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The Changing Nature of Work

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The Changing Nature of Work

Abstract

We provide new evidence on the changing nature of work and its influence on individuals' capacity to work by linking historical measures of occupational job demands with harmonized data on individual abilities from a unique survey conducted in the RAND American Life Panel in 2018. We start by examining how job demands have evolved over time between 2003 and 2018 for different dimensions of abilities (cognitive, physical, sensory and psychomotor), overall and by educational group. We then decompose job demand changes into within-occupation changes and changes in the economy's distribution of occupations. Finally, we provide evidence on how individuals' work capacities have evolved over time due to job demand changes.

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Introduction

Recent trends showing a decline in physically demanding job tasks and an increase in tasks with higher cognitive and interpersonal job demands in the United States and OECD countries have been cited as potential influences on decreased or delayed disability or old-age pension claiming (Handel 2012; Johnson, Mermin, & Resseger 2011). In this paper, we provide new evidence on the changing nature of work and its influence on an individual's work capacity by linking historical measures of occupational job demands with harmonized data on individual abilities from a unique survey conducted in the RAND American Life Panel in 2018. We start by examining how job demands have evolved over time between 2003 and 2018 for different dimensions of abilities (cognitive, psychomotor, physical, and sensory), overall and by educational group. We then decompose changes in job demands into within-occupation changes and changes in the economy's distribution of occupations. Finally, we provide evidence on how individuals' work capacity has evolved over time due to job demand changes. Combining panel data on job demands with contemporaneous data on individual abilities, we construct time-varying measures of work capacity, holding individuals' abilities fixed in 2018, which enables us to assess how many jobs of the past the individuals of today would have been able to perform given their current abilities.

We obtain three key findings. First, the decline in physically demanding work and increase in cognitively demanding work is unevenly distributed across workers by education. While workers with a high school education or less face *increasing* job demands across all four dimensions — cognitive, physical, sensory, and psychomotor — over the 2003 to 2018 period, college-educated workers face *decreasing* job demands for all dimensions except sensory requirements, which nevertheless increase less for more educated workers than for lower educated workers. Second, we find that most of these changes over time are due to changes in occupational requirements *within* occupation rather than due to changes in the national economy's composition of occupations. For example, the required proficiency level for written skills increased more than fourfold for construction laborers between 2003 and 2018, while construction workers' share of jobs in the national economy increased from 0.89% to 1.44% over the same period. Finally, we find that differential changes in occupations' functional ability requirements translate into differential changes in individuals' *work capacity* by educational group, where work capacity is defined as the fraction of jobs in the national economy that an individual possesses the functional abilities to perform. Specifically, we find that the fraction of jobs available to individuals based on their current abilities grew between 2003 and 2018 for those individuals with at least some college. This increase in the size of the potential job set increases with education. Notably, we find that work capacity did not grow, and potentially shrank, for workers with a high school degree or less.

Data

We draw on three main data sources. The first data source is occupation-level data from the federal Occupational Information Network (O*NET) database, which contains detailed information on occupational requirements and characteristics, starting in 1998 and updated periodically to reflect changing job demands and occupations. We use data from the O*NET abilities module in 2003 and 2018. The second data source is the Current Population Survey (CPS), which we use to construct occupation-level data on the shares of jobs held by American workers in 2003 and 2018 by educational group. Using a crosswalk that maps occupation codes across the two years, we combine these two data sources to construct occupation-level data on ability requirements and job shares in 2003 and 2018 for a balanced panel of detailed occupations.

The third data source is individual-level data from a unique 2018 survey fielded in the nationally representative RAND American Life Panel (ALP). This data contains ratings of abilities that each individual can perform, where the ability measures are harmonized to the O*NET abilities module. Combining the occupation- and individual-level data, we construct measures of each individual's capacity to perform any given job by comparing self-reported abilities from the ALP to abilities required to perform jobs from O*NET in 2003 and 2018. We then compare the fraction of jobs in the national economy that individuals could perform in 2003 and 2018, conditional on the same distribution of abilities in 2018.

*O*NET Abilities Data*

The O*NET database contains comprehensive information about the abilities required to perform all occupations in the U.S. economy. Data collection is ongoing and performed in cycles: Approximately 10% of occupations are rerated each year, and new occupations are added as needed. We use data from O*NET 5.0, released in April 2003, and O*NET 23.0, released in August 2018. The 5.0 database is the earliest release with data comparable to the modern databases.[1] The 2003 version of O*NET classifies occupations according to the 2000 Standard Occupation Classification (SOC)

[1] See https://www.onetcenter.org/db_transitional.html.

system, and the 2018 version classifies occupations according to the 2010 SOC system. We aggregate eight-digit O*NET-SOC codes to the six-digit level of the SOC system in each year.[2] In 2003, the O*NET database included ability ratings for 731 occupations out of 803 total occupations coded at the six-digit level of the 2000 SOC system. In 2018, the database included ability ratings for 781 occupations out of 821 total occupations coded using the 2010 SOC system.

