Chapter 2
Workplace Aging and Jobs in the Twenty-First Century

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2.1 Introduction

The global workforce is aging and life expectancies are rising, impacting the relationships between aging, work, and retirement. Consider that a person born in 1950 and retiring at age 62 could expect to live only a few years post-retirement. People born in 1990, however, can expect to live at least a decade into retirement; people born in the current century can expect to live upwards of two decades into retirement given the same retirement age. As a consequence, people may choose to work longer to finance their longer retirements and because of the health benefits associated with work for some workers (e.g., self-efficacy, identity, and subjective well-being; Fasbender, Wang, Voltmer, & Deller, 2015). Indeed, society has an interest in engaging workers longer given that disengaged and unproductive citizens can impose a strain on resources (Czaja, Sharit, Charness, & Schmidt, 2015).

Moreover, expanded life expectancy will impact worker perceptions of how much time they have left to contribute in the workforce. For some workers, work provides meaning and a sense of efficacy and identity that they want to preserve into their later years. As such, the motivation to remain engaged in work may be impacted for older workers regardless of their financial situation (Fasbender et al., 2015). A recent study by the American Association of Retired Persons (AARP, 2014), for instance, sug-

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gested that 72% of workers plan to work during retirement. Of these, almost 30% reported continuing work for enjoyment, 5% to start a new career, and just over 10% to work for themselves. About a quarter (23%) indicated that income would drive the decision to continue working. As such, enjoyment and the possibility to explore new opportunities in the realm of work are the main drivers for continuing to work in retirement. Of course, this pattern may change as the numbers of retirees increase and federal assistance for retirement diminishes, but these data suggest that many people are not ready to give up work in their third age.

Market demands are also affecting the extent to which older workers are desired by organizations. The advantage of older workers is their institutional knowledge and expertise, which organizations need to remain productive. Indeed, the population of younger workers with the same skills and education is neither big enough nor growing fast enough to replace retiring workers (Paullin, 2014). Moreover, even though they have the reputation of being expensive (e.g., a senior employee's salary versus an entry-level salary), retaining and retraining older workers who have institutional knowledge and expertise may in fact be cheaper than hiring and training younger workers. There is evidence, for example, that investment in training older workers may pay off given that older workers are more likely than younger workers to stay at an organization afer training, even considering pending retirements. Consequently, many organizations have implemented programs to retain their mature workforce (Economist Intelligence Unit, 2011). In sum, even in the face of economic decline and job shortages, there is evidence that older workers will remain an important and large part of the workforce (Beier, 2015; Paullin, 2014).

The older worker's desire for a longer work lifespan and the organization's need for older worker talents seem like a fortuitous coincidence and a relatively straightforward arrangement. But the arrangement is complicated by the dynamic nature of both the worker and the work. The purpose of this chapter is to explore the characteristics of mature workers in the context of work in the twenty-first century. The discussion is framed in theories that highlight the importance of job design for impacting worker motivation and performance (Parker, 2014) with the underlying assumption that the better a person fits within the demands of his or her job, the better his or her performance, job satisfaction, and health (among myriad positive outcomes; Kristof-Brown, Zimmerman, & Johnson, 2005). Accordingly, we describe lifespan changes in job-relevant attributes (motivation and abilities). Although we are neither economists nor fortune tellers, we present the latest thinking on how jobs—and the labor market—will change in the coming decades and discuss how these changes might affect mature workers.

2.2 Work Design

Work design is defined as "the content and organization of one's work tasks, activities, relationships, and responsibilities…" (Parker, 2014, p. 662). Work design research examines the influence of work features on attitudinal, behavioral,

cognitive, well-being, and organizational outcomes (Morgeson & Humphrey, 2008). Previous meta-analytic research shows that work design can have an impact on individual and organizational outcomes (Fried & Ferris, 1987; Humphrey, Nahrgang, & Morgeson, 2007). The significant effects of work design on outcomes suggest that organizations may be able to influence the experience of workers by strategically designing job tasks, activities, and responsibilities. In this section, we briefly review work design theory; for a more comprehensive review we refer readers to Grant, Fried, and Juillerat (2011), Parker (2014), and to Parker, Morgeson, and Johns (2017).

2.2.1 Work Design Models

The Job Characteristics Model (JCM) is one of the most popular work design models (Hackman & Oldham, 1976). The JCM recognizes a handful of job characteristics that serve to increase the potential of a job to motivate workers to perform successfully and that positively affect worker attitudes. The five core job characteristics are: *task and skill variety* (the ability to use a variety of skills or activities to accomplish job tasks), *autonomy* (the ability to choose how, when, and where work gets done), *feedback* (the ability to gain information about job performance or effectiveness), *task significance* (perceiving the impact work has on other people in or outside the organization as important), and *task identity* (the ability to see work completed from start to finish). These core job characteristics are posited to impact motivation, performance, and satisfaction by triggering critical psychological states—experiencing meaningfulness, feeling responsible for outcomes, and understanding the results of one's efforts. A meta-analysis by Humphrey et al. (2007) found that these five job attributes were related to job satisfaction, growth satisfaction, and internal work motivation. Although the JCM model has received empirical support, researchers have recently called for a broader view of work design, beyond motivational job tasks (Morgeson & Humphrey, 2006; Parker, Wall, & Cordery, 2001).

