The Link between Health and Working Longer: Differences in Work Capacity

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Abstract

Little is known about how health conditions impact work-related functional abilities and even less is known about how those abilities interact with occupation-specific demands. Using new survey data, we quantify individuals' functional abilities, combine that information with occupation-specific ability requirements, and create new measures of individuals' potential occupations and earnings. We find that older respondents reported somewhat lower abilities on average than younger respondents, but this only modestly decreased their potential occupations and earnings, indicating many older individuals maintain significant work capacity. Similarly, women reported lower abilities than men on average, and black and Hispanic respondents reported lower abilities than white respondents, but these differences led to only modest differences in potential earnings, suggesting that health-related abilities explain only part of observed differences in earnings. Finally, we find that college graduates report higher functional abilities than non-graduates across all ability domains, leading to sizable differences in potential occupations and earnings.

Key Words: functional abilities, disability, working longer, work capacity, aging.

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I. Introduction

As workers age, they become increasingly likely to experience serious health problems and these conditions may ultimately 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 some middle-aged Americans (Case and Deaton 2015), which raise the question of whether gains in functional capacity and employment will persist among future cohorts of older Americans.

Health problems in middle age 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 medical conditions affect functional abilities are not well understood, especially for individuals who are or could possibly be in the labor force.

Furthermore, two individuals with the same work capacity may nonetheless have different occupational opportunities by virtue of the fact that they have different education, training, and work experience; that is, they would be qualified for different types of occupations, which in turn vary in their functional demands. Indeed, not only do we understand little about the ways in which various medical conditions affect functional capacity, we understand even less about how those functional capacities interact with occupational demands.

In this paper, we use new measures of individual work capacity to characterize the interaction between health-related functional abilities and potential occupations, both in the population overall and across different population groups. 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 Resource Center 2017). 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 whether there exist significant differences in work capacity by age, gender, race and education in the U.S.

We find that differences in cognitive abilities drive the largest differences in potential occupations and earnings among individuals, with a one standard deviation increase in reported cognitive abilities associated with an increase of $35,000 in maximum potential earnings. Sensory abilities have a smaller but economically meaningful effect on potential occupations and earnings. Physical abilities have a significant effect on potential occupations, but this effect is driven completely by jobs that do not require a Bachelor’s degree and tend to be low paying. Accordingly, physical abilities have no effect on 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.

With respect to gender, women report lower ability scores on average than men, with the largest differences in physical abilities and the smallest in cognitive abilities. These reported ability differences significantly reduce women’s potential occupations, but, as with age, this reduction is driven mostly by the loss of lower-paying jobs that do not require a Bachelor's Degree. Consequently, there are no significant differences in potential earnings between men and women. College graduates have significantly higher functional abilities than non-grads across all ability domains, including reported physical abilities. This leads to an average difference in maximum potential earnings of over $34,000. We also find differences in reported abilities across race that lead to a 11 percent gap in maximum potential earnings between white and black respondents and a 7 percent gap between white and Hispanic respondents, both of which are smaller than the observed differences in earnings. Finally, we consider how age interacts with gender, educational attainment, and race. We find that middle-age white respondents have lower potential earnings than white respondents ages 62-71, reflecting the troubling trends in health illuminated by Case and Deaton (2015). We also find that potential earnings decline in age more slowly among college graduates than non-graduates. We suggest that this may be due to the deleterious effects of physically demanding and hazardous jobs that are disproportionately held by non-graduates.

II. Data

To measure work capacity, we combine data from two sources: the American Work Capacity and Abilities Survey (Lopez-Garcia, 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, 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 which 2,355 (83%) 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 by incorporating cognitive, psychomotor, physical, and sensory dimensions of ability. 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.[i]

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. 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 six 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), which contains 773 six-digit SOC occupations and 967 O*NET-SOC occupations (which encompass the 773 SOC occupations).[ii] This data release is based on the 2010 version of the SOC system.

For each occupation, eight O*NET labor analysts rate the *level* of each ability needed to perform the occupation's tasks. Each ability is rated on a scale from 0 to 7 where 0 corresponds to no level of ability needed and 7 corresponds to the highest possible level of the ability needed. The required level of any given ability for any given occupation is the average of the eight analyst ratings. The O*NET analysts also evaluated the *importance* of each ability to the occupation, on a scale of 1 to 5. If an ability's *importance* was rated as "1-Not Important" for a particular occupation, then the *level* of the ability required for that occupation was set to 0.

To address subjectivity in the choice of ability level, 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. See Table 1 for a complete list of all O*NET abilities with detailed descriptions of each ability.

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

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 ALP 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 (BLS 2018). The OES data contain estimates of mean and median earnings nationwide for each occupation at the six-digit SOC level. To each of the eight-digit O*NET-SOC codes nested within the same six-digit SOC code, we assign the mean and median earnings of the six-digit occupation. Further, some occupations in the O*NET data do not appear in the OES data so are not considered in this paper. After merging the two datasets, there are 936 occupations with both abilities data from O*NET and wage data from OES.

