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Curvilinear Relationships Between Age and Job Performance and the Role of Job Complexity

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Abstract

Despite suggestions that work performance varies with age, the empirical evidence is inconclusive and contradictory. Possible reasons for this are the lack of differentiation between different types of performance and a naive assumption of a negative linear relationship between age and task performance across the working lifespan. With this study we question and revisit these expectations. We take a lifespan perspective to explore differential and curvilinear relationships between age (measured as chronological age) and three types of task performance (task proficiency, proactivity, and adaptivity), moderated by job complexity (measured as cognitive demands). Using Bayesian polynomial regression on survey data from 903 employees, we tested the relationships between age and each performance type, with job complexity as a moderator. The data indicated a U-shaped age–adaptivity relationship (main effects for job complexity) and an S-shaped age–proactivity relationship that was more pronounced under low job complexity (interaction effect). We identify the turning points for these changes, which show midlife as a critical period for changes in performance where the job context itself shapes the gradient and direction of these changes. Our findings provide crucial evidence that different types of job performance vary by age and the role of perceived job complexity in explaining trajectories in proactivity and adaptivity. Implications for job design, organizational interventions, and human resource management are discussed.

Keywords: age, job performance, job complexity, lifespan perspective

Understanding the factors linked to performance across the lifespan is a priority among governments and organizational researchers (Shultz & Adams, 2007). In the current climate of an aging workforce and ongoing global challenges in economic and employment conditions, discerning whether task performance is stable or whether it changes with age can have substantial implications for managing an older workforce, employability, and sustainability (Dalal et al., 2014; Zacher, 2015). However, existing research does not allow for conclusive evidence on the direction or shape of this relationship: some studies indicate that performance increases with age, others that it decreases, and others that the two are unrelated (for reviews, see McEvoy & Cascio, 1989; Sturman, 2003; Waldman & Avolio, 1986; Warr, 1994).

There are two possible reasons for this. First, the majority of research has tended to neglect the life course. Different age periods are characterized by different time-role transitions, challenges, changes in needs and priorities, life stages, and changes in abilities and competencies (Heckhausen, 2001; Lachman, 2004). Indeed, there is some evidence from work psychology and organizational research for differences in task performance across different age groups: an initial increase in performance that is followed by a plateau (Avolio et al., 1990; Hoffman et al., 1992; McEvoy & Cascio, 1989; Ng & Feldman, 2008; Sparrow & Davies, 1988; Sturman, 2003). It is therefore possible that the commonly reported near-zero correlation between age and performance mask curvilinear effects (McEvoy & Cascio, 1989; Strauss et al., 2015a, 2015b) of changes over time.

Second, research has tended to focus on performance as on-the-job competence. Often erroneously equated to productivity (Koopmans et al., 2011), performance has been measured as sales quotas (Porath & Bateman, 2006), job knowledge (McDaniel et al., 1988), or work facilitation (Wright & Bonett, 2007), using a range of sources such as supervisory ratings, peer ratings, and self-reports (McDaniel et al., 1988; Waldman & Avolio, 1986; Wright & Bonett, 2007). However, research findings vary depending on whether task performance is assessed by objective measures or supervisor ratings (Cleveland et al., 2019). Furthermore, there is

consensus that as a multidimensional construct (Koopmans et al., 2011; Ng & Feldman, 2007), performance also reflects positive and active work behaviors (Griffin et al., 2010), which can have more complex links with individual age-related changes. As per Cleveland and colleagues (2019, p. 296), "when examining the relationship between age and task performance, it is important to consider the operationalization of performance." Because human functioning, goals, motivation, and psychological and tangible resources change across the life course, different types of performance may have different trajectories with age.

The aim of this study is to examine the relationship between age and performance. We apply a life course lens to explore change and stability in three types of task performance, focusing specifically on the core dimensions of positive work role performance: proficiency, proactivity, and adaptivity (Griffin et al., 2007). Using more active conceptualizations of task performance that approach it as a multidimensional construct can help us to fully understand how it may vary with age. In addition, because job complexity ("the extent to which a job is multifaceted and difficult to perform," Humphrey et al., 2007) is an essential part of role definitions, a motivational feature of work, and important for positive work behaviors (Humphrey et al., 2007), we consider it as an explanatory factor in this relationship. As the current available evidence is inconclusive, we use a blend of confirmatory and exploratory approaches. We revisit relationships examined in past research and extrapolate on relationships not yet examined—we therefore consider these analyses exploratory. Finally, it is beyond the scope of this study to consider all types of performance—rather, we focus on task or work role performance, and specifically the distinct task proficiency, proactivity, and adaptivity. Next, we define performance, present the conceptual bases for our study, review the evidence on differential relationships for age and performance, discuss the role of job complexity in this relationship, and finally present the study and its findings.

Understanding Performance

Job performance is about applying one's abilities and resources to the needs of the job and the organization. There are several proposals of what facets a multidimensional view of performance should consider (e.g., Griffin et al., 2007; Koopmans et al., 2011; Ng & Feldman, 2007). A first distinction is that of task performance (behaviors focused on completion of tasks defined in the formal job description) versus contextual performance (or citizenship: positive behaviors focused on organizational efficiency that also enhance completion of job tasks; Motowidlo & Scotter, 1994). *Task performance* or *task proficiency* is the competency that helps an individual to meet goals and perform central tasks of their job (Koopmans et al., 2011). Although task proficiency represents the narrowest definition of performance, its relationship with age has received the most attention by researchers (Griffin et al., 2007). However, performance is more than meeting job role expectations. It also covers behaviors that support the broader environment of "the technical core" (Koopmans et al., 2011) and contribute to broader organizational goals (Rotundo & Sackett, 2002).

To *task proficiency*, Griffin and colleagues (2007) added *proactivity* and *adaptivity* to include behaviors that describe "individuals adapt to changing conditions and proactively act to anticipate new challenges" (Griffin et al., 2010, p. 174). Whereas task proficiency is about responding to predictable situations, proactivity and adaptivity are more change-oriented, forward-looking and appropriate in unpredictable situations or uncertain work environments (Griffin et al., 2010). They are also important for supporting task performance (Koopmans et al., 2011; Motowidlo, 2000), and not just individual but also team and organizational effectiveness (Griffin et al., 2007, 2010). Furthermore, "proactivity emphasizes self-initiated change to actively change the self or the environment, whereas adaptivity emphasizes successfully accommodating the uncertainties of externally initiated change" (Griffin et al., 2010, p. 175). Such a capacity to change and adapt to the needs of the situation and achieve "dynamic fit" is essential (De Vos et al., 2018) as it can support sustainable development by supporting career growth, continuity (De Lange et al., 2015, 2021), and the creation of opportunities (Holling, 2001).

These three facets of performance reflect the shift towards viewing it as a dynamic behavior that includes an element of within-person variability (Dalal et al., 2014). Such a shift makes practical and conceptual sense. It is highly relevant to a life-course perspective and its essential elements of change and adaptation. It implies a key role for individual differences such as age and developmental or career stages in performance. It places the individual in the center, not as a passive recipient but as an actor who defines their relationship with work and responds to environmental influences.

Job Performance and Age: A Lifespan Perspective

Adult aging is characterized by gains and losses, growth and reorganization (Fuller-Iglesias et al., 2010; Heckhausen, 2001; Kanfer & Ackerman, 2004). Aging brings declines in physical, mental, and cognitive abilities (Kenny et al., 2008; Kunze et al., 2013; Ng & Feldman, 2007, 2008; Verhaeghen & Salthouse, 1997) but also growth in sought-after experience and skills (Oswick & Jones, 1991), motivation, and intellectual and social capital (Peterson & Spiker, 2005). Some capacities increase with age (e.g., job knowledge, psychosocial resources; Zacher & Kooij, 2017) and others remain stable through life (e.g., crystallized intellectual abilities; Kunze et al., 2013). Importantly, aging is not uniform. Individually and in combination, environment and individual agency determine growth and decline, making it difficult to ascertain the shape of the trajectory of performance across the working lifespan.

To understand age-related changes in job performance, a wider lens is therefore needed. The lifespan approach allows for a more supple and comprehensive understanding of environmental/contextual factors (e.g., resources, demands) and individual factors (e.g., goals, self-regulation) as they vary over the life course, and in turn, change the trajectory of work performance across the lifespan. Next, we outline the stages of adulthood and changes in resources that each brings, before we explore counterbalancing individual changes.

Resource gains and losses across the three stages of adulthood

Accumulation of resources over the lifespan supports better adaptation with age-related losses (Baltes & Lang, 1997).

According to the deficits-breed-growth mechanism (Baltes et al., 1999), losses are as important for human adaptation and development as they can fuel adaptive capacity and the application of proactive strategies (Zacher & Kooij, 2017). The balance and timing of gains and losses across the life course is also important, while the midpoint, midlife, is critical for understanding changes in resources across the lifespan.

There are three broad stages of adulthood (Levinson, 1986), each characterized by different resource gains and losses (Baltes & Dickson, 2001; Huffman et al., 2013). The early or exploration stage (18–30 years of age) is characterized by identity exploration and minimal role strain, and is manifested through experiences such as furthering education, starting a career or a family (Erikson, 1968; Huffman et al., 2013). Key concerns are education, child-rearing, and career establishment (Lachman, 2004). The middle or establishment stage (25–49 years of age) is characterized by progressively more responsibilities in all life domains. Multiple roles can lead to conflict and, in turn, to poor integration in the workplace (e.g., reduced job performance and commitment, higher accident rates and turnover; Biddle, 1986), heightening opportunities for role conflict and consequences of ambiguity, discontinuity, and overload. Key concerns include child-rearing, career changes, pre-retirement planning, the menopause, and the empty nest (Lachman, 2004). The late or maintenance stage (45–65 years of age) is characterized by integration of life experiences and a shift in goals from work to family and leisure, with fewer work and family responsibilities, increased resources available to manage multiple demands (Huffman et al., 2013), and more stable relationships (Lachman & Firth, 2004). Key concerns include retirement, caregiving, the empty nest, and grand-parenting (Lachman, 2004).

Midlife "holds a sandwich position" (Heckhausen, 2001), a unique "age-temporal position in the life-course" between the first half, characterized by growth processes (e.g., the development of expertise and improved emotional functioning), and the second half, characterized by losses and stability (e.g., in physical functioning and future time perspective) (Heckhausen, 2001; Fuller-Iglesias et al., 2010). In midlife, there seems to be an accumulation of both resource losses (Glymour et al., 2009) and resource gains, such as work motivation (Kanfer & Ackerman, 2004) and health (Fuller-Iglesias et al., 2010). Pivotal points here are time-based role change transitions (e.g., becoming a parent) and exit transitions (e.g., state or role changes; Fuller-Iglesias et al., 2010), which pose demands (e.g., related to one's family or career) but also boost the capacity to adapt and be proactive (Fuller-Iglesias et al., 2010; Zacher, 2015). Importantly, there is some discontinuity in this "reorganization" (Kanfer & Ackerman, 2004, p. 447) and the timing of gains and losses, which appears to be around the midpoint of the working life course. The resources necessary to manage more excessive work and non-work demands are not yet developed (Huffman et al., 2013), compromising successful coping and impacting on performance. Indeed, an inverted-U pattern for age and job satisfaction and context-free mental health has been found (Clark et al., 1996), suggesting that both "are affected by non-job factors of life-stage and personal circumstances" (Clark et al., 1996, p. 57). Thus, irregular resources at midlife or the midpoint of the working life course will affect the relationship between age and performance.