More recently, Parker et al. (2001) proposed an elaborated model of work design, which involved antecedents of work design including internal organizational factors (e.g., management style), external organizational factors (e.g., technology availability), and individual factors (e.g., proactive personality). Further, their expanded set of work characteristics included individual-level (e.g., opportunity for skill acquisition) and group-level (e.g., team autonomy) features of work and their interactions (e.g., interdependence and autonomy). In a similar vein, Morgeson and Humphrey (2006) identified a broad set of job characteristics. They proposed three categories to describe the structure of work: (1) motivational work characteristics (i.e., work attributes that make work more motivating; autonomy, task variety, task significance, task identity, feedback from job), (2) social work characteristics (i.e., the social aspects of work; social support, interdependence, feedback from others, interactions outside the organization), and (3) contextual characteristics (i.e., the

physical and environmental work conditions; ergonomics, physical demands, work conditions, equipment use). These expanded work characteristics highlight the complicated and layered aspects of work that workers experience.

Grant and Parker (2009) emphasized two viewpoints of work design that are relevant for the changing nature of work. First, due to the uncertainty of the labor market, proactive perspectives highlight the initiative needed from workers to act in ways that address constant change in the workplace. Second, due to the interdependent nature of work (work roles as part of a larger social system), relational perspectives highlight the social systems and social relationships that exist in the workplace (e.g., teams, interdependent tasks, collaborations), which have been neglected in work design research (Oldham & Hackman, 2010). These perspectives highlight the strengths older workers bring to today's workforce, such as the ability to mentor others and to address new problems through use of prior experience and knowledge.

2.2.2 Age and Work Design

Work design can be used strategically to promote other outcomes, such as mental and physical health, learning and development, and control and flexibility (Parker, 2014). These outcomes can be especially relevant to support aging in the workplace through work design (Truxillo, Cadiz, & Hammer, 2015; Zacher, 2015).

Health Job characteristics may put workers at risk for mental and physical health issues, which can be particularly problematic for older workers. For example, routine and repetitive jobs may lead to musculoskeletal issues (Griffiths, 1999); high-stress jobs can cause anxiety, exhaustion, and depression (Gershon, Lin, & Li, 2002); and overtime work (more than 60 h a week), particularly in physically demanding jobs, can lead to myriad health problems (Allen, Woock, Barrington, & Bunn, 2008). Work design models can offer approaches that buffer workers' negative reactions to stress.

The *job demands-control model* assesses the effects of job demands and job decisions on stress and strain, with strain occurring when job demands are high and job control is low (Karasek, 1979). The implication of the job demands-control model is that work design is relevant to health, and that one way to address such effects is for workers to have a say in how they approach their work. Similarly, the *job demands resources model* is a general model that predicts burnout, exhaustion, and disengagement when demands of the job (e.g., time pressure, shift work) exceed those of resources (e.g., supervisor support, rewards; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). The job demands resources model is proposed to be a more generalized model than the job demands-control model because it takes a broader view of what can serve as a resource. These models reveal that resources can buffer the negative experiences of work, such as allowing for more decision-making or promoting social support.

Training and Development There are stereotypes that older adults may not be interested in continued development and training opportunities (Chiu, Chan, Snape, & Redman, 2001). However, older adults are indeed interested in development and training activities, especially when training will help them achieve their work goals (Mitzner et al., 2010). Lifespan development perspectives highlight the goal selection process among older adults. For example, the *selection, optimization, compensation model* is a theory of successful aging that focuses on the process of goal selection and the adaptive approaches used to optimally make use of available resources or compensate for unavailable resources (Baltes & Baltes, 1990). Selection, optimization, and compensation theory highlights the resources older adults may use as they pursue work relevant goals. In addition, socioemotional selectivity theory is a lifespan development theory that can be used to understand how work goals may be chosen (Carstensen, Isaacowitz, & Charles, 1999). Socioemotional selectivity theory predicts that older adults are more present-oriented than younger adults and perceive positive experiences and emotional connections as being more important because they experience time as limited. By contrast, younger adults are thought to be more future-oriented, and view achievement goals as a higher priority because they perceive time as open. Older adults may therefore be more motivated toward achieving workplace goals that emphasize relationship building and applying their expertise (e.g., mentoring opportunities, leadership positions) over achievement (e.g., promotions). For example, Zaniboni, Truxillo, and Fraccaroli (2013) studied two job characteristics (task and skill variety) and their differential effects on burnout and turnover intentions for older and younger workers. Framed under socioemotional selectivity theory, they found that younger workers experienced less burnout and turnover intentions with more task variety (opportunity to work on different tasks) than older workers. By contrast, older workers reported lower turnover intentions than younger adults with more opportunities for skill variety (opportunity to make use of knowledge and skills to complete job tasks).

