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Employee Age Differences in Using Internet-Based Tools at Work

Gabriela Burlacu, Donald M. Truxillo, and Talya N. Bauer

Introduction

As the nature of work becomes more global and complex, Internet-based tools are increasingly being used to help organizations recruit, manage, and retain today's employees on a large scale (Bhatt, 2015; Marler & Fisher, 2013; Stone, Deadrick, Lukaszewski, & Johnson, 2015; Stone & Dulebohn, 2013). These tools provide organizations with numerous benefits including more efficient, streamlined processes and reduced cost compared with traditional, paper-and-pencil based human resources management (HRM) activities (Bauer, Truxillo, Paronto, Weekley, & Campion, 2004; Bhatt, 2015; Davoudi & Fartash, 2012; Parida & Nayak, 2012; Strohmeier, 2009). Although much emphasis has been given to the organization-level benefits of using these tools, relatively little attention has been paid to how these tools impact individuals' productivity and wellbeing.

One characteristic influencing the use of technology-based tools within and outside of work is employee age (e.g., Chang, McAllister, & McCaslin, 2015; Mitzner et al., 2010; Wolfson, Cavanagh, & Kraiger, 2014). Research examining age and technology has revealed a complex relationship in which individuals of different ages may have different needs, preferences, and requirements when it comes to technology design and use (e.g., Wolfson, Cavanagh, & Kraiger, 2014). Relatively little research has been conducted on age and the use of Internet-based work tools specifically, however, within both developmental and industrial and organizational psychology literatures chronological age has been extensively researched in other ways, which may provide insight into how employees of different ages might approach these tools. Given that the global workforce is aging and is concurrently becoming more diverse with regards to age (Hedge, Borman, & Lammlein, 2006; Leibold & Voelpel, 2006; Truxillo, Cadiz, & Hammer, 2015), we propose that the

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relationship between employee age and the increasingly popular use of Internet-based work tools needs to be better understood.

This chapter provides an overview of the current landscape of the aging workforce, as well as the kinds of tools that organizations are increasingly adopting to support their HRM processes. We then describe the lifespan changes in cognition, personality, motivation, and societal context that influence the way adults perceive and approach work. We apply these lifespan development theories and research findings toward exploring how employees of different ages will be impacted by use of Internet-based work tools, proposing further research that needs to be conducted in order to determine how these tools can be designed and deployed to drive effective use across the increasingly age-diverse workforce.

The Aging Workforce

Demographic analysis demonstrates that the average age of the industrialized workforce around the world is increasing and will continue to do so at least through the middle of the twenty-first century (Hertel & Zacher, in press; Leibold & Voelpel, 2006; Truxillo et al., 2015). This trend is due to a convergence of demographic, economic, and sociological changes. First, relatively low birth rates in developed nations mean fewer younger workers are entering the workforce. Second, recent economic downturns have influenced people to work later in life, resulting in older employees in the workplace than we have seen in the past. Third, medical advances have resulted in better overall health for older individuals as they progress into their senior years, and many of these healthy individuals choose to continue working, as work represents an important aspect of their mental and social wellbeing (Kim & Feldman, 2000). This longer life expectancy and better health in later years will also force retirement systems to raise the retirement age in order to stay solvent (Coile, Milligan, & Wise, 2016). It is estimated that by the year 2020, 25% of the workforce in the United States will be over the age of 55 years (Toossi, 2012). In the European Union nations, the rate of employment among people aged 55–64 years has increased from 39.9% in 2003 to 50.1% in 2013 and will likely continue increasing due to initiatives to enhance the workforce through 2020 (European Agency for Safety and Health at Work, 2014). This trend is occurring in Asia as well. For instance, Singapore's Ministry of Manpower reported that over 40% of people aged 65–69 years were still in the workforce in 2015, up from 24% in 2006 (Khalik & Wei, 2016). Finally, older individuals are also increasingly taking up bridge employment post-retirement, which allows them to continue working or return to work in a job that may be less demanding than a full-fledged career (Kim & Feldman, 2000; M. Wang, Adams, Beehr, & Schultz, 2009). As such, older workers are not found just at the top levels of organizations – there may be an increasing number of older workers in all job positions and at all organizational levels (Leibold & Voelpel, 2006; Truxillo et al., 2015).

As the proportion of older workers increases, the younger generation of workers, termed "millennials" (Myers & Sadaghiani, 2010; PricewaterhouseCoopers, 2011), is rising in numbers as well. It is estimated that by the year 2020, 45–50% of the developed workforce will consist of millennials (PricewaterhouseCoopers, 2011). These demographic trends are coinciding such that workers of all ages are working side by side as never before, creating much greater age diversity in the workplace. Furthermore, because of factors such as bridge employment, older workers may find themselves working *for* younger managers. Indeed, research is showing we have greater age diversity in today's organizations than we have in the past, and this increased diversity occurs at the workforce, organization, and even team level (Boehm & Kunze, 2015; Truxillo et al., 2015). In short, researchers and practitioners

cannot afford to focus on just engaging millennials or on just engaging older workers – they need to consider holistically how these different age groups work together and what impact this has on individuals and the organizations in which they work. But because Internet-based tools are typically deployed in a one-size-fits-all fashion (Stone et al., 2015), little groundwork has been done to understand age differences in how these tools will be adopted and how they will impact attitudes and behaviors across the entire base of employees.

There is reason to believe that employees of different ages approach elements of work differently. Extensive research has been conducted to understand the attitudes (e.g., Ng & Feldman, 2010), motivations (e.g., Inceoglu, Segers, & Bartram, 2012; Kanfer & Ackerman, 2004; Kooij, de Lange, Jansen, Kanfer, & Dikkers, 2011), and behaviors (e.g., Ng & Feldman, 2008) of different age groups at work, even though relatively little research has looked at these relationships in the context of Internet-based work tools. We begin by defining what is meant by an older or younger worker and then review the literature on age and Internet use in general. We will then present developmental and sociological theories we believe are relevant to the study of age differences in this area. Very little research has been conducted to link these theories to the adoption of Internet-based tools that support a variety of HRM processes, but in subsequent sections we apply what little is known to discuss how age may impact experience with these tools, laying the groundwork for future research that needs to be conducted in this area by presenting a series of research questions (summarized in Box 20.1). It is critical for the field of industrial and organizational psychology to address these questions to gain a better understanding of the impact these tools have on employees of different ages as their prevalence in managing an increasingly age-diverse workforce grows.

Who is an older worker? Who is a younger worker?

Although age is typically studied as a continuous variable (e.g., Bertolino, Truxillo, & Fraccaroli, 2013; Carstensen, 1992; Ng & Feldman, 2008; 2013; Shore, Cleveland, & Goldberg, 2003), it has historically been difficult for researchers to ascertain when an individual becomes an "older worker." This categorization varies across cultures, industries, and national and other contexts. Stereotypes regarding age may influence when an employee can be considered "old," and these stereotypes differ depending on job and industry characteristics (Ng & Feldman, 2012; Truxillo et al., 2015). Legal aspects of age such as workplace protection and retirement age vary across countries. For instance, in the United States, once an individual turns 40, he or she becomes part of a legally protected class, and the typical retirement age is around 65. However, in China, the retirement age tends to occur earlier and thus their conceptualization of what constitutes an "older worker" may differ (Giles, Wang, & Cai, 2011). As people live longer and work later in life, traditional retirement ages in many nations are changing (Coile et al., 2016), and conceptualizations about older/younger workers are gradually changing as well (Truxillo et al., 2015). But as the global workforce also increases in age diversity, it becomes critical for researchers to better understand changes that occur within individuals throughout the lifespan and how these influence attitudes and behaviors regarding work and the tools employees are increasingly being called on to use in their jobs.

