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The Link between Health and Working Longer

Disparities in Work Capacity

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1. Introduction

As workers age, they become increasingly likely to experience serious health problems that may interfere with their ability to continue working. Fortunately, over the last century, improvements in population health and life expectancy have reduced the likelihood of illness and disability in older age (Vaupel 2010; Crimmins 2015), at the same time as employment at older ages has become increasingly common (Cahill, Giandrea, and Quinn 2016). However, recent research has revealed troubling trends in health and life expectancy among middle-aged Americans (Woolf et al. 2018; Woolf and Schoomaker 2019; Case and Deaton 2020; Case, Deaton, and Stone 2020), which raise the question of whether gains in functional capacity and employment will persist among future cohorts of older Americans.

Health problems among middle-aged cohorts today may portend rising rates of work disability among future older Americans. But the extent to which this occurs depends on how health conditions impact the specific functional abilities needed to meet job demands. For health conditions that can be effectively managed through treatment, there may be little effect on functioning or job performance—or at least a delayed effect. The ways in which various health conditions affect functional abilities are not well understood, especially for individuals who are or could possibly be in the labor force. One promising avenue for research is to investigate the intersection between the "supply" of functional abilities in the population and the demand for functional abilities by U.S. employers.

Health-related functional abilities are "enduring attributes of the individual that influence [work] performance" (O*NET Resource Center 2019). As defined by O*NET, a U.S. government database of occupational information, these attributes comprise the cognitive, physical, psychomotor, and sensory dimensions of ability that individuals can use

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to accomplish work. While these abilities are persistent, they are not innate; they depend directly on health. For instance, the sensory ability *Near Vision*—the ability to "see details at close range"—may deteriorate from the visual complications of diabetes. Degenerative joint disease may erode *Static Strength*—the ability to "exert maximum muscle force to lift, push, pull or carry objects." Mental health impairments can reduce *Selective Attention*—the ability to "concentrate on a task over a period of time without being distracted." In other words, adverse health events reduce functional abilities, limiting the activities individuals can comfortably perform in the workplace.

Occupations themselves demand different levels of functional abilities. Surgeons and jewelers may need a high level of *Arm-Hand Steadiness*, but lawyers and retail salespeople may not. This interaction of an individual's health-related functional abilities with occupational demands produces what we term *work capacity*, the individual's set of *potential* occupations and associated earnings given their current functional abilities.

We use new measures of individual work capacity to characterize the interaction between health-related functional abilities and occupational demands, both in the population overall and across different population groups. Our study of functional abilities differs sharply from previous research because we explicitly consider how individuals' functional abilities interface with the economy's occupational demands. Specifically, we investigate how health-related functional abilities map to the ability requirements of different occupations in the U.S. economy by combining new survey data with information from the Occupational Information Network (O*NET) database. O*NET is the definitive source for detailed information about occupational requirements for all occupations in the national economy.

We then compare average work capacity across different groups to assess how work capacity varies by age cohort, gender, race/ethnicity, and education in the United States. Identification of disparities in work capacity across demographic groups are of first-order importance because they may contribute to disparities in realized employment and income. If many Americans, especially those in disadvantaged groups, are unable to work longer because poor health undermines the functional abilities they need to do their jobs, or if their health constrains them to a narrow set of occupations, then policies that reduce health disparities may increase the proportion who are healthy enough to work longer. Large bodies of research document significant health disparities along demographic lines, stemming not from innate differences but from the unequal distributions of societal advantages and disadvantages groups face. These disparities may thus propagate to differences in the comparative functional abilities and work capacity of U.S. adults.

Black adults in particular face structural racism in their daily lives which adversely impacts health by limiting access to and quality of health care, manifesting unjust risks to personal and community health, and causing psychosocial trauma and chronic stress (Bailey et al. 2017). These health disparities may then be reflected in reduced functional abilities and greater limitations on labor market opportunities. For instance, significant disparities in diabetes prevalence exist between non-Hispanic white and Black adults (Centers for Disease Control and Prevention 2020). Diabetes itself may cause vision loss, cognitive impairment, and reduced mobility, and racial disparities in access to quality health care and opportunities for intensive physical activity may further exacerbate disparities in functional

abilities (Rejeski et al. 2012; Newhall et al. 2016). Racial discrimination itself has been shown to provoke a stress response. Exposure to repeated stress from racial discrimination may worsen mental health and affect cognitive functional abilities (Berger and Sarnyai 2015). Understanding how these health disparities affect the relative occupational opportunities and challenges faced by different groups is key to determining how policy encouraging adults to work longer will heterogeneously impact Americans.

We find that cognitive abilities are the most important determinant of potential occupations and earnings, with a one standard deviation increase in self-reported cognitive abilities associated with an increase of 126 potential occupations (out of 936 possible occupations) and an increase of $35,000 in maximum potential earnings. Sensory abilities have a smaller but economically meaningful association with potential occupations and earnings. A one standard deviation increase in physical abilities is associated with an additional 35 potential occupations, most of which do not require a college degree. Since physically demanding jobs tend to be low-paying, there is little association between physical abilities and potential earnings.

Average functional abilities decline somewhat with age, led by significant declines in physical and psychomotor abilities; however, potential occupations and earnings fall only modestly. This suggests that many adults maintain the functional abilities to work at least into their late 60s, although older adults who can no longer work their physically demanding jobs may nonetheless face significant barriers to new employment in the form of educational requirements, costs to acquire new skills, and discrimination.

We do observe differences by gender and race/ethnicity in self-reported functional abilities, but these differences are small compared to real-world differences in earnings, suggesting that health is not a major driver of gender- and race-related earnings gaps. Education-related gaps in functional abilities are substantially larger and more economically consequential than gaps by either gender or race/ethnicity. College graduates report significantly higher functional abilities than nongraduates across all ability domains, including physical abilities. This leads to an average difference in maximum potential earnings of over $34,000. This is consistent with extensive research on educational disparities in health (see e.g., Montez et al. 2019, for an overview).

Finally, we consider how potential earnings vary across cohorts by gender, educational attainment, and race. We find that middle-aged white respondents have *lower* potential earnings than white respondents ages 62–71. The reverse is true for middle-aged Black respondents, who have substantially higher potential earnings than older Black respondents. Our evidence suggests that health may be a bigger barrier to work at older ages for white Americans now in middle age than it has been for white Americans now at retirement age. We also find that potential earnings decline with age more slowly among college graduates than nongraduates. We suggest that this may be due in part to the deleterious effects of physically demanding and hazardous jobs that are disproportionately held by nongraduates, but many factors that jointly determine education and health may be at play.

Overall, our analysis indicates that health is an important determinant of ability to work as people age; that disparities in health translate to diminished labor market opportunities for those with less education; and that worse health among younger cohorts of white Americans may reduce their ability to work up to and past traditional retirement ages.