Flexibility Changes in the workplace may allow for more flexibility about where work gets done, which may benefit workers across all ages. The option of flexibility in the workplace is partly due to changes in technology (e.g., tools available to keep teams connected remotely) and a more global workforce, with more team members spread across the physical space. Flexible work arrangements, such as telecommuting, may be beneficial to workers' stress and health (Halpern, 2005) and can be particularly advantageous for older workers who want to continue working (Ulrich & Brott, 2005).

2.2.3 Summary

Work design is important in the context of the aging workforce because features of work can impact older workers' ability to remain engaged and productive in the labor market. There are a few key elements of work design that organizations can consider when designing for older workers. First, work design should take

advantage of the acquired knowledge, skills, and abilities that are possessed by older workers. Second, work design should emphasize flexible work arrangements. Lastly, work design should consider the opportunities for training and development provided to older workers, especially given that workplace demands will continue to change and require skill updating.

2.3 Moving Targets

The above discussion highlights the importance of job characteristics and the context in which work takes place on worker attitudes, motivation, and performance. However, one important consideration in understanding the fit between the worker and the work is that both the individual and the job are constantly changing in ways that complicate the examination of person-environment fit. Here, we describe these two moving targets: age-related changes in the worker and changes in jobs associated with market demands and the proliferation of technology in industrialized countries.

2.3.1 Person-Related Traits: Moving Targets

It is helpful to define what we mean by "older worker." There is—after all—incredible variability in aging such that one 50-year old might have the cognitive and motivational profile of a 30-year old and another might resemble the cognitive and motivational profile of a 75-year old. As such, there is actually no precise age at which a worker becomes an older worker. Rather, we describe normative changes in abilities and motivation recognizing that people's talents, motivations, and abilities will change over the lifespan in incredibly idiosyncratic ways (Beier, Bradshaw, Torres, Shaw, & Kim, 2019).

Age-Related Ability Changes Normative changes in cognitive abilities are relatively well understood. That is, *fluid abilities* are most associated with solving novel problems, working memory abilities, and cognitive processing speed and are expected to decrease throughout the lifespan starting in early adulthood or late adolescence (in the 20s and 30s). By contrast, *crystallized abilities* associated with expertise and education are likely to remain stable or even increase with age (Salthouse, 2010). The decline in fluid abilities and the relative stability in crystallized abilities thus point to an overall net loss in abilities with age.

The perception of an overall net loss in cognitive abilities is somewhat misleading, however, because researchers are not well equipped to measure the idiosyncratic ways in which crystallized abilities develop through adulthood. That is, if consideration of crystallized abilities is broadened to include the knowledge that one acquires throughout the lifespan, then older adults show continuous growth in intellectual abilities rather than decline (Ackerman, 2000). Thus, limitations in how crystallized

abilities are measured mask the continuous development of knowledge throughout adulthood (Beier, Young, & Villado, 2018). Fluid and crystallized abilities are also theorized to work in tandem throughout the lifespan. In particular, investment theories suggest that the intellectual currency of youth (the ability to reason through novel problems, memorize information, and respond quickly—i.e., fluid abilities) is invested in the development of knowledge over the lifespan (i.e., crystallized abilities). This acquired knowledge supports the endeavors of adult life (Ackerman, 1996; Cattell, 1987).

Even though knowledge is the currency of adult intellect (Ackerman, 2000), most organizational scientists have focused on measures of general fluid abilities and measures of general crystallized abilities (e.g., vocabulary, general knowledge) and/or broad general mental ability measures (composed of items spanning both fluid and crystallized domains) for research and selection purposes. This position is unfortunate because general ability measures do not give older workers credit for what they know—the knowledge that makes them successful workers—and renders confusing results when examining the relationship between age and job performance. For example, research has consistently shown a null relationship between age and job performance (Ng & Feldman, 2008; Sturman, 2003). This finding is somewhat perplexing given that cognitive ability accounts for more variance in job performance than any other variable (i.e., 25% of the variance in job performance is accounted for by cognitive abilities; Schmidt & Hunter, 1998) and given that overall cognitive abilities are expected to show a net decline with age. Indeed, if abilities do decline with age, and abilities account for substantial variance in job performance, then age should be negatively correlated with job performance.