Familiarity with technology such as the Internet has often been studied as a generational issue, with older generations being further removed from and thus less familiar with Internet-based tools (Tacken, Marcellini, Mollenkopf, Ruoppila, & Szeman, 2005). However, there are several reasons why employee age, rather than generation, is critical to study with regards to attitudes toward and behaviors around use of Internet-based work tools. First, although generational differences have received much attention in the popular press, research has found few consistent differences across generations at work

(Cadiz, Truxillo, & Fraccaroli, 2015; Costanza & Finkelstein, 2015). There is considerable variability within generations in attitudes, motivations, and behaviors (Costanza & Finkelstein, 2015; Giancola, 2006; Parry & Urwin, 2011; Twenge, 2010), and there is reason to believe that the limited generation-based variations that have been found can be explained by the chronological aging process (Benson & Brown, 2011; Cadiz et al., 2015; Smola & Sutton, 2002). Second, generations tend to be relevant only in the cultural context in which they were created (Egri & Ralston, 2004; Yu & Miller, 2005). Generations, defined as groups of people that share birth years, birth location, and experiences of significant life events at key developmental stages (Kupperschmidt, 2000) may look different from one country or geographic region to the next. As we seek to develop theory and practice that is relevant worldwide, we need to determine how people differ along dimensions that are relevant across cultural contexts. Finally, the rise of Internet-based work tools means that generational category is no longer a valid reason for lack of familiarity with these tools. Employees have been increasingly called on to learn and use these tools, regardless of the generational category they belong to. Our task then is to identify how this call will impact the attitudes and behaviors of employees of all ages and how we can optimize these tools for all age groups, rather than identifying generations for whom these tools may or may not work.

Internet-based work tools

The use of Internet-based tools have enabled organizations to more effectively and efficiently manage their people, with a variety of HR practices now supported by online applications for many of today's companies (Bhatt, 2015; Cascio, 2000; Stone et al., 2015). These tools provide numerous benefits to organizations in the areas of recruitment, selection, training, and development, as well as for facilitating virtual team and e-leader communications and tasks. When it comes to recruiting new talent, Internet-based recruiting and marketing tools allow organizations to cast a wider hiring net than ever before, reaching qualified job candidates from all over the world (Chapman & Gödöllei, 2017; see Chapter 11 of this volume; Maurer & Liu, 2007; Venkatesh, 2013). Companies are increasingly using tools such as job-posting sites to more simply and inexpensively advertise and fill open job positions (Lee, 2005). Furthermore, first, because Internet-based tools have a broad reach, companies are able to increase their pool of qualified candidates and be more selective, increasing the chances that they will find the right candidates to fit with their culture, vision, and roles (Maurer & Liu, 2007; Singh & Finn, 2003). Second, Internet-based assessment and selection measures save companies time and money, enabling them to process a greater number of job applicants than was previously possible (Anderson, 2003; Bauer et al., 2004, 2006).

The application of Internet-based tools for employee training, learning and development has led to huge advancements in how organizations provide training content to employees. E-learning allows organizations to quickly deliver onboarding, training, and employee development content at a greater scale than ever before. It allows companies to cut costs associated with training instructors, pencil-and-paper based instruction, and securing physical locations for training courses (Cascio, 2000; Derouin, Fritzsche, & Salas, 2005; Johnson & Brown, 2017, see Chapter 17 in this volume; Wang, Wang, & Shee, 2007). Use of Internet-based tools has also enabled new communication channels in an increasingly virtual world. As organizations expand and adopt increasingly advanced technology, the concept of a "work team" is no longer limited to people who work closely together in the same location. Virtual teams are an increasingly common organizational structure in which people in different locations work together remotely (Cascio, 2000; Martins,

Gilson, & Maynard, 2004; Maynard, Gilson, Young, & Vartiainen, 2017, see Chapter 15 of this volume; Truxillo, Cadiz, & Rineer, 2014), sometimes in vastly different countries or cultures (Kraimer, Takeuchi, & Frese, 2014). Virtual teams function as regular work teams, but they have added challenges in effective communication and collaboration via use of Internet-based communication tools (Shachaf, 2008).

With the increase in prevalence of virtual teams, some attention has been given to the people who manage those teams. Virtual leadership, or e-leadership, not only carries the traditional challenges of managing people, but also requires leaders to manage effectively and communicate strategy via virtual communication channels. Furthermore, an e-leader may experience challenges in managing subordinate performance in a world where they rarely see that performance first-hand (Cascio, 2000; Kahai, Avolio, & Sosik, 2017, see Chapter 14 of this volume; Zigurs, 2003). Organizations are increasingly supporting managers in this task by using electronic and Cloud-based technology to track, measure, and document employee performance, particularly with the advent of "big data" (Stone et al., 2015). Some technology is also focused on assisting managers in coaching and providing effective feedback (London, 2003).

While the benefits of Internet-based technology are well documented, the success of any workplace technology intervention is heavily dependent on whether employees actually use it (Venkatesh & Bala, 2008). The extent to which employees adopt technology depends on many factors, including social norms and influence (Fishbein, 1979; Liker & Sindi, 1997), perceptions around usefulness and ease of use (Davis, 1989), self-efficacy in one's ability to effectively use the technology (Tarhini, Hone, & Liu, 2014), prior experience and proper training (Venkatesh, Morris, Davis, & Davis, 2003), and enjoyment derived from using the technology (Venkatesh, Thong, & Xu, 2012). This suggests that there are ways to design and position Internet-based work tools in a way that will foster employee adoption of those tools. However, as we discuss in this chapter, there are unique needs and preferences that employees of different ages may have regarding these tools as a result of cognitive, personality, motivational, and societal changes over their lifespan. These preferences need to be better understood for organizations to ensure Internet-based work tools are adopted by and effective for all employees.

Age and internet use

Although stereotypes suggest that older individuals are resistant to using Internet technology (Czaja et al., 2015; Mitzner et al., 2010), in 2000, Trocchia and Janda's US-based research showed that individuals over 50 years were an active and growing group when it came to regular use of the Internet, with peer comparisons, ease of use, and physical dexterity influencing the regularity with which these people used the Internet. Since then, more research has shown that a majority of older individuals use the Internet in the United States, with 88% of those aged 50–64 years reporting regular or daily use, as well as 57% of those over 65 years (Pew Research Center, 2014). In 2014, 18% of all Internet users in Europe were over the age of 55 years (Statista Dossier, 2014). As a group, older adults in developed nations have had the fastest growth in Internet usage over the second decade in 2000 (Chang et al., 2015). Occupational Internet use among older workers has also increased, particularly given the increased access to Internet-based tools, which eliminates a barrier that hinders some older adults from using technology recreationally (e.g., Czaja & Lee, 2003; Porter & Donthu, 2006).