O*NET defines *abilities* as "relatively enduring attributes of an individual's capability for performing a particular range of different tasks" (Fleishman, Costanza, & Marshall-Mies 2004). O*NET identifies 52 abilities broadly applicable to jobs in the "world economy," and grouped into four domains: cognitive, physical, sensory and psychomotor. Examples of abilities rated by O*NET include:

- oral comprehension, deductive reasoning, number facility (cognitive);
- static strength, stamina, extent flexibility (physical);
- near vision, depth perception, sound localization (sensory);
- and arm-hand steadiness, multilimb coordination, reaction time (psychomotor).

Abilities are distinct from *skills*, which are "proficiencies that are developed through training or experience" (Fleisher & Tsacoumis 2012b). For each occupation, 16 trained occupational analysts provide ability ratings using summary information about relevant tasks, knowledge, and work activities obtained from job incumbent surveys and following standardized procedures (Fleisher & Tsacoumis 2012a).

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[2] See https://www.onetcenter.org/taxonomy.html for more details on how O*NET classifies occupations.

For each ability, analysts rate the *importance* of the ability for the performance of the occupation's associated tasks and work activities, as well as the *required level* of ability needed to carry out those tasks and work activities. Importance is rated on a scale of 1 to 5, where 1 = "Not Important," 2 = "Somewhat Important," 3 = "Important," 4 = "Very Important," and 5 = "Extremely Important." The required level of ability is rated on a scale from 0 to 7, where 0 means not relevant (i.e., "not important" for the job) and 7 is the highest possible level. Each ability has a unique set of three scale anchors that give an example of a job-related activity that could be done at that ability level. For example, the ability Arm-Hand Steadiness has anchors at levels 2, 4, and 6 corresponding to the degree of arm-hand steadiness needed to "light a candle," "thread a needle," and "cut facets in a diamond," respectively. Final level and importance ratings of each ability for each occupation are averages of the ratings provided by the 16 raters.

CPS data on job shares by educational group

We obtain information on the national economy's empirical distribution of occupations by educational group using data from the 2003 and 2018 Center for Economic and Policy Research uniform extracts of the CPS Outgoing Rotation Group (ORG).[3] We aggregate data on job shares by education using the following groups: high school or less, some college, Bachelor's degree, and post-graduate degree. Note that, although the Bureau of Labor Statistics (BLS) publishes estimates of the number of jobs in the national economy by occupation in its Occupational Employment Statistics (OES) program, these estimates do not include breakdowns by educational group. Due to

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[3] See https://ceprdata.org/cps-uniform-data-extracts/cps-outgoing-rotation-group/cps-org-data/.

sampling error, some occupations are not observed in the CPS that may nevertheless exist in the national economy in 2003 and/or 2018. In these cases, we impute the job share as zero.

Constructing a balanced panel of occupation-level data on ability requirements and job shares

In the SOC system, a total of 803 occupations are measured using six-digit 2000 SOC codes, and 821 occupations are measured using 2010 SOC codes. We use a crosswalk published by the BLS to map 2000 to 2010 SOC codes[4] and create a balanced panel of occupations based on the 842 unique combinations of 2000/2010 SOC codes. Specifically, 2000 SOC codes corresponding to $J > 1$ 2010 SOC code are classified as J unique occupations, where the job share in 2000 is allocated proportionately according to the relative job shares in 2010. In the same way, multiple ($J > 1$) 2000 SOC codes that merge into a single 2010 SOC code are classified as J unique occupations, with the job share in 2010 allocated proportionately according to the relative job shares in 2000. Every 2000 SOC code maps to at least one 2010 SOC code, and vice versa. That is, the 2010 update to the SOC system did not retire or create any occupation classifications.

Table 1 describes how we reached our final sample of occupations accounting for data limitations we encountered both in the O*NET and CPS data sets. The columns present the number of unique combinations of 2000/2010 occupations with nonmissing data on ability ratings in both the 2003 and 2018 O*NET databases, in the 2003

[4] The crosswalk is available at https://www.bls.gov/soc/soccrosswalks.htm.

database only, in the 2018 database only, and in neither year, respectively. From the universe of unique combinations of 2000-2010 occupations, 753 have ability ratings in both years, none have ability ratings for 2003 only, 42 have ability ratings in 2018 only, and 47 lack ability ratings for either year. As we are interested in comparisons of ability requirements across years, we drop combinations with any missing data from our sample; these occupations represent 5.64% of jobs in 2003 and 1.65% of jobs in 2018.