Job Complexity in the Context of Changing Abilities One reason that the relationship between age and job performance is not straightforward is because job complexity is not well understood or measured. Most studies include a relatively coarse assessment of complexity, such as the agreement between two raters who "classified each sample occupation into high and low job complexity according to the general intelligence, verbal ability, and numerical ability required to perform the job" (Ng & Feldman, 2008, p. 400). Unfortunately, this approach does not consider ability-related job demands in the context of changes in abilities over the lifespan. If job complexity were operationalized with consideration of the extent to which job tasks tapped fluid and crystallized abilities, then one would expect that the relationship between age and job performance would be positive for those jobs in which most tasks were associated with crystallized and knowledge abilities, and the relationship to be negative for those jobs in which most tasks are associated with fluid abilities (Warr, 1994).

Our research program has attempted to test the feasibility of examining the fluid and crystallized ability demands of jobs. In one study, we used the Occupational Information Network (O∗NET; Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999) to identify the different ability demands of jobs relative to fluid and crystallized abilities (Beier & Beal, 2010). Among other information, the O∗NET provides importance ratings for 120 knowledge, skills, and abilities for over 800 jobs. These ratings are provided by job analysts, job incumbents, and occupa-

Table 2.1 Importance ratings for a sample of knowledge, skills, and abilities for the job of industrial and organizational psychologist from the Occupational Information Network (O*NET)

Importance rating	Knowledge	Knowledge description
96	Psychology	Knowledge of human behavior and performance; individual differences in ability, personality, and interests; learning and motivation; psychological research methods; and the assessment and treatment of behavioral and affective disorders
95	Personnel and human resources	Knowledge of principles and procedures for personnel recruitment, selection, training, compensation and benefits, labor relations and negotiation, and personnel information systems
89	English language	Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar
	Skills	Skill description
96	Critical thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems
92	Active listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times
89	Speaking	Talking to others to convey information effectively
	Ability	Ability description
75	Oral comprehension	The ability to listen to and understand information and ideas presented through spoken words and sentences
75	Written comprehension	The ability to read and understand information and ideas presented in writing
75	Oral expression	The ability to communicate information and ideas in speaking so others will understand

Note. Taken from https://www.onetonline.org/

tional experts (see https://www.onetonline.org/ for additional information). An example of the top three knowledge, skills, and ability factors for the job of Industrial and Organizational Psychologist is shown in Table 2.1.

We subjected the knowledge, skills, and ability ratings in the O∗NET to a confirmatory factor analysis based on independent ratings of whether the O∗NET knowledge, skill, or ability best represented fluid ability, crystallized ability, or some other ability (e.g., perceptual, physical). Two factors—one with abilities most related to fluid ability and one with abilities most related to crystallized ability—emerged in the confirmatory factor analysis (although the fit was not ideal; Beier & Beal, 2010). Interpretation of the factors was difficult, however, because the fluid and crystallized factors were highly correlated (over .90), meaning that jobs that were relatively demanding in terms of one ability were also demanding in terms of the other. To further examine this effect, we created a scatterplot with the extent to which job tasks rely on crystallized abilities on the *x*-axis and the extent to which job tasks rely on fluid abilities on the *y*-axis (both in standardized units; see Fig. 2.1).

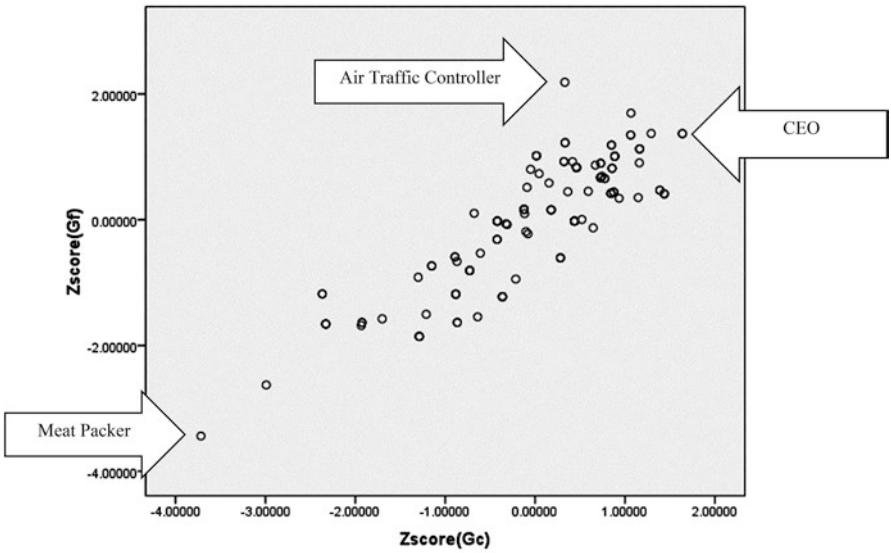

Fig. 2.1 Scatterplot of jobs on the importance ratings of tasks that are related to crystallized abilities (Gc) and tasks that are related to fluid abilities (Gf). *Z*-scores are charted for each of the abilities. *CEO* Chief Executive Officer