III. Measuring Functional Abilities

We begin by summarizing functional ability levels as measured in the AWCAS data. Table 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 centered in the middle of the scale, between levels 4-5 (on a scale from 0 to 7). Average functional ability in the sample is highest for Reaction Time (5.62)[iv] and Speed of Limb Movement (5.09),[v] and lowest for Spatial Orientation (3.75)[vi] and Hearing Sensitivity (3.89). [vii]

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 differences in average functional abilities by gender, race, education and age group. In Figure 1, the upper left panel compares men versus women, showing the fraction of males and females with each average ability level. The ability distribution for men is centered to the right of the distribution for women, indicating that men on average report higher ability levels than women. As we explore later (see Table 4) men on average report higher abilities than women in all four ability domains, with the difference being most pronounced for physical abilities and least pronounced for cognitive abilities. The upper right panel compares the densities for Whites and Blacks. While the densities are centered about the same location, Black respondents are more likely to report ability profiles in the extremes—a greater fraction report both low and high average abilities compared to whites.

In the lower left panel of Figure 1, we observe very pronounced differences by education. College graduates report substantially greater abilities on average than non-college graduates. As shown later (see Table 5), college graduates report higher ability levels across all domains, with the differences being most pronounced for cognitive abilities. This likely reflects both selection into higher education by individuals with higher cognitive abilities, and the possibility that although abilities are relatively enduring talents, they may be somewhat modifiable by exposure to certain kinds of work activities.[viii] Lastly, we compare the distribution of functional ability by age group. The ability distribution for respondents ages 25-49 is located to the right of the ability distributions for those ages 50-61 and 62-71, indicating higher reported functional abilities among the young. The density for the middle-aged group is located slightly to the right of the density for the older group, indicating slightly lower abilities for the older group compared to the middle-aged group.

IV. Measuring Work Capacity

Next we examine how individual abilities interact with occupational requirements to determine work capacity. We consider several definitions of work capacity, including occupation-specific work capacity, the size of an individual's potential occupation set, and respondents' potential earnings. We also explore how education constrains potential occupations and earnings.

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.[ix] Specifically, we measure occupation-specific work capacity OWC as:

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

Where $\theta_{i,k}$ is 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 (that is, 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 rather strict, since if an individual is missing even one important ability, they are not credited with the potential occupation.[x] 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:

$$WC_i = \sum_{j=1}^{J} OWC_{i,j}, \qquad (2)$$

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)).[xi] Notably, these measures are *not* affected by individuals' educational attainment, only their reported abilities and the interaction of those ability profiles with occupational demands. Therefore, it is perfectly possible for an individual with only a high school education to have many potential occupations that require a baccalaureate or advanced degree.

Figure 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.[xii] Most individuals have many potential occupations; however, there is a large mass 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 Lopez-Garcia, Maestas and Mullen (2019). They suggest that missing abilities may limit 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).

Finally, we construct two measures of individuals' potential annual earnings, aggregating over each occupation's within-occupation median annual earnings, where median earnings are top-coded at $208,000. Because we aggregate over each occupation's median earnings to construct potential earnings, all differences in potential earnings are driven entirely by differences in earnings across occupations, rather than within occupation. Specifically, we 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.[xiii]

Figure 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). The fact that the median of max 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. 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. Occupations that pay highly may do so 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 of idiosyncratic preferences for 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 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 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 have a large but somewhat smaller effect on 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 smaller effect on 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 number of potential occupations that do not require a Bachelor's Degree; in fact, there is no statistically significant effect of self-assessed physical ability on the number of potential occupations that require either a Bachelor's Degree or the number that require an advanced degree. The fact that physical abilities only drive the number of potential jobs that do not require a Bachelor's Degree shows up again in Columns 5 and 6: because occupations that do not require a Bachelor's 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 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 an adequate measure of work capacity, we would expect it to be positively associated with many labor outcomes. As a validation exercise, Appendix Figures A.1 and A.2 plot observed earnings and employment rate by binned number of potential occupations and show a positive relationship for both labor outcomes. In particular, earnings and employment rates are higher on average for those with a larger potential occupation set.

V. Differences in Work Capacity

Next, we examine how differences in average functional abilities interact with occupational demands in the economy to create differences in work capacity. We examine these differences by age group, gender, education, and race.