Although limited research has focused on age and use of Internet-based work tools specifically, some research has looked at older adults' attitudes toward and adoption of technology both within and outside of work, revealing that older adults are a varied

group when it comes to technology use. For instance, Czaja and Lee (2003) found that older adults tend to experience greater anxiety about computers and feel more negatively about the effort required to utilize technology. However, some evidence shows these effects disappear over time (Adams, Stubbs, & Woods, 2005; Pew Research Center, 2014; Weatherall, 2000). Tarhini and colleagues (2014) found that factors such as perceived ease of use, perceived usefulness of the technology, and self-efficacy are key determinants of intention to adopt new technology for all individuals, but age moderates this relationship, such that for older adults these determinants are particularly important. Rizzuto (2011) suggested that workers' acceptance of IT innovations at work depends in part on department-level climate and attitude toward these innovations. He found that older workers have more positive perceptions of IT innovations than younger workers when department climate around the innovations is perceived as positive. Furthermore, older adults' motivation to learn about and use technology may look different from that of their younger counterparts. Morris and Venkatesh (2000) found that while younger adults were more likely to adopt technology at work in a manner that was consistent with their attitudes toward the technology, older adults had other influences, such as perceived social norms around technology adoption and behavioral control. However, this work has not yet been expanded to determine how Internet-based HRM tools can be designed to foster perceptions of positive department climate, social norms and behavioral control.

By and large, researchers agree that older adults' relationship to technology is complex and needs to be properly addressed to level the playing field for employees of all ages in the increasingly technological workplace (Abbasi, Tarhini, Hassouna, & Shah, 2015; Charness, 2006). As such, age-related changes in cognition, personality, and motivation, as well as the broader societal context of aging at work, need to be taken into account when designing and deploying technological workplace interventions (Czaja et al., 2015; Wolfson et al., 2014; Truxillo et al., 2015). We now briefly review the changes occurring within individuals over the course of their lifespan that impact their attitudes, behaviors, and motivations at work. We also summarize research that has been conducted on the societal context within which older workers operate. We then link these age-related workplace factors to the study of attitudes toward and adoption of Internet-based work tools.

Within-Person Changes Over Lifespan

Age and cognition

Extensive research shows that as people age, they experience changes in memory and cognition. Although there is wide variance within age groups in terms of cognitive ability (Curtis, Windsor, & Soubelet, 2015), older adults tend to experience gains in some types of cognitive ability while simultaneously experiencing loss in others. Specifically, crystallized intelligence, or learned and practiced knowledge which includes job knowledge, tends to increase for older adults, while fluid intelligence, which includes working memory and the ability to quickly solve novel or unfamiliar problems, tends to decrease (Salthouse, 2011), beginning from the early twenties. This decrease impacts daily cognitive functioning in a variety of ways. For instance, older adults tend to have reduced processing speed (Salthouse, 1995), working memory capacity, and cognitive control processes (e.g., a decline in the ability to coordinate and integrate information; Salthouse, 2011). Verhaegen and Salthouse (1997) showed that the negative relationship between age and fluid intelligence is mediated by cognitive processing speed, such that older adults tend to process new information more slowly and therefore less effectively. In addition, decline in

working memory impacts new skill acquisition (Kennedy, Patridge, & Raz, 2008) and search task performance (Sharit, Hernandez, Czaja, & Pirolli, 2008). Because working memory acts as "a system for the temporary maintenance and manipulation of information" (Baddeley, 1992, p. 281), this puts older adults at a disadvantage for quickly learning and comprehending new, complex information.

Although people tend to experience cognitive losses with age, crystallized intelligence, which continues to increase in the fifth and sixth decades of life, can largely offset these losses, especially through the adult working lifespan (Truxillo et al., 2015). In his review of age-related cognitive decline, Salthouse (2011) suggested that losses in fluid intelligence and reduced working memory capacity have limited or nonsignificant consequences for day-to-day functioning. He also suggested that contexts such as the workplace rarely require maximal working memory capacity to succeed, and that older adults can rely on accumulated knowledge, accommodations, and other determinants of success in life (for instance, conscientiousness) to offset cognitive losses. Basic cognitive training can significantly reduce the losses older adults may face: sustained participation in cognitively demanding, novel activities has been shown to have positive effects on older adults' memory (Park et al., 2014), as does training specifically targeted toward improving working memory (Zinke et al., 2014). Furthermore, both on-site and at-home instruction positively impact numerous types of cognitive functioning in adults over 50 years and over 65 years (Wolinsky et al., 2013). As such, although older adults tend to experience cognitive declines as a result of age, these declines are reversible and can be minimized in a context such as the workplace. To an extent, these cognitive changes have been applied toward the study of older adults and technology (e.g., Wolfson et al., 2014). In their review of technology-based training requirements for older workers, Wolfson and colleagues (2014) described the cognitive load theory (CLT) and the cognitive theory of multimedia learning (CTML). CLT suggests that humans have a limited working memory capacity in general, which can be overwhelmed during learning (Sweller, van Merrienboer, & Paas, 1998). CTML suggests that technology-based instruction methods that have multiple sensory demands (e.g., requiring learners to listen to a speaker while also viewing presentation slides) have an even greater likelihood of overwhelming working memory demands (Mayer, 2005). Because these theories posit that people have limited working memory in general, older adults' continued declines in working memory capacity may be particularly detrimental in how well they can learn from and use novel Internet-based HRM tools without proper training and guidance.

Age and personality

Personality traits tend to stay relatively stable throughout the lifespan, but certain personality characteristics differ between older and younger adults (Heggestad & Andrew, 2012; Roberts & DelVecchio, 2000). Older adults tend to exhibit more conscientiousness (Warr, Miles, & Platts, 2001), more agreeableness (Bliedorn et al., 2013), and less neuroticism (Roberts, Walton, & Viechtbauer, 2006), and some of these changes commence as individuals transition into early adulthood. However, older adults also tend to exhibit slightly reduced extraversion and openness to experience (Costa Jr, et al., 1984), although certain facets of extraversion, such as independence and self-confidence, increase with age (Roberts et al., 2006; Soto, 2015). These trends are robust across different cultures (McCrae et al., 1999). There is significant empirical evidence that personality traits shift to some extent with age, influenced by external factors such as physical and mental health (Chow & Roberts, 2014; Magidson, Roberts, Collado-Rodriguez, & Lejuez, 2014; Soto, 2015). Despite these overall trends, older adults are a varied group when it comes

to personality, and it has been suggested that differences in cognitive ability may account for some of these variations. Specifically, researchers have suggested a link between conscientiousness, openness, and slower rates of cognitive decline (Curtis et al., 2014).

While personality is not necessarily indicative of how and when an individual will adopt Internet-based tools at work, differences in conscientiousness, openness to experience, and general willingness to share knowledge and experiences will likely predict performance in general (Barrick & Mount, 1991; Hurtz & Donovan, 2000) and possibly willingness to take on and adopt new tools at work. Major, Turner, and Fletcher (2006) found that proactive personality, openness, extraversion, and conscientiousness predict motivation to learn and develop. However, this work has not been extended to explain whether older adults will be more or less likely to adopt Internet-based work tools given their personality tendencies. Furthermore, it has not been explored how lifespan changes in extraversion may influence the use of communication-focused Internet work tools.