Identifying specific jobs on the scatterplot is illuminating in terms of understanding job complexity related to these two abilities. For instance, the job lowest on both abilities is that of meat packer shown in the lower left-hand corner of Fig. 2.1. From there, job complexity increases linearly in terms of fluid and crystallized demands. One job for which the fluid demands are slightly higher than the crystallized/knowledge demands is that of air traffic controller. These findings are perhaps not surprising given that research suggests that air traffic control is one of the most cognitively demanding jobs in terms of attentional capacity, memory, and processing speed—sub-facets of fluid abilities (Nunes & Kramer, 2009). But air traffic control jobs are also demanding in terms of crystallized demands. For example, air traffic controllers are required to know the rules of engagement and flight patterns in their sectors. Likewise, CEO—the job highest in crystallized abilities—requires extensive knowledge and experience so CEOs can effectively devise and execute business strategy. CEO jobs also require solving novel problems and responding quickly and decisively to crises; that is, these jobs comprise tasks that are also demanding of fluid abilities. Figure 2.1 shows that all jobs rely on both abilities to some extent, and highly complex jobs tend to rely heavily on both fluid and crystallized abilities to a large extent. In retrospect, our original idea that complex jobs could be differentiated in terms of their fluid and crystallized ability demands seems naïve. Indeed, it is difficult to think of a job that relies exclusively on fluid-type abilities and not crystallized/knowledge abilities and vice versa. Thus, one reason researchers fail to find a significant relationship between age and job performance is because work tasks seem to be highly dependent on both fluid and crystallized abilities, particularly at high levels of job complexity.

Age-Related Motivation Changes The ability demands of a job are likely to affect experiences of stress and/or boredom on the job. Job characteristics related to the ability demands of a job will also affect worker perceptions of their own abilities to do the job (self-efficacy and work ability; McGonagle, Fisher, Barnes-Farrell, & Grosch, 2015) and perceptions of the amount of effort involved in executing job tasks. Ability demands of jobs are also likely to interact with age to affect perceptions of how much effort will be involved in executing job tasks, which will also affect work-related motivation (Kanfer & Ackerman, 2004). The motivation theories described above (selection, optimization, and compensation theory and socioemotional selectivity theory) further suggest that older workers should be more likely than younger workers to focus on goals that capitalize on their existing knowledge, oriented toward socioemotional connections at work, and attracted to work that provides autonomy and flexibility.

Integrating Ability and Motivation Theories Changes in abilities through the lifespan described above can be considered in terms of growth (crystallized abilities) and decline (fluid abilities). Changes in motivation can be considered in terms of a reorganization of goals (Kanfer & Ackerman, 2004). With growth, decline, and reorganization in mind, Kanfer and Ackerman described functions relevant to work motivation for older workers that take into consideration worker perceptions of effort, utility, and the value of the outcomes. In essence, the models state that as workers age, they will need to expend more effort to accomplish tasks related to fluid versus crystallized abilities. As such, their perceptions of the amount of effort required to engage in such tasks will be negatively affected, which will reduce motivation and self-efficacy for these types of job tasks. In essence, changes in abilities will not only negatively affect a person's ability to accomplish tasks related to fluid abilities as they age, but it will also (and relatedly) negatively influence their motivation for these tasks. In contrast to tasks that rely heavily on fluid abilities, workers should perceive that tasks associated with their existing knowledge do not necessarily require increased effort as they age. Indeed, crystallized-based tasks should be perceived as easier as a worker acquires expertise.

How do these changes in abilities and motivation with age interface with job characteristics? In general, research suggests that as people age, they will be less likely to have the ability and motivation to engage in constantly learning novel tasks. However, abilities and motivation to engage in well-learned knowledge-based tasks or tasks that require interpersonal or socioemotional skills will not be diminished with age (Beier et al., 2018; Kanfer & Ackerman, 2004).

2.3.2 Jobs and Their Tasks: Moving Targets

The Labor Market The impact of changes in abilities and motivation that occur throughout the lifespan on work must be understood within the context of the labor market and the availability of certain types of jobs (Bureau of Labor Statistics,

2017b). Indeed, the shift from manufacturing jobs (e.g., assembly line jobs) to knowledge jobs (e.g., manager/supervisor) over the past 50 years is partly a function of technological innovation. This change in the labor market suggests that the availability of jobs that rely heavily on physical abilities will continue to decrease, while the need to operate technology and thus the need to constantly update technological skills will increase. The shift from physical to knowledge work is promising for older workers who will be able to apply the vast repertoire of knowledge gained through past experiences to their current jobs (Beier et al., 2018). Nonetheless, the need for constant skills updating may disadvantage older workers who may be less motivated for continuous training and who may experience decrements in learning abilities associated with age when the content to be learned is novel (Beier, Teachout, & Cox, 2012).

