Beyond Blue and White Collar: Age-related Decline, Occupation, and Retirement Timing

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Abstract

Most research on retirement timing has accounted for age-related decline by simply looking at whether an occupation is classified as blue or white collar. The basic assumption is that white-collar workers can work longer because their work relies on mental ability, which is implicitly assumed to decline slower than physical ability as workers approach retirement. But not all blue-collar jobs are equally reliant on physical skills that decline with age, while some white-collar jobs rely on cognitive abilities known to decline early. Thus, the distinction of blue- or white-collar may be too simple when it comes to predicting retirement. To address this issue, this paper presents a "Susceptibility Index" that measures how susceptible the abilities required by an occupation are to decline during the working years. The results suggest that: 1) considerable variance exists, especially within white-collar occupations, in the importance of abilities that are known to show early decline; and 2) this variance, as captured by the Index, is predictive of early retirement. The predictive power of the Index exists when individual-level controls are included in the model, including physical health, and is greater than the more commonly used white- and blue-collar division.

Introduction

Nobody can withstand the effects of time. With age, even among the fittest individuals, skin and arteries harden, reaction times slow, and immune function diminishes. While declines in physical and mental performance are inevitable, they are not uniform across the various systems of the body. This variance means that the different abilities used to perform tasks at work decline at different rates as individuals age.[1] For example, explosive strength (e.g. the ability to jump) declines significantly during one's working life, while static strength (e.g. the ability to hold up a weight) declines relatively little during the same period.[2] Workers in occupations that rely on abilities that decline fastest are also likely to be at the greatest risk of retiring early. Most research on retirement timing attempts to proxy the possibility of early decline by controlling for whether a worker's occupation is blue or white collar – the basic assumption is that white-collar workers can work longer and blue-collar workers cannot. But is this distinction appropriate? Are all white-collar workers able to work well into their sixties and, if not, which occupations are most vulnerable? Are certain blue-collar jobs better than others in terms of allowing a long working life? Although these questions have implications for policymakers considering ways to encourage individuals to work longer, to date researchers have not identified a systematic way to fully account for the relationship between occupation and early retirement.

To address this issue, this paper presents a Susceptibility Index that measures how susceptible the abilities required by an occupation are to decline during the working years. The project draws inspiration from a "work-ability index" developed in Finland to measure municipal

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1 As one example, fluid intelligence (the ability to think logically) declines well in advance of crystalized intelligence (acquired knowledge). See Salthouse (2009).

2 Spirduso, Francis, and MacRae, 2005.

workers' physical, mental, and psychological capacity to meet work demands and identify workers in need of occupational therapy. Several studies using this index reported significant heterogeneity in work ability across occupations among older workers (Ilmarinen and Klockars 1997; Ilmarinen, Tuomi and Seitsamo 2005). The goal of this project is to first construct an index that identifies occupations that place importance on abilities that decline early and then to explore whether workers in such occupations will retire earlier regardless of whether the occupation is white or blue collar.

To construct the Index, the first step is a substantial review of the aging literature to identify which abilities, both cognitive and physical, decline by the early to mid-sixties. The second step is to construct the Index by using the Occupational Information Network (O*NET) database to evaluate occupations based on the number and importance of abilities required for the job – the higher the Index the more the occupation relies on abilities that decline early. The Index is then placed in a model of early retirement using the *Health and Retirement Study* (HRS) and restricted detailed occupation data to better estimate how likely individuals in certain occupations are to retire early. The project compares how well this occupation-specific Index predicts early retirement relative to more standard measures, like being in blue- or white-collar occupations.

The Index represents a substantial improvement over the occupational information typically contained in studies of early retirement. Past research on retirement timing among American workers typically classified workers as blue or white collar. This classification does not account for the fact that, even within these broad occupational groups, levels of ability decline vary significantly. For example, food servers can often work well into their 60s but roofers have trouble working past 50 – yet, both groups are considered blue collar. Other studies on American workers have found a correlation between the physical demands of an occupation and early retirement. However, these studies have not examined characteristics of occupations beyond gross physical demands, despite research that shows a heterogeneous, age-related decline in various physical *and* mental abilities (for example, Holden 1988; Iversen and Poulsen 2001; Karpansalo et. al. 2002).

Of course, occupation is not the only thing that determines a worker's ability to work longer, and ignoring these characteristics could lead to an overestimate of the role of the Index in measuring the susceptibility of workers to early retirement. A significant minority of older workers, through luck and lifestyle, will not experience a significant decline in ability relative to their job requirements. These workers are likely to remain productive in their jobs even in their late 60s and may select into occupations amenable to doing so. Workers in occupations that rely on accumulated knowledge and verbal ability, such as postsecondary teachers, are particularly likely to fall under this category (Skirbekk, 2008). Thus, controlling for individual cognitive ability (through education) is an important aspect of the early retirement model.

The results suggest that: 1) considerable variance exists, even within white-collar occupations, in the importance of abilities that are known to show early decline; and 2) this variance, as captured by the Index, is predictive of early retirement. The predictive power of the Index exists when individual-level controls are included in the model and is greater than the more commonly used white- and blue-collar division. Overall, similar individuals in occupations sitting at the 90th percentile of the Index (very susceptible to age-related decline) are 5.3 percentage points more likely than individuals at the 10th percentile to retire before age 65. Interestingly, even when controls for declines in physical health are included in the model, the Index is still predictive of early retirement, suggesting it captures aspects of employment beyond the physical. Indeed, when the analysis is restricted to just white-collar workers, the Susceptibility Index is still a significant predictor of early retirement, suggesting it captures well variance in the decline of the cognitive abilities these occupations are more likely to rely on.

Constructing a Susceptibility Index

To construct the Susceptibility Index described above, this project uses the Occupational Information Network (O*NET) database to measure occupation-related ability requirements. The O*NET surveys job-holders, occupational analysts, and occupational experts to measure the importance of each ability for each occupation. The O*NET Content Model identifies the importance of 51 abilities that contribute to a worker's capacity to do the job within each of over 900 occupations. These abilities include physical abilities (e.g., "Explosive Strength", "Manual Dexterity"), cognitive abilities (e.g., "Deductive Reasoning", "Memorization"), and sensory abilities (e.g., "Night Vision", "Sound Localization"). The importance of these 51 abilities differs significantly across occupations. As is described in detail below, only some of these abilities are expected to decline substantially before workers hit their mid-sixties. Our hypothesis is that occupations that rely heavily on abilities known to decline prior to the mid-sixties will tend to retire early.