Age and work motivation

There is considerable evidence that motivation changes with age, which ultimately impacts how individuals approach work over their lifespan. An important note here is that motivation does not *decline* with age, but rather *shifts* to focus on other priorities (Kanfer & Ackerman, 2004). Several lifespan development theories have been proposed to explain why and how this happens. The theory of selection, optimization, and compensation (SOC theory; Baltes, 1987; Baltes & Baltes, 1990) suggests that as older adults experience losses in specific capabilities (e.g., in fluid intelligence), they *compensate* by *optimizing* the strengths they have remaining (e.g., performing tasks that require greater use of their crystallized intelligence), and *select* goals that allow them to do so. Research has shown that with increasing age, adults tend to exhibit more SOC behaviors (Freund & Baltes, 1998, 2002), and effective use of SOC strategies has been linked to healthy aging, both in general (Charles & Carstensen, 2009; Ouwehand, de Ridder, & Bensing, 2007) and in the context of the workplace (Kooij, 2015; Muller, Heiden, Herbig, Poppe, & Angerer, 2015; Weise, Freund, & Baltes, 2002; Zacher, 2015). Socioemotional selectivity theory (SST; Carstensen, 1991, 1992) also suggests that the kinds of activity and goals pursued are impacted by age, such that older adults are more focused on short-term rewards, positive emotional regulation, and strengthening social relationships due to their perception that the time they have is limited. In contrast, SST posits that younger adults, who perceive time as being relatively unlimited, are more motivated by opportunities for development and advancement. Research evidence supports SST in the workplace, with older employees exhibiting more organizational citizenship behaviors (Ng & Feldman, 2008), better attitudes toward work and co-workers (Ng & Feldman, 2010), and greater intrinsic work motivation (Inceoglu et al., 2012; Kooij et al., 2011). In addition, Kanfer and Ackerman (2004) described generativity, or concern for the success and wellbeing of future generations (McAdams, de St Aubin, & Logan, 1993; McAdams, 2001), as a motivation that emerges with age.

It is unclear how these age-related changes in motivation influence the adoption of Internet-based tools at work. However, it is possible that these tools can be presented in a manner consistent with the goals older individuals tend to pursue, driving adoption for this group. For instance, SST suggests that if Internet-based tools are positioned in a way that optimizes positive affect and meaningful social interaction, they will be more appealing to older adults. We will explore the implications of lifespan development and changes in motivation in more detail, but in general, more research is needed to determine how age and motivation interact to influence adoption of and experience with Internet-based work tools.

Older workers and the societal context

Although older workers are legally protected in many industrialized nations, they face stereotypes regarding their ability to perform and learn at work (Posthuma & Campion, 2009). These stereotypes exist in many countries and across different cultures (Shiu, Hassan, & Parry, 2015) and are prevalent across industries and job types in varying degrees. We focus here on stereotypes that negatively impact older workers, but age-related stereotypes exist for younger workers as well (Bertolino et al., 2013; Crumpacker & Crumpacker, 2007; Twenge, 2010; Truxillo, McCune, Bertolino, & Fraccaroli, 2012; Weiss & Maurer, 2004). These stereotypes can sometimes influence whether an individual is hired (Bal, Reiss, Rudolph, & Baltes, 2011), how performance is measured (Cleveland & Shore, 1992; Gordon & Arvey, 2004; Truxillo et al., 2014), and the types of opportunities an employee receives (Goldberg, Finkelstein, Perry, & Konrad, 2004; Maurer, Shultz, & Adams, 2007; Shiu et al., 2015). Furthermore, some research has examined the concept of meta-stereotypes, or beliefs that different groups may have about how *others* perceive them and how this influences behavior (e.g., Finkelstein, King, & Voyles, 2015). Such research builds on the stereotype threat literature, which suggests that older adults may perform in ways that match expectations of them, particularly when they are aware of those expectations (e.g., Hughes, Geraci, & De Forrest, 2013). Both age-related stereotypes and older adults' meta-stereotypes may influence the opportunities older workers receive with regard to learning and adopting technology at work (Morris & Venkatesh, 2000). However, more research is needed to determine the impact that these contextual elements may have on older adults' adoption of and experience with Internet-based tools that support HR processes.

Age and Technology as Applied to Different Human Resources Functions

We now discuss Internet-based tools that support a range of HR functions and the likely consequences for workers of different ages, particularly older workers. Note that in certain areas there is woefully little research. As such, we apply what we know about age-related changes in cognition, personality, and motivation, as well as stereotyping and meta-stereotyping, in discerning how age might affect the use of Internet-based tools at work. We also propose future research questions that will help us better understand how to optimize the use of Internet-based work tools for employees of all ages.

Age and e-recruiting

While little research has investigated the extent to which employees of different ages are effectively recruited using Internet methods, some research has explored age differences in the recruiting process in general. Such research has focused on the discrimination older adults face during recruitment, which may negatively impact their decision to move forward with an organization (Doverspike, Taylor, Shultz, & McKay, 2000; Hedge, 2008; Riach, 2007). Building on research that suggests that certain recruiting messages are more effective in attracting minority populations (e.g., Avery, 2003; Gully, Phillips, & Kim, 2014), different recruiting methods and messages may be warranted when attempting to recruit workers of different ages. For instance, Doverspike and colleagues (2000) suggest using images of older workers in job advertisements, removing age discrimination from all parts of the process, and considering and highlighting job design factors such as flexible work hours, which will be more attractive to older workers. Indeed, Rau and

Adams (2005) found that recruiting messages communicating schedule flexibility and equal opportunity employment were successful in attracting older workers seeking bridge employment. By contrast, younger workers are more attracted to messages focused on opportunities for development (a preference that is compatible with SST [Carstensen, 1991, 1992]), as well as a direct discussion of the reasons a particular company would be a desirable place to work relative to competitors.

Older-worker–friendly messaging in the recruiting process does more than simply allow older adults to feel represented – it provides an avenue for communicating a company's age-diversity climate, or the extent to which the organization demonstrates support for workers of all ages. Goldberg, Perry, Finkelstein, and Shull (2013) found that positive organizational diversity climate predicts the extent to which organizations target older workers in recruitment. Because organizations that develop practices to support and value older employees tend to be more successful in attracting and retaining older workers (Armstrong-Stassen & Schlosser, 2011), older job applicants are likely to have positive views of companies that specifically target them in their recruiting efforts. However, further research is needed to directly examine how companies can effectively tailor their recruiting messages around age diversity using Internet-based delivery methods. There is some evidence that online recruiting tool design features directly influence perceptions of an organization (e.g., Allen, Mahto, & Otondo, 2007; Cober, Brown, Keeping, & Levy, 2004; Maurer & Liu, 2007; Stone et al., 2015), but age differences in this area are not well understood and are a critical avenue for future research.