2. Data

Previous research on the links between health and work capacity has been constrained by the lack of data that use the same measures to rate (a) individuals' functional abilities and (b) the functional abilities required for various occupations. We use new data collected specifically to fill this gap. To measure work capacity, we combine data from two sources: the American Work Capacity and Abilities Survey (López García, Maestas, and Mullen 2019) and the Occupational Information Network (O*NET). The American Work Capacity and Abilities Survey (AWCAS) collected data on self-assessed abilities from participants in the RAND American Life Panel (ALP), a nationally representative (when weighted), probability-based panel of individuals age 18 or older who are regularly interviewed over the internet for scientific research purposes. AWCAS was fielded between July and September 2018 to 2,829 subjects, of whom 2,355 (83 percent) completed the survey. Respondents were asked to rate their level of ability for 52 different abilities, collectively intended to provide a comprehensive picture of individuals' functional ability along cognitive, psychomotor, physical, and sensory dimensions. The 52 abilities in AWCAS correspond exactly to the abilities used by O*NET to classify occupations in the U.S. economy. Raked sampling weights were created to match the 2018 Current Population Survey.[2]

O*NET is a database maintained by the Bureau of Labor Statistics that comprehensively rates and classifies all occupations in the national economy in terms of required abilities, skills, knowledge, and other characteristics.[3] For each occupation, eight O*NET labor analysts rate the *level* of each ability needed to perform the occupation's tasks on a scale from 0 to 7. The required level of any given ability for any given occupation is the average of the eight analyst ratings. The O*NET analysts also evaluate the *importance* of each ability to the occupation on a scale of 1 to 5.

To standardize ability assessment across occupations, O*NET assigned level anchors to particular numbers in each ability scale. Each anchor has an example of a job-related activity that could be done at that level of ability. For example, the ability *Stamina* has anchors at levels 1, 4, and 6, corresponding to the activities "Walk a mile," "Climb 6 flights of stairs," and "Run 10 miles," respectively. *Reaction Time* has anchors at levels 4 and 6, corresponding to being able to "Throw a switch when a red warning light goes off" and to "Hit the brake when a pedestrian steps in front of the car." *Number Facility* has anchors at levels 1, 3, and 5, corresponding to "Add 2 and 7," "Balance a checkbook," and "Compute the interest payment that should be generated from an investment." See Table 5.1 for a complete list of all O*NET abilities.

A key difference between AWCAS and the O*NET ability data is that AWCAS measures individuals' reported abilities while O*NET measures occupations' required abilities. Specifically, AWCAS asked survey respondents to rate their level of each ability, while O*NET

TABLE 5.1 O*NET abilities and estimated population means using the AWCAS sample

	Ability	Mean	Description
			COGNITIVE ABILITIES
1	Oral comprehension	4.99	The ability to listen to and understand information and ideas presented through spoken words and sentences.
2	Written comprehension	5.03	The ability to read and understand information and ideas presented in writing.
3	Oral expression	4.88	The ability to communicate information and ideas in speaking so others will understand.
4	Written expression	4.55	The ability to communicate information and ideas in writing so others will understand.
5	Fluency of ideas	4.52	The ability to come up with a number of ideas about a topic (the number of ideas is important, not their quality, correctness, or creativity).
6	Originality	4.19	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
7	Problem sensitivity	4.85	The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.
8	Deductive reasoning	4.46	The ability to apply general rules to specific problems to produce answers that make sense.
9	Inductive reasoning	4.49	The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
10	Information ordering	4.12	The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).
11	Category flexibility	4.55	The ability to generate or use different sets of rules for combining or grouping things in different ways.
12	Mathematical reasoning	3.76	The ability to choose the right mathematical methods or formulas to solve a problem.
13	Number facility	4.37	The ability to add, subtract, multiply, or divide quickly and correctly.
14	Memorization	3.99	The ability to remember information such as words, numbers, pictures, and procedures.
15	Speed of closure	4.22	The ability to quickly make sense of, combine, and organize information into meaningful patterns.
16	Flexibility of closure	4.43	The ability to identify or detect a known pattern (a figure, object, word, or sound) that is hidden in other distracting material.
17	Perceptual speed	4.14	The ability to quickly and accurately compare similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.

(continued)

TABLE 5.1 Continued

	Ability	Mean	Description
18	Spatial orientation	3.75	The ability to know your location in relation to the environment or to know where other objects are in relation to you.
19	Visualization	4.55	The ability to imagine how something will look after it is moved around or when its parts are moved or rearranged.
20	Selective attention	4.45	The ability to concentrate on a task over a period of time without being distracted.
21	Time sharing	4.46	The ability to shift back and forth between two or more activities or sources of information (such as speech, sounds, touch, or other sources).
	PSYCHOMOTOR ABILITIES		
22	Arm-hand steadiness	4.65	The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position.
23	Manual dexterity	4.74	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.
24	Finger dexterity	4.57	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.
25	Control precision	4.26	The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.
26	Multi-limb coordination	4.32	The ability to coordinate two or more limbs (for example, two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. It does not involve performing the activities while the whole body is in motion.
27	Response orientation	4.65	The ability to choose quickly between two or more movements in response to two or more different signals (lights, sounds, pictures). It includes the speed with which the correct response is started with the hand, foot, or other body part.
28	Rate control	4.39	The ability to time your movements or the movement of a piece of equipment in anticipation of changes in the speed and/or direction of a moving object or scene.
29	Reaction time	5.62	The ability to quickly respond (with the hand, finger, or foot) to a signal (sound, light, picture) when it appears.
30	Wrist-finger speed	4.71	The ability to make fast, simple, repeated movements of the fingers, hands, and wrists.
31	Speed of limb movement	5.09	The ability to quickly move the arms and legs.
	PHYSICAL ABILITIES		
32	Static strength	4.67	The ability to exert maximum muscle force to lift, push, pull, or carry objects.
33	Explosive strength	3.99	The ability to use short bursts of muscle force to propel oneself (as in jumping or sprinting), or to throw an object.
34	Dynamic strength	4.27	The ability to exert muscle force repeatedly or continuously over time. This involves muscular endurance and resistance to muscle fatigue.
35	Trunk strength	4.46	The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without "giving out" or fatiguing.

TABLE 5.1 Continued

	Ability	Mean	Description
36	Stamina	3.86	The ability to exert yourself physically over long periods of time without getting winded or out of breath.
37	Extent flexibility	4.78	The ability to bend, stretch, twist, or reach with your body, arms, and/or legs.
38	Dynamic flexibility	4.05	The ability to quickly and repeatedly bend, stretch, twist, or reach out with your body, arms, and/or legs.
39	Gross body Coordination	4.18	The ability to coordinate the movement of your arms, legs, and torso together when the whole body is in motion.
40	Gross body equilibrium	3.99	The ability to keep or regain your body balance or stay upright when in an unstable position.
	SENSORY ABILITIES		
41	Near vision	4.51	The ability to see details at close range (within a few feet of the observer).
42	Far vision	4.57	The ability to see details at a distance.
43	Visual color Discrimination	4.36	The ability to match or detect differences between colors, including shades of color and brightness.
44	Night vision	4.41	The ability to see under low light conditions.
45	Peripheral vision	4.10	The ability to see objects or movement of objects to one's side when the eyes are looking ahead.
46	Depth perception	4.15	The ability to judge which of several objects is closer or farther away from you, or to judge the distance between you and an object.
47	Glare sensitivity	4.17	The ability to see objects in the presence of glare or bright lighting.
48	Hearing sensitivity	3.89	The ability to detect or tell the differences between sounds that vary in pitch and loudness.
49	Auditory attention	4.60	The ability to focus on a single source of sound in the presence of other distracting sounds.
50	Sound localization	5.06	The ability to tell the direction from which a sound originated.
51	Speech recognition	4.73	The ability to identify and understand the speech of another person.
52	Speech clarity	4.81	The ability to speak clearly so others can understand you.