Identifying Abilities that Decline Early

To identify abilities that decline during working years, we rely on the literature from a wide range of fields, including gerontology, psychology, medicine, and occupational studies. This section is broken down into the four broadest categories contained in O*Net: Cognitive, Psychomotor, Physical, and Sensory.

Cognitive Abilities

The extent to which cognitive abilities decline with age generally depends on whether the cognitive ability in question benefits from accumulated knowledge or not. "Crystalized" cognitive ability, or knowledge (such as one's vocabulary), tends to accumulate well into one's sixties and even seventies.[3] Older workers in occupations requiring extensive work-related knowledge to be productive will hold a productivity advantage over younger workers to the extent that the work-related knowledge in question is static.

On the other hand, "fluid" cognitive abilities, such as episodic memory, working memory, and reaction time – which people need to acquire new information and make decisions – steadily decline with age starting in one's twenties or thirties.[4] This decline in fluid cognitive ability is observed at the neurological level, in controlled tests of cognitive ability, and in real world tasks that involve fluid cognitive ability.[5] While a high degree of individual variation exists in the rate of decline in fluid cognitive ability,[6] one's initial levels of ability, education, or occupation are not correlated with the rate of decline.[7] The only factors consistently linked to the rate of cognitive change are exercise (correlated with slower decline) and poor health (diabetes and strokes are correlated with faster decline).[8] Controlling for health in the model of early retirement will be important if the effect of occupation is to be isolated from the effect of individual characteristics on early retirement.

3 Schaie andWillis, 2010, Salthouse, 2009.

4 Singh-Manoux et al, 2012.

5 Salthouse, 2012, Gross et al, 2011.

6 Ylikoski et al 1999.

7 Yaffe, et al, 2009.

8 Salthouse, 2009.

The O*NET measures the importance of seven broad types of cognitive abilities – verbal ability, spatial ability, ability to generate ideas and reason, attentiveness, quantitative ability, memory, and perceptual abilities – for over 900 occupations. Within these categories, and in keeping with the discussion above, verbal and quantitative abilities (which generally reflect crystalized ability) do not decline significantly by age 60 for most individuals. On the other hand, spatial abilities, perceptual speed, and memory (which generally reflect fluid ability) tend to undergo measurable and practically significant decline by the end of most workers' careers.[9] Table A1 in the Appendix provides a detailed breakdown of how each of the cognitive abilities was assigned the status of declining with age or not.

Psychomotor Abilities

Psychomotor abilities function using a combination of cognitive (or neurological), physical, and sensory abilities. For example, arm-hand steadiness requires neurons to trigger muscles to react to changes in body position and visual cues.[10] The O*NET categorizes psychomotor abilities into fine manipulative abilities, control movement abilities, and reaction time and speed. A review of the literature indicates that control movement abilities (e.g. the ability to walk in a coordinated manner) does not decline significantly during a typical career while fine manipulative abilities (e.g., the motions needed to sew) and reaction time and speed typically declines significantly as workers approach retirement-age. While some studies suggest fine manipulative abilities can be preserved through practice, declines in reaction time and speed do not appear to be possible to mitigate through practice.[11] Table A2 in the Appendix provides a

9 Craik and Salthouse, 2011.

10 Spirduso, Francis, and MacRae, 2005.

11 Verhaeghen, 2013, Czaja, S. J., & Sharit, J. 1998.

breakdown of whether each of the psychomotor abilities was assigned the status of declining with age or not.

Physical Abilities

The O*Net divides physical abilities into four broad categories: strength, endurance, flexibility, and coordination. Strength declines with age, but not uniformly across activity types. This result stems from the fact that muscle fibers that are important when force must be maintained for long periods of time do not atrophy nearly as quickly as muscle fibers that are most useful in short bursts.[12] Thus, strength declines tend to be slower for activities that require a force be held constant over a period of time (e.g., holding a grocery bag, supporting one's body) than for activities that require quick exertions of force (e.g., throwing an object). The ability to exert force quickly – often called "explosive" force – is further compromised by a general reduction in the ability to coordinate muscles for quick actions.[13] The nature of these declines suggests that a worker's ability to do jobs that rely on a static type of strength, whereby force is held constant, or that rely on the abdominal and back muscles (so-called "trunk strength") to hold a position would not be compromised through the early 60s. This conclusion seems especially true since several studies have reported ways to stave off declines in static strength; use through work activity and resistance training have been shown to aid in the

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12 Spirduso, Francis, and McRae (2005) provide an excellent summary of this research as well as discussion on Type I versus Type II muscle fibers. See Vandervoort (2002) for a discussion of differential muscle atrophy.

13 Spirduso, Francis, and McRae (2005).

maintenance of static and trunk strength.[14] Less evidence exists regarding the impact of training or work on reducing the effects of aging on explosive strength.[15]

An individual's endurance or stamina is largely determined by the functioning of his cardiovascular system. This system undergoes a number of changes that can, especially with inactivity, reduce the ability to function with age: arteries become stiffer; blood pressure increases; communication between the automatic nervous system and cardiovascular systems becomes slower; and maximal heart rate declines, as does the amount of blood pumped from the heart.[16] However, the most common measures of these changes show that as long as an individual remains active the decline is very slow. Indeed, active individuals in their 60s have similar stamina as inactive individuals in their 30s. In other words, workers who use stamina in their jobs on a daily basis (e.g., dancers, firefighters) are unlikely to experience the declines with age that may be common for less active individuals. Endurance is not assumed to decline early. Flexibility refers to the range of motion a person has in their joints and is largely a function of the suppleness of tendons and ligaments that attach muscles to bone. Because tendons and ligaments lose water as people age, most measures of flexibility show substantial declines. One of the most extreme examples of flexibility decline with aging is spinal flexibility and trunk extension, both crucial components of being able to bend ones' body to meet the demands of work or daily activity. The sit-and-reach test, which measures spinal flexibility, shows declines of 15 percent per decade between the ages of 30 and 70, and losses in trunk extension are

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14 For example, see Frontera et al. (1988) or Hagerman et al. (2001) for evidence related to strength gains in the quadriceps.