Regulation of goals and emotions

The regulation of goals and emotions is critical for successful aging as it can help to successfully balance gains and losses across the lifespan, thus allowing us to forecast performance trajectories. As individuals grow older, they select goals to enhance the use of relevant resources and manage the losses appropriately and efficiently, thus enabling them to achieve successful aging (Freund, 2008). As Selection–Optimization–Compensation theory (SOC; Bajor & Baltes, 2003) describes, individuals select the goals to direct their efforts, optimize resources to achieve these goals, and compensate for potential losses by applying alternative means to achieve these goals (Bajor & Baltes, 2003). In this way, they are able to support capacities that tend to decrease with age (Zacher & Kooij, 2017). The use of SOC strategies in the workplace (Demerouti et al., 2014) is linked to positive outcomes for older workers (Freund & Baltes, 1998, 2002) and can contribute to successful aging at work (Baltes & Baltes, 1990). Dealing with loss becomes increasingly important, as the losses-to-gains ratio changes with age (Baltes, 1987). Indeed, middle-aged and older individuals report higher use of SOC strategies (Freund & Baltes, 2002). Older workers are better able to deploy resources to cope with demands, distinguish between important goals, and adapt to change (Kunze et al., 2013). They use their mental, physical, and social resources to deal with age-related losses (Cleveland et al., 2019) and are thus progressively more able to regulate imbalances in gains and losses, with a positive impact on work outcomes such as performance.

Progression through the stages of adulthood may lead to a shift of attention to emotion goals (socioemotional selectivity theory [SST]; Carstensen, 1992; Carstensen et al., 2003), especially given perceived limitations of time (future time perspective). Owing to the remaining time in life, chronological age appears to be robustly related to shifts towards more emotionally meaningful goals (Carstensen et al., 2003), in turn affecting individuals' interactions with their environments (e.g., the workplace) (Rudolph et al., 2018). For example, older workers may focus more on the development of social relationships and generativity motives (Kooij & Van de Voorde, 2011), whereas younger workers may be more motivated by career goals and developing more skills and knowledge (Cubrich & Petruzzelli, 2020; Penningroth & Scott, 2012). Due to perceived limitations of time, older workers tend to be more motivated by goals to establish powerful social relationships within the work environment (e.g., Henry et al., 2015) and less so by accomplishment and excellence at work (Kanfer & Ackerman, 2004). Changing goal orientations are also reflected in behavior. Specifically, SST has been applied to explain the motivational process behind the age effects on work-related outcomes and successful aging at work (Cubrich & Petruzzelli, 2020; Ng & Feldman, 2013; Zacher et al., 2018), whereas Ng and Feldman's (2008) meta-analysis also showed stronger organizational citizenship behavior with age. Therefore, through goal regulation, individuals may become progressively more focused on goals that are intrinsically meaningful, in turn yielding positive impacts on work performance.

Differentiated Relationships Between Age and Performance

Although individuals use different approaches to maintain optimal functioning, regulate their emotions, and optimize

their resources at different stages of life, this process will be highly idiographic to each individual and their life stage, personal needs, life goals, or job characteristics. In addition, if different stages of the working lifespan are linked to different goals, roles, and resources, then different facets of performance may have different change trajectories with age. Next, we explore the changes in task proficiency, adaptivity, and proactivity across the life course. Note that in this study we measure age as a continuum but draw on life stages to understand when and how different facets of performance may change, with a focus on midlife as the working life midpoint where major changes take place.

Age and task proficiency

Task proficiency, the narrowest definition of performance (Griffin et al., 2007), is concerned with the extent to which employees perform the central tasks of their job (Koopmans et al., 2011) and meet the expectations of their job role (Griffin et al., 2007). Task proficiency can vary with changes in skills and knowledge (Motowidlo & Scotter, 1994) and in abilities and experience (Skirbekk, 2008). Early cross-sectional research indicated that the quality of job performance increases with age but only up to a certain point, after which it starts to decrease (McEvoy & Cascio, 1989; Sparrow & Davies, 1988). Supervisor ratings also support a positive age–performance relationship, with performance declining from the fourth decade of life (Avolio et al., 1990). However, meta-analytical research has not supported the idea of an inverted U-shaped relationship between age and performance (Sturman, 2003).

The difficulty in sketching a universal relationship between age and task proficiency may be explained in three ways. First, the complexity of the person–situation context that determines performance outcomes limits our ability to generalize on the age–performance relationship across the lifespan (Sturman, 2003). Second, some physiological and cognitive changes only start in the final decades of working life and before retirement (i.e., 45–65; Levinson, 1986; Shephard, 2000) but the exact timing shows high intraindividual variability. Second, physiological and cognitive changes may be compensated for or moderated by a broad range of contextual work factors such as the type of task (Riby et al., 2004), work experience (Ilmarinen, 2006; Peeters & Van Emmerik, 2008), instability of the work environment (Niessen et al., 2010), or promotion to more demanding jobs (Sturman, 2003). Finally, in later working life stages, gains are accrued in experience and resources (e.g., social support, marital status, stable friendships, social mobility, socioeconomic status) that can match increasing work challenges, promote adaptation, and offset physiological and cognitive losses (Heckhausen, 2001). Because task performance captures effectiveness on the job under relatively stable and predictable situations (Griffin et al., 2010) and because task proficiency can change with contextual characteristics (Sturman, 2003) as opposed to more idiosyncratic characteristics, it is also more volatile, which makes it difficult to extract a universal relationship between age and task proficiency.

To further explore this question, we turn to job-related contextual factors. Sturman (2003) examined contextual factors to explain possible curvilinear relationships between age and performance. Job complexity describes stimulating and challenging demands at work (Fried et al., 2002) or the extent to which the work is difficult, requires high-level skills, and is mentally demanding (Morgeson & Humphrey, 2006). It can be measured both objectively as job title/seniority and subjectively as respondents' perceptions. Subjective job complexity is just as relevant, maybe even more so, than objective job complexity, because the subjective better captures how well a person is equipped with knowledge, skills, and abilities for the job, which may be more important for performance than objective job complexity. Sturman's meta-analysis showed that a curvilinear age–performance relationship exists for jobs of high complexity, such that, over time, "experience becomes more predictive of job performance in high complexity jobs" (Sturman, 2003, p. 626). In addition, job complexity is positively linked to work performance (Fried & Ferris, 1987), both directly and indirectly by enhancing the focus on opportunities (Zacher et al., 2010), helping to focus resources on the task itself.

Hypothesis 1a: There is a linear relationship between age and task proficiency

Hypothesis 1b: The relationship between age and task proficiency is moderated by job complexity, such that higher job complexity is linked to greater task proficiency over the life course

Age and proactivity

Where performance also describes the ability to respond to unpredictable situations and meet certain job tasks under expected as well as unstable conditions, it would depend more strongly on within-person changes. Proactivity has been conceptualized as initiative, innovative work behavior, voice, job crafting, feedback seeking, and career management (Zacher & Kooij, 2017). It has two broad dimensions: on-the-job proactivity, in terms of responding to changes in the work environment in order to optimize performance, and developmental proactivity, in terms of seeking opportunities to learn and develop new skills in order to remain employable (Van Veldhoven & Dorenbosch, 2008).

We adopt the definition of proactivity as personal initiative (Warr & Fay, 2001) as self-initiated behavior that has a direct impact on the individual or their environment in the workplace (Grant & Ashford, 2008). Daily proactivity is linked to higher evening fatigue and higher daily cortisol levels, possibly through the effect of increased cognitive demands (e.g., goal setting, planning, monitoring) as a repose to unplanned or non-routine work (Fay & Huttges, 2017). Furthermore, proactivity is linked to higher overall job performance (Grant et al., 2009) and lower withdrawal behaviors such as absenteeism (Greenglass & Fiksenbaum, 2009).

Despite calls to focus on age to better understand proactive performance (Fay & Sonnentag, 2010), we have little empirical evidence on how proactive behaviors may change with age (Zacher & Kooij, 2017) and how, in turn, this may impact on job performance. Motives related to proactive behavior and its outcomes change over the life course (Kooij et al., 2011), while proactivity is an aspect of the psychological and emotional capital that individuals acquire in their later working life stages (Peterson & Spiker, 2005).

Proactivity will start off as higher, in the early life stage, as individuals are more open to new experiences, are exploring opportunities and options, and strive to build resources (Zacher & Kooij, 2017). Younger workers tend to be perceived more positively with regard to proactive personality than the older ones (Truxillo et al., 2012). For midlife, the picture is less clear. The midlife stage can pose challenges to enacting proactivity as an extra-role behavior because of time-role changes, role conflict, and delayed accumulation of resources in the face of increasing demands. There are two conflicting forces at play. On the one hand, the establishment phase and a growing career also demand more resources, potentially leading to an upward trend in proactivity. On the other hand, when regulatory resources needed to balance multiple commitments and demands are scarce, individuals will have less flexibility or capacity to initiate change behaviors. They may have to choose the areas (of growth and maintenance) where they can invest resources (Heckhausen, 2001), the difficulty of balancing the responsibilities that a new family brings (Karanika-Murray & Cooper, 2020), or the need for eldercare (Burch et al., 2019) with existing work commitments. Thus, "this situation of conjoint growth and decline requires a differentiated approach on the part of the midlife person" (Heckhausen, 2001, p. 349). Growth and decline may therefore counteract each other, leading to a plateau that masks the resource fragility of midlife. Finally, later in life, the accumulation of resources combined with reduced demands due to role transitions may bring positive changes, potentially allowing enacted proactivity to be restored. At the same time, a decline in fluid cognitive ability may affect innovative work behavior and adaptability that is required in innovation (Schaffer et al., 2012). In addition, changes in motives and needs, learning preparedness, preparation for retirement, and one's future time perspective may drive the focus away from extra-role behaviors (Kooij et al., 2011; although in their meta-analysis, Ng and Feldman [2008] found a positive relationship between age and organizational citizenship behaviors). Together, these changes may render knowledge goals less salient than emotional goals (as per SST theory; Carstensen, 1992) and, therefore, it is possible that proactivity will continue to show a downward trend after the midlife point.

Job complexity is also important for proactivity. There is evidence that the relationship between age and innovative work behavior, which is akin to proactivity, depends on contextual factors such as job complexity (Schaffer et al., 2012). Schaffer and colleagues (2012) showed that proactivity is more stable across the working lifespan in jobs characterized by higher complexity. Job complexity fosters innovative work behaviors (Shalley et al., 2004), perhaps because complex jobs require individuals to attend to multiple elements, deal with ambiguity, and maintain coordination and cooperation. Therefore, it is possible that after a plateau in proactivity that masks the resource fragility of midlife, job complexity can lead to different trajectories of proactivity in later life.

Hypothesis 2a: The age–proactivity relationship is curvilinear U-shaped, such that it plateaus at the midpoint of midlife but is higher or lower in early and later life

Hypothesis 2b: Job complexity moderates the relationship between age and proactivity, such that high job complexity supports a positive relationship after midlife

Age and adaptivity

Adaptivity is defined as "the extent to which an individual adapts to changes in a work system or work roles" (Griffin et al., 2007, p. 329). It is a self-regulatory behavior that denotes preparedness and readiness for change, agency, and an ability to negotiate uncertainties (Tolentino et al., 2014). Performing well in a task depends on one's ability to adjust to new conditions (Koopmans et al., 2011), respond to changes in task demands (Betsch et al., 2001), and adapt to change (Niessen et al., 2010).

The evidence on the relationship between age and adaptive performance is unclear. Mirvis and Hall (1996, p. 285) argued that "there is no physiological and scant psychological evidence that aging is in any way related to personal adaptability and resistance to change." More recent empirical work reported no significant effects between age and individual adaptability (Kunze et al., 2013; O'Connell et al., 2008). Nevertheless, there is evidence of both the importance of adaptivity and changes in adaptivity with age.