Along with the general trends of decreases in the availability of manufacturing jobs and increases in knowledge jobs, demographic shifts that affect the aging of the labor force will also affect the types of jobs that are available to that labor force. In particular, the aging of the population in many industrialized countries will significantly impact the availability of jobs related to healthcare. According to the Bureau of Labor Statistics (2017a), four out of five of the fastest growing industries—in terms of percent increase in workers—over the decade between 2016 and 2026 are expected to be in social services and healthcare (i.e., individual and family services, outpatient care, other health practitioners, and medical and diagnostic labs). The percent change in the workforce is significant for these industries and ranges from 39 to 27%. With the exception of the physical aspects of many healthcare jobs (e.g., nurses who lift patients and work on their feet all day), the proliferation of jobs in healthcare should positively affect the labor market for older workers, owing to the necessity of interpersonal skills for many of these jobs. Older workers should—for instance—be more oriented toward occupations that focus on helping others, according to socioemotional selectivity theory. Moreover, if one conceptualizes interpersonal skills as a type of knowledge that a person can develop through the lifespan (Beier, Bradshaw, et al., 2019), older workers should have well-developed interpersonal skills and knowledge about dealing with difficult people and for handling difficult situations (Bal & Smit, 2012; Scheibe, Spieler, & Kuba, 2016). All of these attributes align well with the demands of work in healthcare.

Recall that four of the five fastest growing industries are related to social services and healthcare, which should provide some advantage to older workers. The fastest growing industry overall, however, is information technology, which permeates all other industries (e.g., healthcare, customer service, sales, farming, and manufacturing). Unlike healthcare, the growth in information technology may not be good news for older workers in that jobs in this sector are reliant on constant skill updating and innovation rather than existing knowledge, experience, and interpersonal skills (Brooke, 2009; O'Connor, 2017). This is not to say that older workers will have no place in technology industry—organizations will always benefit from business expertise, management skills, and so on—but there should generally be more of an advantage for younger workers in the technology sector (Wickre, 2017; Wright, 2017). The bottom line is that organizations and workers should expect

technology to significantly change the jobs that are available and the tasks that comprise those jobs.

Job Tasks Even though organizational scientists have examined the extent to which job characteristics affect motivation and performance, surprisingly few have attended to the dynamic nature of job tasks. Economists and computer scientists, however, have highlighted the impact that technology has had—and will continue to have—on the nature of work over the coming decades. The current version of the O∗NET provides a taxonomy for the array of knowledge, skills, abilities, as well as the work activities and tasks required by jobs (Peterson et al., 1999). Frey and Osborne (2017) applied a novel algorithm to these job attributes to understand the extent to which the jobs in the O∗NET were susceptible to computerization. They reviewed the job tasks and abilities listed in the O∗NET as essential for jobs and identified those that would be bottlenecks to computerization. That is, they identified the job attributes that could not be easily replaced by technology, and linked those to the job attributes in the O∗NET.

Frey and Osborne's algorithm classifies job tasks in a 2-by-2 matrix that crosses routine versus non-routine tasks and cognitive versus physical job tasks. Furthermore, they identified routine work activities as likely to be automated and non-routine, emotional, and creative skills as less likely. Some of the routine tasks identified by Frey and Osborne (2017) as ripe for computerization may be surprising. That is, the list of job tasks that are easily automated include not only routine physical tasks, but also routine decision-making and cognitive tasks that can be accomplished by applying big-data and decision algorithms as well as tasks such as the sentencing of criminals, fraud detection, and disease diagnosis.

Bottlenecks to computerization were organized across three categories: (a) *perception/manipulation*, which includes finger and manual dexterity and the ability to work in cramped spaces and/or in awkward positions from the O∗NET; (b) *creative intelligence*, which includes originality (i.e., the ability to develop novel solutions/ideas given a topic or problem), and knowledge of fine arts from the O∗NET; and (c) *social intelligence*, which includes social perceptiveness, negotiation and persuasion skills, and assisting/caring for others from the O∗NET (Frey & Osborne, 2013, 2017). Further, different waves of computerization of jobs were identified based on the algorithm and the bottleneck categories described above. The first wave will supposedly happen in the relatively near future and will include jobs in the first category (perception and manipulation) because technology is evolving quickly and will soon be able to easily manipulate or perceive non-standard objects or work in small/cramped spaces. In summary, the first wave of automation will eliminate administrative support and other office jobs as well as many labor and production jobs (Frey & Osborne, 2017).