Notes: N = 2,222. AWCAS sample of respondents from ALP. Abilities measured on a scale from 0 to 7. Means are sample-weighted to approximate population average. AWCAS, American Work Capacity and Abilities Survey. O*NET, Occupational Information Network. ALP, American Life Panel.

tasked analysts with evaluating the level of each ability needed to perform each occupation.[4] Critically, AWCAS and O*NET measure the exact same abilities using the exact same scales.

Nonetheless, an important limitation of our approach is that the individual functional abilities elicited by the AWCAS are self-reported. Self-reported data are subjective in nature and thus prone to known and unknown response biases. We discuss one particular form of bias below. At the same time, in comparison with objective ability assessments, self-reports are less costly to elicit and respondents' own views of their abilities likely influence their occupational and employment choices in important ways.

Additionally, we use data from AWCAS on demographics, including age, gender, race, ethnicity, education, and self-reported health, as well as earnings data from the 2018 American Working Conditions Survey (Maestas et al. 2018), which was fielded to American Life Panel respondents in the same year as AWCAS and contains additional data for a majority of its respondents. Of the 2,355 total respondents, we conduct analysis on a main sample of 2,222 respondents, omitting respondents who responded too quickly or too repetitively; respondents who did not report their age, race/ethnicity, education, or their level of ability for any of the 52 abilities; and respondents younger than 25.

Finally, we link the O*NET abilities data to wage data from the May 2018 release of the Occupational Employment Statistics (OES) published by the Bureau of Labor Statistics (U.S. Bureau of Labor Statistics 2018). The OES data contain estimates of mean and median earnings nationwide for each occupation at the six-digit SOC level. After merging the two datasets, there are 936 occupations with both abilities data from O*NET and wage data from OES.

3. Summarizing Functional Abilities

We begin by summarizing functional ability levels as measured in the AWCAS data. Table 5.1 presents the 52 O*NET abilities, their definitions, and their AWCAS sample means, the latter obtained by averaging over all individuals in the sample. Across the different measures of ability, average ability is generally between levels 4 and 5 (on a scale from 0 to 7). Note that ability levels may not be directly comparable across different functional abilities because their interpretations are relative to ability anchors, as described above.

Next, to evaluate overall functional ability, we construct within-person averages of self-reported ability over all of the individual's 52 O*NET ability scores and for the subset of abilities belonging to each ability domain—cognitive, psychomotor, physical, and sensory. We then investigate average functional abilities by gender, race/ethnicity, education, and age cohort. As the ability distributions in Figure 5.1 show, men report higher ability levels than women, college graduates report higher ability levels than nongraduates, and younger age cohorts report slightly higher abilities than older age cohorts. By race, while the distributions of abilities reported by white and Black respondents are centered about the same location, Black respondents are more likely to report ability profiles in the extremes—a greater fraction report either low or high average abilities compared to white respondents. We explore these differences in detail below.

4. Measuring Work Capacity

Next we examine how individuals' health-related functional abilities interact with occupational requirements to determine work capacity. We consider two definitions of work capacity: (a) the size of an individual's potential occupation set and (b) their maximum and median potential earnings. We also explore how education constrains potential occupations and earnings.

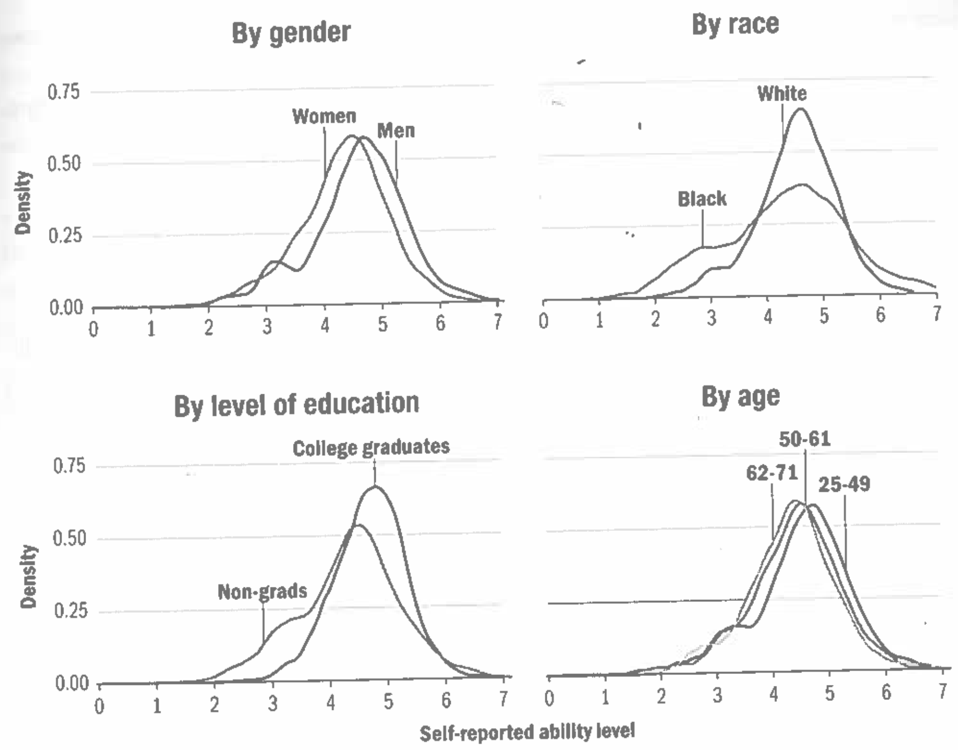

FIGURE 5.1 Distribution of average self-reported ability

First, we combine individuals' reported abilities with occupational ability requirements from O*NET in order to define a set of potential occupations for each individual. For an occupation to qualify as one of an individual's potential occupations, each of the individual's reported O*NET ability levels must either meet or exceed the required level for the occupation, or otherwise be relatively unimportant for the occupation.[5] Specifically, we measure occupation-specific work capacity OWC as:

$$OWC_{i,j} = \prod_{\substack{k=1 \\ \{k: IM_{j,k} \geq 3.0\}}}^{K} 1\left(\theta_{i,k} \geq c_{j,k}\right), \tag{1}$$

where $\theta_{i,k}$ is an individual i's level of ability k, and $c_{j,k}$ is the level of k needed to perform occupation j, as determined by the average level assigned by the O*NET raters. If $\theta_{i,k} \geq c_{j,k}$, for all k abilities that are important for performing occupation j (i.e., abilities with O*NET importance rating $IM_{j,k} \geq 3.0$), then $OWC_{i,j} = 1$; otherwise, $OWC_{i,j} = 0$. This definition of occupation-specific work capacity is strict, since if an individual is missing even one important ability, they are not credited with the potential occupation.[6] Note that here potential occupations are based solely on individuals' functional abilities and their match with current occupational requirements, and not on other factors that may be vital in qualifying for jobs such as education, acquired skills, or knowledge.