On the one hand, a range of psychological resources (i.e., increased competence, emotional regulation, sense of control or mastery, and social responsibility; e.g., Lachman, 2004; Lachman & Firth, 2004; Lang, 2001) and adaptive capacities (i.e., emotion regulation and social integration; e.g., Haslam et al., 2009) protect from stressors, minimize the negative of losses that aging brings, and are essential for adapting to new work challenges. Such psychological resources and adaptive capacities are "robust well into late life" (Wagner et al., 2013) and impact on adaptive performance by enabling "an individual to guide his or her goal-directed activities over time and across changing circumstances, including the modulation of thought, affect, and behavior" (Porath & Bateman, 2006, p. 185).

On the other hand, major life changes in midlife may also challenge adaptive capacity. As psychological/socioemotional resources start to increase in midlife (Zacher & Kooij, 2017), substantive physical changes (e.g., the menopause, muscle tone changes, or sensory changes) also take place that may be a substantial factor for work performance (Geukes et al., 2012; Scheibe & Zacher, 2013). Such obstacles to goal achievement, such as the demands of parenting (e.g., a new family or young children) or progressively more demanding career or work roles (e.g., a new job or a promotion), may inhibit control over and adaptation to life domains (Huffman et al., 2013). Indeed, Huffman and colleagues (2013) found an inverted-U relationship between age and work–family conflict with conflict was more pronounced in middle age, noting that "factors at work and home are the most taxing on resources." Furthermore, as mentioned earlier, because patterns of change vary greatly across different dimensions (Lachman, 2004), the adaptive resources needed in midlife to deal with increased demands in different life domains may not develop at the same rate to support adaptive performance. Therefore, adaptive resources may be challenged in midlife, even more so due to increased demands, creating a "dip" in adaptivity in midlife (Scheibe & Zacher, 2013).

If job complexity is important for work performance (Zacher et al., 2010), it may also play a role in adaptive performance. As a job resource, a degree of job complexity can help to capitalize on age-related resources such as experiential knowledge (Zacher et al., 2009). Specifically, job complexity can help to boost adaptivity because it requires individuals

to attend to multiple elements, deal with ambiguity, and maintain coordination and cooperation, and thus supports cognitive and emotional functioning (Frese, 1982), intellectual flexibility (Schooler et al., 1999), and a good fit between changing needs and abilities in older workers (Zacher & Kooij, 2017). However, too much complexity may interfere with adaptivity when other resources are compromised at the midpoint of the life course.

Hypothesis 3a: The age–adaptivity relationship is curvilinear S-shaped, such that it is lowest at the midpoint of midlife but is higher or stable in early life and late life

Hypothesis 3b: Job complexity moderates the relationship between age and adaptivity, such that high job complexity supports a weaker relationship after midlife

Method

Participants and procedure

A self-report survey was administered in one large local government organization in Great Britain, in 2014, that employed just over 5,000 employees in a broad range of job roles. During that time, the organization was affected by budget cuts, organizational restructuring, and uncertainty that impacted across all job roles. Both online and paper-and-pencil survey options were available to participants. Examination of the characteristics of participants who took part via the two different methods did not reveal any differences in the study variables.

Note that although in this study we discuss time-role transitions as a way to gauge when in the working life course performance may change, we use chronological age as a proxy for that. We should not assume uniform experiences of roles and responsibilities across the lifespan. However, we use chronological age for the purpose of understanding the patterns of relationships between age and performance that can also inform workplace decisions.

In total, 1,241 questionnaires were completed. This represents a response rate of 24.42% and is consistent with reported rates for online questionnaires (e.g., Kaplowitz et al., 2004) and reflects the start of a period of planned organizational change. Removing cases with missing values yielded a final sample of 903 participants, 61.9% of whom women. Participants' average age was M = 43.48 years (SD = 10.54, range: 18–69); 73.8% had completed secondary education, 19% had an undergraduate degree, and 7.1% had a postgraduate degree. Average job tenure was M = 11.24 years (range: 0–40). Job roles included managers (22%), operational staff (43.8%), and support staff (33.1%).

Measures

We used self-ratings as a more reliable way of assessing internal psychological states such as work role performance and job complexity that have a cognitive and motivational element, since ratings from different sources do not always converge (Facteau & Craig, 2001), especially relation to interpersonal and cognitive dimensions (Conway & Huffcutt, 1997).

Performance was measured with nine items that captured individual level *task proficiency*, *proactivity*, and *adaptivity* (three items each; Griffin et al., 2007). Respondents were asked to indicate to what extent a range of statements had been true in the past month (e.g., "Carried out the core parts of your job well," "Adapted well to changes in core tasks," and "Initiated better ways of doing your core tasks," for task proficiency, proactivity, and adaptivity, respectively) on a 5-point Likert-style scale (from 1 = *not at all* to 5 = *a great deal*). The scales have excellent psychometric properties (Griffin et al., 2007). In this sample, Cronbach's alphas for the three scales were .85, .91, and .81, respectively.

We evaluated discriminant validity using the X^2(cut) approach recommended by Rönkkö and Cho (2020), which is based on comparing a confirmatory factor analysis model of the three factors to a number of different constrained models. Each of the comparison models is constrained by fixing one of the correlations between different pairs of factors to a pre-determined value. Using a more stringent cutoff correlation coefficient of .80, all comparisons indicated that the three-factor model was significantly better than any of the constrained models—specifically, we compared the baseline to (i) a model where proficiency and proactivity were highly correlated (X^2 = 391.24, p < .001), (ii) a model where proficiency was correlated to adaptivity (X^2 = 285.92; p < .001), and (iii) a model where proactivity was correlated with adaptivity (X^2 = 24.10, p < .001).

Job complexity was measured with four items on cognitive job demands from the Copenhagen Psychosocial Questionnaire (Kristensen et al., 2005). This is in line with Schaffer and colleagues (2012) who operationalized job complexity as higher cognitive demands. Respondents were asked to indicate to what extent they agreed with a range of statements about their job (e.g., "I have to keep my eyes on lots of things while I work") on a 5-point scale (from 1 = *always*, to 5 = *never*). Cronbach's alpha for this scale was .72.

Gender and *job tenure* were included as control variables. Overall work performance may reflect non-work commitments at different life stages which differ greatly for men and women (Martin et al., 2020) and with tenure (Sturman, 2003). Although performance expectations may vary by occupational type (Waldman & Avolio, 1986), we found no differences between managers, operational staff, and support staff and therefore did not include job type as a control variable. Finally, we found that health (measured using one item asking participants how they would evaluate their health at that given time) did not affect the results and therefore omitted it from the final analyses.

Analytical approach

Following preliminary examinations of the data, we identified issues of skewness with the dependent variables that were more pronounced for proficiency and adaptivity. As we were unable to rectify these issues using logarithmic or reciprocal transformation, we used a Bayesian regression, which makes skewness an assumption of the model, and specified the model likelihood as a skewed normal distribution. The skewed normal distribution is a generalization of the normal distribution that includes an additional parameter (alpha) to allow for skewed rather than symmetrical distributions (positive values denote that the distribution is skewed to the right and negative values to the left). The Bayesian approach allows to easily estimate this additional parameter in the same way that we estimate all other coefficients in our regression model.

The analysis was performed using R (R Core Team, 2019), Stan (Stan Development Team, 2019) for performing

Hamiltonian Monte Carlo, and the brms (Bürkner, 2017) front end to Stan Development Team. For all parameters we used the default priors suggested by brms. Specifically, for all the regression coefficients and the alpha parameter, the priors used were normal distributions with location set at 0 and scale set at 4 *SD*s. For the error term of the model, we used a student-*t* distribution with 3 degrees of freedom, 0 location, and scale of 10. These are all weakly informative priors, allowing sufficient flexibility for the model to account for any reasonable regression coefficient (and shape for the curves) as well as for fairly large values of skewness. As we did not use informative priors, the key advantage of the Bayesian approach was allowing to flexibly fit models with a non-normal likelihood. Thus, we would expect a frequentist model with similar assumptions about the form of the likelihood to produce equivalent inferences.

We conducted three polynomial regression models that assessed the relationship between age and task proficiency (no effect), proactivity (quadratic effect), and adaptivity (cubic effect). We used the same cubic model for all three both for completeness and to be able to explore the possibility that relationships are more complex than anticipated. We employed a hierarchical procedure of four blocks with job tenure and gender as control variables in the first block and adding the first-, second-, and third-order polynomial terms of age.

To compare model fit after adding each subsequent block, we used Leave-One-Out cross-validation (LOO; Vehtari et al., 2017), a Bayesian information criterion that can be interpreted in a similar way to other information criteria such as the AIC and DIC. To examine model fit, we also estimated the Bayesian analogue to R^2 (Gelman et al., 2019). Each model was tested with four simulation chains and 5,000 iterations, 2,500 for warm-up and 2,500 for sampling. These iterations were sufficient to reach convergence according to the effective sample sizes, and Monte Carlo *SE*s. Equally, traceplots and the scale reduction factor (Gelman & Rubin, 1992) showed good mixing of the four chains. To avoid any issues of multicollinearity, we used orthogonal polynomial terms, which are polynomial transformations of the original age variable so that they are uncorrelated with each other. Note that our examination of variation between work groups/departments did not offer foundations for multilevel analysis so we proceed with the analyses as described.

Results

Table 1 shows the correlations and means (with *SD*s) for the study variables. The R^2, ΔR^2, LOO (and *SE* of LOO), *B* values, and their credible intervals (and *p* values) for the five blocks for each of the three models are shown in Tables 2–4. For proficiency (Table 2), the results showed that the best fit was for the first block that included only job tenure of the control variables (R^2 = .00, LOO = 1041.63, SD_{LOO} = 56.83) and that none of the subsequent blocks improved on the model fit. Thus, there was no relationship between age and proficiency, or job complexity and proficiency, nor a significant interaction between age and job complexity.

For proactivity (Table 3), the best fit was for the fifth block data (R^2 = 0.10, LOO = 2457.57, SD_{LOO} = 38.34), which included the linear, quadratic, and cubic components for the effect of age as well as the three interaction effects of each of these with job complexity. For proactivity, job tenure had a positive effect, but gender did not, job complexity was positively related, *b* = 0.37, 95% CI [0.27, 0.46], and the cubic term for age was negatively, *b* = −16.15, 95% CI [−29.85, −2.39]. In terms of the interaction effects, the only significant interaction was between job complexity and the cubic term, *b* = 3.69, 95% CI [0.20, 7.17]. Plots of this interaction effect (Figure 1) showed that, as hypothesized, the relationship between age and proactivity is curvilinear. Specifically, it follows a sigmoid pattern: as age increases, proactivity initially decreases, and then reaches a plateau until it starts to decrease again. This pattern is more intense for jobs of low complexity showing sharper reductions to proactivity. In contrast, for jobs of high job complexity, the second decrease never happens, and it seems that there may even be a small increase of proactivity at later life stages.

For adaptivity, the analysis (Table 4) showed that block 3 had the best fit to the data (R^2 = .07, LOO = 2305.20, SD_{LOO} = 42.72) indicating a quadratic relationship between age and adaptivity and that adding a cubic predictor for the interaction between age and job complexity reduced model fit. The results at block 3 showed positive effects for the two controls (job tenure and gender), the main effect for job complexity, *b* = 0.25, 95% CI [0.17, 0.33], and a main effect for the quadratic, *b* = 3.56, 95% CI [1.63, 5.44], but not the linear term of age. The quadratic solution was identified as a more parsimonious model of adaptivity, since blocks 4 and 5 did not represent an improvement from block 3.