The second and third bottlenecks, however, are not susceptible to short-term automation according to Frey and Osborne (2013, 2017) owing to the fact that technology cannot easily replace creative and social job tasks. Nonetheless, creative tasks are not immune to computerization. For example, books and movies are now being written by artificial intelligence. However, these endeavors are more success-

ful when artificial intelligence is performing more routine and mundane work, while people are central to the creative process (IBM, 2015). Using this algorithm, Frey and Osborne estimate that 47% of jobs will be eliminated over the next few decades. Whether whole jobs will be eliminated or just job tasks is still up for debate (Frey & Osborne, 2017).

Regardless of whether the stark estimate of 47% of jobs eliminated in the next 25 years is correct, technology and automation will significantly impact the types of jobs that will be available over the next three decades. That is, jobs that tap creativity and social skills will remain relatively safe from automation, but many medium and lower skilled workers should expect some disruption in their work—if not total replacement. Thus, many workers may find themselves moving from relatively higher paying service, construction, and manufacturing jobs into lower paying jobs due to technological innovation (Frey & Osborne, 2017).

The doom and gloom of Frey and Osborne's (2013, 2017) estimates of job automation should be tempered, however, with some common sense about work and workers. These authors admit that—as in past industrial revolutions—technology will result in new inventions, regulations, and technological breakthroughs that will affect the labor market in unforeseen ways. Thus, it is difficult to imagine that technological innovation would eliminate almost half of the jobs in an economy without replacing them with different jobs. Second, it is important to note that Frey and Osborne's algorithm is far from perfect. For instance, using their algorithm, they estimate that the job of bartender has a 77% probability of being computerized over the next 25 years (i.e., high probability of computerization). And although many people are currently flocking to bars that employ robot bartenders (Jones, 2017), it is likely that the novelty of these experiences will wear off as people realize how boring it is to interact socially with robots. In essence, the idea that robots will replace bartenders misses the social reasons people go to bars in the first place and misses the social aspects of a bartender's job. This scenario is just one example of how applying algorithms to understand labor market trends may miss important nuances in job tasks; there are likely many more. Nonetheless, it is clear that automation will significantly impact the availability of jobs and job tasks, particularly the availability of low-skill, routine, and physical labor jobs. Unfortunately, the most vulnerable workers will likely be most negatively affected by technological innovation.

Technology also promises to continue to change the social aspects of work. Technology has already provided workers opportunities to work remotely and at all hours of the day and night. These advances have advantages in terms of providing workers with flexibility and autonomy in how they approach their work, which can be motivating to workers (Humphrey et al., 2007). However, remote work can also be lonely and have negative effects on relationships with coworkers (Gajendran & Harrison, 2007). Furthermore, the flexibility of when to work that is afforded by technology can soften the boundary between home life and work life, leading to the impression that workers are available for work during all hours of the day, which can lead to burnout (Hoeven, Zoonen, & Fonner, 2016; Maier, Laumer, & Eckhardt, 2015).

Technology that impacts the ability to work flexibility and remotely and that impacts the social context of work may be experienced differently by younger and older workers. As stated above, the ability to work flexibly will appeal to older workers, but not if it means that they will be on call around the clock. Socioemotional selectivity theory further suggests that older and younger workers would be motivated by different aspects of work; older workers would find opportunities to experience positive relationships at work more appealing than younger workers, and younger workers would find opportunities for promotion and growth to be more appealing than older workers (Carstensen et al., 1999).

2.4 Conclusions and Future Research

2.4.1 Implications of an Aging Workforce in the Twenty-First Century Workforce

Above we have described the importance of job characteristics and person-job fit for organizational performance, motivating workers, and for worker health and well-being. That is, when job tasks outpace the skills and abilities of the worker, workers may experience lower job performance, less motivation, and health detriments related to stress. When job tasks do not match the abilities of the worker, workers may experience boredom and a different type of stress (Kristof-Brown et al., 2005). Work design models can be understood in the context of the interplay of changing abilities and motivation through the lifespan with changes in the labor market and job tasks due to technological innovation described above. For instance, the shift in the labor market from physical to knowledge jobs should benefit the maturing workforce. Likewise, jobs that focus on the socioemotional aspects of work, which might include mentoring or caring for others, will also be good matches for mature workers. Thus, the increase in healthcare jobs—particularly those that require less physical work—and the continued need for interpersonal skills regardless of technological innovation should benefit older workers. But jobs in the technology sector (the fastest growing segment of the job market in developing countries) may present barriers to older workers. Jobs that provide flexible work arrangements may also be appealing to the aging workforce, and flexibility may be a method for organizations to engage expert older workers (Beier, 2015; Paullin, 2014).