Differences by Age Group

Table 3 presents comparisons by age group. The average score for all functional abilities is highest for the youngest cohort at 4.5 while the average scores are for the middle-age and oldest cohorts are 4.4 and 4.3, respectively. This pattern holds for the cognitive, psychomotor, and sensory ability domains, but not for physical abilities. Compared to the youngest cohort, average physical ability is 6.9 percent lower in the middle-age cohort and 11.3 percent lower in the oldest cohort. Although the declines in physical abilities are statistically significant, they are modest in magnitude. The work capacity measures show similar patterns by age. The set of potential occupations is largest among those ages 25-49 (319), declines by 13.5 percent among those ages 50-61 (276), and holds steady at that level through ages 62-71. The modest decline in physical abilities observed between middle and older age, is not large enough to reduce the set of potential occupations.

Table 3 also reveals the degree to which education requirements constrain potential occupations sets. Out of 276 potential occupations on average for the middle-age cohort, 70 percent of these occupations 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 ability 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 groups.

Lastly, we consider median and maximum potential earnings. Potential earnings from individuals' median potential occupation (when ranked by average occupational earnings) average $35,298 among the youngest cohort and are only slightly lower (and not significantly so) among the middle-age and older cohorts ($34,119 and $34,643 respectively). Maximum potential earnings (that is, earnings on the individual's highest paying potential occupation) are substantially greater than median potential earnings, and exhibit a modest and marginally significant ($p<0.10$) decline with age ($114,460 on average for the younger cohort and roughly $105,000 for the middle-age and older cohorts).

Differences by Gender

Table 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 half a standard deviation. These differences manifest in the measures of work capacity with women having fewer potential occupations for all levels of education requirements. However, this difference appears to have little effect on potential earnings, which is partly explained by the finding from Table 2, that physical ability does not correlate heavily 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 consistent with bias from overconfidence among men (or under confidence among women). The use of anchors in the O*NET ability scale is intended in part to guard against this type of bias by relating ability levels to specific tasks individuals should be able to perform rather than more subjective criteria. It is difficult to rule out overconfidence altogether; however, even if male overconfidence bias is a significant driver of the male-female ability gap, our key finding that potential earnings are not statistically different between men and women would either hold or indicate that women actually have higher potential earnings than men after accounting for overconfidence bias.

Differences by Education

Differences in functional abilities and, consequently, in work capacity, are especially large across education groups. As shown in Table 5, college graduates report higher ability scores than non-college graduates, overall and by ability domain. The difference is especially pronounced for cognitive ability scores where college graduates report an average score of 4.720 while non-college graduates had an average score of 4.251, a difference of 0.469. Perhaps surprisingly, there is also a large difference in reported *physical* abilities, with non-college graduates reporting average scores that are almost a third of a standard deviation lower than college graduates. This difference may be due to more hazardous working conditions among less educated individuals. The gap in abilities translates into fewer potential occupations for all required levels of education. These education requirements constrain the options of non-college graduates who have the abilities to increase their potential occupation set by 27 percent if they had a Bachelor's degree. Further, both maximum and median potential earnings are lower for non-college graduates at an economically meaningful level. 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,[xiv] compared to approximately 35 percent among non-college graduates.

Differences by Race

Table 6 examines differences in functional abilities and work capacity by race. We present data for all race/ethnic groups classified in the data, but due to small sample sizes, we focus on comparisons for blacks, whites and Hispanics. Black respondents report slightly lower ability scores than whites on average ($p<0.10$) and for the physical ($p<0.10$), psychomotor ($p<.05$), and sensory classes ($p<.05$). Hispanic respondents similarly report slightly lower abilities than whites on average ($p<0.10$) but with lower reported scores in the cognitive ($p<.05$) and sensory ($p<.05$) domains. These functional ability differences translate into notable differences in potential occupations. Compared to whites, blacks have 16 percent fewer potential occupations while Hispanics 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 whites, by 35 percent among blacks, and by 28 percent among Hispanics. In terms of potential earnings, whites have higher median (and maximum) potential earnings compared to blacks[xv] and Hispanics—at $36,065, $32,057, and $33,433 respectively. 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 blacks (based solely on reported abilities) contain substantially more occupations that require little experience or formal training[xvi] compared to those of whites, and, to a lesser degree, Hispanics; similarly, the potential occupation sets of blacks have a smaller share of growing occupations, compared to whites and Hispanics. Lastly, it bears noting that these gaps in *potential* earnings are smaller than *observed* earnings gaps,[xvii] suggesting that differences in functional ability explain some but not all of the unexplained observed race-earnings gaps.

Differences in Age Patterns by Gender, Race and Education

Table 4 revealed a difference in maximum potential earnings between men and women (although the difference was not statistically significant). Table 7 examines this difference more closely by disaggregating by both age group and gender. This table shows that the aggregated difference in maximum potential earnings between men and women is primarily driven by the middle-age cohort (where the difference is statistically different), possibly due to earlier onset of health problems for women. Notably however, the discrepancy disappears completely in the oldest age group. Potential earnings for older women are higher than for their middle-age counterparts while the opposite is true for men.