Researchers have also examined age differences in how employees seek out jobs in general, particularly as the number of older adults returning to work after retirement is rising (Wang et al., 2009). Findings in this area have been somewhat discouraging for older adults. For instance, Wanberg, Watt, and Rumsey (1996) showed that, on average, older adults tend to engage in job-seeking behaviors less frequently than their younger counterparts, and even when they do match younger adults' job-seeking frequency they are less likely to find work. Zacher (2013) showed that age is negatively related to job search intensity, although this is moderated somewhat by a proactive personality and perceptions of time and opportunities remaining in one's work life. Chan and Stevens (2001) found that adults over 50 years who had lost their jobs involuntarily were far less likely to be employed four years later. Kanfer, Wanberg and Kantrowitz's (2001) meta-analysis revealed that certain personality traits, such as openness to experience and extraversion, and other personal factors such as job search self-efficacy, were related to unemployment duration. This suggests that age-related within-person changes and other contextual influences work against older adults in the job search process, although older adults can be taught skills and capabilities that allow them to build self-efficacy in this area and appear more attractive to potential employers (Liu, Huang, & Wang, 2014; Taha, Czaja, & Sharit, 2015; Salmela-Aro, Mutanen, & Vuori, 2012; Vuori, Toppinen-Tanner, & Mutanen, 2012). Still, major research is needed to determine whether Internet-based recruiting tools in particular help older workers in their job search efforts by providing greater access to possible opportunities, or hurt older workers by introducing a potentially unfamiliar technology into an already complex process.

Limited research has investigated age differences in recruiting effectiveness, but there is some evidence that employees of different ages have different desires regarding and expectations of work. Older adults have greater intrinsic motivation (Inceoglu et al., 2012) and generativity motives (McAdams et al., 1993), which suggests that they are more attracted to job opportunities that emphasize these elements. Indeed, the job design literature suggests that older workers thrive in jobs that allow greater autonomy (Hertel et al., 2013; Ng & Feldman, 2014; Truxillo et al., 2012) and application of accumulated skills and knowledge (Kanfer & Ackerman, 2004; Zaniboni, Truxillo, & Fraccaroli, 2013). Kanfer

and Ackerman (2004) also suggested that older adults are attracted by opportunities to exercise their generativity motives and provide mentorship and guidance to others. However, the jobs that attract employees of different ages do not depend just on within-person changes over the lifespan, but also on societal context: Truxillo and colleagues (2014) observed that older and younger workers may desire different things from work because of different career expectations, norms, and nonwork responsibilities (e.g., family duties) at different life stages. Further research is needed to determine how organizations can effectively communicate, using Internet-based delivery methods, the job aspects that may be more attractive to older workers.

While researchers suggest that organizations should consider the needs of job applicants of all ages in the recruiting process, little attention has been paid to the application of Internet-based tools for supporting these processes and how these tools impact the attitudes and experiences of older and younger workers. There is considerable opportunity to apply existing research on age-related changes in cognition, personality, motivation, and societal context toward understanding how Internet-based recruiting tools can be designed to effectively recruit workers of all ages: for instance, to determine how older job applicants utilize SOC strategies in a recruiting setting (selecting job postings designed to match their cognitive needs and so on), and how these strategies can be optimized through e-recruiting methods. Additionally, there is opportunity to study more deeply the tendency among older adults toward positive emotional regulation as posited by SST (Carstensen, 1991) and how this can be optimized via use of Internet-based recruiting tools. Finally, given the importance of perceived social norms and behavioral control in older adults' use of technology (Morris & Venkatesh, 2000), future researchers should address how e-recruiting tools can be designed to enhance these perceptions, in order to ensure older adults are motivated to learn and utilize the technology.

Age and e-selection

Some research has been conducted on older adults in the job selection process, and it has been shown that older job applicants are less likely to be hired (Bal et al., 2011), which may be due to age stereotyping (Perry, Kulik, & Bourhis, 1996; Posthuma & Campion, 2009; Richardson, Webb, Webber, & Smith, 2013; Truxillo et al., 2014) and possibly even due to perceptions of candidate over-qualification (Erdogan, Bauer, Peiro, & Truxillo, 2011). However, some evidence also exists that widely used selection measures adversely impact older adults. For instance, because of within-person changes across the lifespan in cognition and personality, traditional cognitive ability and personality measures may capture different data from employees of different ages (Truxillo et al., 2014). Klein, Dilchert, Ones, and Dages (2015) found that older job applicants tended to score lower on tests of general mental ability, particularly on tests assessing fluid intelligence capabilities such as inductive reasoning. Because older adults tend to engage in compensation behaviors that may offset cognitive declines (e.g., Kanfer & Ackerman, 2004), lower scores on certain cognitive ability tests may not be indicative of how an older employee will perform on the job. Furthermore, while measures of proactive personality predict performance in a training context (Major et al., 2006), Bertolino, Truxillo, and Fraccaroli (2011) found that this was only true for younger workers. These findings indicate that older adults may be at a disadvantage not just in the traditional recruiting process, but also in the job assessment and selection process.

Much of the research in this area focuses on the content within selection measures and how this impacts the hiring process for job applicants of different ages. While provision of these measures via use of Internet-based tools will likely not change the content

(e.g., Bauer et al., 2006; Salgado & Moscoso, 2003), it is possible that the online nature of these tests will result in a different experience for job applicants of different ages. For instance, discomfort or unfamiliarity with technology can impact motivation to take tests and intentions toward an organization in an online selection context, as can concerns around information privacy (Bauer et al., 2006). These negative applicant reactions may influence test performance (Borman, Hanson, & Hedge, 1997). Older adults in particular display discomfort toward technology when it is unfamiliar or poses a possible information security risk (e.g., Mitzner et al., 2010). Furthermore, the decline in fluid intelligence and working memory capabilities with age (Salthouse, 2011) may be especially detrimental in an online measurement format in which applicants have to complete a test in limited time. However, the extent to which Internet-based selection test formats directly impact the performance of older job applicants relative to more traditional methods has not been studied.

In general, more research is needed to determine whether use of Internet-based selection tools negatively impact older workers, and whether these tools can be designed and positioned in a way that maximizes older workers' strengths while minimizing their limitations. Little is known about how lifespan changes in cognition, personality, and motivation can be addressed when designing online job selection tools. For instance, research has not determined whether there are design elements of e-selection measures and methods that can minimize age-related cognitive deficits in learning speed and capacity and maximize gains in crystallized intelligence, although providing unlimited time to complete an online selection test might help. Additional opportunities include exploring how older adults' tendencies toward optimization of current strengths (Baltes & Baltes, 1990) and positive emotional regulation (Carstensen, 1991, 1992) can be addressed in an Internet-based job selection process. Researchers should also explore the design elements of e-selection measures that foster job applicant perceptions of social norms and behavioral control (Morris & Venkatesh, 2000), given the importance of these perceptions for older adults. Finally, existing research around age-related bias in the job selection context (e.g., Richardson et al., 2013) has not been expanded to incorporate selection measures that are completed via the Internet. More research is needed to determine whether online selection measures exacerbate possible bias against older adults in the hiring process, or whether they can be designed to reduce age disparities in hiring.

Age and e-learning

Research shows that employees of different ages have different needs and requirements when it comes to training, regardless of the delivery medium. Kubeck, Delp, Haslett, and McDaniel (1996) found that older workers tend to take longer during training and they also tend to perform worse in a training context than their younger counterparts. Relatedly, stereotypes regarding the capabilities of older workers and relative lack of support may contribute to reduced self-efficacy and confidence in a training setting, inflating these negative age-related effects (Maurer, 2001). However, extensive research shows that age-related deficits in training outcomes disappear when the training is designed to meets the unique needs of older workers (e.g., Beier, 2008; Colquitt, LePine, & Noe, 2000; Kanfer, 1990; Maurer, Weiss, & Barbeitte, 2003). In her comprehensive review of training requirements for older workers, Beier (2008) described the distal traits and proximal processes that need to be taken into account when designing effective training for older workers. She suggested that factors such as employee cognitive ability, personality, self-efficacy, and goal preferences (all posited to change with age) greatly impact the way training is perceived and completed.