15 Spirduso, Francis, and McRae (2005)

16 Safar (1990), Fleg et al. (1985), Tanaka et al. (2001), Lakatta (2002).

larger.[17] Furthermore, the evidence is mixed on whether age-related reductions in flexibility can be mitigated with exercise or use, and so it is unclear at this point that individuals working in occupations that demand flexibility (e.g., roofing, plumbers) will maintain it better than those in occupations that do not.[18] For these reasons, it is assumed that all measures of flexibility included in the O*Net data show early decline.

Finally, an individual's ability to balance themselves and coordinate movement involves a complicated mixture of sensory and cognitive abilities, physical strength, and flexibility. Regarding the sensory systems, age-related declines clearly affects the ability to balance. An individual's vision (which will be discussed in more detail below) changes in several ways that influence balance and coordination: depth perception is reduced, the individual becomes more sensitive to glare, and the vision field narrows.[19] Older individuals also have a reduced sense of touch.[20] Finally, the vestibular system, which is an extremely important contributor to balance and coordination by helping the body understand its position, reduces functionality as people age.[21] As mentioned above, flexibility declines early as well. In other words, an older individual's balance and coordination are compromised by a reduced ability to see and feel where they are in space and to move their body freely to make adjustments. Because changes with age in the sensory system are difficult to mitigate with physical activity or work, it seems likely workers' ability to do jobs where balance and coordination are important will be

17 Golding and Lindsay (1989).

18 For example, see discussion in Stathokostas et al. (2013).

19 Bell (1972), Higgins (1988), Fozard (1990), and Fozard and Gordon-Salant (2001).

20 Bruce (1980).

21 Rosenhall and Ruben (1975).

compromised. Table A3 in the Appendix provides a breakdown of whether each of the physical abilities was assigned the status of declining with age or not.

Sensory Abilities

Vision, hearing, and speech also play essential roles in some occupations, and the O*Net provides detail on the importance of each. Although vision obviously declines as an individual ages, with correction many aspects of vision can be maintained. In general, both near vision, far vision, and color discrimination can be maintained (with correction as necessary) well into an individual's seventies.[22] Other aspects of the visual system are less easy to correct and do show early declines. For example, because pupils shrink and do not dilate as quickly as people age, older individuals typically have worse night vision and are more sensitive to glare than others.[23] Additionally, the field of vision decreases, reducing peripheral vision.[24] Finally, several studies have shown that the ability to perceive depth declines quickly with age.[25] The O*Net includes seven measures of visual ability: far vision, near vision, color discrimination, night vision, peripheral vision, depth perception, and glare sensitivity. Due to the ability to correct, near and far vision are assumed not to decline early. Neither is visual color discrimination. However, night vision, peripheral vision, depth perception, and glare sensitivity are all assumed to decline early.

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22 Fozard (1990). It is worth noting there is some disagreement as to how quickly color vision declines – for example, see Schieber (2006).

23 Higgins (1988), Harrison (1993), Jackson et al (1997), Jackson and Owsley (2000), and Schieber (2006).

24 Fozard and Salant (2001).

25 Bell (1972) and Fozard (1990).

In general, auditory and speech abilities are relatively well maintained throughout an individual's working life. Hearing sensitivity certainly declines with age, but not in any significant way until after age 70.[26] Similarly, speech recognition and speech clarity also decline with age, but not until much later in an individual's life.[27] Perhaps the only auditory or speech ability that does decline relatively early is the ability to locate sound. In one study, individuals ages 45-66 showed a significant decline in the ability to locate sound horizontally. Thus, of the five O*Net abilities related to hearing and speech – hearing sensitivity, auditory attention, sound localization, speech recognition, and speech clarity – only sound localization is assumed to show early decline. Table A4 in the Appendix provides a breakdown of whether each of the sensory abilities was assigned the status of declining with age or not.

Constructing the Index

To construct the Index, the project merges the results from the literature review onto data contained in *O*Net* on the importance (scaled between 1 and 5) of those 52 attributes across 923 unique occupations. The purpose of the Index is to give occupations an ordering reflecting both the number of abilities the occupation relies on that decline and on the importance of those abilities. The construction of the Index proceeds in five steps, laid out below for the hypothetical example of budget analysts:

26 Fozard and Gordon-Salant (2001), Gordon-Salant (2005).

27 For example, Fozard and Gordon-Salant (2001), Gordon-Salant (2005) find large declines only in individuals over age 80.

Description	Hypothetical example for “Budget Analysts”
Step 1: Identify abilities important to the occupation as abilities that receive an *O*Net* importance score of 3 or over.	For Budget Analysts, 12 of the 52 abilities recorded by O*Net have this importance level, including “Deductive Reasoning,” “Oral Comprehension,” and “Information Ordering.”
Step 2: Apply from Tables A1 to A4 the important abilities that decline early in a worker’s career	For Budget Analysts, 3 of the 12 important abilities decline this quickly.
Step 3: Determine the aggregate importance score for the abilities identified in Step 2 by summing the *O*Net* importance scores for those abilities.	For Budget Analysts, this score is the sum of the importance scores for the 3 important abilities identified in Step 2. Two had scores of 5 and one of 4, so the sum is 14.
Step 4: Identify the aggregate importance score for all abilities identified in Step 1 by summing the *O*Net* importance scores for those abilities.	For Budget Analysts, this score is the sum of the 12 importance scores identified in Step 1. These scores sum to 50.
Step 5: Calculate the Susceptibility Index as the ratio of the sum calculated in Step 3 and the sum calculated in Step 4.	For Budget Analysts, the Susceptibility Index is 14/50 or 28 percent.