To identify the points where the relationship between age and proactivity and age and adaptivity change trajectories, we used the tangents of the partial derivatives to identify the local minima and maxima of the curves (Karanika-Murray et al., 2009). Since we used orthogonal polynomials for the analysis, we first transformed the regression coefficient

Table 1. Pearson's bivariate correlations between predictor and outcome variables

	M	*SD*	1	2	3	4	5
1. Age	43.47	10.53					
2. Job tenure	15.08	9.37	.331**	.014			
3. Job complexity	3.89	0.71	0.09**	0.15***			
4. Proficiency	13.44	1.81	-0.01	-0.02	0.07*		
5. Proactivity	10.06	2.91	-0.09**	-0.10**	0.23***	0.25***	
6. Adaptivity	10.94	2.75	-0.08*	-0.10**	0.19***	0.32***	0.66***

Note. N = 903;
* $p \leq .05$,
** $p \leq .01$,
*** $p \leq .001$

Table 2. Polynomial regression model for task proficiency

	Block 1			Block 2			Block 3			Block 4			Block 5		
	B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI	
Intercept	4.39*	4.35	4.44	4.38*	4.31	4.46	4.38*	4.31	4.45	4.38*	4.32	4.45	4.38*	4.31	4.45
Job tenure	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00
Gender	0.01	-0.01	0.02	0.01	-0.01	0.02	0.01	-0.01	0.02	0.01	-0.01	0.02	0.01	-0.02	0.03
Job complexity (JC)				0.00	-0.01	0.02	0.00	-0.01	0.02	0.00	-0.01	0.02	0.00	-0.01	0.02
Age				0.00	0.00	0.00	-0.02	-0.37	0.35	-0.01	-0.39	0.35	-0.06	-1.77	1.70
Age2							0.16	-0.15	0.56	0.18	-0.15	0.59	0.02	-1.73	1.94
Age3										0.03	-0.36	0.44	0.01	-2.28	2.21
JC*Age													0.01	-0.46	0.47
JC*Age2													0.06	-0.43	0.55
JC*Age3													0.00	-0.57	0.59
Alpha	-27.00	-32.00	-22.49	-26.68	-31.47	-22.14	-26.59	-31.32	-22.20	-26.46	-31.37	-21.81	-26.17	-31.13	-21.64
R2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ΔR2				.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
LOO	1041.63			1044.84			1046.07			1047.51			1052.61		
SDLOO	56.83			56.58			56.54			56.49			56.31		

Note. N = 903; CI = Credible Intervals; Polynomial terms are based on orthogonal polynomials;
* $p \leq .05$.

Table 3. Polynomial regression model for proactivity

	Block 1			Block 2			Block 3			Block 4			Block 5		
	B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI	
Intercept	3.27*	3.03	3.51*	2.22*	1.77	2.69	1.89*	1.48	2.30	1.90*	1.51	2.29	1.88*	1.46	2.30
Job tenure	0.00*	0.00	0.00*	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00
Gender	0.10	-0.03	0.23	0.09	-0.04	0.22	0.09	-0.04	0.23	0.08	-0.05	0.21	0.09	-0.04	0.21
Job complexity (JC)				0.35*	0.26	0.43	0.36*	0.27	0.45	0.36*	0.27	0.45	0.37*	0.27	0.46
Age				-0.01	-0.01	0.00	-2.36*	-4.60	-0.11	-2.51*	-4.69	-0.29	-10.10	-21.04	0.69
Age2							2.24*	0.14	4.30	2.82*	0.61	5.07	2.38	-8.76	13.78
Age3										-2.40	-4.85	0.09	-16.15*	-29.85	-2.39
JC*Age													2.10	-0.65	4.95
JC*Age2													-0.07	-3.02	2.87
JC*Age3													3.69*	0.20	7.17
Alpha	-0.54	-1.46	0.57	-0.34	-1.26	0.69	-0.31	-1.25	0.70	-0.27	-1.21	0.75	-0.32	-1.26	0.71
R2	.01	.00	.03	.08	.05	.11	.09	.05	.12	.09	.06	.12	.10	.07	.13
ΔR2				.07	.05	.08	.01	.00	.01	.00	.01	.00	.01	.01	.01
LOO	2517.13			2461.07			2458.87			2457.71			2457.57		
SDLOO	37.06			37.95			38.55			38.24			38.34		

Note. N = 903; CI = Credible Intervals; Polynomial terms are based on orthogonal polynomials;
* $p \leq .05$.

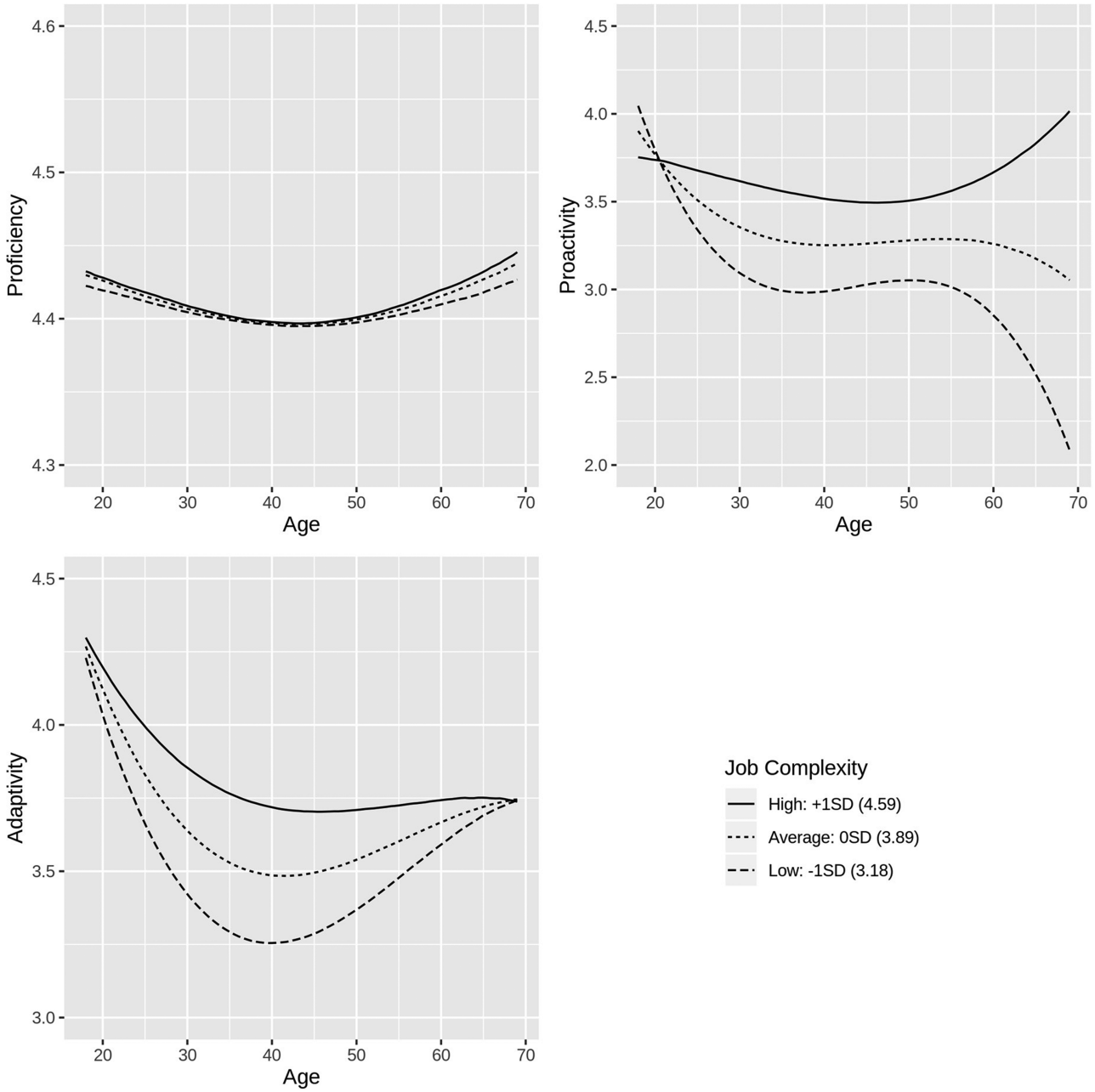

Figure 1. The relationship between age and performance (proficiency, proactivity, and adaptivity) for different levels of job complexity.

estimates to what they would have been if we have used the original raw age data. Since proactivity is moderated by job complexity, we estimated the turning points for low, average, and high job complexity. On average, proactivity followed a sigmoid pattern, gradually decreasing until 40.1 years after which point it appeared to plateau and then start decreasing again at 55.3 years of age. For jobs of *low* complexity, this pattern was more pronounced with both turning points occurring earlier in life at 37.9 and 49.7 years. In contrast, for jobs of *high* job complexity, the pattern seems to be more of a U-shaped rather than a sigmoid curve. Still, there were two turning points whereby proactivity appears to decrease until 29.9, then decreases at a slower pace or plateaus until 44.2 years, and after that it starts to increase again. For adaptivity, job complexity did not have a significant interaction with age and therefore we only estimated the turning points when job complexity was at the average. A U-shaped curve was revealed, whereby proactivity decreased until 41.5 years and then showed a gradual increase until 70.8 (the latter is beyond the range of our data and should only be treated as an extrapolation from the model coefficients).

Discussion

This study offers support for the proposition that different types of performance have different trajectories across the working lifespan and that perceived job complexity moderates this relationship. We used the lifespan perspective, specifically life stages, SOC, and SST, to understand this. Life stage theory views the midpoint of midlife as "a sandwich position" (Heckhausen, 2001) of time-role transitions characterized by expanding work and physical challenges

Table 4. Polynomial regression model for adaptivity

	Block 1			Block 2			Block 3			Block 4			Block 5		
	B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI		B	2.5 - 97.5% CI	
Intercept	3.42*	3.22	3.62	2.70*	2.27	3.12	2.45*	2.08	2.80	2.45*	2.09	2.82	2.43*	2.07	2.80
Job tenure	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00	0.00*	0.00	0.00
Gender	0.16*	0.05	0.28	0.16*	0.05	0.27	0.17*	0.06	0.28	0.16*	0.05	0.27	0.16*	0.05	0.27
Job complexity (JC)				0.22*	0.14	0.30	0.25*	0.17	0.33	0.25*	0.17	0.33	0.26*	0.18	0.33
Age				0.00	-0.01	0.00	-1.35	-3.34	0.68	-1.46	-3.33	0.48	3.72	-5.52	13.04
Age2							3.56*	1.63	5.44	3.85*	1.85	5.81	11.47*	1.54	21.28
Age3										-1.56	-3.74	0.74	-3.78	-16.88	8.68
JC*Age													-1.31	-3.75	1.07
JC*Age2													-2.00	-4.58	0.66
JC*Age3													0.64	-2.57	3.94
Alpha	-2.24	-2.89	-1.70	-1.96	-2.50	-1.47	-1.94	-2.51	-1.45	-1.94	-2.49	-1.45	-1.91	-2.48	-1.40
R2	.02	.00	.03	.05	.03	.08	.07	.04	.10	.07	.04	.10	.07	.05	.11
ΔR2				.03	.02	.05	.02	.01	.02	.00	.00	.00	.01	.00	.01
LOO	2343.80			2316.79			2305.20			2305.30			2308.69		
SDLOO	41.24			42.36			42.72			42.74			42.94		

Note. N = 903; CI = Credible Intervals; Polynomial terms are based on orthogonal polynomials;
* $p \leq .05$.

that are coupled with increasing socioemotional resources. SOC (Bajor & Baltes, 2003) suggests a differentiated use of resources, whereas SST (Carstensen, 1992) outlines how goals shift across the lifespan. Both indicate that within-person changes over time are powerful determinants of variability in person characteristics and resources that change at different rates (Lachman, 2004; Zacher & Kooij, 2017). These starting points sketch an overall picture of the age–performance relationship that defies a simple and straightforward answer as to whether performance increases or decreases with age. To understand this relationship, we looked at differentiation and curvilinearity in performance across the lifespan and included job complexity as an important job-related contextual resource. We found differentiated relationships for each of the three performance variables, and a curvilinear shape that varied depending on the perceived complexity of the job, and thus supporting our hypotheses for proactivity and adaptivity but not for proficiency.