Although Ng and Feldman (2012) dispelled many commonly held stereotypes regarding older workers' performance and motivation, they found support for the idea that older workers may be less motivated to learn – which makes sense in terms of SST and the value of investing in development when time is perceived as being relatively limited. This may also be partially explained by the stereotype and meta-stereotype literatures (e.g., Finkelstein et al., 2015; Hughes et al., 2013). However, as with training performance, other research shows that when the training is designed and positioned in certain ways, the negative relationship between age and training motivation diminishes (e.g., Beier, Teachout, & Cox, 2012). For instance, older workers are just as motivated and capable in a training context as younger workers when they receive organizational support (Beier, 2014), when task self-efficacy is high (McCausland & King, 2014), and when the training is collaborative (Wolfson & Kraiger, 2014a). Aside from variations in training motivation, individual differences may also contribute to older employees' performance in learning and training exercises. Beier and Ackerman (2005) suggested that prior knowledge and ability is critical for older adults' acquisition of new knowledge. They found that levels of crystallized intelligence (posited to increase with age) predicted the extent to which older adults learned from an instructional video. Similarly, Carter and Beier (2010) reported that error management training, or training in which errors are framed as learning opportunities, was beneficial for learning among older adults, particularly when their pretraining cognitive ability was high. Self-pacing (Callahan, Kiker, & Cross, 2003) and generally allowing more time for completion of learning tasks (Beier, 2008) can greatly reduce age-related deficits in learning.

In relation to technology-based training in particular, similar requirements have been noted for older workers. Wolfson and colleagues (2014) proposed technology-based instruction should be highly structured, incorporate feedback and adaptive guidance, include metacognitive prompts, incorporate principles derived from CLT and CTML, and utilize a simple and consistent user interface to account for age-related cognitive changes. However, Goldstein and Ford (2002) argued many of these recommendations reflect best practices in training for all trainees. On applying some of these recommendations to a computer-based training course, Wolfson and Kraiger (2014b) observed that instructional coherence (or removing all irrelevant information from the course) improved training performance across all age groups, and that using advance organizers (e.g., bullet lists of the information that would be presented in the course) improved training performance among older adults. Furthermore, self-pacing is considered particularly beneficial for the learning of older adults and an advantage of offering training courses in a technology-based format (Derouin et al., 2005). However, as Beier (2008) posited, with traditional training design, simply crafting courses to promote older workers' training motivation and performance is not sufficient to eliminate age-related learning deficits. Contextual factors such as organizational support, trainee self-efficacy, and training content also need to be taken into account to ensure training effectiveness across all ages (Liu, Courtenay, & Valentine, 2011; Maurer et al., 2003; van Rooij, 2012). Although Wolfson and colleagues' (2014) recommendations give us an elementary understanding of how Internet-based training courses can be designed to support the needs of older workers effectively, further research is needed to determine how these courses and the processes surrounding them can be designed to promote self-efficacy and communicate organizational support.

Taken together, findings regarding age and learning suggest that older adults can be competent in a training context when the right contextual and course design elements are included. Due to limited research in the area to date, it is unclear how Internet-based training in particular will impact training motivation and performance among employees

of different ages, and how these courses can be designed to best support the needs of all workers. We have speculated on how organizations might achieve this based on prior research findings around age and learning, but further research is needed to determine how age-related changes over the course of the lifespan influence learning and self-efficacy in an Internet-based training context. For instance, while some research has investigated the role of age-related cognitive changes in computer-based instruction (e.g., Wolfson et al., 2014), further research is needed to determine how e-learning in particular can be designed to offset cognitive declines and optimize cognitive strengths. Furthermore, little is currently known about how e-learning can be designed to maximize older adults' motivation to learn, account for older adults' tendency toward positive emotional regulation (Carstensen, 1991, 1992), and enhance perceptions of social norms and behavioral control (Morris & Venkatesh, 2000).

Career development Although it goes beyond traditional training, career development is also increasingly being supported in organizations using Internet-based tools (Crocitto, Sullivan, & Carraher, 2005; Hendrickson, 2003). Age differences in this area have been relatively understudied, but there is some evidence that older adults may not have the same developmental opportunities as their younger counterparts. For instance, Finkelstein, Allen, and Rhoton (2003) showed that older adults receive less mentoring. Older workers are also less likely to receive any form of career counseling from their supervisors (Cleveland & Shore, 1992), they tend to receive lower ratings of promotabilty (Shore et al., 2003), and they have a lower likelihood of actually receiving promotions (Goldberg et al., 2004). SST posits that older adults are less motivated by career advancement (Carstensen, 1991, 1992). However, Zacher and Frese (2011) found that effective use of SOC strategies predicts greater interest in furthering one's career. Age-related stereotyping may also lead to disparate treatment of older adults around career development. T. J. Maurer and colleagues (2007) suggested that employee development is influenced by negative stereotypes, discrimination, and differences in access to developmental opportunities among employees in different age groups. Further research is needed to determine whether supporting career development via use of Internet-based tools increases the detrimental effect of aging on development opportunities, or whether these tools can be leveraged to provide more equitable access to career advancement programs and training for workers of all ages.

Age and virtual teams

As virtual teams are rapidly gaining popularity, considerable research has investigated the antecedents of and barriers to virtual team effectiveness. This research has revealed that the more successful virtual teams are those in which team members have some common ground, loosely coupled work tasks, and readiness for collaboration and adopting collaboration technology (Olson & Olson, 2000). Furthermore, when virtual team members' collaboration frequency matches the style of work (e.g., more interrelated tasks requiring more frequent, scheduled communication), the teams will have higher performance (Rico & Cohen, 2005). It seems that although factors typically related to team performance, such as trust, are important, they are even more important in driving team outcomes when members do not meet face to face (Zigurs, 2003). However, the age composition of virtual teams and the impact this has on team member attitudes and performance remains unresearched (Gilson, Maynard, Young, Vartiainen, & Hakonen, 2015). This area seems particularly ripe for study, given possible differences in comfort levels, especially between age groups, in using social media to manage relationships.

Researchers examining traditional teams have given us some understanding about how age may impact team functioning, especially age disparity or diversity within the team: teams composed of members of varied ages may not perform as effectively as those composed of members closer in age (e.g., Kunze, Boehm, & Bruch, 2011; Liebermann, Wegge, Jungmann, & Schmidt, 2013; Molleman, 2005). Several theories have been applied toward explaining this phenomenon. Social identity theory (SIT; Tajfel, 1974) suggests that people categorize others as being part of their "in-group" or "out-group." Although a number of factors can cause these categorizations, demographic characteristics have been found to be particularly robust. The concept of relational demography suggests that individuals categorize others who are demographically similar to themselves as part of their "in-group" (Riordan, 2000), and display more positive attitudes towards them. Field studies of demographic differences in the workplace, however, have shown mixed results. With regards to age diversity in particular, some studies have reported negative outcomes (Kearney & Gebert, 2009; Kunze et al., 2011; Liebermann et al., 2013; Timmerman, 2000), whereas others show no effect (Horwitz & Horwitz, 2007; Webber & Donahue, 2001) or even positive outcomes (Boehm, Kunze, & Bruch, 2014; Kearney, Gebert, & Voelpel, 2009; Wegge, Roth, Neubach, Schmidt, & Kanfer, 2008). However, no research to date has examined outcomes for age-diverse teams that operate and communicate virtually.