Table 1: Numbers of occupations in 2003 and 2018 O*NET and CPS data sets

		ONET ability ratings				**Total**
		2003 and 2018	**2003 only**	**2018 only**	**None**	
CPS occupation shares	**2003 and 2018**	699 [681, 688]	0 [0, 0]	9 [9, 9]	18 [17, 18]	726 [704, 715]
	2003 only	22 [22, 22]	0 [0, 0]	0 [0, 0]	1 [1, 1]	23 [23, 23]
	2018 only	10 [10, 10]	0 [0, 0]	22 [18, 22]	25 [25, 25]	57 [53, 57]
	None	22 [22, 20]	0 [0, 0]	11 [9, 10]	3 [3, 3]	36 [34, 32]
Total		753 [731,740]	0 [0, 0]	42 [30, 41]	47 [46, 47]	842 [803, 821]

Note: Each cell shows the total number of unique combinations of 2000/2010 SOC six-digit occupations, and in brackets the corresponding number of occupations in 2003, measured with 2000 SOC codes, and the number of occupations in 2018, measured with 2010 SOC codes. Columns show the availabilty of O*NET data on ability requirements to perform jobs for each year, and rows show the availability of CPS data on job shares for each year. Note that samples sizes using 2000 and 2010 codes, respectively, do not necessarily add up across columns or rows because individual 2000 or 2010 codes can be represented in multiple unique combinations where their counterparts are differentially observed across years.

The rows in Table 1 present the number of unique combinations of 2000/2010 occupations with nonmissing job shares in both the 2003 and 2018 CPS, in the 2003 CPS only, in the 2018 CPS only, and in neither year, respectively. For 699 out of the

753 unique combinations of 2000/2010 SOC codes in our sample (Column 1), we observe at least one worker in the 2003 and 2018 CPS, respectively. For 22 occupations, we observe at least one worker in the 2003 CPS only; these “disappearing” occupations correspond mostly to industrial/production-based occupations. For 10 occupations, we observe at least one worker in the 2018 CPS only; these “emerging” occupations correspond to very specific professions. Finally, there are 22 occupations which are rare enough that we do not observe anyone working in them in either 2003 or 2010. These are effectively excluded from our analysis because we impute their job shares as zeros in both years.[5]

American Work Capacity and Abilities Survey

The ALP is a nationally representative sample of Americans 18 and older who have agreed to participate in regular online social science surveys. In July 2018, we invited English-speaking ALP participants ages 18 to 70 to complete the American Work Capacity and Abilities Survey (AWCAS) over a two-month period. The survey had a completion rate of 82% (N=2,270). We restrict our analysis sample to working-age respondents (N=2,244 individuals between 25 and 70 years old). For each of the 52 O*NET abilities, we asked respondents to *rate their own level of ability*, using the same scales and level anchors that the O*NET analysts use to rate occupational ability requirements. The innovation of this technique is that it measures individuals’ functional abilities, which are asked about in general and not in relation to their current job or past

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[5] These include 12 post-secondary teaching occupations, three legal occupations, three related to solar panel installation, as well as funeral service managers, postmasters, social science RAs, and janitors.

jobs, *in the same terms and on the same scales* as occupational requirements are measured. This enables us to build a measure of an individual's work capacity based on direct comparisons between the abilities an individual possesses and those abilities required to perform jobs in the national economy.

The instructions provided to respondents stated: "In this survey, you will be asked to rate your level of functioning for a series of different abilities. When giving your rating, please rate your *current* level of ability, not what you were able to do in the past or what you could do in the future with additional training. If you use an assistive device (e.g., glasses), please rate your ability when using the assistive device." For each question, we first defined an ability (using the same language as O*NET) and we then asked the respondent to rate their level of ability on a scale from 1 to 7, with the same three anchor points used in O*NET. Respondents who could not perform any level of ability were instructed to select a response button marked "I cannot do any level of this ability" (which we code as 0 in our analysis data set). Respondents were told that these examples are "meant to help you find your own rating with the scale; do not focus on whether you perform the *specific* activity, which may come from an unfamiliar context."