Similarly, Table 8 compares potential earnings by both age group and race. The previously noted potential earnings difference between whites and blacks (see Table 6) is explained largely by the oldest age cohort where whites are estimated to have maximum potential earnings of $112,319 on average compared to only $78,026 for blacks. The differences in earnings potential between the oldest and middle-age age groups among black respondents is strikingly high and negative, contrasting with the small but *positive* difference for white respondents (consistent with Case and Deaton's (2015) observation of worse health and mortality among middle-age whites (Case and Deaton 2015)). The black-white difference is consistent with a widening health gap between the two groups in later age. Table 10 shows that while both groups report very good or excellent health about 47 percent of the time within the youngest age group, whites report very good or excellent health at a rate 2.5 times higher than blacks in the age 62-71 cohort. As in the case of potential earnings, the oldest whites report very good or excellent health more frequently than middle-age whites, but oldest blacks report poorer health on average than middle-age blacks.

Table 9 displays potential earnings by age group and education level. The difference between college graduates and non-college graduates appears at every age cohort. Interestingly, average potential earnings (both maximum and median) are constant for college-educated respondents but are smaller for older age groups among non-college graduates, which amplifies the education difference in older age. These differences by age for non-college graduates may be due to poorer working conditions that accelerate health deterioration.

VI. 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 in age, potential earnings decline only modestly, suggesting that many people maintain the ability to work into their late sixties and early seventies. 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. Similarly, while the existence of differences in reported functional ability by race and gender have sizeable effects on potential occupations, differences in potential earnings are more modest. This suggests that differences in functional abilities can explain only part of the observed gender- and race-gaps in earnings, implying that other factors, such as discrimination or differences in occupational preferences, play an important role.

Finally, considering how work capacity evolves over age for different groups is crucial to understanding the heterogeneous impacts of working longer. 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 any 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 ages that suggest how work capacity may evolve. Middle-age white respondents have lower potential earnings than whites ages 62-71 and report worse health. 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. We also find that differences in potential earnings between college graduates and non-graduates are largest among the oldest cohorts. While we cannot definitively attribute this to faster health deterioration among non-graduates, who disproportionately work in dangerous and physically demanding jobs, this result is consistent with that hypothesis.

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[i] The raking procedure is described here: https://www.rand.org/research/data/alp/panel/weighting.html.
[ii] These figures give the number of occupations for which data is collected. The database includes an additional 136 six-digit SOC occupations for which data is not collected. These include military occupations and occupations in the catch-all category "All Other" that are not classified elsewhere.
[iii] 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.
[iv] From O*NET, level 4 on Reaction Time corresponds to being able to "Throw a switch when a red warning light goes off" while level 6 is the ability to "Hit the brake when a pedestrian steps in front of the car."
[v] From O*NET, level 4 on Speed of Limb Movement corresponds to being able to "Swat a fly with a fly swatter" while level 6 is the ability to "Throw punches in a boxing match."
[vi] From O*NET, level 3 on Spatial Orientation corresponds to being able to "Find your way through a dark room without hitting anything" while level 6 is the ability to "Navigate an ocean voyage using only positions of the sun and stars."
[vii] From O*NET, level 2 on Hearing Sensitivity corresponds to being able to "Notice when a watch alarm goes off" while level 4 is the ability to "Diagnose what's wrong with a car engine from its sound."
[viii] This is possible because for the higher levels of the cognitive abilities the O*NET scale anchors sometimes refer to example activities that would be performed by a worker who had advanced education and training or work experience. An example is Oral Comprehension, level 6 "Understand a lecture on advanced physics."
[ix] We also do not require individuals to exceed the levels of 153 ability-occupation pairs that O*NET analysts recommend to suppress due to the high variance of the analysts' required level ratings. Requiring these abilities for occupations does not substantially change any of our results.
[x] Lopez-Garcia, 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.
[xi] 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.
[xii] While all individuals in the sample have a positive number of potential occupations, it is theoretically possible for an individual to have zero. For example, if the threshold for ability importance is reduced to 2-Somewhat Important, then some individuals will have an empty potential occupation set.
[xiii] Because individuals can theoretically have zero potential occupations, both potential earnings measures are constructed using one placeholder occupation with zero wage. This occupation is not counted in counts of potential occupations.
[xiv] 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.
[xv] The black-white difference seems to be driven by the oldest black respondents (see Table 8).
[xvi] 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.
[xvii] 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, metro status and region of residence (Wilson and Rogers 2016).

Table 1: O*NET Abilities and Estimated Population Means using 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.
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	Multilimb 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.
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.