Once we obtain the individual's occupation-specific work capacity for every occupation, we define total work capacity WC as their total number of potential occupations:

$$WC_i = \sum_{j=1}^{J} OWC_{i,j}, \tag{2}$$

This definition of work capacity sheds light on whether health-related functional abilities are an important limiting factor for working longer. However, individuals with all the necessary functional abilities will nonetheless be excluded from particular jobs for many reasons, such as education, experience, social networks, discrimination, geography, and economic conditions. While we cannot examine all the factors that prevent adults from gaining suitable employment, we do examine a major one: educational attainment. To examine the degree to which education requirements might constrain an individual's potential occupation set, we also compute the number of potential occupations for the subset of occupations requiring a high school degree or less, a baccalaureate degree, or an advanced degree (all of which sum to equation (2)).[7]

Figure 5.2 shows the sample distribution of individuals' counts of potential occupations out of 936 possible detailed occupations recorded in O*NET. The maximum number of potential occupations in the AWCAS sample is 936 and the minimum is 1. Most individuals have many potential occupations; however, there is a large share of individuals with fewer than 50 potential occupations. This is a consequence of the all-or-nothing nature of equation (1). If these individuals were credited with occupations for which they were only partially qualified (possessing, say, nine out of ten required abilities), then the mass would disperse to the right, as shown by López García, Maestas, and Mullen (2019). Missing abilities may limit

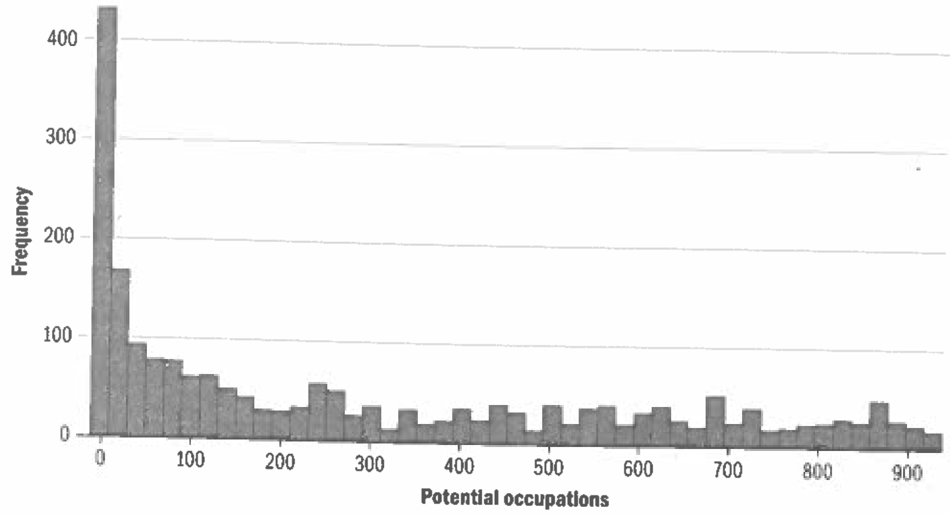

FIGURE 5.2 Sample distribution of the number of potential occupations

prospects more on the hiring margin than the exit margin; while employers might be reluctant to hire individuals with missing abilities into an occupation that requires those abilities, employers are required by law to provide reasonable accommodations to job incumbents who lose abilities (i.e., who become disabled).

Our second approach to work capacity considers potential earnings. We first compute each occupation's median annual earnings (top-coded at $208,000). We then construct each individual's *maximum potential earnings* as the maximum over all potential occupations' median earnings and *median potential earnings* as the median over all potential occupations' median earnings.

Figure 5.3 depicts the sample distribution of potential earnings using both the maximum and median potential earnings measures. Individuals' maximum potential earnings have a population-weighted median of $80,200, and median potential earnings have a median of $34,170. In contrast, median observed earnings are $30,000 ($48,000 among workers and zero among nonworkers). The fact that the median of maximum potential earnings is more than twice as high as observed median earnings indicates that some in the United States are earning far less than their potential (if functional abilities were the only limiting factor). There are many possible reasons for this discrepancy. People may face barriers to obtaining more lucrative occupations such as discrimination or costly educational requirements and certification. Some occupations pay a premium in part because they involve a hazardous or unpleasant work environment, leading many people to accept lower earnings at a safer or more pleasant job. People also may accept lower earnings because they prefer a particular line of work. Finally, some people choose not to work at all. Altogether there are numerous reasons that individuals might earn significantly less than their potential.

Table 5.2 summarizes the relationship between the four classes of abilities and individuals' work capacity, revealing which abilities drive differences in work capacity. For all measures of work capacity, higher average cognitive and sensory abilities are associated with