Once the Index is constructed, each occupation is assigned its percentile among all the occupations considered by O*Net. Figure 1 shows the percentile position of 20 occupations in the HRS, and Table 1 provides some descriptive statistics comparing white- to blue-collar occupations.[28] Importantly, white-collar occupations are represented not only in the low range (as expected) but also in the high range of the Index. Indeed, as shown in Table 1, 19.2 percent of workers in white-collar occupations are above the 50th percentile of the Index; less than the 92.6 percent for blue-collar occupations, but still substantial. This fact confirms that blue-collar

28 We define an occupation as white collar if it falls under any of the following HRS occupational classifications: managerial/specialty operations, professional specialty operations/technology, sales, clerical/administrative, protective services, health services. An occupation is blue collar if it is one of the following: private household/cleaning/building services, farming/forestry/fishing, mechanics/repair, construction/extractor, precision production, machine operators, transportation operators, handlers, members of the armed forces, personal services, food preparation services.

occupations are likely harder to work at as individuals get older. However, Table 1 also reflects a main contention of this paper: not all occupations within the broad white- and blue-collar categories are created equally in terms of the abilities they use and those abilities rate of decline with age. Does this variance translate to earlier retirement amongst workers in these occupations? To answer that question, the paper next embeds the Index in a standard early retirement model.

A Model of Early Retirement

To incorporate the Index into a model of early retirement, this paper uses data from waves 1-11 of the HRS, collected between 1992 and 2012. In this draft of the paper, "early" retirement" is defined variously as: 1) retirement before age 63; 2) retirement before age 65; and retirement before age 67. In each of these specifications, retirement is defined as the first wave in which an individual claims to be "fully" retired. We choose each age for its importance in relation to Social Security. By looking at individuals who retire before 63, we allow everyone in the sample to work until and then retire during their first year of the Social Security eligibility. The later ages – 65 and 67 – represent old and future FRAs. Our definition of "early retirement" looks at individuals who come up short of both of these dates. The sample consists of all individuals working at the interview closest to their 58th birthday (the "age-58 interview") and who reach the age of early retirement by 2012.[29]

Table 2 separately provides descriptive statistics on the sample being used in the analysis for workers in occupations in the bottom 50 percent of the Index and those in the top 50 percent. Among other things, workers in occupations in the bottom 50 percent are better educated, earn

29 If an individual is not working at their age-58 interview, they are excluded from the analysis to maintain the distance between the time an individual is observed in an occupation and the various measures of early retirement.

more, and are less likely to be a minority than workers in the top. This result stems from the fact that white-collar occupations are more likely to be in the bottom 50 percent of the Susceptibility Index and white-collar workers are more educated. Table 2 illustrates the importance of controlling for individual-level effects in the early retirement model. Table 2 also shows very clearly that workers in the top 50 percent are more likely to retire before all three selected retirement ages.

Because the publicly available HRS data do not contain the detailed occupational codes needed to merge the Index onto individual workers, restricted Social Security Administration administrative occupation data is used to combine the 2010 version of the Occupational Information Network (O*NET) database with the HRS. This merge is conducted by creating an occupation code cross-walk between the 1980, 1998, 2002, and 2010 census codes (used in different waves of the HRS restricted data) and the 2010 Standard Occupational Codes (SOC, used in the O*NET). The end result of this merge is that each working individual, except for the 9 percent of workers for whom a match between O*Net and the HRS occupation was unsuccessful, has the Index assigned for their age-58 occupation.

Aside from the Index, our empirical model will also include controls for individual-level demographic and job characteristics that may alter the retirement date. These controls include a vector of demographic and other "initial" characteristics associated with the individual's age-58 job. The demographic variables include an individual's education (less than high school, high school graduate, some college), race, Hispanic origin, gender, and region. Variables related to the individual's employment status include self-employment, indicators for the presence of a DB or DC pension at a prior job. We also include controls for an individual's health, which has an obvious impact on their retirement date. To gauge a person's health, we create indicator variables for 13 health conditions that are asked in each wave of the HRS and add them up at the individual's age-58 or age-55 interview to create a health index taking on a value of 0 (best health) to 13 (worst health).[30]

To control for the possibility that certain aspects of a worker's life unrelated to their occupation change between age-58 (when their occupation is identified) and the early retirement date, the empirical approach will also control for certain "shocks." These shocks include changes in the health index, a layoff or business closing, or a spouse's illness or retirement. Controlling for these events, which may lead to early retirement and also may be correlated with occupation, ensures that the effect of the Index is limited to the effect of occupation on retirement and does not include changes workers in those occupations are more likely to experience relative to other workers.

Probit regressions were estimated for three measures of early retirement, taking the forms:

$$\varphi(Y_i) = \alpha_0 + \alpha_1 SI_{i,j} + \gamma X_i + \varepsilon_i \qquad (1)$$

where Y_i indicates one of the three measures of retirement timing being studied. The variable $SI_{i,j}$ is the Susceptibility Index in occupation *j* for the individual's job closest to age 58.

30 These 13 conditions include eight health conditions and five limitations to activity of daily living. The health conditions included are: 1) "high blood pressure with medication"; 2) "diabetes with insulin"; 3) "cancer of any kind, seeing doctor"; 4) "activity limiting lung disease"; 5) "heart condition, taking medication"; 6) "emotional/psychological problems"; 7) "stroke with problems afterward"; and 8) "arthritis with medication". The limitations to activities of daily living are: 1) "needs help bathing"; 2) "needs help getting dressed"; 3) "needs help eating"; 4) "needs help using a map"; and 5) "needs help walking". A similar index, albeit using a slightly different set of health indicators, was used by Dwyer and Mitchell (1999).

Thus, the coefficient of interest is α_1, which indicates the effect of the Susceptibility Index on early retirement. The vector of variables represented by X_i is meant to capture the controls described above (both the initial conditions and the shocks).