Table 2: Relationship Between Average Abilities and Work Capacity

	Outcome: # Potential Occupations by Required Education Level				Outcome: Potential Earnings	
	(1) All Education Levels	(2) No Bac. Degree Required	(3) Bac. Degree Required	(4) Adv. Degree Required	(5) Maximum	(6) Median
Average of Self-Assessed Cognitive Ability Scores (standardized)	125.7***	55.79***	46.93***	22.93***	35176.0***	6174.5***
	(12.45)	(7.158)	(4.240)	(1.990)	(2738.4)	(474.8)
Average of Self-Assessed Physical Ability Scores (standardized)	35.21***	27.99***	5.549	1.678	1900.4	-156.4
	(9.527)	(5.405)	(3.316)	(1.482)	(2164.5)	(372.4)
Average of Self-Assessed Psychomotor Ability Scores (standardized)	2.690	12.79	-7.330	-2.766	1947.3	943.0
	(13.91)	(8.406)	(4.466)	(2.017)	(3169.0)	(683.2)
Average of Self-Assessed Sensory Ability Scores (standardized)	85.01***	61.09***	18.77***	5.154**	18202.5***	3321.1***
	(11.29)	(6.784)	(3.710)	(1.665)	(2553.8)	(461.0)
R^2	0.569	0.575	0.472	0.447	0.586	0.676
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 # 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.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Average Abilities and Work Capacity by Age Group

	(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)
# of Potential Occupations	318.9	275.9	276.1
	(16.6)	(13.9)	(14.2)
# of Potential Occupations not requiring a Bachelor's Degree	224.3	193.7	190.5
	(10.9)	(9.2)	(9.0)
# of Potential Occupations requiring only a Bachelor's Degree	69.0	59.8	62.7
	(4.5)	(3.9)	(4.1)
# of Potential Occupations requiring an Advanced Degree	25.7	22.3	22.9
	(1.9)	(1.7)	(1.8)
Max 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: # of Potential Occupations is out of 936 occupations possible.

Table 4: Average Abilities and Work Capacity by Gender

	(1) Men	(2) Women	(3) 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)
# of Potential Occupations	339.0	264.2	-74.8
	(18.2)	(10.4)	(21.0)
# of Potential Occupations not requiring a Bachelor's Degree	237.7	184.9	-52.8
	(12.0)	(6.7)	(13.7)
# of Potential Occupations requiring only a Bachelor's Degree	73.9	57.7	-16.2
	(5.0)	(2.9)	(5.8)
# of Potential Occupations requiring an Advanced Degree	27.3	21.5	-5.8
	(2.1)	(1.3)	(2.4)
Max 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	1307	

Notes: # of Potential Occupations is out of 936 occupations possible.

Table 5: Average Abilities and Work Capacity by Education

	(1) College Graduates	(2) Non-Grads	(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)
# of Potential Occupations	389.0	251.1	-137.9
	(13.5)	(13.3)	(19.0)
# of Potential Occupations not requiring a Bachelor's Degree	258.7	183.5	-75.2
	(7.9)	(9.1)	(12.0)
# of Potential Occupations requiring only a Bachelor's Degree	93.4	50.2	-43.2
	(4.2)	(3.5)	(5.5)
# of Potential Occupations requiring an Advanced Degree	36.9	17.5	-19.4
	(1.9)	(1.4)	(2.4)
Max 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	1088	1134	

Notes: # of Potential Occupations is out of 936 occupations possible.

Table 6: Average Abilities and Work Capacity by Race

	(1) Non-Hispanic White	(2) Non-Hispanic Black	(3) Hispanic	(4) American Indian or Alaska Native	(5) Asian or Pac. Islander	(6) Other Ethnicity
Average of Self-Assessed	4.516	4.285	4.373	4.154	4.628	4.261
Ability Scores	(0.035)	(0.134)	(0.069)	(0.307)	(0.111)	(0.168)
Average of Self-Assessed	4.475	4.335	4.297	4.013	4.662	4.244
Cognitive Ability Scores	(0.037)	(0.153)	(0.078)	(0.277)	(0.199)	(0.181)
Average of Self-Assessed	4.293	3.998	4.242	4.183	4.470	4.208
Physical Ability Scores	(0.042)	(0.153)	(0.069)	(0.351)	(0.144)	(0.120)
Average of Self-Assessed	4.776	4.453	4.690	4.283	4.787	4.504
Psychomotor Ability Scores	(0.045)	(0.139)	(0.076)	(0.353)	(0.098)	(0.157)
Average of Self-Assessed	4.539	4.272	4.340	4.272	4.556	4.127
Sensory Ability Scores	(0.036)	(0.129)	(0.081)	(0.315)	(0.121)	(0.254)
# of Potential Occupations	319.8	267.9	250.1	232.2	307.0	272.2
	(12.3)	(31.1)	(23.1)	(102.3)	(48.1)	(47.0)
# of Potential Occupations	224.6	179.4	181.7	172.9	204.6	190.1
not requiring a Bachelor's Degree	(7.9)	(20.7)	(15.1)	(78.5)	(25.5)	(31.8)
# of Potential Occupations	70.0	62.7	50.5	47.1	67.8	58.7
requiring only a Bachelor's Degree	(3.5)	(8.0)	(6.6)	(21.4)	(14.7)	(11.7)
# of Potential Occupations	25.2	25.8	18.0	12.2	34.6	23.4
requiring an Advanced Degree	(1.5)	(3.6)	(2.7)	(6.0)	(9.5)	(4.9)
Max Potential Earnings	114,147	105,596	102,562	90,218	113,266	99,522
	(2,915)	(8,659)	(5,824)	(22,150)	(12,827)	(12,240)
Median Potential Earnings	36,065	32,057	33,433	30,859	36,588	31,763
	(507)	(1,714)	(903)	(3,076)	(1,792)	(2,805)
Observations	1495	254	242	26	61	144