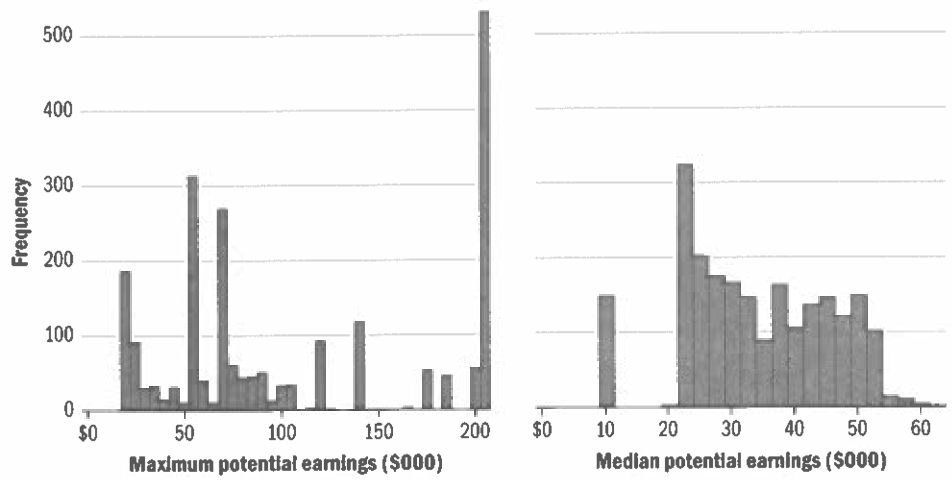

FIGURE 5.3 Sample distribution of potential earnings measures

TABLE 5.2 Relationship between average abilities and work capacity

	Outcome: Number of potential occupations by required education level				Outcome: Potential earnings	
	(1) All education levels	(2) No bachelor's degree required	(3) Bachelor's degree required	(4) Advanced degree required	(5) Maximum	(6) Median
Average of self-assessed cognitive ability scores (standardized)	125.66***	55.79***	46.93***	22.93***	35,176.01***	6,174.54***
	(12.45)	(7.16)	(4.24)	(1.99)	(2,738.40)	(474.77)
Average of self-assessed physical ability scores (standardized)	35.21***	27.99***	5.55	1.68	1,900.41	-156.38
	(9.53)	(5.41)	(3.32)	(1.48)	(2164.48)	(372.43)
Average of self-assessed psychomotor ability scores (standardized)	2.69	12.79	-7.33	-2.77	1,947.25	943.01
	(13.91)	(8.41)	(4.47)	(2.02)	(3,168.99)	(683.20)
Average of self-assessed sensory ability scores (standardized)	85.01***	61.09***	18.77***	5.15**	18202.46***	3321.09***
	(11.29)	(6.78)	(3.71)	(1.66)	(2553.84)	(460.98)
R^2	0.57	0.57	0.47	0.45	0.59	0.68
Observations	2,222	2,222	2,222	2,222	2,222	2,222
Mean of dependent variable	300	210	65	24	110,176	34,870
Total number of occupations in O*NET	936	525	260	151		

Notes: Explanatory variables are standardized to have mean zero and standard deviation 1. Potential occupations are determined only by individuals' abilities, excluding their level of education and other required skills. Occupations requiring a bachelor's degree include jobs that also require an additional certification. All regressions are survey-weighted. Standard errors are in parentheses.
O*NET, Occupational Information
* p<0.05, ** p<0.01, *** p<0.001

higher work capacity. A one standard deviation increase in self-assessed cognitive ability increases the average individual's number of potential occupations by 126 (out of 936 possible occupations), leading to an increase in maximum potential earnings of $35,176 and in median potential earnings of $6,175. Sensory abilities also have a meaningful association with work capacity, with a one standard deviation increase increasing the average individual's number of occupations by 85, maximum potential earnings by $18,203, and median potential earnings by $3,321.

Physical abilities have a weaker association with the number of potential occupations, with a one standard deviation increase increasing the number of potential occupations by 35. This is driven almost entirely by the effect of physical abilities on the number of potential occupations that do not require a college degree (Column 2). Among people without a college degree, low levels of physical ability (such as a deterioration in strength, stamina, or flexibility that comes with age) substantially limit the number of available occupations. Among people with a college degree, who tend to work in occupations that are not physically demanding, physical ability scarcely affects the number of potential occupations (Columns 3 and 4). Consequently, as shown in Columns 5 and 6, because occupations that do not require a college degree tend to be low-paying, increases in physical ability have no effect on potential earnings. Average self-reported psychomotor ability has no significant effects on work capacity using either the number of potential occupations or potential earnings.

We next investigate which specific abilities are most important for driving differences in potential earnings. Figure 5.4 displays the association of individual abilities with maximum potential earnings by reporting the t-statistics from a regression of maximum potential earnings on each ability. The abilities most associated with maximum potential earnings are cognitive abilities (problem sensitivity, inductive reasoning, memorization, selective attention), certain sensory abilities (near vision, speech recognition, and speech clarity), and the psychomotor ability of control precision.

If the number of potential occupations is a reasonable measure of work capacity, we would expect it to be positively associated with many labor outcomes. In analyses not shown, we find that both observed earnings and employment rates are higher on average for those with a larger potential occupation set.

5. Work Capacity by Demographic Groups

Next, we examine how the interaction of functional abilities with occupational demands varies by age cohort, gender, education, and race/ethnicity.

5.1. Work Capacity by Age Cohort

As Table 5.3 shows, the average score for all functional abilities declines only slightly across age cohorts, from 4.523 for the youngest cohort to 4.326 for the oldest cohort. Declines are minimal for the cognitive, psychomotor, and sensory ability domains, and slightly larger (though still modest in magnitude) for physical abilities. The work capacity measures show similar patterns by age cohort. The set of potential occupations is largest among those ages

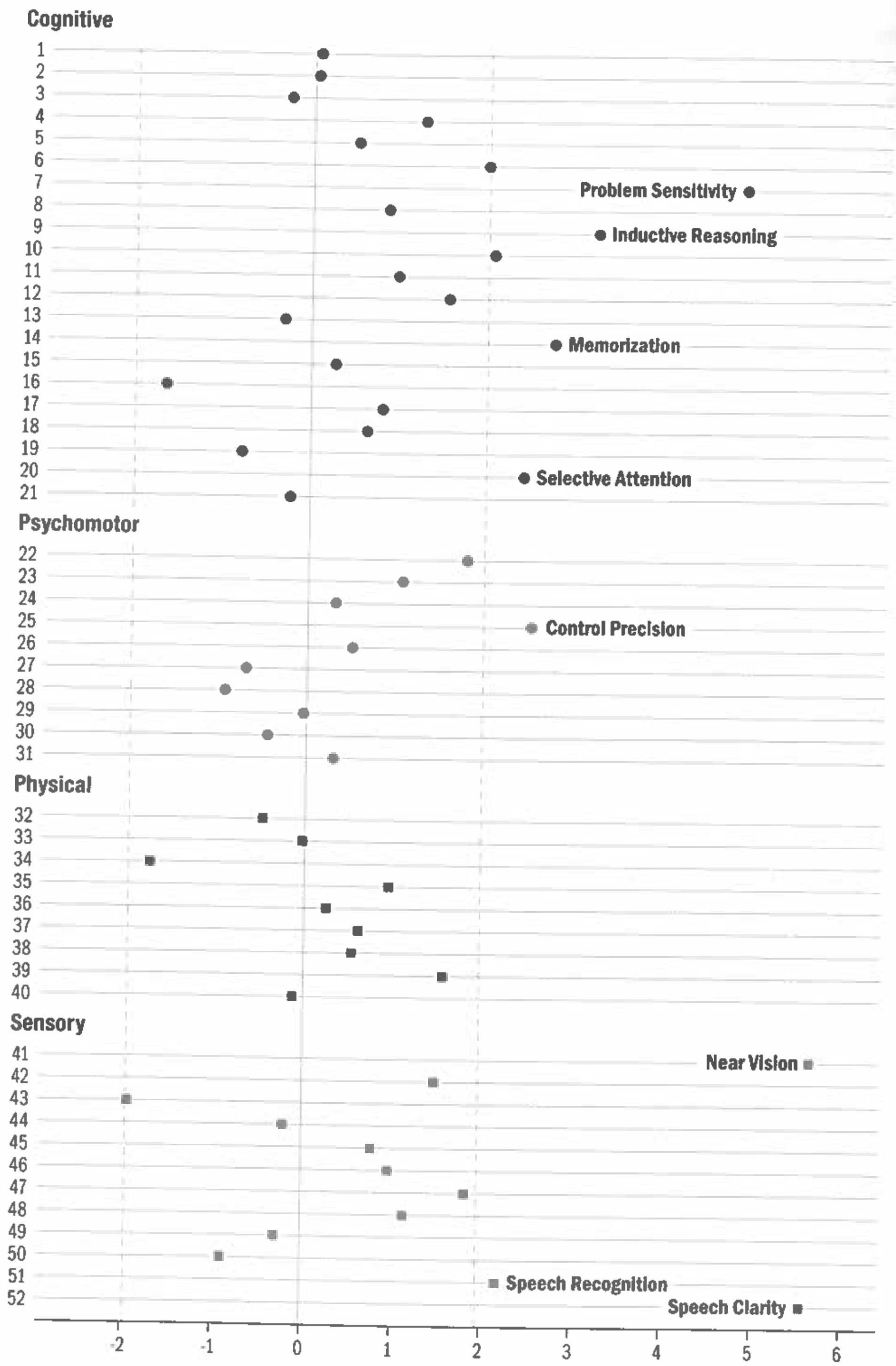

FIGURE 5.4 Association of abilities with maximum potential earnings
Reported t-statistics from the regression of maximum potential earnings on each of the 52 O*NET abilities