Measuring work capacity

We start by defining an indicator variable denoting an individual's ability to perform the tasks required for a given occupation based on the comparison between the individual *i*'s level of ability *k*, $\theta_{i,k}$, and the level of ability *k* required to perform occupation *j*, $c_{j,k}$. If $\theta_{i,k} \geq c_{j,k}$, then we classify the individual as having the required ability level for that occupation and the indicator variable takes value 1. If $\theta_{i,k} < c_{j,k}$, then the individual is classified as not having the required ability level for that occupation and the indicator variable takes value 0.

We next define an individual's *occupation-specific work capacity* as the fraction of abilities required to perform a given (hypothetical) occupation that an individual possesses, weighted by the ability's relative importance for that occupation, denoted by $\pi_{j,k}$. Formally, the occupation-specific work capacity for individual i in occupation *j*, $OWC_{i,j}$, is the single index constructed by taking the weighted sum of all ability indicators, where the weights are the relative importance ratings of the abilities re-normed so a rating of "not important" is given zero weight and normalized such that $\sum_{k=1}^{K} \pi_{j,k} = 1$:

$$OWC_{i,j} = \sum_{k=1}^{K} \pi_{j,k} 1\left(\theta_{i,k} \geq c_{j,k}\right). \qquad (1)$$

This index ranges between 0 and 1, where 0 signifies the individual is unable to perform any of the abilities at the level required for the occupation, and 1 signifies the individual is able to perform all abilities required for that occupation.

Finally, we define the individual's *total work capacity* as the fraction of jobs in the economy the individual can perform given her set of occupation-specific work capacities for all potential occupations. Formally, the individual's total work capacity TWC_i is the weighted sum over all jobs $j = 1,..,J$ of a series of indicators for whether the individual has sufficient *functional* capacity to do a given job, j, where ω_j is the weight for occupation *j*. These indicators take value 1 if the occupation-specific work capacity $OWC_{i,j}$ exceeds a threshold $T \in (0,1]$ (regardless of training or skills), and zero otherwise:

$$TWC_i = \sum_{j=1}^{J} \omega_j * 1(OWC_{i,j} \geq T). \qquad (2)$$

Higher values of T make the measure more strict and lower values make the measure more generous. For example, if $T = 1$, an individual must possess every ability at a high enough level to be considered as having the potential to perform a given occupation. If a single ability is below the required level, then she is considered unable to do the job. Thus, letting $T < 1$ allows individuals who are missing a small number of abilities to still be considered eligible for that occupation. In our analysis, we present results for two thresholds: one setting $T = 1$, the most conservative case, and another setting $T = 0.91$, which corresponds to the 25th percentile of *OWC* in one's own (actual) occupation among workers in the AWCAS sample.

The interpretation of total work capacity depends on the weights. In our case, *TWC* can be interpreted as *the fraction of jobs in the national economy that the individual possesses the functional abilities to perform* because we use as weights the occupation's share of jobs in the national economy, conditional on education. We weight by the observed distribution of jobs by educational group to account for educational constraints in accessing certain jobs.

