4%	-61%	2.53
Asian	13.2%	6.5%	103%	0.49
Black	0.9%	11.1%	-92%	12.98
Hispanic or Latino	5.3%	17.5%	-70%	3.31
Multiracial	4.1%	4.1%	0%	1.00
White	76.5%	60.4%	27%	0.79
Race/ethnicity			59%	
Male	81.5%	56.0%	46%	0.69
Female	18.5%	44.0%	-58%	2.38
Gender			52%	

The analysis above focuses on changes in disproportionality, but for 142 occupations, the occupation code does not match between 2010 and 2021, preventing a direct comparison between the two periods. For the interactive tool, we only report diversity changes using occupations that had the same code across both time periods. This does not introduce bias, since our CFI score is not correlated with whether or not the occupation changed. While the database notes when this occurs using a "flag" variable, we report 2010 data using the most detailed occupation data available.

GENDER AND RACIAL DIVERSITY

Proportionality measures the difference between the demographic composition of occupations compared to the composition of the workforce. Diversity, by contrast, measures the evenness of group occupation shares, without regard to the workforce composition. A diversity index was calculated using the following Gini/Simpson formula, which is widely used in the scientific literature,[35] where p refers to the percentage of all workers in group i, where i refers to their race/ethnicity or gender, depending on which index is being calculated.

$$\text{Diversity} = 1 - \sum_i (p)^2$$

The race-ethnicity index would be 0.00 if every group member was White non-Hispanic or some other group and 0.83 if all six race-ethnicity groups were equally represented. The gender diversity index reaches 0.50 when men and women were equally represented. Using this formula, the diversity index also indicates the probability that two people selected at random will be of different race-ethnicity (in the race-ethnicity index) or gender (in the gender index). These data are available in the complete database.

CAREER TRANSITIONS

The database includes a summary measure that indicates the career prospects of adjacent careers to the reference occupation. In other words, we recognize that one career branches off into others, so each career has its own CFI score, as well as a score that summarizes all the linked careers. We call this the career transitions score. It recognizes the fact that careers use knowledge domains, and those domains are also useful for other careers.

The motivation for this analysis is that some occupations, more than others, have favorable potential career prospects. We attempt to measure the desirability of an occupation by the adjacent opportunities that it presents. To do so, we combine census data with data from the Department of Labor O*NET database, which collects features associated with every occupation classified by the SOC system, including ability requirements, skills and knowledge domains. We focus on knowledge domains for this exercise since they align neatly with fields of study and training that connect one occupation to another.

There are 32 knowledge domains, and each occupation is scored on a scale of 1 to 7 by the level of knowledge it requires in each domain. We consider a knowledge domain relevant to the occupation if that occupation scores a 5 or higher on the 1 to 7 scale. O*NET follows the SOC system closely but provides more detail, so occsoc and O*NET codes cannot be directly matched for most occupations. The analysis proceeds in several steps.

The first step entails using the occupation-knowledge domain database and creating knowledge-level summary data. We first calculate summary data on income and job growth for each Census occupation (occsoc) at the 4-digit, 5-digit and 6-digit levels and merge these files into the O*NET database, matching at the 4-, 5- and 6-digit levels and replacing higher-level matches with data from the more detailed matches.

For example, O*NET may have several occupations connected to one Census code, as is the case for occupation 151299, "All other computer occupations." O*NET has 10 occupations with this 6-digit code, including "blockchain engineers" (151299.07). The income, automation, job growth, and job vacancy data from 151299 would be matched to all 10 O*NET codes and each relevant knowledge domain associated with those codes.

The last part in this process is to average the job quality components data over the knowledge domains associated with the occupations that require those knowledge domains. Since some occupation groups are much larger than others, we weighted the averages by the number of jobs associated with each occupation in 2021.

35 Nijkamp, Peter, and Jacques Poot. "Cultural diversity: a matter of measurement." In *The economics of cultural diversity*, pp. 17-51. Edward Elgar Publishing, 2015.

The second step merges the O*NET knowledge domain meta-data back into the raw O*NET database. This provides rankable values for each domain that can be linked back to the connected occupations that require them. From here, we calculate mean job quality values (linked by knowledge domain) for each occupation. The result is that each occupation can be ranked by the job qualities associated with its knowledge domains.

The final step is to merge this O*NET summary data back to the Census occsoc codes. To do this, we create summary values at the 3-, 4-, 5- and 6-digit occupation levels in the O*NET database and merge those into the Census database, replacing less detailed data with the most detailed data available.

The final values capture the economic prospects of the set of jobs that share knowledge domain requirements with the reference job.

A limitation of these data is that they do not consider the degree, licensing or experience requirements necessary to move from one occupation to another with similar knowledge requirements. For example, some technical science occupations require knowledge domains that are similar to those of higher-paying, fast-growing science occupations. Because of this, the present analysis indicates that the technical science occupations have very good career prospects. However, in this case, making a transition to the higher-paying and faster-growing occupations would have more licensing and education requirements. Naturally, this makes some career transitions more practical or attainable than others. The data on educational requirements can be considered alongside these results.

INDEED CAREER CLUSTERS

Our final database has information on 529 occupation titles. To condense this information, we matched every occupation to a career cluster, using categories created by the job vacancy advertising firm, Indeed.[36] These can be thought of as fields of work, sectors, or industries. They are similar to U.S. government sector classifications (which categorize business goods and services provided by organizations) but include occupational concepts, which refer to the tasks performed by workers. The final list is a short and intuitive classification.

36 https://www.indeed.com/career-advice/finding-a-job/what-are-the-career-clusters

ABOUT AMAZON FUTURE ENGINEER

Amazon Future Engineer is a childhood-to-career computer science education program intended to inspire and educate millions of students from historically underrepresented communities globally, including millions of students in the U.S. each year. Students explore computer science through school curriculum and project-based learning, using code to make music, program robots, and solve problems. Additionally, each year Amazon Future Engineer awards hundreds of students with four-year, $40,000 scholarships and paid industry internships, as well as names 10 Teacher of the Year winners, awarding $30,000 prize packages for going above and beyond to inspire students in computer science and to promote diversity and inclusion in the field. The program is currently available in Canada, France, Germany, India, the UK and U.S. For more information, visit amazonfutureengineer.com.

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