Our data did not support a relationship, either linear or curvilinear, for age and task proficiency. This is in line with Ng and Feldman's (2008) meta-analysis which indicated that age and task performance are largely unrelated. It is also not surprising given that some abilities decrease (e.g., fluid cognitive abilities, health, future time perspective) and others increase (e.g., crystallized cognitive abilities, socioemotional abilities) (Zacher & Kooij, 2017). Modern work is characterized by enrichment rather than specialization, a broad utilization of skills and abilities, and the importance of fit between the person and the requirements of the work and environment, in terms of their knowledge, skills, and abilities. "Good work" is work that is aligned to personal needs and abilities, that aspires to meaning, fulfillment, and self-determination—this alignment is highly idiosyncratic to each individual.

The data supported a curvilinear relationship between age and proactivity, such that proactivity shows a downward trend across the working lifespan, but with a plateau in midlife, and is moderated by job complexity. Job complexity defined the shape of the curve: U-shaped for high job complexity and S-shaped for low job complexity. It also changed the direction of proactivity: after around 50–55 years of age, proactivity increased for high complexity jobs but decreased for low complexity jobs. When job complexity is perceived to be low, proactivity plateaus after midlife and then drops further later on. But when the job is cognitively demanding, perceived job complexity reinforces a return of proactivity (a U-shaped relationship). The findings support the benefits of higher job complexity.

These new findings are aligned with available evidence. Not only personal and socioemotional age-related resources such as self-initiated change and future orientation change with age, but also new roles, demands, and uncertainties may further impede efforts to future-focused responses to unexpected demands and to "proactively act to anticipate new challenges" (Griffin et al., 2010). Aging tends to bring a loss of age-sensitive resources (Morgeson & Humphrey, 2006) and a focus away from growth (Zacher & Kooij, 2017). As the selection of goals to concentrate one's efforts on varies throughout the life course (Freund & Baltes, 2002), fewer resources will be invested on proactively seeking and dealing with work-related challenges that are allocated a lower priority. It is important to have clarity when studying proactivity: on-the-job proactivity, where the individual responds to changes in the work environment in order to optimize performance (which this study focused on), is different from developmental proactivity, where the individual seeks opportunities to learn and develop new skills (Van Veldhoven & Dorenbosch, 2008). On-the-job proactive behavior and personal initiative (Grant & Ashford, 2008; Warr & Fay, 2001) may be less important when for those who focus more on establishment and maintenance and away from growth (Fuller-Iglesias et al., 2010).

Increasing job complexity can not only help counteract the loss of proactivity after midlife (when job complexity is reported as average) but also help proactivity to recover to early life stage and even rise to levels higher than that (when job complexity is reported as high). Thus, higher job complexity can protect one's future-oriented goals and forward-planning focus, perhaps because it supports cognitive and emotional functioning (Frese, 1982), intellectual flexibility (Schooler et al., 1999), an optimal fit between changing needs and abilities (Zacher & Kooij, 2017), and a focus on opportunities (Zacher et al., 2010). According to the model of successful proactivity (Kahana et al., 2014; Ouwehand et al., 2007) older individuals are "active, self-constructing, and self-reflecting agents within their environment, capable of shaping their environment rather than only responding to it" (Zacher & Kooij, 2017). Note that proactivity is different from proficiency and adaptivity because it requires a more future-oriented, forward-planning, and a job-specific focus, but both describe a strength to absorb, respond to, or anticipate unexpected demands.

The data also supported a quadratic relationship between age and adaptivity, with job complexity determining the shape of the curve, which resembled an L-shape for high job complexity and a pronounced U-shape for low job complexity. Job complexity changed not just the shape of the curve but the direction of adaptivity. Specifically, after midlife, adaptivity more or less *plateaued* for high complexity jobs but *dropped* and then *increased steeply* for low complexity jobs (but did not reach the levels of adaptivity in the early life stage). Increasing job complexity can help to suppress any potential loss of adaptivity levels after midlife. Note that there was a main effect for job complexity but no significant interaction with age.

This is aligned with the evidence. Emotional regulation increases with age (Gross et al., 1997; Scheibe et al., 2016) such that older workers are better able to deploy psychosocial resources to cope with organizational change, distinguish between important goals, and thus be more willing or able to adapt to change (Kunze et al., 2013). But the power of adaptivity can be thwarted when a job is perceived to be too complex. It may be that low complexity in the work domain helps to avoid depletion of resources or release additional resources to support adaptivity a work or in life more broadly. Three psychological capacities can help to explain why adaptivity starts to climb up again after midlife and its unexpected effect for low job complexity. Self-efficacy, the belief that one can manage and carry out new tasks efficiently (e.g., Fay & Frese, 2001) is positively related to adaptive behavior (Griffin & Hesketh, 2003). Self-efficacy increases with experience (Wolters & Daugherty, 2007) but only up to a certain point, after which it starts to decrease (Klassen & Chiu, 2010). Hope, as an important cognitive capacity, can help to illuminate alternative paths to problems and desired goals by using motivation and agency-thinking to achieve these (Snyder, 2002;

Strauss et al., 2015b). It also peaks in early mid adulthood (30–45 years) and is lowest in adolescence and older adulthood (Marques & Gallagher, 2017). Job morale (one's overall positive outlook, attitude, and confidence) also follows a similar pattern with adaptivity: it decreases steadily from the first years of employment until middle and late twenties or early thirties, after which period it increases steadily with age (Herzberg et al., 1957; as cited in Clark et al., 1996). Self-efficacy, hope, and job morale may help to replenish adaptivity as a resource when it is depleted but also most needed. Finally, in addition to psychological aspects, factors related to work and employment may also explain changes in adaptivity. For example, midlife is a period when accumulated job experience may lead to job status changes such as promotion or job change. But the influence of experience may change if there are changes in job tasks (Betsch et al., 2001), the work environment becomes unstable (Sturman, 2003), or there are changes in one's work settings (Niessen et al., 2010).

Our overall findings are in line with the lifespan perspective that views midlife as a midpoint period of gains and losses, with demands changing as resources accumulate, albeit perhaps more slowly. SOC processes (Baltes & Baltes, 1990; Baltes et al., 1999) that allow individuals to use their growing social and psychological resources to compensate for biological declines (Lachman, 2004) may have not yet developed sufficiently, supporting the idea of midlife as a vulnerable period. SST also shows how changes in goals can lead to changes in outcomes (Carstensen, 1992). Thus, the combination of faster external time-based role transitions and slower internal resource growth may impose a delay in adjustment capacity. Disadvantages (Glymour et al., 2009) and resources accrue over time (Van Dijk et al., 2020) yielding a cumulative effect on outcomes such as health (Fuller-Iglesias et al., 2010).

Implications for theory and practice

Our findings sketch different performance trajectories that some, but not all individuals in the working population may experience. Economists and psychologists (Rauch, 2018) have observed an inverted-U pattern in happiness and life satisfaction. The "midlife dip" seems to be a tendency that is supported by theory, is evident in a range of psychosocial outcomes, and varies between individuals, as SOC (Bajor & Baltes, 2003) and SST (Carstensen, 1992) would support. Because it is not universal, it allows us to expect and ameliorate negative changes related to person characteristics and also build on positive changes at different life stages to support job performance and, more broadly, life adaptation.

One of the key implications of our findings relate to understanding how performance can be supported across the working lifespan and possible intervention foci to achieve this. Changes in workforce characteristics necessitate changes in management practices to maintain productivity, optimize resource use, and address negative attitudes and tackle age discrimination in the workplace (Van Veldhoven & Dorenbosch, 2008). Thus, a better understanding of the turning points in performance across the working lifespan and the factors that drive these can help to improve knowledge on *when* and *how* to intervene to support different aspects of performance. For example, SOC strategies (Bajor & Baltes, 2003) may be most effective when used before performance starts to change in midlife. Similarly, since decisions to delay retirement are affected by one's goals, sense of purpose, and self-fulfilment (Carstensen, 1992), planned actions to support workers in later life should take these into account.

If performance is a function of resources and life stages, then individuals at different life stages would benefit from access to different types of resources to achieve optimal performance. Flexible work schedules may be especially beneficial to young parents striving to balance work commitments with family demands (Karanika-Murray & Cooper, 2020). In addition, training and development opportunities may be especially useful to those who are at the early exploration stage and focusing on establishing their career. Similarly, developing inclusive climates (Van Dijk et al., 2020) may be needed at critical points to tackle inequality whereas age-aware policies and practices would allow to accommodate changing individual strengths and needs (Gkiontsi & Karanika-Murray, 2016). Age-aware and employee-centered, as opposed to targeted, practices that are sensitive to life stage or age-related factors can accommodate diverse needs and strengths. Work practices that prioritize and promote flexibility to adapt work to the needs of specific groups (as defined by said groups) would be more effective. It is within the employer's remit to support employees' personal resources by showing awareness of changing needs at different life stages, maximizing use of skills as well as of increasing expertise and experience, sense of control (Heise, 1990), and social networks (Lachman & Firth, 2004). Ultimately, organizations that are successful in tackling the shortage of younger workers will be those that "fully capitalize on the powerful growth of the new mature workforce" (Dychtwald & Baxter, 2007, p. 35). Sensitivity to time-role transitions, goals, and resource use across the lifespan is necessary to maximize the assets of a maturing workforce.

Our findings highlighted the importance of high job complexity, as perceived by the individual, for both proactivity and adaptivity. Jobs can be redesigned or adjusted to older workers' needs and preferences to increase job complexity and maximize its benefits for maintaining intellectual flexibility (Schooler et al., 1999) and for cognitive and emotional functioning (Zacher et al., 2009) with its focus on opportunities (Zacher et al., 2009).

A note on our use of the term "older worker" is due. Definitions of an "older worker" put the threshold between 40 and 75 years (Warr, 2000), depending on the disciplinary lens and purpose of the research. For example, studies on changes in market participation, on employability, or on skills and attitudes, invariably set the threshold at 50–55, 45, or 40–45, respectively (Brough et al., 2011). Such definitions and thresholds are arbitrary if they are not based on an understanding that the aging process is changeable and cumulative rather than sudden and episodic (Fuller-Iglesias et al., 2010). They are also inaccurate since change in human capacities is too broad, varied, and multifaceted to adhere to neat stereotypes and definitions of an "older worker." Chronological age may be a useful crude measure and starting point to understand time-role changes, but more fine-grained examinations are needed to account for the intraindividual variability of the aging process and its impact on work outcomes. A lifespan perspective that looks at age threshold changes by specific roles and responsibilities or target outcomes would be more realistic, practical, and also fairer.

Finally, careful sampling in this line of research is also warranted. Research on age and work outcomes has tended to include a restricted age range (Zacher & Kooij, 2017), with workers over 50 years of age being underrepresented (McDaniel et al., 2012), and with a focus mainly on young or middle-aged employees under 50 years of age (Ng & Feldman, 2008, 2013). This bias can attenuate relationships or restrict the range of observed relationships (Zacher & Kooij, 2017), compromising the ability to detect curvilinearity (Warr, 1990) and subtleties in the age–performance relationship. We have avoided such population partitioning by using a broad age-lens, but research and theorizing should focus on the whole range.