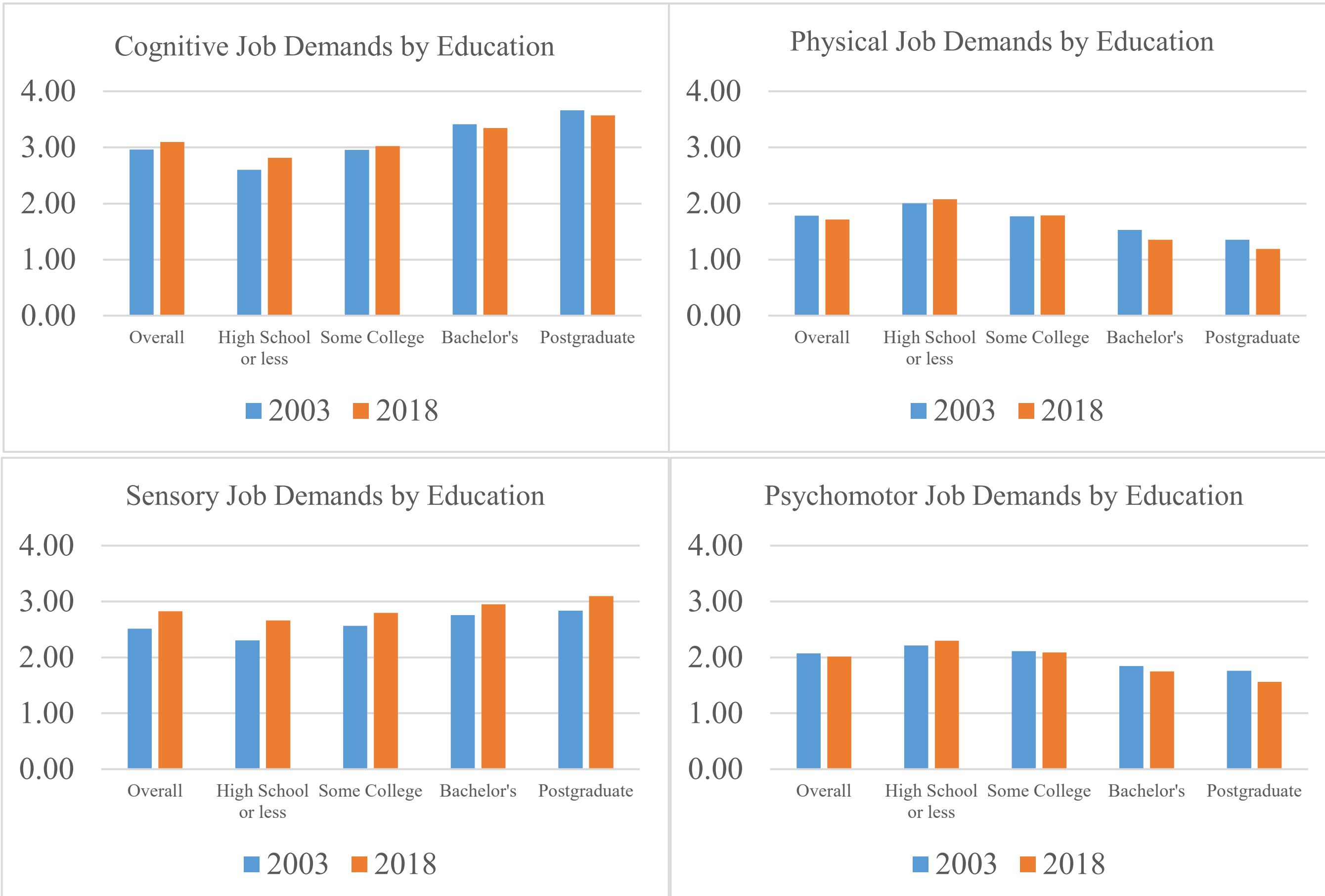
Changes in average job demands, 2003 to 2018

Our first set of results describes changes in the weighted average job demands over time for each of the four domains of ability requirements measured by O*NET: cognitive, physical, sensory, and psychomotor abilities. To construct weighed averages of ability requirements, we proceed in two steps. Within occupation, we reweight average ability requirements by the relative importance rating of the abilities for that occupation. Across occupations, we reweight average ability requirements using the job shares by educational group obtained from the CPS.

Figure 1 presents comparisons of average job demands between 2003 and 2018 by domain, overall and by educational level. Consistent with previous literature, we find that overall, on average, cognitive job demands increased between 2003 and 2018 from an average level of 2.96 to 3.10 (+4.7%, $p<0.05$), and physical job demands decreased from 1.78 to 1.71 (-3.9%, $p<0.1$). Mirroring cognitive and physical job demands, respectively, sensory job demands increased from 2.52 to 2.82 (+11.9%, $p<0.05$), and psychomotor job demands decreased slightly from 2.07 to 2.01 (-2.9%), although this last result is not statistically different from zero.

However, as Figure 1 demonstrates, the changes in job demands over time are highly unequal across educational groups. For example, among the set of jobs held by those with a high school degree or less, ability requirements *increased* in all four domains, including physical requirements. At the same time, among the set of jobs held by those with a college degree or more, ability requirements *decreased* in three out of the four domains. Only sensory job demands increased significantly across all educational groups, though they increased the most for low-skilled workers. These changes are all statistically significant ($p<0.05$). These results suggest that the changing nature of work over the last 15 years may have deepened inequality across educational groups, as jobs held by low-education workers have become more difficult on average while jobs held by high-education workers have become easier.

Figure 1: Average job demands by education in 2003 versus 2018



Note: The graphs show weighted average job demands by functional ability dimensions, overall and by educational level, obtained from O*NET data for years 2003 and 2018. Average ability levels for a given functional dimension and occupation are weighted by the relative importance of abilities for that occupation, normalized to sum 1. Weighted averages across occupations are obtained using occupational job shares by educational level obtained from CPS data for each year. The sample is 753 combinatons of 2000 and 2010 SOC codes, which correspond to 731 occupations in 2003 and 740 occupations in 2018.