Notes: # of Potential Occupations is out of 936 occupations possible.

Table 7: Average Potential Earnings by Age and Gender

	(1) Men		(2) Women		(3) Difference	
Maximum Potential Earnings:						
Age 25-49	116,897	(7,236)	112,125	(4,266)	-4,772	(8,400)
Age 50-61	114,102	(5,856)	96,723	(3,913)	-17,379	(7,043)
Age 62-71	105,314	(4,571)	105,316	(4,658)	2	(6,526)
Median Potential Earnings:						
Age 25-49	35,650	(1,490)	34,962	(673)	-688	(1,635)
Age 50-61	35,750	(988)	32,792	(712)	-2,958	(1,218)
Age 62-71	35,073	(796)	34,255	(768)	-818	(1,106)
Observations	915		1307			

Notes: Standard errors in parentheses.

Table 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	(5,338)	109,312	(13,673)	-12,014	(14,678)
Age 50-61	103,632	(3,769)	112,420	(12,429)	8,788	(12,988)
Age 62-71	112,319	(3,649)	78,026	(9,060)	-34,293	(9,767)
Median Potential Earnings:						
Age 25-49	37,156	(955)	32,091	(2,712)	-5,065	(2,875)
Age 50-61	34,436	(603)	33,678	(2,248)	-758	(2,328)
Age 62-71	35,827	(592)	28,828	(2,126)	-6,999	(2,207)
Observations	1495		254			

Notes: Standard errors in parentheses.

Table 9: Average Potential Earnings by Age and Education

	(1) College Graduates		(2) Non-Grads		(3) Difference	
Maximum Potential Earnings:						
Age 25-49	133,890	(4,617)	102,903	(5,696)	-30,987	(7,332)
Age 50-61	130,689	(3,810)	93,785	(4,516)	-36,903	(5,909)
Age 62-71	129,562	(3,677)	90,402	(4,481)	-39,160	(5,797)
Median Potential Earnings:						
Age 25-49	39,456	(687)	32,825	(1,122)	-6,631	(1,316)
Age 50-61	38,779	(632)	32,207	(783)	-6,572	(1,006)
Age 62-71	38,943	(634)	31,998	(755)	-6,945	(986)
Observations	1088		1134			

Notes: Standard errors in parentheses.