Results

The regression results presented in Tables 3a, 3b, and 3c are for early retirement prior to age 63, age 65, and age 67, respectively. Each table presents three specifications of the model: 1) without any controls; 2) with a blue-collar dummy and controls for demographic variables; and 3) with all other controls (remaining initial conditions and shocks).[31] Importantly, the Index is a significant predictor of earlier-than-planned retirement in most of the model's specifications, with the exception of the age 63 regressions. The results reported are marginal effects and so can be interpreted as the percentage-point increase on the probability of early retirement for a 1 percentile change in the Index. Looking at the specification that uses full controls, an increase of 10 percentiles in the Index increases the probability of retiring before age 63, 65, and 67 by 0.46, 0.66, and 0.83 percentage points, respectively. This means workers in occupations in the 90th percentile of the Index are 5.3 percentage points more likely to retire before age 65 than individuals in the 10th percentile, even controlling for demographic, health, and other individual characteristics. The fact that the effect of the Susceptibility Index is significant even conditional on health shocks is especially interesting; it implies that it is not just that workers in certain occupation experience sharper health declines, but rather that even conditional on changes in health their occupation is associated with earlier retirement.

31 For space reasons, the coefficients on demographic variables are not shown, but are available upon request. In general, the coefficients were consistent with expectations with less than a high school education and being male associated with early retirement and having a college education associated with working past the retirement dates.

The last two specifications also include the more standard control of whether the individual's occupation was white- or blue-collar. In the second and third specifications, blue-collar is not statistically significant for any retirement age, suggesting that it has no significant explanatory power beyond what is captured by the Index—i.e., the Index captures at least the information contained in this, more standard, variable. But does the Index provide information beyond this measure? To examine this issue, we also ran a version of the early retirement model restricted to just white-collar workers. The results of this regression are contained in Table 4. It shows that even within the group of white collar workers, the Index is a significant predictor of early retirement – each 10 percentile increase in the Susceptibility Index is associated with a 1.2 percentage point increase in the probability of retiring early.

In all of the regressions, the other controls have intuitive interpretations. Individuals who are in jobs that provide health insurance and pensions at age-58 are less likely to retire early. People who are in worse health at their age-58 job are significantly more likely to retire before the various benchmarks than are healthier workers. Regarding the shock variables, workers whose health deteriorates, who lose their job through a layoff or business closing, or whose spouse retires prior to the retirement age being studied are also more likely to retire early. These intuitive results confirm that many individual characteristics beyond occupation can lead to early retirement. However, the results suggest that even when controlling for the various reasons someone may be forced to retire earlier than the selected Social Security benchmarks, their occupation still matters considerably.

Once estimates of the early retirement model are obtained, a useful way to put them in context is to examine how different the share of individuals retiring early would be if certain groups of workers had different Index values. This exercise can be accomplished by plugging in the estimates from the model, but using a "counterfactual" value of the index:

$$\widehat{pr}_i = \widehat{\alpha}_0 + \widehat{\alpha}_1 SI'_{i,j} + \hat{\gamma} X_i + \varepsilon_i \qquad (2)$$

where $SI'_{i,j}$ is equal to an alternative value of the Susceptibility Index, $\widehat{\alpha}_0$, $\widehat{\alpha}_1$, and $\check{\gamma}$ are the estimates obtained in Tables 3a to 3c, and X_i are the individuals demographic characteristics. Table 5 show the results of one such set of counterfactuals, where for each group of workers the Index is changed from its actual value to the 25th percentile. The first column shows the actual predicted share retiring early for each group. Importantly, as we move from the top of the table (those in occupations not very susceptible to ability declines) to the bottom (those in susceptible occupations), the actual predicted share increases for two reasons: 1) the Susceptibility Index is increasing; and 2) the individuals in the group are more likely to retire early for the other reasons included in the regressions. The second column eliminates the first source of variation by assuming that everyone has a Susceptibility Index in the 25th percentile, leaving only the differences in terms of individual characteristics or the shocks.

As an example of the effect of being in an occupation with a high Susceptibility Index, consider the row of Table 5 related to those in an occupation with an Index in the 80th to 90th percentile. If these individuals instead had an Index in the 25th percentile, just 79.7 percent would retire before age 67 instead of the actual number of 84.3 percent. This represents a reduction of 4.6 percentage points over the real world. These counterfactuals illustrate the importance of occupation in determining retirement age. Importantly, occupations in the 80th to 90th percentile include several white-collar occupations, such as police detectives and airline pilots. In a model that included only the standard controls of white- and blue-collar, these individuals would be assumed to have the same retirement pattern as other white-collar workers, an assumption that turns out to be false. This observation carries with it one of the primary lessons of this paper – that some white-collar workers may be unable to respond to increases in the FRA by working longer, because their occupations require abilities that show early decline. Indeed, Table 5 highlights exactly this point.

Conclusion

Standard models of early retirement divide individuals into white- and blue-collar workers. The logic is that workers in blue-collar occupations are typically involved in physical work that can't be done once they're older. While this assumption is partially true, this paper has shown through construction of a Susceptibility Index that a variety of white-collar occupations are also susceptible to early declines in the ability to work and that a variety of blue-collar occupations are not. Indeed, once the Susceptibility Index is included in early retirement regressions, the commonly used variable of blue- or white-collar is not statistically significant. This fact indicates that it not so much whether a job is blue- or white-collar, but instead whether or not the job uses abilities that decline during a worker's life. It just so happens that blue-collar jobs, on average, are more likely to fall into this category.

The results show that those workers in occupations in the 90th percentile of the Index are 5.3 percentage points more likely than those in the 10th percentile to retire before age 65 and are

6.6 percentage points more likely to retire before 67. This result persists whether or not controls are included for demographics and health.

These results have important implications for policymakers. First, workers in blue-collar occupations are indeed more likely to retire early than other workers. The skills their jobs require do decline more rapidly, on average, than the skills white-collar workers use. Policymakers should consider the ramifications of changes like FRA increases on the finances of older blue-collar workers – these workers may not be able to respond by working longer. Yet, this first lesson was largely known already. Just as importantly, policymakers must also consider the ability of certain white-collar workers to work longer in occupations such as police detective and licensed practicing nurse, both of which rely on many of the dynamic cognitive skills known to decline early. The analysis in the paper suggests that these workers may have difficulty working longer in response to policy changes, even though they are often grouped with people who can. This paper shows that a careful understanding of the abilities used by each occupation and their tendency to decline (or not) with age can put a finer point on any analysis of early retirement.