Decomposing changes in job demands, 2003 to 2018

Have average job demands changed because the intrinsic nature of the requirements needed to perform all jobs has changed or rather because of changes in the national economy's composition of occupations? The next set of results answers this question by decomposing job demand changes for each functional domain into within-occupation changes and changes in the distribution of occupations. Specifically, we estimate the following equation for each ability domain, by education group:

$$\overbrace{\sum_{j=1}^{J}(s_{j,18}X_{j,18} - s_{j,03}X_{j,03})}^{\text{Total change}} = \overbrace{\sum_{j=1}^{J} s_{j,03}(X_{j,18} - X_{j,03})}^{\text{Within-occupation}} + \overbrace{\sum_{j=1}^{J} X_{j,18}(s_{j,18} - s_{j,03})}^{\text{Between-occupation}}, \quad (3)$$

where $s_{j,y}$ is occupation *j*'s share of jobs in year *y* (=2003 or 2018) and $X_{j,y}$ is the weighted average ability requirement for occupation *j* in year *y.* In this equation, the first term on the right-hand side represents the within-occupation change, that is, the change in the average job demands over time holding the distribution of occupations fixed using the 2003 job shares. The second term is the between-occupation change, that is, changes in average job demands holding the average ability requirements within occupations fixed using the 2018 job demands and varying the composition of occupations held by workers with a given educational level over time.

Table 2 presents the decomposition's results where, in each of the four panels (one for each functional domain), the first column shows the total change in average job demands between 2003 and 2018, the next two columns show the within- and between-occupation changes, respectively, and the final column shows the within-occupation change as a percentage of the total change. Note that this percentage may be less than zero if the within-occupation change is in the opposite direction from that of the total change and may be greater than 100 if the between-occupation change is in the opposite direction from that of the total change. Within each domain, we present the decomposition by educational group.

The first pattern that emerges from the analysis is that within-occupation changes account for the majority of job demand changes over time, regardless of domain or education group. There is one important exception: Among jobs held by workers with a high school degree or less, average physical ability requirements *increased* between 2003 and 2018, while within-occupation levels *decreased* over this period. In this case, changes in the composition of jobs held by low-skilled workers accounted for more than 100% of the overall increase in physical demands for workers with a high school degree or less. In other words, for workers with low education, while occupations themselves have become physically less demanding over time, these workers are increasingly likely to work in an occupation that is more physically demanding relative to other occupations available to lower skilled workers, leading to an overall increase in average physical demands. However, in all other cases, the opposite pattern emerges: Within-occupation changes either more than offset or reinforce between-occupation changes.

Table 2: Average job demands by education in 2003 versus 2018

	Total Change	**Within Occupation**	**Between Occupation**	**Within Occup. as % of Total**
Cognitive				
High school or less	0.215	0.235	-0.020	109%
Some college	0.065	0.105	-0.040	160%
Bachelor's	-0.067	-0.046	-0.021	68%
Postgraduate	-0.093	-0.055	-0.039	59%
Physical				
High school or less	0.032	-0.024	0.056	-76%
Some college	-0.035	-0.121	0.086	346%
Bachelor's	-0.225	-0.233	0.007	103%
Postgraduate	-0.200	-0.222	0.022	111%
Sensory				
High school or less	0.361	0.377	-0.016	105%
Some college	0.233	0.262	-0.029	113%
Bachelor's	0.193	0.217	-0.023	112%
Postgraduate	0.257	0.285	-0.028	111%
Psychomotor				
High school or less	0.082	0.055	0.027	67%
Some college	-0.020	-0.068	0.047	333%
Bachelor's	-0.094	-0.142	0.048	151%
Postgraduate	-0.199	-0.177	-0.022	89%
Observations	753			

Note: The table shows the decomposition of average job demand changes between 2003 and 2018 by functional dimensions of abilities and educational level. The sample is 753 combinatons of 2000/2010 SOC codes, corresponding to 731 occupations in 2003 and 740 occupations in 2018. Within-occupation change is the difference in average job demands across years weighted by the occupational job share in 2003. The between-occupation change is the difference in occupational job shares across years weighted by the average job demand in 2018.

Another interesting finding is that, holding the composition of jobs fixed at their 2003 levels, occupations held by less educated workers evolved to be cognitively more demanding while those held by more educated workers evolved to be less cognitively demanding. At the same time, occupations held by workers of all educational levels evolved to be less physically demanding — though the decrease in physical demands is highest for workers with a college education or more. Yet, holding within-occupation ability requirements fixed (at their 2018 levels), average cognitive requirements actually *decreased* and average physical requirements *increased* for all educational groups. That is, conditional on education, the composition of jobs in the national economy shifted to include more occupations with cognitive requirements and higher physical requirements in 2018 versus 2003. The patterns are slightly different for sensory and psychomotor demands, but as before in all cases, those with lower education are worse off (or less well off) than those with higher education.