Table 10: 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	1,495	254

Standard errors in parentheses

Figures

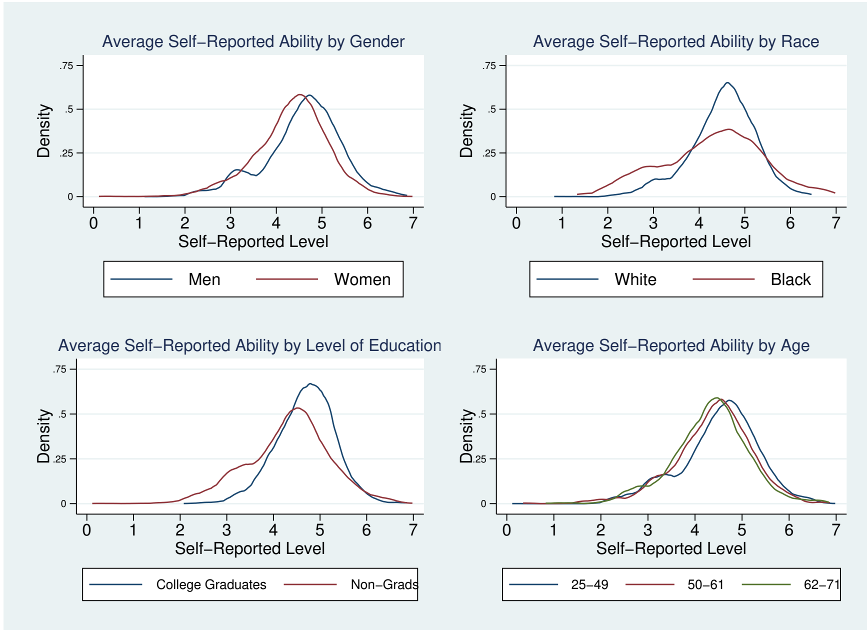

Figure 1: Distribution of Average Ability

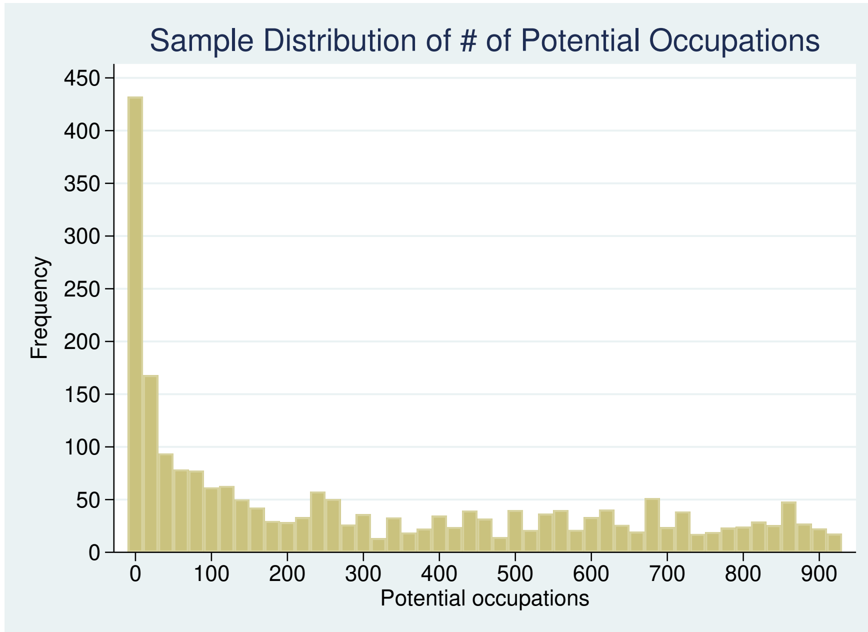

Figure 2: Sample Distribution of # of Potential Occupations

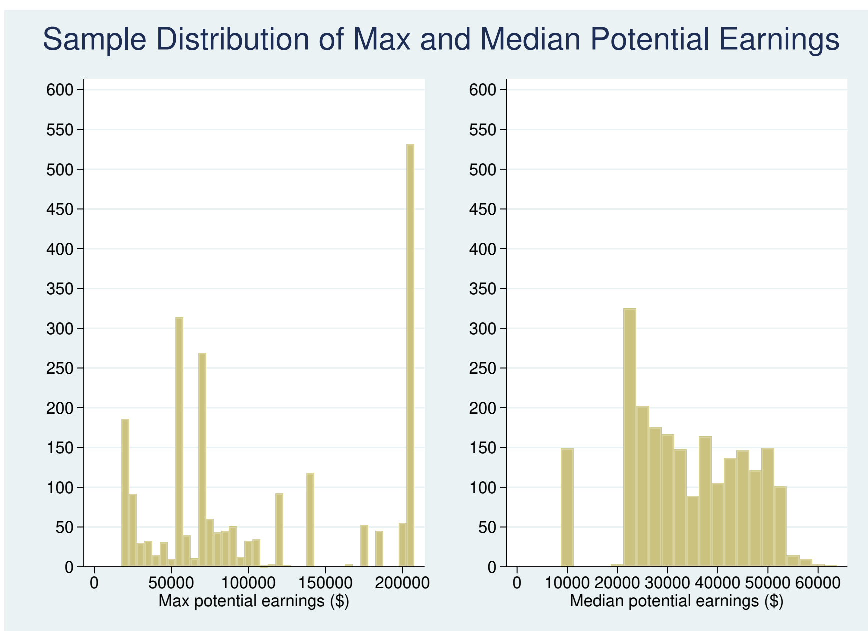

Figure 3: Sample Distribution of Potential Earnings Measures