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Table 1 *Variation in Susceptibility Index Percentiles by Occupation Type*

	White Collar	Blue Collar
Mean Susceptibility Index Percentile	32.2%	74.9%
Share below 50%	80.5%	5.1%
Share above 50%	19.2%	92.6%

Source: Authors' calculations from the *Health and Retirement Study* 1992-2012 waves

Table 2 *Descriptive Statistics by Susceptibility Index Percentile*

Variable	Bottom 50%	Top 50%
Retired at 63	47.5%	50.1%
Retired at 65	63.0%	67.1%
Retired at 67	78.4%	82.3%
Blue Collar	4.3%	77.4%
Female	60.5%	40.1%
Male	39.5%	59.9%
Less than high school	7.4%	33.8%
High school	34.3%	44.0%
College	58.2%	22.2%
Black	10.3%	21.1%
White	87.4%	74.9%
Hispanic	4.7%	11.0%
Married	77.4%	75.7%
Health Index	0.92	1.02
Health insurance	68.7%	63.4%
Current earnings	49,828.6	34,686.6
Number of Observations	2,605	2,708

Source: Authors' calculations from the *Health and Retirement Study* 1992-2012 waves

Table 3A *Probit Regression Estimating Retirement by Age 63*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
Job-Related Initial Conditions			
Susceptibility Index Percentile (in 10s)	0.0065***	0.0069*	0.0046
	(0.000)	(0.000)	(0.000)
Blue Collar	--	-0.00006	-0.00002
	--	(0.021)	(0.024)
Self employed	--	--	-0.04987 †
	--	--	(0.028)
Employer covered health insurance	--	--	-0.12281***
	--	--	(0.022)
Retiree health insurance	--	--	0.24590***
	--	--	(0.019)
Previous DB	--	--	0.02785
	--	--	(0.021)
DB	--	--	-0.10824**
	--	--	(0.032)
DC	--	--	-0.01134
	--	--	(0.018)
Job tenure	--	--	-0.00125
	--	--	(0.001)
Job tenure x DB	--	--	0.00759***
	--	--	(0.001)
Wealth-Related Initial Conditions			
Current earnings	--	--	-0.00031
	--	--	(0.000)
Pension income	--	--	0.00175
	--	--	(0.001)
Financial wealth	--	--	-0.00002
	--	--	(0.000)
Health-Related Initial Conditions			

Table 3A *Probit Regression Estimating Retirement by Age 63*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar	Susceptibility Index, Blue Collar, + All
Health index	--	--	0.03396***
	--	--	(0.008)
Family-Related Initial Conditions			
Married	--	--	0.03095
	--	--	(0.026)
Presence of resident child	--	--	0.01141
	--	--	(0.021)
Spouse's current earnings	--	--	0.00142***
	--	--	(0.000)
Spouse covers health insurance	--	--	0.01123
	--	--	(0.026)
Spouse works	--	--	0.05173 †
	--	--	(0.027)
Spouse is in fair or poor health	--	--	-0.02742
	--	--	(0.025)
Job-Related Shocks			
Different employer	--	--	-0.08230*
	--	--	(0.034)
Involuntary job loss	--	--	0.24729***
	--	--	(0.026)
New job after involuntary job loss	--	--	-0.30081***
	--	--	(0.045)
Partially retires	--	--	-0.02537
	--	--	(0.022)
Wealth-Related Shocks			
Financial gain of at least 40%	--	--	-0.05146**
	--	--	(0.019)
Financial loss of at least 40%	--	--	-0.01451
	--	--	(0.022)
Health-Related Shocks			
Health index difference	--	--	0.05229***
	--	--	(0.010)
Retiree health insurance x health index difference	--	--	-0.05116**
	--	--	(0.015)
Family-Related Shocks			
Marital status change	--	--	-0.08265***

Table 3A *Probit Regression Estimating Retirement by Age 63*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar	Susceptibility Index, Blue Collar, + All
	--	--	(0.023)
Resident child leaves home	--	--	-0.02659
	--	--	(0.027)
Spouse retires	--	--	-0.00013
	--	--	(0.023)
Spouse continues work	--	--	-0.16762***
	--	--	(0.025)
Demographic controls?	No	Yes	Yes
Number of Observations	5,464	5,463	4,594

Source: Authors' estimates from the Health and Retirement Study 1992-2012 waves

Table 3B *Probit Regression Estimating Retirement by Age 65*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
Job-Related Initial Conditions			
Susceptibility Index Percentile (in 10s)	0.0089***	0.0095**	0.0066 †
	(0.000)	(0.000)	(0.000)
Blue Collar	--	0.00713	0.01415
	--	(0.020)	(0.022)
Self employed	--	--	-0.01967
	--	--	(0.026)
Employer covered health insurance	--	--	-0.09926***
	--	--	(0.020)
Retiree health insurance	--	--	0.26358***
	--	--	(0.018)
Previous DB	--	--	0.04375*
	--	--	(0.020)
DB	--	--	-0.09746**
	--	--	(0.030)
DC	--	--	0.01465
	--	--	(0.017)
Job tenure	--	--	-0.00140
	--	--	(0.001)
Job tenure x DB	--	--	0.00724***
	--	--	(0.001)
Wealth-Related Initial Conditions			
Current earnings	--	--	-0.00013
	--	--	(0.000)
Pension income	--	--	0.00008
	--	--	(0.001)
Financial wealth	--	--	-0.00005***
	--	--	(0.000)
Health-Related Initial Conditions			
Health index	--	--	0.02266**