On net, the evidence from Table 3 enable us to conclude that changes in the nature of work over the last 15 years have been driven to a greater extent by changes *within* occupations, or in the nature of the tasks needed to perform jobs, than by changes in the national economy's distribution of occupations.

Changes in work capacity, 2003 to 2018

How have changes in job demands over the last 15 years translated into changes in individuals' capacity to perform jobs in the national economy? In this section we address this question by using our measures of self-reported abilities on the same scale that O*NET uses to rate occupational requirements to estimate individuals' *work capacity*, defined earlier as the fraction of jobs individuals would be able to do given the functional abilities they possess and the ability requirements for all jobs in the economy in a given year, 2003 or 2018. That is, we estimate how many jobs individuals could do in 2018 compared to how many jobs they would have been able to do in 2003, with the same abilities they had in 2018.

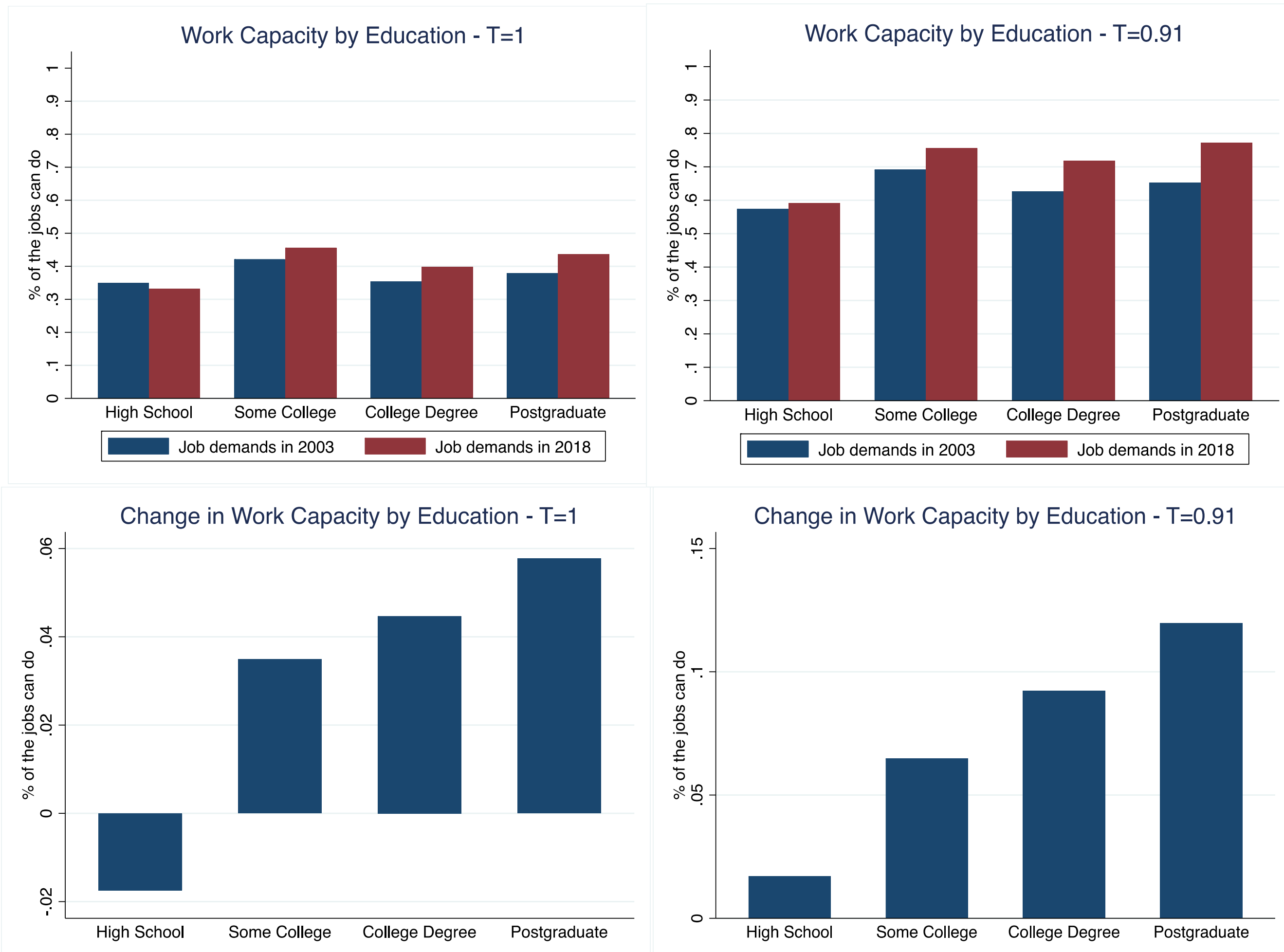
Figure 2 summarizes these results. In the top-left and bottom-left panels we present the levels and change in total work capacity by educational group, respectively, assuming an individual possesses the functional abilities to perform an occupation if she possesses all the abilities required for that occupation $(T = 1)$. In top-right and bottom-right panels we present the analogous results where we adopt a partial credit approach and an individual is assumed to possess the functional abilities to perform an occupation if she possesses 91% of the abilities required for that occupation $(T = 0.91)$.