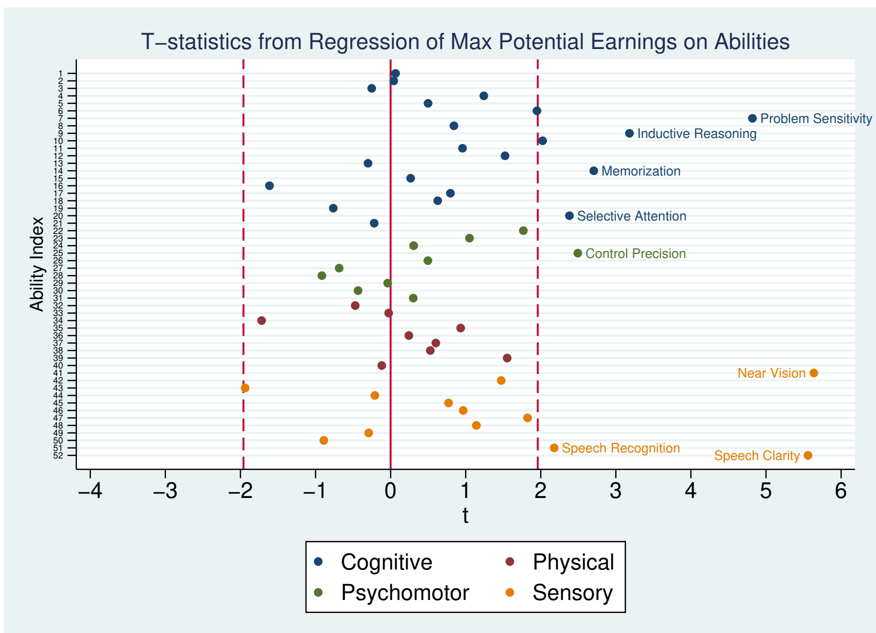

Figure 4: T-statistics from Regression of Potential Earnings on All Abilities

A Appendix Figures

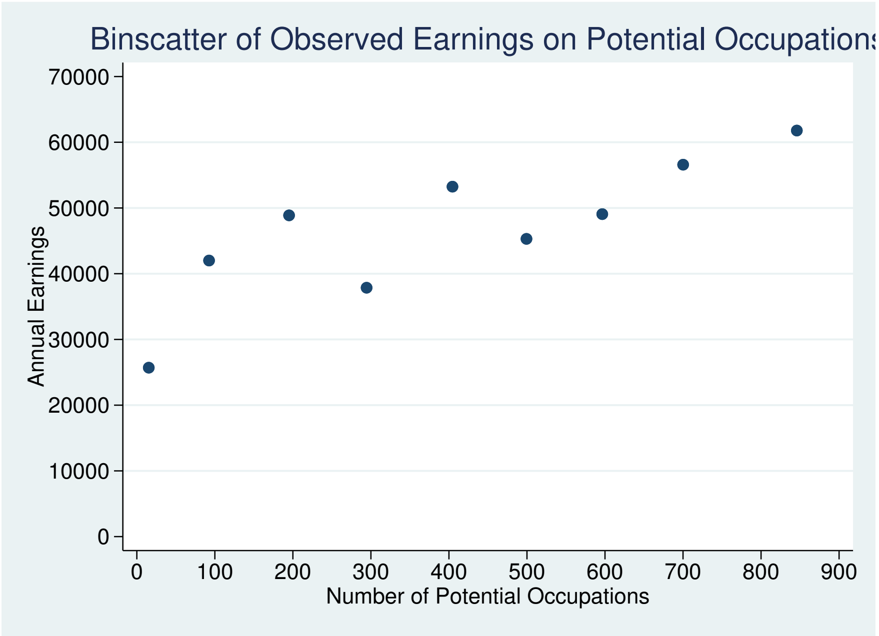

Figure A.1: Binscatter of Observed Earnings on Number of Potential Occupations

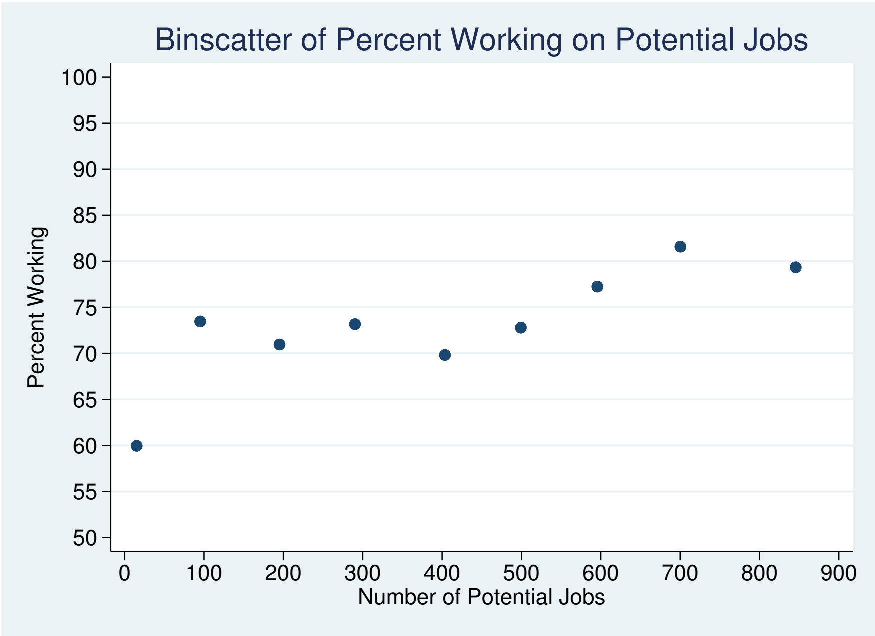

Figure A.2: Binscatter of Percent Working on Number of Potential Occupations