In the context of the preferences and skills of the mature workforce, technology has much to offer; but it is a double-edged sword. As technology facilitates flexible work arrangements, it also potentially disrupts the social fabric of work—the informal interactions that may impact worker well-being and the interpersonal connections that might motivate older workers and keep them engaged in the workforce longer. Innovation that permits flexible work arrangements also facilitates working at all hours of the day or night, which will be less appealing to workers as they shift from achievement to socioemotional goals with age. Technology will also increase

the value of knowledge jobs that require extensive expertise, which should benefit older workers. At the same time, however, an increased technological infrastructure will require constant skills updating on the part of workers to keep pace with innovation. Constant skills updating will disadvantage the older worker, particularly to the extent that new skills are completely novel and not relatable to existing ways of doing things (i.e., transformative innovation).

History suggests that fears about the elimination of jobs through automation are unfounded (Manyika et al., 2017); but the types of jobs that people have will change significantly with technological innovation into the twenty-first century. For all workers, technology will make low-skill jobs relatively less available as these jobs are the most vulnerable to automation. Workers without significant knowledge or expertise (whether it be in a trade, the arts, or in business strategy) will find themselves at an even greater disadvantage in the labor market of the future than today. The trend toward fewer low-skill jobs will potentially produce high unemployment—a glut of low-skilled workers—which will further constrict wages for those few jobs available (Manyika et al., 2017). High unemployment is particularly problematic for older workers given that finding jobs as one advances in age becomes increasingly difficult (Wanberg, Kanfer, Hamann, & Zhang, 2016).

Future Research As described above, the potential for technology to disrupt the experience of work for all workers is immense. Unfortunately, organizational scientists have not focused extensively on the dynamic nature of work, so much research is needed to answer questions about the automation of different jobs and job tasks. Above, we provided theoretical background for understanding how older workers will fit with jobs in the twenty-first century. In particular, we call for research that examines person-job/person-environment fit with an eye toward aging. It may be, for example, that the experience of mis-fit—when the ability demands of the job are greater than the abilities of the work—is different for older workers than it is for younger workers. For example, it may be that mis-fit when person abilities outweigh job demands may result in boredom that might spur a younger worker to consider changing jobs while older workers might consider job-related boredom a benefit that permits them to focus on other aspects of their lives that are more important to them (e.g., cultivating relationships with friends and family). Conversely, mis-fit when demands outweigh abilities might be stressful for older workers, but it might present younger workers with opportunities for desired stretch assignments. Recently, organizational scientists have begun theorizing about person-job fit throughout the working lifespan (Zacher, Feldman, & Schulz, 2014), but very little empirical research has examined specific questions related to age and fit. Our first recommendation for researchers is to begin examining the relationship between person-job fit and age and the environmental factors that could contribute to engaging the aging workforce for a longer period of time.

As stated above, jobs in the twenty-first century are going to require constant skills updating to ensure that workers keep up with the rapid pace of innovation/automation. Although learning novel skills becomes increasingly difficult with age (Kubeck, Delp, Haslett, & McDaniel, 1996), evidence demonstrates that adults do

learn in training, particularly when the training environment allows ample time and/or is self-paced (Callahan, Kiker, & Cross, 2003). There are likely other ways in which training environments might be modified to meet the unique needs of the older learner, and as technology continues to proliferate in the workplace, more research on age and training in needed. For excellent reviews, see Czaja and Sharit (2012) and Wolfson, Cavanagh, and Kraiger (2014). Our second suggested research area is a greater emphasis on how to design training interventions to train the skills needed for twenty-first century work, with a focus on training older workers. The good news is that training that benefits older workers tends to be training that benefits all workers (i.e., it tends to be straightforward, clear, and allows ample time for learning; Beier et al., 2012).

Our third suggested area of research is a focus on the social aspects of work. Above we describe how jobs will likely change in ways that will affect the social context of work. For example, work teams may be more likely to include robots in the future; technological innovations will make remote work increasingly popular, changing the dynamics of the work team. Even outside of work tasks themselves, technology will affect how much work is done alone (or in the company of technobots) and how much is done in the company of other humans. There is evidence that the presence of others is important for productivity and well-being (Triplett, 1898). The social context of work may be especially important for older workers who will be increasingly motivated by socioemotional goals and will want to engage in mentoring and other generative activities (Carstensen et al., 1999). We thus call for more research in organizational science investigating the impact of technology on the social context of work.

2.4.2 Conclusion

There is no question that jobs are changing rapidly and with them the psychological experience of work. The confluence of two factors—the impact of technology on the workplace and the aging of the global population—promise to affect not only the types of jobs that are available but the types of workers. Due to age-related changes in abilities and motivation with age, it is likely that older workers will choose to engage in different opportunities than younger workers, and more mature workers have a unique set of skills and abilities to offer. We hope to have provided some insight about particular issues that might arise and fruitful areas of future research related to engaging older workers in the jobs of the twenty-first century.

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