Remarkably, regardless of the threshold used, the same pattern by education arises: With one exception, the fraction of jobs individuals can perform in 2018 is greater than the percentage of jobs they would have been able to do in 2003 with the same abilities, and this increase in work capacity is greater for individuals with more education. The exception is individuals with a high school degree or less, whose work capacity did not increase or decrease statistically under either threshold. With setting

$T = 1$, we find that the fraction of jobs individuals can do increased 3.5 percentage points for those with some college education, 4.5 percentage points for those with a bachelor's degree, and 5.7 percentage points for with postgraduate education increased. Under $T = 0.91$, the changes in work capacity are even more dramatic: 6.5 percentage points for those with some college education, 9.2 percentage points for those with a bachelor's degree, and 12 percentage points for those with postgraduate education. These changes are all statistically different from zero ($p<0.05$).

In sum, we find that while individuals with a high school degree or less can perform statistically the same fraction of jobs in 2018 as in 2003, individuals with more education have likely expanded their work capacity over time due to changing job demands. These results are consistent with the evidence on changes in average job demands by educational groups suggesting that individuals with low educational attainment have been penalized by the changing nature of work, while those with more education have instead benefited from those changes.

Figure 2: Change in the fraction of jobs in the economy individuals can do by education, 2003 to 2018



Note: The figures in the top panels show the fraction of the economy's jobs individuals can perform by education in 2003 and 2018, holding fixed their own abilities measured in 2018 if: a) (top-left) they are required to have all abilities to perform each job (T=1), and b) (top-right) they are required to have at least 75% of the abilities to perform each job (T=0.91). The bottom panels show the change in the fraction of jobs individuals can perform between 2003 and 2018 by educational level under T=1 (bottom-left) and T=0.91 (bottom-right).

Conclusion

We provide new evidence on the changing nature of work and its influence on individuals' capacity to work by linking historical measures of occupational job demands with harmonized data on individual abilities from a unique 2018 survey conducted in the RAND American Life Panel. We start by examining how job demands have evolved over time between 2003 and 2018 for different dimensions of abilities (cognitive, psychomotor, physical, and sensory), overall and by educational group. We reproduce the finding from the previous literature that there has been a decline in physically demanding work and an increase in cognitively demanding work between 2003 and 2018. However, we find that these changes in job demands have been unevenly distributed across workers by education. While workers with a high school education or less face *increasing* job demands across all four dimensions — cognitive, physical, sensory, and psychomotor — over the 2003 to 2018 period, college-educated workers face *decreasing* job demands for all dimensions except sensory requirements. These requirements, nevertheless, increase less for more educated workers than for less educated workers).

Next, we decompose job demand changes into within-occupation changes and changes in the economy's distribution of occupations. We find that most of the changes in job demands over time are due to changes in occupational requirements *within* occupation rather than due to changes in the national economy's composition of occupations in. This is consistent with previous literature, e.g.., Atalay et al. (2020), who documented changes in task composition of jobs over the second half of the 21st century.

Finally, we provide evidence on how individuals' work capacity has evolved over time due to changes in job demands. Combining panel data on job demands with contemporaneous data on individual abilities, we construct time-varying measures of work capacity, holding individuals' abilities fixed in 2018. This enables us to assess how many jobs of the past the individuals of today would have been able to perform given their current abilities. We find that the fraction of jobs available to individuals based on their current abilities grew between 2003 and 2018 for those individuals with at least some college, and that the increase in the size of the potential job set increases with education. However, we find that work capacity did not grow, and potentially shrank, for workers with a high school degree or less.

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