TABLE 5.3 Average abilities and work capacity by age cohort

	(1) Age 25–49	(2) Age 50–61	(3) Age 62–71
Average of self-assessed ability scores	4.523	4.380	4.326
	(0.055)	(0.042)	(0.042)
Average of self-assessed cognitive ability scores	4.453	4.368	4.376
	(0.059)	(0.048)	(0.045)
Average of self-assessed physical ability scores	4.436	4.129	3.859
	(0.057)	(0.053)	(0.055)
Average of self-assessed psychomotor ability scores	4.736	4.687	4.608
	(0.063)	(0.045)	(0.047)
Average of self-assessed sensory ability scores	4.533	4.333	4.352
	(0.064)	(0.050)	(0.045)
Number of potential occupations	318.9	275.9	276.1
	(16.6)	(13.9)	(14.2)
Number of potential occupations not requiring a bachelor's degree	224.3	193.7	190.5
	(10.9)	(9.2)	(9.0)
Number of potential occupations requiring only a bachelor's degree	69.0	59.8	62.7
	(4.5)	(3.9)	(4.1)
Number of potential occupations requiring an advanced degree	25.7	22.3	22.9
	(1.9)	(1.7)	(1.8)
Maximum potential earnings	114,460	104,519	105,315
	(4,136)	(3,458)	(3,271)
Median potential earnings	35,298	34,119	34,643
	(802)	(598)	(553)
Observations	780	767	675

Notes: Number of potential occupations is out of 936 occupations possible. Standard errors are in parentheses.

25–49 (319), declines by 13.5 percent among those ages 50–61 (276), and holds steady at that level through ages 6–71. The modest decline in physical abilities observed between middle and older age is not large enough to reduce the set of potential occupations.

Table 5.3 also shows how education requirements constrain potential occupations sets. Of 276 potential occupations on average for the middle-aged cohort, 70 percent do not require a college degree, 22 percent require a college degree (but no more), and 8 percent require an advanced degree. In other words, holding functional abilities constant, the potential occupation set of a middle-aged individual without a college degree would be 31 percent larger if they had a college degree and 42 percent larger if they had an advanced degree. Education constraints are of similar magnitude among the younger and older age cohorts.

Lastly, we consider median and maximum potential earnings. Potential earnings from individuals' median potential occupation average $35,298 among the youngest cohort and are only slightly lower (and not significantly so) among the middle-aged and older cohorts. Similarly, maximum potential earnings exhibit a modest and marginally significant ($p < 0.10$) decline with age ($114,460 on average for the younger cohort and roughly $105,000 for the middle-aged and older cohorts).

5.2. Work Capacity by Gender

Table 5.4 reveals that women report lower levels of ability than men overall and across all ability domains. The difference is especially notable for physical ability, where women report a level of 3.995 on average while men report an average score of 4.528, a difference of over

TABLE 5.4 Average abilities and work capacity by gender

	(1)	(2)	(3)
	Men	Women	Difference
Average of self-assessed ability scores	4.579	4.331	−0.248
	(0.061)	(0.031)	(0.069)
Average of self-assessed cognitive ability scores	4.500	4.341	−0.159
	(0.066)	(0.035)	(0.074)
Average of self-assessed physical ability scores	4.528	3.995	−0.532
	(0.059)	(0.039)	(0.071)
Average of self-assessed psychomotor ability scores	4.817	4.593	−0.224
	(0.070)	(0.036)	(0.079)
Average of self-assessed sensory ability scores	4.559	4.346	−0.213
	(0.071)	(0.035)	(0.079)
Number of potential occupations	339.0	264.2	−74.8
	(18.2)	(10.4)	(21.0)
Number of potential occupations not requiring a bachelor's degree	237.7	184.9	−52.8
	(12.0)	(6.7)	(13.7)
Number of potential occupations requiring only a bachelor's degree	73.9	57.7	−16.2
	(5.0)	(2.9)	(5.8)
Number of potential occupations requiring an advanced degree	27.3	21.5	−5.8
	(2.1)	(1.3)	(2.4)
Maximum potential earnings	114,071	106,639	−7,433
	(4,418)	(2,702)	(5,179)
Median potential earnings	35,568	34,236	−1,332
	(894)	(437)	(995)
Observations	915	1,307	

Notes: Number of potential occupations is out of 936 occupations possible. Standard errors are in parentheses.

half a standard deviation. As a result, women have fewer potential occupations for all levels of education requirements. However, this difference has little effect on potential earnings because (as shown in Table 5.2) physical ability does not correlate with potential earnings. The statistical equality of *potential* earnings between men and women suggests that the *observed* male-female earnings gap arises from factors other than functional abilities or their interaction with occupational requirements.

The differences in reported abilities between men and women are also consistent with bias from overconfidence among men (or underconfidence among women). The use of anchors in the O*NET ability scale is intended to guard against this type of bias by relating ability levels to concrete tasks individuals should be able to perform at each level. However, if male overconfidence bias contributes to the male-female ability gap, our key finding that potential earnings are not statistically different between men and women would either hold or we would find that women have higher potential earnings than men after accounting for overconfidence bias. Moreover, overconfidence and underconfidence may themselves affect observed labor outcomes; that is, while they do not change individuals' actual abilities, they may impact the occupations individuals feel they have the abilities to do and thus employment and income.

5.3. Work Capacity by Education

Differences in functional abilities and, consequently, in work capacity, are especially large across education groups. As shown in Table 5.5, college graduates report higher ability scores than non–college graduates, overall and by domain. The difference is especially pronounced for cognitive and physical abilities. Nongraduates have 138 (35 percent) fewer potential occupations than college graduates. The occupational penalty for not having a college degree is large; holding their abilities fixed, the potential occupation set of a nongraduate would increase by 50 occupations (27 percent) if they had a college degree. Further, both maximum and median potential earnings are lower for non–college graduates by 26 and 17 percent, respectively. Lastly, in analyses not shown, we find that 40 percent of the potential occupations of college graduates are expected to grow rapidly in the next several years or have large numbers of job openings,[8] compared to approximately 35 percent among non–college graduates.