Positive relationships have been reported between age and some components of job performance (Ng & Feldman, 2008) and workplace attitudes (Ng & Feldman, 2010). Together these findings indicate that older workers may be at an advantage in building relationships within a virtual team, as their performance and attitudes could favorably impact other team members. Indeed, SST suggests that older adults gravitate toward forming meaningful social relationships, which may be beneficial in building and maintaining relationships among virtual team members (Carstensen, 1992), and older adults' increased generativity motives (e.g., Kanfer & Ackerman, 2004) may help build effective team relationships in a virtual context. However, we base these suggestions on prior research that has examined age, job performance, and teams – researchers need to consider how these research streams can be combined to deepen our understanding of how age manifests itself in a virtual team setting. In addition, age-related lifespan changes in particular have not yet been applied toward understanding the experience of workers of different ages in virtual teams. For instance, little is known about how virtual team communication tools and processes can be designed with respect to age-related cognitive changes, and whether these tools can optimize older workers' cognitive strengths. The extent to which SOC strategies are used in virtual team settings, and how virtual team communication tools and methods can foster these strategies also needs to be better understood. Finally, how virtual team communication tools and methods can enhance older workers' perceptions of social norms and behavioral control, which influence their attitudes toward and adoption of these tools, also needs further attention.

Age and e-leadership

Virtual teams have been shown to rely more heavily on team member relationships than on the influence of one particular leader (Hoch & Kozlowski, 2014). However, as with all teams, a leader is critical for directing and driving virtual team performance (e.g., Cascio, 2000; Kearney & Gebert, 2009), and effective communication is an important component of this process. Although leaders may be challenged to use Internet-based communication channels effectively (Cascio, 2000; Walvoord, Redden, Elliott, & Coovert, 2008), leadership styles are evident even in virtual communications. Kelloway,

Barling, Kelley, Comtois, and Gatien (2003) conducted a study in which they sent emails to students from a "manager" that were written in such a way as to capture different management styles. The email recipients could distinguish between the different management styles in the emails, and emails drawing on a transformational leadership style in particular led to better perceived justice and greater satisfaction with the manager. Other research on e-leader effectiveness also suggests transformational leadership styles are associated with the greatest success (Grant, 2012; Judge & Piccolo, 2004), and that transformational leadership in particular predicts more successful outcomes for e-leaders than in typical face-to-face management (Purvanova & Bono, 2009; Zigurs, 2003). There is some evidence that transformational leadership behaviors increase with age (Barbuto, Fritz, Matkin, & Marx, 2007), which suggests that older leaders may be particularly effective in a virtual setting. However, little is known about how age-related changes in cognition, for both leaders and followers, impact experiences with and effectiveness of e-leader communication tools and processes. Further research is needed to determine how lifespan changes impact e-leader effectiveness, as well as how e-leader communication tools can be designed to enhance perceptions of social norms and behavioral control for both older leaders and followers.

A well-researched predictor of leadership effectiveness is leader–member exchange (LMX), or the quality of the relationship between a leader and his or her followers (e.g., Bauer & Erdogan, 2016). Little research has directly examined the impact of the age of the leader and follower(s) on LMX (Truxillo & Burlacu, 2016). Although followers' *expectations* of leaders and how this influences perceptions of their effectiveness has been examined, this has rarely been investigated in an e-leadership setting. For instance, although we know followers have more positive impressions of older leaders who display generativity and legacy beliefs, that is, beliefs that their work will be remembered and remain impactful after they are gone (Zacher, Rosing, Henning, & Frese, 2011; Zacher, Rosing, & Frese, 2011), no research has examined the extent to which these characteristics are evident in a virtual setting. Furthermore, age-related stereotypes in the context of e-leadership need to be better understood, particularly given e-leaders' reliance on technology and possible attitudes regarding older adults' capabilities in learning and using technology (e.g., Czaja et al., 2015).

Performance management Employees' performance management is one of the critical HRM responsibilities of a leader. The role of age in using and adopting Internet-based performance management tools has not been researched. However, employee and manager age have been studied in the context of traditional performance measurement and management. Such research has shown that age-related stereotypes influence expectations of how employees will perform, as well as ratings of that performance (Landy & Farr, 1980; Murphy & Cleveland, 1995). Older workers are generally expected to have lower job performance than younger workers (Gordon & Arvey, 2004; Hedge et al., 2006), possibly due to assumptions that older adults have lower ability and motivation (Kite, Stockdale, Whitley, & Johnson, 2005). It is worth noting, however, that studies examining job performance (Ng & Feldman, 2008) and motivation (Inceoglu et al., 2012) do not support these claims. Employee age has also been found to interact with supervisor age, such that younger supervisors tend to give older subordinates lower ratings of promotability (Shore et al., 2003). Further research is needed to determine whether use of Internet-based tools that allow companies to collect and report performance data can alleviate some of these stereotype-driven outcomes.

Although performance feedback continues to be an important component of performance management in organizational practice (Alvero, Bucklin, & Austin, 2001; Wang, Burlacu, Truxillo, James, & Yao, 2015), it is not always effective in eliciting improved performance. Kluger and DeNisi (1996) showed that 40% of feedback events lead to performance decline, which may be due in part to how the feedback is perceived by the receiving employee. Feedback that is perceived as being more credible and useful tends to elicit better outcomes (Brett & Atwater, 2001). Little research has examined feedback reactions and how they differ with employee age, but employees of different ages may desire different things from their feedback experiences. For instance, SST suggests that younger adults will be more concerned with growth and development, while older adults will be more concerned with positive emotions and meaningful relationships. This argument is supported by the findings of a feedback study which showed that older workers had feedback orientations focused on social awareness, while younger workers had feedback orientations focused on utility, or usefulness of the information contained in the feedback (Wang et al., 2015). Furthermore, they found that older workers had stronger positive reactions to feedback that was favorable and delivered in a polite, forthcoming manner, while younger adults had stronger positive reactions to feedback that contained high-quality information. Wang et al.'s (2015) findings imply that age differences in motivation may extend to the performance feedback experience, particularly influencing reactions to the delivery medium. For instance, older workers may find technology-delivered performance appraisal and Internet-based performance metrics less palatable, although this still needs to be empirically examined.

In general, further research is needed to determine the role that cognitive, motivational, and developmental lifespan changes play in the adoption of and experience with e-performance management tools. It is not yet understood how these tools can be developed and positioned to optimize older workers' motivation, or their perceptions of social norms and behavioral control around using these tools. Furthermore, because performance management impacts both leaders and followers, it is important to investigate the age-related factors that influence the acceptance, adoption, and optimization of this technology from the perspective of both groups.