Limitations and directions for future research

Because of the necessarily hybrid exploratory–confirmatory nature of the study, our findings are tentative. Yet, they also sketch priorities for future research. First, we used chronological age as a proxy of lifespan changes in roles and responsibilities. This a valid starting point as it is used by-and-large in workplace decisions and legislation and is thus most relevant to most applied research contexts. However, it is important to improve on this crude measure by directly assessing roles and responsibilities and the time-role transitions (e.g., starting a family, career milestones, etc.), or perhaps examining additional meanings of age (i.e., lifespan development, organizational, psychosocial, and functional age; Sterns & Doverspike, 1989). Job tenure and job complexity afforded us a view of aging broader than chronological age, especially in the direction of functional/organizational age. However, alternative conceptualizations would provide different lenses to help unravel the multidimensionality of the aging–work relationship and how it impacts on performance.

Second, closer attention should be paid to the role of the work environment, the nature of the job, and broader contextual factors (Ferris et al., 1991; Treadway et al., 2005) as well as dimensions of health and their differential impact on the age–performance relationship. We relied on participants from one large local government organization, which may offer a civil service perspective of performance where the notion of "job for life" can define work outcomes, especially affecting proactivity (but note that in our study organization the climate of uncertainty due to budget cuts and restructuring may have counteracted this effect). Others concur on the importance of broader factors. In their meta-analysis, Ng and Feldman (2008) showed that age and core task performance are largely unrelated, also suggesting that this relationship can be sensitive to socio-demographic characteristics such as race, education, or job level. Avolio and colleagues (1990) showed that occupational differences can define the relationship between age and performance. Understanding the broader context is important for both understanding performance and because it can signify different intervention foci. For example, improving psychological climate (e.g., Karanika-Murray et al., 2017), job design and job enrichment, or age-aware policies and practices (Gkiontsi & Karanika-Murray, 2016) may have variable effects on supporting performance of workers at different life stages, with different resources, demands, and time-role transitions. In terms of the individual context, performance has been linked to health (Ford et al., 2011), and therefore research should consider how physical health, mental health, and workability can explain variations in performance.

Third, since we focused on task performance, the findings cannot be generalized to contextual performance. It would also be important to examine the relationships between age and additional types of performance and how these may reinforce each other. This will allow us to inform a more dynamic model of job performance across the lifespan, combining subjective and objective measures. It is possible that adaptivity and proactivity may compensate for task proficiency or be enacted as resources that further support overall job performance. Here, diary research offers evidence that proactive behavior is strongly linked to higher daily perceived competence and vitality (Cangiano et al., 2019). It is important to explore what and how different types of resources are selected and optimized, or compensated for, in relation to different facets of performance and also over time. Finally, richer information can be obtained from objective data as opposed to self-report, which can be problematic if a social desirability effect in reporting performance is in force. Although self-perceptions are more relevant for job complexity, objective measures or a 360-degree assessment of performance could inform more practical solutions.

Furthermore, research is needed on critical job-specific resources that can act as catalysts in age-related midlife-specific changes, beyond job complexity, such as other job or individual and cultural factors. For example, midlife factors may be ameliorated in cultures where there is greater community or family support for child-rearing, although this may also bring demands caring for elderly family. Such resources can help to protect performance in late adulthood. Here, although job complexity has been positively linked with high job strain and over time (Li et al., 2017), in our study it was shown to be positively linked to maintaining adaptivity and increasing proactivity. It may be possible that a losses–benefits trade-off exists, such that priorities and use of resources changes (e.g., higher use of SOC strategies with increasing age; Freund & Baltes, 2002), where other job-related or person-related resources also play a role, or where job complexity acts as a challenge stressor (Podsakoff et al., 2007) that bolsters resources over time.

Finally, it is important to explore within-person changes in performance through the life course. Although relying on cross-sectional data, we offered a starting point for further examining such changes. A longitudinal research perspective is especially important in aging and work research because "many aging effects only start to manifest at older ages" and thus "it is important to hypothesize and routinely address the possibility of nonlinear relationships" (Rudolph et al., 2019, p. 619). Both SOC and SST highlight within-person processes that, over time, can augment between-person variation, rendering linear models insufficient. Further examining time-role transitions is critical as these can explain how the balance between new demands and changing capacities can trigger upward or downward changes in different facets of performance. In turn, this raises the question of whether there are cumulative or compensating effects on performance and job resources at specific turning points in the working lifespan. In inequality research, Van Dijk and colleagues (2020) argue that initial inequality can accumulate over time and through several mechanisms, such that inequality becomes increasingly more pronounced later in life. Similarly, a dynamic lens could help to understand how earlier job-related resources

lead to resource accumulation or poverty throughout the life course that, in turn, impact on performance. Future research should therefore examine how losses in capacities and gains in experience counteract each other over time or at certain life transactions.

Conclusions

We have tried to unfold the shape of the age–performance relationship to examine possible curvilinear relationships for three types of job performance with perceived job complexity as a moderator. The data indicated that changes in the trajectories of adaptivity and proactivity take place around midlife, as the benefits of time-role change transitions are delayed and acquired after a period of adjustment, and as individuals' socioemotional goals and use of SOC strategies change. The nature of the job itself, conceptualized as job complexity, is an important factor that shapes the steepness and direction of these changes. Specifically, we found that higher job complexity increases proactivity and sustains adaptivity from midlife onwards. We hope that this work will open new avenues for research on how performance changes with age, on the role of job-related contextual resources, and on the importance of nonlinear approaches in lifespan research.

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References

Avolio, B. J., Waldman, D. A., & McDaniel, M. A. (1990). Age and work performance in nonmanagerial jobs: The effects of experience and occupational type. *Academy of Management Journal,* 33(2), 407–422. doi:10.5465/256331

Bajor, J. K., & Baltes, B. B. (2003). The relationship between selection optimization with compensation, conscientiousness, motivation and performance. *Journal of Vocational Behavior*, 63, 347–367. doi:10.1016/S0001-8791(02)00035-0

Baltes, P. B. (1987). Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology*, 23(5), 611–626. doi:10.1037/0012-1649.23.5.611

Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 1–34). CUP.

Baltes, B. B., & Dickson, M. W. (2001). Using life-span models in industrial-organizational psychology: The theory of selective optimization with compensation. *Applied Developmental Science*, 5(1), 51–62. doi:10.1207/S1532480XADS0501_5

Baltes, M. M., & Lang, F. R. (1997). Everyday functioning and successful aging: The impact of resources. *Psychology & Aging*, 12(3), 433–443. doi:10.1037/0882-7974.12.3.433

Baltes, P. B., Staudinger, U. M., & Lindenberger, U. (1999). Lifespan psychology: Theory and application to intellectual functioning. *Annual Review of Psychology*, 50, 471–507. doi:10.1146/annurev.psych.50.1.471

Betsch, T., Haberstroh, S., Glockner, A., Haar, T., & Fiedler, K. (2001). The effects of routine strength on adaptation and information search in recurrent decision making. *Organizational Behavior & Human Decision Processes*, 84(1), 23–53. doi:10.1006/obhd.2000.2916

Biddle, B. J. (1986). Recent developments in role theory. *Annual Review of Sociology*, 12, 67–92. doi:10.1146/annurev.so.12.080186.000435

Brough, P., Johnson, G., Drummond, S., Penisi, S., & Timms, C. (2011). Comparisons of cognitive ability and job attitudes of older and younger workers. *Equality, Diversity & Inclusion*, 30(2), 105–126. doi:10.1108/02610151111116508

Burch, K. A., Dugan, A. G., & Barnes-Farrell, J. L. (2019). Understanding what eldercare means for employees and organizations: A review and recommendations for future research. *Work, Aging & Retirement*, 5(1), 44–72. doi:10.1093/workar/way011

Bürkner, P. C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of Statistical Software*, 80(1), 1–28. doi:10.18637/jss.v080.i01

Cangiano, F., Parker, S. K., & Yeo, G. B. (2019). Does daily proactivity affect well-being? The moderating role of punitive supervision. *Journal of Organizational Behavior*, 40(1), 59–72. doi:10.1002/job.2321

Carstensen, L. L. (1992). Social and emotional patterns in adulthood: Support for socioemotional selectivity theory. *Psychology & Aging*, 7(3), 331. doi:10.1037//0882-7974.7.3.331

Carstensen, L. L., Fung, H. H., & Charles, T. S. (2003) Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation & Emotion*, 27(2), 103–123. doi:10.1023/A:1024569803230

Clark, A., Oswald, A., & Warr, P. (1996). Is job satisfaction U-shaped in age? *Journal of Occupational & Organizational Psychology*, 69, 57–81. doi:10.1111/j.2044-8325.1996.tb00600.x

Cleveland, J. N., Huebner, L. A., Anderson, K. J., & Agbeke, D. V. (2019). Lifespan perspectives on job performance, performance appraisal/management and creative performance. In B. B. Baltes, C.W. Rudolph & H. Zacher (Eds.), *Work across the lifespan* (pp. 291–321). Academic Press.

Conway, J. M., & Huffcutt, A. I. (1997). Psychometric properties of multisource performance ratings: A meta-analysis of subordinate, supervisor, peer, and self-ratings. *Human Performance*, 10(4), 331–360. doi:10.1207/s15327043hup1004_2

Cubrich, M., & Petruzzelli, A. (2020). Advancing our understanding of successful aging at work: A socioemotional selectivity theory perspective. *Industrial & Organizational Psychology*, 13, 369–373. doi:10.1017/iop.2020.71

Dalal, R. S., Bhave, D. P., & Fiset, J. (2014). Within-person variability in job performance: A theoretical review and research agenda. *Journal of Management*, 40(5), 1396–1436. doi:10.1177/0149206314532691

De Lange, A. H., Kooij, D. T. A. M., & Van der Heijden, B. I. J. M. (2015). Human resource management and sustainability at work across the lifespan: An integrative perspective. In L. M. Finkelstein, D. M. Truxillo, F. Fraccaroli, & R. Kanfer (Eds.), *Facing the challenges of a multi-age workforce: A use-inspired approach* (pp. 50–79). Routledge.

De Lange, A. H., Van der Heijden, B., Van Vuuren, T., Furunes, T., De Lange, C., & Dikkers, J. (2021). Employable as we age? A systematic review of relationships between age conceptualizations and employability. *Frontiers in Psychology*, 11, (article 605684). doi:10.3389/fpsyg.2020.605684

De Vos, A., Van de Heijden, B. I. J. M., & Akkermans, J. (2018). Sustainable careers: Towards a conceptual model. *Journal of Vocational Behavior*, 117, 1–13. doi:10.1016/j.jvb.2018.06.011

Demerouti, E., Bakker, A. B., & Leiter, M. (2014). Burnout and job performance: The moderating role of selection, optimization, and compensation strategies. *Journal of Occupational Health Psychology*, 19(1), 96–107. doi:10.1037/a0035062

Dychtwald, K., & Baxter, D. (2007). Capitalizing on the new mature workforce. *Public Personnel Management*, 36, 325–334. doi:10.1177/009102600703600403

Erikson, E. H. (1968). *Identity, youth and crisis*. Norton.