5.4. Work Capacity by Race and Ethnicity

Table 5.6 examines functional abilities and work capacity by race/ethnicity. Due to small sample sizes for other groups, we focus on Black, white, and Hispanic adults. Black respondents report statistically equivalent ability scores compared to whites on average, and for cognitive and physical abilities. In contrast, they tend to report lower psychomotor and sensory abilities. Hispanic respondents similarly report statistically equivalent ability scores compared to whites on average, and for physical and psychomotor abilities, but report lower scores in the cognitive and sensory domains. These disparities in functional abilities translate into disparities in potential occupations. Compared to whites, Black adults have 16 percent fewer potential occupations while Hispanic adults have 22 percent fewer. The occupational penalty for not having a college degree is slightly higher for Blacks compared to whites, but slightly lower for Hispanics—a college degree increases the number of potential occupations by 31 percent among white adults, by 35 percent among Black adults, and by 28 percent among Hispanic adults. In terms of potential earnings, white adults have higher median (and maximum) potential earnings than Black[9] and Hispanic adults—at $36,065, $32,057, and $33,433, respectively.

TABLE 5.5 Average abilities and work capacity by Education

	(1) College graduates	(2) Nongraduates	(3) Difference
Average of self-assessed ability scores	4.688	4.319	−0.369
	(0.027)	(0.047)	(0.054)
Average of self-assessed cognitive ability scores	4.720	4.251	−0.469
	(0.031)	(0.050)	(0.059)
Average of self-assessed physical ability scores	4.456	4.135	−0.321
	(0.037)	(0.051)	(0.063)
Average of self-assessed psychomotor ability scores	4.863	4.610	−0.253
	(0.031)	(0.055)	(0.063)
Average of self-assessed sensory ability scores	4.659	4.332	−0.327
	(0.029)	(0.055)	(0.063)
Number of potential occupations	389.0	251.1	−137.9
	(13.5)	(13.3)	(19.0)
Number of potential occupations not requiring a bachelor's degree	258.7	183.5	−75.2
	(7.9)	(9.1)	(12.0)
Number of potential occupations requiring only a bachelor's degree	93.4	50.2	−43.2
	(4.2)	(3.5)	(5.5)
Number of potential occupations requiring an advanced degree	36.9	17.5	−19.4
	(1.9)	(1.4)	(2.4)
Maximum potential earnings	132,337	98,082	−34,256
	(2,920)	(3,389)	(4,473)
Median potential earnings	39,208	32,502	−6,707
	(444)	(653)	(790)
Observations	1,088	1,134	

Notes: Number of potential occupations is out of 936 occupations possible. Standard errors are in parentheses.

The white-Black and white-Hispanic potential earnings gaps are at 11 percent and 7 percent, respectively. In analyses not shown, we find that the potential occupation sets of Black adults (based solely on reported functional abilities) contain substantially more occupations that require little experience or formal training[10] compared to those of white adults, and, to a lesser degree, Hispanic adults; similarly, the potential occupation sets of Black adults have a smaller share of growing occupations, compared to white and Hispanic adults.

Lastly, it bears noting that these gaps in *potential* earnings are smaller than *observed* earnings gaps. For example, Black men earn 22 percent less than white men, while Black women earn 11.7 percent less than white women, holding constant education, experience,

TABLE 5.6 Average abilities and work capacity by race

	(1) Non-Hispanic White	(2) Non-Hispanic Black	(3) Hispanic
Average of self-assessed ability scores	4.516	4.285	4.373
	(0.035)	(0.134)	(0.069)
Average of self-assessed cognitive ability scores	4.475	4.335	4.297
	(0.037)	(0.153)	(0.078)
Average of self-assessed physical ability scores	4.293	3.998	4.242
	(0.042)	(0.153)	(0.069)
Average of self-assessed psychomotor ability scores	4.776	4.453	4.690
	(0.045)	(0.139)	(0.076)
Average of self-assessed sensory ability scores	4.539	4.272	4.340
	(0.036)	(0.129)	(0.081)
Number of potential occupations	319.8	267.9	250.1
	(12.3)	(31.1)	(23.1)
Number of potential occupations not requiring a bachelor's degree	224.6	179.4	181.7
	(7.9)	(20.7)	(15.1)
Number of potential occupations requiring only a bachelor's degree	70.0	62.7	50.5
	(3.5)	(8.0)	(6.6)
Number of potential occupations requiring an advanced degree	25.2	25.8	18.0
	(1.5)	(3.6)	(2.7)
Maximum potential earnings	114,147	105,596	102,562
	(2,915)	(8,659)	(5,824)
Median potential earnings	36,065	32,057	33,433
	(507)	(1,714)	(903)
Observations	1,495	254	242

Notes: Number of potential occupations is out of 936 occupations possible. Standard errors are in parentheses.

metro status, and region of residence (Wilson and Rodgers 2016). This suggests that disparities in functional ability may explain some but not all of the observed race-earnings gaps.

6. Work Capacity across Cohorts by Gender, Race, and Education

Although work capacity in aggregate declines modestly across age cohorts (see Table 5.3), it is nonetheless possible that health problems among specific demographic groups within these cohorts may portend rising rates of work disability among future older Americans in these groups. In this section, we investigate the age cohort patterns in work capacity—as summarized by potential earnings—within gender, race, and education groups.

Beginning with gender, Table 5.7 shows that maximum potential earnings for men decline slightly across age cohorts. In sharp contrast, potential earnings for women are U-shaped—that is, *lower* for middle-aged women than for their older (and younger) counterparts. This pattern reflects earlier onset of health problems for today's middle-aged women.

Table 5.8, which compares potential earnings by both age cohort and race, shows that changes across cohorts in potential earnings differ sharply between Black and white respondents. Although white and Black respondents' maximum potential earnings are similar among the young and middle-aged groups, they diverge at older ages. Maximum potential earnings drop substantially from the middle-aged cohort to the oldest cohort among Black respondents, contrasting with the small but *positive* difference for white respondents.

These differing potential earnings trajectories are consistent with cohort trends in health. Table 5.9 shows that while both groups report very good or excellent health about 47 percent of the time within the youngest cohort, white respondents report very good or excellent health at a rate 2.5 times higher than Black respondents in the age 62–71 cohort. As in the case of potential earnings, the oldest white respondents report very good or excellent health more frequently than middle-aged white respondents, but the oldest Black respondents report poorer health on average than middle-aged Black adults. These contrasting Black-white cohort-age trajectories likely reflect the very different life experiences of

TABLE 5.7 Average potential earnings by age and gender

	(1) Men	(2) Women	(3) Difference
Maximum potential earnings			
Age 25–49	116,897	112,125	-4,772
	(7,236)	(4,266)	(8,400)
Age 50–61	114,102	96,723	-17,379
	(5,856)	(3,913)	(7,043)
Age 62–71	105,314	105,316	2
	(4,571)	(4,658)	(6,526)
Median potential earnings			
Age 25–49	35,650	34,962	-688
	(1,490)	(673)	(1,635)
Age 50–61	35,750	32,792	-2,958
	(988)	(712)	(1,218)
Age 62–71	35,073	34,255	-818
	(796)	(768)	(1,106)
Observations	915	1,307	

Notes: Standard errors are in parentheses.