Future Research

As noted throughout this chapter, little research has been conducted on the impact that use of Internet-based work tools has on the motivation, learning, and performance of employees of different ages. Yet the limited research on age-mindful HRM processes that accommodate, build, and develop workers of all ages (e.g., Boehm et al., 2014; Kooij, Jansen, Dikkers, & de Lange, 2014; Kunze et al., 2011; Truxillo et al., 2014; Truxillo et al., 2015), combined with the extensive research on lifespan and societal factors that influence age-related changes in cognition, personality, motivation, and self-efficacy and ability to use technology, provides a framework for research questions that industrial and organizational psychologists should address in the future and which are outlined in Box 20.1. We start by providing examples of broad research questions that may be addressed by combining the existing literatures on age and Internet-based HRM tools, which has not previously been done. Such an exercise will greatly advance our understanding of how these tools can be developed and positioned to meet the needs of employees of all ages, with particular attention paid to the cognitive, motivational, and contextual needs of older workers. We then provide additional research questions that build on existing findings around age and HR processes, which provide a fruitful

Box 20.1 Suggested research questions regarding age-related changes and Internet-based workplace technology use.

Age and e-recruiting
How can age-related changes in cognition, personality, motivation, and lifespan development be taken into account when designing e-recruiting tools and processes?

Research questions examining lifespan development influences on e-recruiting:

- How do older adults utilize SOC strategies in the context of e-recruiting, and how can recruiting tools be designed to maximize the use of these strategies?
- How can organizations factor in older adults' disposition toward positive emotional regulation in an e-recruiting context?
- Given findings around age and technology use, how can organizations design e-recruiting tools and methods that enhance perceptions of social norms and behavioral control?

Research questions applying existing findings around age and recruiting toward the study of Internet-based recruiting tools:

- What are the aspects of e-recruiting processes that minimize perceptions of age discrimination and maximize older adult representation?
- Can elements of e-recruiting be altered to reduce perceived discrimination and effectively communicate positive age diversity climate?
- How do the design features of e-recruiting tool influence older and younger adults' perceptions of an organization?
- How do Internet-based recruiting methods impact older adults' job search experience?
- How can e-recruiting tools and methods be designed to effectively communicate job aspects that are likely to appeal to older adults?

Age and e-selection
How can age-related changes in cognition, personality, motivation, and lifespan development be taken into account when designing e-selection measures and processes?

Research questions examining lifespan development influences on e-selection:

- How can e-selection measures compensate for age differences in learning speed and capacity?
- Are there specific elements that maximize older adults' cognitive strengths while minimizing their deficits?
- How can organizations factor in older adults' disposition toward positive emotional regulation and SOC strategies in e-selection?
- Given findings around age and technology, how can organizations design e-selection measures and methods that enhance perceptions of social norms and behavioral control?

(*Continued*)

Box 20.1 (*Continued*)

Research questions applying existing findings around age and selection toward the study of Internet-based selection tools:

- Do online selection assessments negatively impact the performance of older job applicants relative to traditional paper-and-pencil testing methods?
- Do online selection assessments exacerbate bias against older workers in the hiring process? How can these tools be designed to reduce bias-driven age disparities in hiring?

Age, e-learning, and career development
How can age-related changes in cognition, personality, motivation, and lifespan development be taken into account when designing e-learning courses and processes?

Research questions examining lifespan development influences on e-learning:

- How can e-learning methods compensate for age differences in learning speed and capacity?
- Are there specific elements that maximize older adults' cognitive strengths while minimizing their deficits?
- How can e-learning courses be designed and positioned to maximize older worker training motivation?
- How can organizations factor in older adults' disposition toward positive emotional regulation in e-learning?
- Given findings around age and technology, how can organizations design e-training courses and methods that enhance perceptions of social norms and behavioral control?

Research questions applying existing findings around age and learning toward the study of Internet-based training and development tools:

- How can organizational support be developed and communicated in an e-learning context to ensure older workers feel self-efficacious, both around technology use and around training capability?
- How do Internet-based career development tools impact the development experience of older workers?

Age and virtual teams
How can age-related changes in cognition, personality, motivation, and lifespan development be taken into account when designing virtual team communication tools and processes?

Research questions examining lifespan development influences on virtual teams:

- How do the motivations and preferences of older adults (e.g., forming meaningful social relationships, generativity) manifest themselves in a virtual team setting?
- Given age-related changes in cognition, what Internet-based team communication tools and processes meet the needs of employees of all ages?
- Are there elements of virtual team communication tools and processes that leverage older workers' cognitive strengths?

(*Continued*)

Box 20.1 (*Continued*)

- How do older workers utilize SOC strategies within virtual teams?
- Given the positive outcomes that result from greater use of SOC strategies, are there design elements of virtual team communication tools that will promote the use of these strategies for older adults?
- Given findings around age and technology, how can organizations design virtual team communication tools and processes that enhance perceptions of social norms and behavioral control?

Research questions applying existing findings around age and teams toward the study of virtual team functioning and communication:

- How does age diversity impact virtual team functioning?

Age, e-leadership, and performance management

How can age-related changes in cognition, personality, motivation, and lifespan development be taken into account when designing e-leader communication and e-performance management tools and processes?

Research questions examining lifespan development influences on e-leadership and e-performance management:

- Given age-related changes in cognition, how can Internet-based communication tools and processes be designed to meet the needs of leaders and followers of all ages?
- Given findings around age and technology, how can organizations design communication tools and methods that enhance perceptions of social norms and behavioral control, from the perspectives of both e-leaders and e-followers?
- How can e-performance management be designed and positioned to maximize older worker motivation?
- Given findings around age and technology, how can organizations design e-performance management tools and processes that enhance perceptions of social norms and behavioral control, both for leaders and followers?

Research questions applying existing findings around age and leadership toward the study of e-leader effectiveness, communication, and e-performance management capabilities:

- How can older leaders effectively communicate aspects of their leadership style, such as generativity and legacy beliefs, via virtual communication channels?
- How do age-related stereotypes manifest themselves in the context of e-leadership? What role does communication technology play in these stereotypes?
- How do Internet-based performance measurement tools impact performance ratings that may be age stereotype-driven?
- Given older adults' preferences regarding meaningful, positive social interactions and the fact that Internet-based performance management may be relatively impersonal, what are the design components of an e-performance management system that can optimize older adults' motivation to attend to and incorporate feedback?

framework for understanding how age manifests itself in the workplace but which have not been extended to the use of Internet-based tools that support organizations in recruiting, training, and managing employees.

Conclusion

The use of Internet-based tools supporting HR processes is solving numerous organizational challenges around managing costs, building efficiencies, and scaling effective workforce management. The tools have rapidly gained popularity (Bhatt, 2015; Cascio, 2000; Marler & Fisher, 2013) and will likely see increased use as the nature of work becomes more global, complex, and technologically based. Although these tools carry the expected challenges of end-user training and change management as with any new HRM process (Caldwell, 2001; De Leede & Looise, 2005; Voermans & van Veldhoven, 2007), there is reason to believe employees of different ages (particularly those who are older) may be differentially impacted by the use of these tools. Changes in cognition, personality, motivation, and socio-emotional preferences may all influence how these tools are perceived and to what extent they are effectively adopted. Societal context and age-related expectations and stereotypes may have a role as well. Given the changing demographic trends in industrialized nations with growing prevalence of older workers at all organizational levels, these impacts need to be better understood. Industrial and organizational and work psychologists are well positioned to lead future research in this area, providing organizations with guidance around how to use cost-saving yet effective technologies to manage their demographically diverse workforces.

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Dianna L. Stone, Richard D. Johnson,
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