Table 3B *Probit Regression Estimating Retirement by Age 65*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
	--	--	(0.007)
Family-Related Initial Conditions			
Married	--	--	0.05521*
	--	--	(0.025)
Presence of resident child	--	--	0.01419
	--	--	(0.021)
Spouse's current earnings	--	--	0.00092**
	--	--	(0.000)
Spouse covers health insurance	--	--	0.02975
	--	--	(0.023)
Spouse works	--	--	0.02733
	--	--	(0.025)
Spouse is in fair or poor health	--	--	-0.01103
	--	--	(0.023)
Job-Related Shocks			
Different employer	--	--	-0.07363*
	--	--	(0.030)
Involuntary job loss	--	--	0.19107***
	--	--	(0.020)
New job after involuntary job loss	--	--	-0.26479***
	--	--	(0.057)
Partially retires	--	--	-0.07568***
	--	--	(0.019)
Wealth-Related Shocks			
Financial gain of at least 40%	--	--	-0.04932**
	--	--	(0.018)
Financial loss of at least 40%	--	--	0.03998 †
	--	--	(0.020)
Health-Related Shocks			
Health index difference	--	--	0.02644**
	--	--	(0.008)
Retiree health insurance x health index difference	--	--	-0.03918**
	--	--	(0.014)
Family-Related Shocks			
Marital status change	--	--	-0.08648***
	--	--	(0.020)

Table 3B *Probit Regression Estimating Retirement by Age 65*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
Resident child leaves home	--	--	-0.06990**
	--	--	(0.027)
Spouse retires	--	--	-0.02466
	--	--	(0.020)
Spouse continues work	--	--	-0.13774***
	--	--	(0.024)
Demographic controls?	No	Yes	Yes
Number of Observations	5,464	5,463	4,725

Source: Authors' estimates from the *Health and Retirement Study* 1992-2012 waves

Table 3C *Probit Regression Estimating Retirement by Age 67*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
Job-Related Initial Conditions			
Susceptibility Index Percentile (in 10s)	0.0085***	0.0092**	0.0083**
	(0.000)	(0.000)	(0.000)
Blue Collar	--	0.00355	-0.00337
	--	(0.017)	(0.017)
Self employed	--	--	-0.02535
	--	--	(0.020)
Employer covered health insurance	--	--	-0.04336**
	--	--	(0.014)
Retiree health insurance	--	--	0.14603***
	--	--	(0.014)
Previous DB	--	--	0.03181*
	--	--	(0.015)
DB	--	--	-0.03456
	--	--	(0.023)
DC	--	--	0.02378 †
	--	--	(0.012)
Job tenure	--	--	-0.00074
	--	--	(0.001)
Job tenure x DB	--	--	0.00357**
	--	--	(0.001)
Wealth-Related Initial Conditions			
Current earnings	--	--	-0.00014
	--	--	(0.000)
Pension income	--	--	-0.00046
	--	--	(0.000)
Financial wealth	--	--	-0.00003*
	--	--	(0.000)
Health-Related Initial Conditions			
Health index	--	--	0.00634
	--	--	(0.005)
Family-Related Initial Conditions			
Married	--	--	0.02449

Table 3C *Probit Regression Estimating Retirement by Age 67*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
	--	--	(0.020)
Presence of resident child	--	--	0.02014
	--	--	(0.016)
Spouse's current earnings	--	--	0.00030
	--	--	(0.000)
Spouse covers health insurance	--	--	0.00923
	--	--	(0.017)
Spouse works	--	--	0.03026 †
	--	--	(0.018)
Spouse is in fair or poor health	--	--	-0.00128
	--	--	(0.018)
Job-Related Shocks			
Different employer	--	--	-0.05053*
	--	--	(0.022)
Involuntary job loss	--	--	0.11602***
	--	--	(0.013)
New job after involuntary job loss	--	--	-0.23664***
	--	--	(0.058)
Partially retires	--	--	-0.10804***
	--	--	(0.015)
Wealth-Related Shocks			
Financial gain of at least 40%	--	--	-0.02311 †
	--	--	(0.013)
Financial loss of at least 40%	--	--	0.02907 †
	--	--	(0.016)
Health-Related Shocks			
Health index difference	--	--	0.00631
	--	--	(0.005)
Retiree health insurance x health index difference	--	--	-0.02488*
	--	--	(0.010)
Family-Related Shocks			
Marital status change	--	--	-0.06033***
	--	--	(0.015)
Resident child leaves home	--	--	-0.04702*
	--	--	(0.022)
Spouse retires	--	--	-0.00817

Table 3C *Probit Regression Estimating Retirement by Age 67*

Variables	Susceptibility Index Only	Susceptibility Index, Blue Collar +Demographics	Susceptibility Index, Blue Collar, + All Controls
	--	--	(0.014)
Spouse continues work	--	--	-0.07735***
	--	--	(0.018)
Demographic controls?	No	Yes	Yes
Number of Observations	5,464	5,463	4,795

Source: Authors' estimates from the *Health and Retirement Study* 1992-2012 waves

Table 4 *Probit Regression Estimating Retiring by Age 65, White-Collar Only*

Variables	Susceptibility Index Only	Susceptibility Index + Demographics	Susceptibility Index + All Controls
Job-Related Initial Conditions			
Susceptibility Index Percentile (in 10s)	0.0110**	0.0113**	0.0120**
	(0.000)	(0.000)	(0.000)
Self employed	--	--	-0.03540
	--	--	(0.036)
Employer covered health insurance	--	--	-0.11635***
	--	--	(0.027)
Retiree health insurance	--	--	0.27125***
	--	--	(0.024)
Previous DB	--	--	0.01073
	--	--	(0.026)
DB	--	--	-0.07113 †
	--	--	(0.038)
DC	--	--	0.01209
	--	--	(0.022)
Job tenure	--	--	-0.00043
	--	--	(0.001)
Job tenure x DB	--	--	0.00529**
	--	--	(0.002)
Wealth-Related Initial Conditions			
Current earnings	--	--	-0.00028
	--	--	(0.000)
Pension income	--	--	-0.00001
	--	--	(0.001)
Financial wealth	--	--	-0.00005**
	--	--	(0.000)
Health-Related Initial Conditions			
Health index	--	--	0.02624**
	--	--	(0.010)
Family-Related Initial Conditions			
Married	--	--	0.09059**
	--	--	(0.034)
Presence of resident child	--	--	0.02142
	--	--	(0.030)
Spouse's current earnings	--	--	0.00099**