Facteau, J. D., & Craig, S. B. (2001). Are performance appraisal ratings from different rating sources comparable? *Journal of Applied Psychology*, 86(2), 215. doi:10.1037/0021-9010.86.2.215

Fay, D., & Huttges, A. (2017). Drawbacks of proactivity: Effects of daily proactivity on daily salivary cortisol and subjective well-being. *Journal of Occupational Health Psychology*, 22(4), 429–442. doi:10.1037/ocp0000042

Fay, D., & Frese, M. (2001). The concept of personal initiative: An overview of validity studies. *Human Performance*, 1, 97–124. doi:10.1207/S15327043HUP1401_06

Fay, D., & Sonnentag, S. (2010). A look back to move ahead: New directions for research on proactive performance and other discretionary work behaviors. *Applied Psychology*, 59, 1–20. doi:10.1111/j.1464-0597.2009.00413.x

Ferris, G. R., Judge, T. A., Chachere, J. G., & Liden, R. C. (1991). The age context of performance-evaluation decisions. *Psychology and Aging*, 6(4), 616–622. doi:10.1037/0882-7974.6.4.616

Frese, M. (1982). Occupational socialization and psychological development: An underemphasized research perspective in industrial psychology. *Journal of Occupational Psychology*, 55, 209–224. doi:10.1111/j.2044-8325.1982.tb00095.x

Freund, M. A. (2008). Successful aging as management of resources: The role of selection, optimization, and compensation. *Research in Human Development*, 5(2), 94–106. doi:10.1080/15427600802034827

Freund, A. M., & Baltes, P. B. (1998). Selection, optimization, and compensation as strategies of life management: Correlations with subjective indicators of successful aging. *Psychology and Aging*, 13, 531–543. doi:10.1037/0882-7974.13.4.531

Freund, A. M., & Baltes, P. B. (2002). Life-management strategies of selection, optimization and compensation: Measurement by self-report and construct validity. *Journal of Personality & Social Psychology*, 82(4), 642–662. doi:10.1037/0022-3514.82.4.642

Ford, M. T., Cerasoli, C. P., Higgins, J. A., & Decesare, A. L. (2011). Relationships between psychological, physical, and behavioural health and work performance: A review and meta-analysis. *Work & Stress*, 25(3), 185–204. doi:10.1080/02678373.2011.609035

Fried, Y., & Ferris, G.R. (1987). The validity of the job characteristics model: A review and meta-analysis. *Personnel Psychology*, 40, 287–322. doi:10.1111/j.1744-6570.1987.tb00605.x

Fried, Y., Melamed, S., & Ben-David, H. A. (2002). The joint effects of noise, job complexity, and gender on employee sickness absence. An exploratory study across 21 organizations—the CORDIS study. *Journal of Occupational & Organizational Psychology*, 75(2), 131–144. doi:10.1348/09631790260098181

Fuller-Iglesias, H., Smith, J., & Antonucci, T. C. (2010). Theories of aging from a life-course and life-span perspective: An overview. In T. C. Antonucci & J. S. Jackson (Eds.), *Annual review of gerontology and geriatrics (Vol. 29): Life-course perspectives on late-life health inequalities* (pp. 3–25). Springer.

Gelman, A., Goodrich, B., Gabry, J., & Vehtari, A. (2019). R-squared for Bayesian regression models. *American Statistician*, 73(3), 307–309. doi:10.1080/00031305.2018.1549100

Gelman, A., & Rubin, D. B. (1992). A single series from the Gibbs sampler provides a false sense of security. *Bayesian Statistics*, 4, 625–631.

Geukes, M., Van Aalst, M. P., Nauta, M. C., & Oosterhof, H. (2012). The impact of menopausal symptoms on work ability. *Menopause*, 19(3), 278–282. doi:10.1097/gme.0b013e31822ddc97

Gkiontsi, D., & Karanika-Murray, M. (2016). Dealing with economic and demographic challenges: Workplace innovation practices as a timely and effective response to older workers' needs. *European Journal of Workplace Innovation*, 2(1), 25–42.

Glymour, M. M., Ertel, K. A., & Berkman, L. F. (2009). What can life-course epidemiology tell us about health inequalities in old age? *Annual Review of Gerontology & Geriatrics*, 29, 27–56. doi:10.1891/0198-8794.29.27

Grant, A. M., & Ashford, S. J. (2008). The dynamics of proactivity at work. *Research in Organizational Behavior*, 28, 3–34. doi:10.1016/j.riob.2008.04.002

Grant, A. M., Parker, S. K., & Collins, C. G. (2009). Getting credit for proactive behavior: Supervisor reactions depend on what you value and how you feel. *Personnel Psychology*, 62, 31–55. doi:10.1111/j.1744-6570.2008.01128.x

Greenglass, E. R., & Fiksenbaum, L. (2009). Proactive coping, positive affect, and well-being. Testing for mediation using path analysis. *European Psychologist*, 14, 29–39. doi:10.1027/1016-9040.14.1.29

Griffin, B., & Hesketh, B. (2003). Adaptable behaviors for successful work and career adjustment. *Australian Journal of Psychology*, 55(2), 65–73. doi:10.1080/00049530412331312914

Griffin, M. A., Neal, A., & Parker, S. K. (2007). A new model of work role performance: Positive behavior in uncertain and interdependent contexts. *Academy of Management Journal*, 50(2), 327–347. doi:10.5465/amj.2007.24634438

Griffin, M. A., Parker, S. K., & Mason, C. M. (2010). Leader vision and the development of adaptive and proactive performance: A longitudinal study. *Journal of Applied Psychology*, 95(1), 174–182. doi:10.1037/a0017263

Gross, J. J., Carstensen, L. L., Pasupathi, M., Tsai, J., Skorpen, C. G., & Hsu, A. Y. C. (1997). Emotion and aging: Experience, expression, and control. *Psychology & Aging*, 12(4), 590–599. doi:10.1037//0882-7974.12.4.590

Haslam, S. A., Jetten, J., & Waghorn, C. (2009). Social identification, stress and citizenship in teams: A five-phase longitudinal study. *Stress & Health*, 25(1), 21–30. doi:10.1002/smi.1221

Heckhausen, J. (2001). Adaptation and resilience in midlife. In M. E. Lachman (Ed.), *Handbook of midlife development* (pp. 345–394). Wiley.

Heise, D. R. (1990). Careers, career trajectories, and the self. In J. Rodin, C. Schooler, & K. W. Schaie (Eds.), *Self-directedness: Cause and effects throughout the life course* (pp. 59–84). Erlbaum.

Henry, H., Zacher, H., & Desmette, D. (2015). Reducing age bias and turnover intentions by enhancing intergenerational contact quality in the workplace: The role of opportunities for generativity and development. *Work, Aging & Retirement*, 1(3), 243–253. doi:10.1093/workar/wav005

Herzberg, F., Mausnes, B., Peterson, R.O., & Capwell, D.F. (1957). Job attitudes: Review of research and opinion. *Psychological Service of Pittsburgh*.

Hoffman, D. A., Jacobs, R., & Gerras, S. J. (1992). Mapping individual performance over time. *Journal of Applied Psychology*, 77(2), 185–195. doi:10.1037/0021-9010.77.2.185

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, 4, 390–405. doi:10.1007/s10021-001-0101-5

Huffman, A., Culbertson, S. S., Henning, J. B., & Goh, A. (2013). Work–family conflict across the lifespan. *Journal of Managerial Psychology*, 28(7–8), 761–780. doi:10.1108/JMP-07-2013-0220

Humphrey, S. E., Nahrgang, J. D., & Morgeson, F. P. (2007). Integrating motivational, social, and contextual work design features: A meta-analytic summary and theoretical extension of the work design literature. *Journal of Applied Psychology*, 92(5), 1332. doi:10.1037/0021-9010.92.5.1332

Ilmarinen, J. (2006). Towards a longer and better working life: A challenge of work force ageing. *La Medicina del Lavoro*, 97(2), 143–147.

Kahana, E., Kahana, B., & Lee, J.E. (2014). Proactive approaches to successful aging: One clear path through the forest. *Gerontology*, 60, 46–474. doi:10.1159/000360222

Kanfer, R., & Ackerman, P. L. (2004). Aging, adult development, and work motivation. *Academy of Management Review*, 29(3), 440–458. doi:10.2307/20159053

Kaplowitz, M. D., Hadlock, T. D., & Levine, R. (2004). A comparison of web and mail survey response rates. *Public Opinion Quarterly*, 68(1), 94–101. doi:10.1093/poq/nfh006

Karanika-Murray, M., Antoniou, A. S., Michaelides, G., & Cox, T. (2009). Expanding the risk assessment methodology for work-related health: A technique for incorporating multivariate curvilinear effects. *Work & Stress*, 23(2), 99–119. doi:10.1080/02678370903068520

Karanika-Murray, M., & Cooper, C. (2020). *Navigating the return-to-work experience for new parents: Maintaining work-family well-being*. Routledge. doi:10.4324/9780429274336

Karanika-Murray, M., Michaelides, G., & Wood, S. (2017). Job demands, job control, psychological climate, and job satisfaction: A cognitive dissonance perspective. *Journal of Organizational Effectiveness: People & Performance*, 4(3), 238–255. doi:10.1108/JOEPP-02-2017-0012

Kenny, G. P., Yardley, J. E., Martineau, L., & Jay, O. (2008). Physical work capacity in older adults: Implications for the aging worker. *American Journal of Industrial Medicine*, 51, 610–625. doi:10.1002/ajim.20600

Klassen, R., & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience and job stress. *Journal of Educational Psychology*, 102(3), 741–756. doi:10.1037/a0019237

Kooij, D. T., De Lange, A. H., Jansen, P. G., Kanfer, R., & Dikkers, J. S. (2011). Age and work-related motives: Results of a meta-analysis. *Journal of Organizational Behavior*, 32(2), 197–225. doi:10.1002/job.665

Kooij, D. T. A. M., & van de Voorde, K. (2011). How changes in subjective general health predict future time perspective, and development and generativity motives over the lifespan. *Journal of Occupational & Organizational Psychology*, 84(2), 228–247.

Koopmans, L., Bernaards, C. M., Hildebrandt, V. H., Schaufeli, W. B., de Vet Henrica, C. W., & Van der Beek, A. J. (2011). Conceptual frameworks of individual work performance: A systematic review. *Journal of Occupational & Environmental Medicine*, 53(8), 856–866. doi:10.1097/JOM.0b013e318226a763

Kristensen, T. S., Hannerz, H., Høgh, A., & Borg, V. (2005). The Copenhagen Psychosocial Questionnaire—a tool for the assessment and improvement of the psychosocial work environment. *Scandinavian Journal of Work, Environment & Health*, 31(6), 438–449. doi:10.5271/sjweh.948

Kunze, F., Boehm, S., & Bruch, H. (2013). Age, resistance to change, and job performance. *Journal of Managerial Psychology*, 28(7–8), 741–760. doi:10.1108/JMP-06-2013-0194

Lachman, M. E. (2004). *Handbook of midlife development*. Wiley.

Lachman, M. E., & Firth, K. M. P. (2004). The adaptive value of feeling in control during midlife. In O. G. Brim, C. D. Ryff, & R. C. Kessler (Eds.), *Studies on successful midlife development. How healthy are we? A national study of well-being at midlife* (pp. 320–349). University of Chicago Press.