TABLE 5.8 Average potential earnings by age and race

	(1) White Non-Hispanic	(2) Black Non-Hispanic	(3) Difference
Maximum potential earnings			
Age 25–49	121,326	109,312	-12,014
	(5,338)	(13,673)	(14,678)
Age 50–61	103,632	112,420	8,788
	(3,769)	(12,429)	(12,988)
Age 62–71	112,319	78,026	-34,293
	(3,649)	(9,060)	(9,767)
Median potential earnings			
Age 25–49	37,156	32,091	-5,065
	(955)	(2,712)	(2,875)
Age 50–61	34,436	33,678	-758
	(603)	(2,248)	(2,328)
Age 62–71	35,827	28,828	-6,999
	(592)	(2,126)	(2,207)
Observations	1,495	254	

Notes: Standard errors are in parentheses.

Black and white Americans. For Black respondents, they may reflect the cumulative effects of structural racism, which has barred many Black Americans from quality education and health care, among other things, throughout their lives. In contrast, economic disadvantage has come relatively recently to white Americans (particularly the less educated), resulting in today's middle-aged cohorts exhibiting worse health than middle-aged cohorts of the past (Case and Deaton 2020; Case, Deaton, and Stone 2020).

TABLE 5.9 Percent of respondents reporting very good or excellent health

	(1) White Non-Hispanic	(2) Black Non-Hispanic
Age 25–49	47.3	46.7
	(3.7)	(8.2)
Age 50–61	42.3	28.3
	(3.0)	(6.1)
Age 62–71	53.9	21.5
	(2.7)	(7.8)
Observations	1495	254

Notes: Standard errors are in parentheses.

TABLE 5.10 Average potential earnings by age and education

	(1) College graduates	(2) Nongraduates	(3) Difference
Maximum potential earnings			
Age 25–49	133,890	102,903	-30,987
	(4,617)	(5,696)	(7,332)
Age 50–61	130,689	93,785	-36,904
	(3,810)	(4,516)	(5,909)
Age 62–71	129,562	90,402	-39,160
	(3,677)	(4,481)	(5,797)
Median potential earnings			
Age 25–49	39,456	32,825	-6,631
	(687)	(1,122)	(1,316)
Age 50–61	38,779	32,207	-6,572
	(632)	(783)	(1,006)
Age 62–71	38,943	31,998	-6,945
	(634)	(755)	(986)
Observations	1,088	1,134	

Notes: Standard errors are in parentheses.

Table 5.10 displays potential earnings by age cohort and education level. Although college graduates have higher potential earnings than non-college graduates in every cohort, the trajectories differ within educational groups. Maximum potential earnings hold steady across age cohorts among college-educated respondents but decline across cohorts among non-college graduates, amplifying inequalities by education in the older cohorts. Our finding above of opposing age-cohort trajectories in work capacity for Black respondents versus whites suggests that the aggregate age-education patterns likely mask important differences by race.

7. Discussion and Conclusions

Our findings suggest that differences in functional ability will influence to whom the burdens and benefits of working longer accrue. While functional ability declines across age cohorts, potential earnings decline only modestly, suggesting that the current cohort of older individuals maintains the ability to work into their late 60s and early 70s. However, declines in physical ability may still disrupt some workers' abilities to do their (physically demanding) jobs as they age—a burden which likely falls primarily on non-college graduates who, as we have shown, have fewer potential occupations and lower potential earnings than graduates. Furthermore, the potential occupations of non-college graduates are more concentrated in

occupations that are not expected to grow in the future. By contrast, while the existence of differences in reported functional ability by race and gender has sizeable effects on potential occupations, differences in potential earnings are modest. This suggests that differences in functional abilities can explain only part of the observed gender- and race-related gaps in earnings, implying that factors other than functional abilities play larger roles.

Finally, considering how work capacity evolves across cohorts for different groups is crucial to understanding the heterogeneous impacts of working longer both for Americans now at traditional retirement ages and for younger cohorts as they age. While our study is the first to collect nationally representative data on individuals' functional abilities on the same scale that O*NET uses to evaluate occupational demands, its cross-sectional design limits us from making definitive statements about the evolution of individuals' work capacity because we do not observe those individuals' abilities at multiple points in time. However, we observe interesting cross-sectional patterns across cohorts that suggest how work capacity may evolve. Middle-aged white respondents have lower potential earnings and report worse health than whites ages 62–71. As these respondents age, their work capacity will decline and thus they may face more difficulties with employment than older-age white individuals do today. The opposite is true for middle-aged Black respondents, who have substantially greater work capacity than Black respondents in the oldest cohort. We also find that gaps in potential earnings between college graduates and nongraduates are large and increase with age, suggesting that declining health and functional abilities disproportionately constrain the capacity of those with less education to work longer.

Notes

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2. The raking procedure is described here: https://www.rand.org/research/data/alp/panel/weighting.html.
3. O*NET uses the Standard Occupational Classification (SOC) system to catalog occupations at a detailed, six-digit level. Six-digit occupations are narrowly defined to include workers who perform similar job tasks. O*NET further subdivides certain six-digit occupations (approximately 6 percent) to an eight-digit level using its O*NET-SOC taxonomy (which is identical to the SOC taxonomy for six-digit occupations that are not further subdivided). The O*NET-SOC taxonomy also includes some new occupations that have not yet been added to the SOC. We use the O*NET 23.3 Database (May 2019 Release) (O*NET Resource Center 2019), which contains 773 six-digit SOC occupations and 967 O*NET-SOC occupations (which encompass the 773 SOC occupations). This data release is based on the 2010 version of the SOC system. The database includes an additional 136 six-digit SOC occupations for which data are not collected. These include military occupations and occupations in the catch-all category "All Other" that are not classified elsewhere.
4. Additionally, while AWCAS self-ratings are in discrete increments between 1 and 7, O*NET ratings are averages of eight occupational analysts' judgments and therefore often take decimal values.

5. We also do not require individuals to exceed the levels of 153 ability-occupation pairs that O*NET analysts recommend suppressing due to the high variance of the analysts' required level ratings. Requiring these abilities for occupations does not substantially change any of our results.
6. López García, Maestas, and Mullen (2019) present formulations of the measure that are less strict, giving partial credit in cases where respondents lack the complete set of abilities required in determining potential occupation sets.
7. We determine required level of education by using data from O*NET on incumbents' assessments of required education. For each occupation, we choose the level of education most frequently reported by incumbents as required. In the event of a tie, we choose the lower level of education.
8. Occupations expected to grow rapidly in the next several years or have large numbers of job openings are assigned a "Bright Outlook" designation by O*NET.
9. The Black-white difference seems to be driven by the oldest Black respondents (see Table 5.8).
10. Such occupations are assigned to Job Zone 1 by O*NET. The five O*NET Job Zone designations tier occupations by level of required preparation (e.g., work experience, education and training), with level 1 indicating the least preparation required and level 5 the most.

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