Table 4 *Probit Regression Estimating Retiring by Age 65, White-Collar Only*

Variables	Susceptibility Index Only	Susceptibility Index + Demographics	Susceptibility Index + All Controls
	--	--	(0.000)
Spouse covers health insurance	--	--	0.00405
	--	--	(0.031)
Spouse works	--	--	0.01635
	--	--	(0.034)
Spouse is in fair or poor health	--	--	-0.05061
	--	--	(0.034)
Job-Related Shocks			
Different employer	--	--	-0.06595 †
	--	--	(0.039)
Involuntary job loss	--	--	0.20679***
	--	--	(0.027)
New job after involuntary job loss	--	--	-0.28466***
	--	--	(0.072)
Partially retires	--	--	-0.04882*
	--	--	(0.025)
Wealth-Related Shocks			
Financial gain of at least 40%	--	--	-0.09281***
	--	--	(0.023)
Financial loss of at least 40%	--	--	0.01896
	--	--	(0.030)
Health-Related Shocks			
Health index difference	--	--	0.01988
	--	--	(0.012)
Retiree health insurance x health index difference	--	--	-0.04934**
	--	--	(0.019)
Family-Related Shocks			
Marital status change	--	--	-0.11161***
	--	--	(0.028)
Resident child leaves home	--	--	-0.06840 †
	--	--	(0.038)
Spouse retires	--	--	0.02838
	--	--	(0.025)
Spouse continues work	--	--	-0.16146***
	--	--	(0.031)
Demographic controls?	No	Yes	Yes

Table 4 *Probit Regression Estimating Retiring by Age 65, White-Collar Only*

Variables	Susceptibility Index Only	Susceptibility Index + Demographics	Susceptibility Index + All Controls
Number of Observations	3,195	3,194	2,762

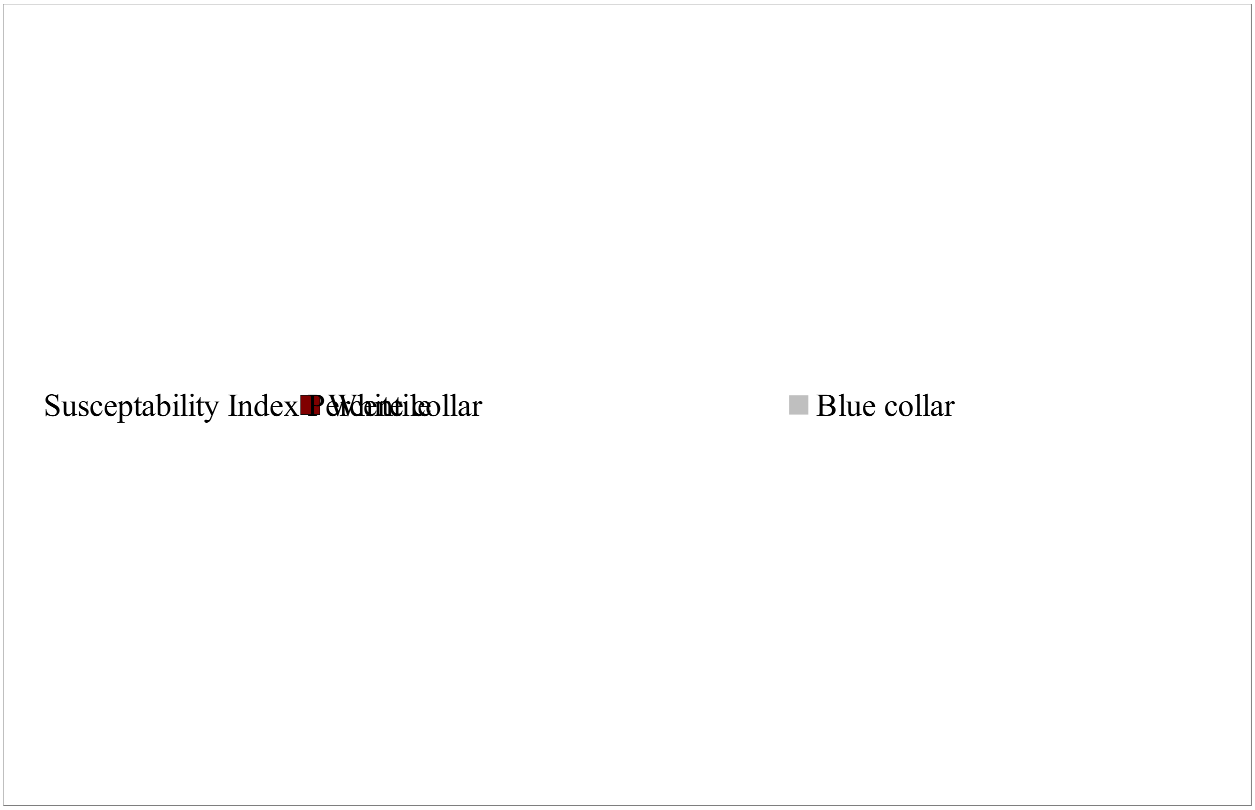
Source: Authors' estimates from the *Health and Retirement Study* 1992-2012 waves

Table 5 *Counterfactual Predictions of Retiring before 67 with 25th Percentile Susceptibility Index*

Susceptibility Index Percentiles	Original Probability	Adjusted Probability	Percent Change
1-10	76.7%	78.4%	2.2%
11-20	77.8%	78.5%	1.0%
21-30	80.2%	80.1%	-0.1%
31-40	78.8%	77.6%	-1.4%
41-50	79.6%	77.9%	-2.1%
51-60	80.5%	77.9%	-3.2%
61-70	81.1%	77.7%	-4.1%
71-80	83.8%	80.0%	-4.6%
81-90	84.3%	79.7%	-5.4%
91-100	85.6%	80.4%	-6.1%

Source: Authors' estimates from the *Health and Retirement Study* 1992-2012 waves

Figure 1. *Sampling of Occupations and Their Susceptibility Index Percentiles*



Source: Authors' review of literature and authors calculation using the Susceptibility Index (see text and references).