Lang, F. R. (2001). Regulation of social relationships in later adulthood. *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 56(1), 321–326. doi:10.1093/geronb/56.6.P321

Levinson, D. J. (1986). A conception of adult development. *American Psychologist*, 41(1), 3–13. doi:10.1037/0003-066X.41.1.3

Li, J., Burch, T. C., & Lee, T. W. (2017). Intra-individual variability in job complexity over time: Examining the effect of job complexity trajectory on employee job strain. *Journal of Organisational Behaviour*, 38(5), 671–691. doi:10.1002/job.2158

Marques, S. C., & Gallagher, M. W. (2017). Age differences and short-term stability in hope: Results from a sample aged 15 to 80. *Journal of Applied Developmental Psychology*, 53, 120–126. doi:10.1016/j.appdev.2017.10.002

Martin, A. J., Dawkins, S., Miles, V. A., Cotton S. J., & Alter, J. (2020). Practical strategies for work–family resources management in the return-to-work experiences of new parents. In M. Karanika-Murray & C. Cooper (Eds.), *Navigating the return-to-work experience for new parents: Maintaining work–family well-being*. Routledge. doi:10.4324/9780429274336

McDaniel, M.A., Schmidt, F.L., & Hunter, J.E. (1988). Job experience correlates of job performance. *Journal of Applied Psychology*, 73, 327–330. doi:10.1037/0021-9010.73.2.327

McDaniel, M. A., Pesta, B. J., & Banks, G. C. (2012). Job performance and the aging worker. In J. Hedge & W. Borman (Eds.), *Oxford handbook of work and aging* (pp. 280–297). Oxford University Press.

McEvoy, G. M., & Cascio, W. F. (1989). Cumulative evidence of the relationship between employee age and job performance. *Journal of Applied Psychology*, 74(1), 11–17. doi:10.1037/0021-9010.74.1.11

Mirvis, P. H., & Hall, D. T. (1996). Career development for the older worker. In D. T. Hall (Ed.), *The career is dead—long live the career: A relational approach to careers* (pp. 278–296). Jossey-Bass.

Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measures for assessing job design and the nature of work. *Journal of Applied Psychology*, 91, 1321–1339. doi:10.1037/0021-9010.91.6.1321

Motowidlo, S. J. (2000). Some basic issues related to contextual performance and organizational citizenship behavior in human resource management. *Human Resource Management Review*, 10(1), 115–126. doi:10.1016/S1053-4822(99)00042-X

Motowidlo, S. J., & Scotter, J. R. V. (1994). Evidence that task performance should be distinguished from contextual performance. *Journal of Applied Psychology*, 79(4), 475–480. doi:10.1037/0021-9010.79.4.475

Ng, T. W. H., & Feldman, D. C. (2007). Organizational embeddedness and occupational embeddedness across career stages. *Journal of Vocational Behavior*, 70, 336–351. doi:10.1016/j.jvb.2006.10.002

Ng, T. W. H., & Feldman, D. C. (2008). The relationship of age to ten dimensions of job performance. *Journal of Applied Psychology*, 93(2), 392–423. doi:10.1037/0021-9010.93.2.392

Ng, T. W. H., & Feldman, D. C. (2013). How do within-person changes due to aging affect job performance? *Journal of Vocational Behavior*, 83(3), 500–513. doi:10.1016/j.jvb.2013.07.007

Niessen, C., Swarowsky, C., & Leiz, M. (2010). Age and adaptation to changes in the workplace. *Journal of Managerial Psychology*, 25(4), 356–383. doi:10.1108/02683941011035287

O'Connell, D. J., McNeely, E., & Hall, D. T. (2008). Unpacking personal adaptability at work. *Journal of Leadership & Organizational Studies,* 14(3), 248–259. doi:10.1177/1071791907311005

Oswick, C., & Jones, P. (1991). The age factor in work performance: Ageism or realism? *Management Services,* 35, 12–15.

Ouwehand, C., de Ridder, D. T. D., & Bensing, J. M. (2007). A review of successful aging models: Proposing proactive coping as an important additional strategy. *Clinical Psychology Review*, 27, 873–884. doi:10.1016/j.cpr.2006.11.003

Peeters, M., & Van Emmerik, H. (2008). An introduction to the work and well-being of older workers: From managing threats to creating opportunities. *Journal of Managerial Psychology,* 23(4), 353–363. doi:10.1108/02683940810869006

Penningroth, L. S., & Scott, D. W. (2012). Age-related differences in goals: Testing predictions from selection, optimization, and compensation theory and socioemotional selectivity theory. *International Journal of Aging & Human Development*, 74(2), 87–111. doi:10.2190/AG.74.2.a

Peterson, S. K., & Spiker, B. K. (2005). Establishing the positive contributory value of older workers: A positive psychology perspective. *Organizational Dynamics*, 34, 153–167, doi:10.1016/j.orgdyn.2005.03.002

Podsakoff, N. P., LePine, J. A., & LePine, M. A. (2007). Differential challenge stressor-hindrance stressor relationships with job attitudes, turnover intentions, turnover, and withdrawal behavior: A meta-analysis. *Journal of Applied Psychology*, 92(2), 438. doi:10.1037/0021-9010.92.2.438

Porath, C. L., & Bateman, T. S. (2006). Self-regulation: From goal orientation to job performance. *Journal of Applied Psychology*, 91(1), 185–192. doi:10.1037/0021-9010.91.1.185

Rauch, J. (2018). *The happiness curve: Why life gets better after 50*. Thomas Dunne Books.

R Core Team. (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Riby, L. M., Perfect, T. J., & Stollery, B. T. (2004). The effects of age and task domain on dual task performance: A meta-analysis. *European Journal of Cognitive Psychology*, 16(6), 863–891. doi:10.1080/09541440340000402

Rönkkö, M., & Cho, E. (2020). An updated guideline for assessing discriminant validity. *Organizational Research Methods*, 25, 16–44. doi:10.1177/1094428120968614

Rotundo, M., & Sackett, P. R. (2002). The relative importance of task, citizenship, and counterproductive performance to global ratings of job performance: A policy-capturing approach. *Journal of Applied Psychology,* 87(1), 66–80. doi:10.1037/0021-9010.87.1.66

Rudolph, C. W., Kooij, D. T., Rauvola, R. S., & Zacher, H. (2018). Occupational future time perspective: A meta-analysis of antecedents and outcomes. *Journal of Organizational Behavior*, 39(2), 229–248. doi:10.1002/job.2264

Rudolph, C. W., Zacher, H., & Baltes, B. B. (2019). Looking forward: A new agenda for studying work across the lifespan. In B. B. Baltes, C. W. Rudolph, & H. Zacher (Eds.), *Work across the lifespan* (pp. 625–623). Academic Press.

Schaffer, S., Kearney, E., Voepel, S. C., & Koester, R. (2012). Managing demographic change and diversity in organizations: How feedback from coworkers moderates the relationship between age and innovative work behavior. *Zeitschrift Fur Betriebswirtschaft,* 82, 45–68. doi:10.1007/978-3-8349-3869-5_4

Scheibe, S., Spieler, I., & Kuba, K. (2016). An older-age advantage? Emotion regulation and emotional experience after a day of work. *Work, Aging & Retirement*, 2(3), 307–320. doi:10.1093/workar/waw010

Scheibe, S., & Zacher, H. (2013). A lifespan perspective on emotion regulation, stress, and well-being in the workplace. In P. L. Perrewé, C. C. Rosen, & J. R. B. Halbesleben (Eds.), *The role of emotion and emotion regulation in job stress and well-being* (pp. 163–193). Emerald.

Schooler, C., Mulatu, M. S., & Oates, G. (1999). The continuing effects of substantively complex work on the intellectual functioning of older workers. *Psychology & Aging*, 14, 483–506. doi:10.1037/0882-7974.14.3.483

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management,* 30(6), 933–958. doi:10.1016/j.jm.2004.06.007

Shephard, R. J. (2000). Aging and productivity: Some physiological issues. *International Journal of Industrial Ergonomics*, 25(5), 535–545. doi:10.1016/S0169-8141(99)00036-0

Shultz, K. S., & Adams, G. (2007). *Aging and work in the 21st century*. Lawrence Erlbaum.

Skirbekk, V. (2008). Age and productivity capacity: Descriptions, causes and policy options. *Ageing Horizons*, 8, 4–12. http://pure.iiasa.ac.at/8588

Snyder, C. R. (2002). Hope theory: Rainbows in the mind. *Psychological Inquiry*, 13(4), 249–275. doi:10.1207/S15327965PLI1304_01

Sparrow, P. R., & Davies, D. R. (1988). Effects of age, tenure, training, and job complexity on technical performance. *Psychology & Aging,* 3(3), 307–314. doi:10.1037/0882-7974.3.3.307

Stan Development Team (2019). *Stan Modeling Language Users Guide and Reference Manual, 2.21.0*. https://mc-stan.org

Sterns, H. L., & Doverspike, D. (1989). Aging and the retraining and learning process in organizations. In I. Goldstein & R. Katzel (Eds.), *Training and development in work organizations* (pp. 229–332). Jossey-Bass.

Strauss, K., Griffin, M. A., Parker, S. K., & Mason, C. M. (2015a). Building and sustaining proactive behaviors: The role of adaptivity and job satisfaction. *Journal of Business Psychology*, 30, 63–72. doi:10.1007/s10869-013-9334-5

Strauss, K., Niven, K., McClelland, C. R., & Cheung, B. K. T. (2015b). Hope and optimism in the face of change: Contributions to task adaptivity. *Journal of Business Psychology*, 30, 733–745. doi:10.1007/s10869-014-9393-2

Sturman, M. C. (2003). Searching for the inverted U-shaped relationship between time and performance: Meta-analyses of the experience/performance, tenure/performance, and age/performance relationships. *Journal of Management*, 29(5), 609–640. doi:10.1016/S0149-2063_03_00028-X

Tolentino, L. R., Garcia, P. R. J. M., Lu, V. N., Restubog, S. L. D., Bordia, P., & Plewa, C. (2014). Career Adaptation: The relation of adaptability to goal orientation, proactive personality and career optimism. *Journal of Vocational Behavior*, 84(1), 39–48. doi:10.1016/j.jvb.2013.11.004

Treadway, D. C., Ferris, G. R., Hochwarter, W., Perrewe, P., Witt, L. A., & Goodman, J. M. (2005). The role of age in perceptions of politics–job performance relationship: A three-study constructive replication. *Journal of Applied Psychology*, 90(5), 872–881. doi:10.1037/0021-9010.90.5.872

Truxillo, M. D., McCune, A. E., Bertolino, M., & Fraccaroli, F. (2012.) Perceptions of older versus younger workers in terms of big five facets, proactive personality, cognitive ability, and job performance. *Journal of Applied Social Psychology*, 42(11), 2607–2639. doi:10.1111/j.1559-1816.2012.00954.x

Van Dijk, H., Kooij, D., Karanika-Murray, M., De Vos, A., & Meyer, B. (2020). Meritocracy a Myth? A multilevel perspective of how social equality accumulates through work. *Organizational Psychology Review.* 10, 240–269.doi:10.1177/2041386620930063

Van Veldhoven, M., & Dorenbosch, L. (2008). Age, proactivity and career development. *Career Development International*, 13(2), 112–131. doi:10.1108/13620430810860530

Vehtari, A., Gelman, A., & Gabry, J. (2017). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. *Statistics & Computing*, 27(5), 1413–1432. doi:10.1007/s11222-016-9696-4

Verhaeghen, P., & Salthouse, T. A. (1997). Meta-analyses of age-cognition relations in adulthood: Estimates of linear and nonlinear age effects and structural models. *Psychological Bulletin*, 122(3), 231–249. doi:10.1037/0033-2909.122.3.231

Wagner, J., Gerstorf, D., Hoppmann, C., & Luszcz, M. A. (2013). The nature and correlated of self-esteem trajectories in late life. *Journal of Personality & Social Psychology*, 105(1), 139–153. doi:10.1037/a0032279

Waldman, D. A., & Avolio, B. J. (1986). A meta-analysis of age differences in job performance. *Journal of Applied Psychology*, 71(1), 33–38. doi:10.1037/0021-9010.71.1.33

Warr, P. (1990). The measurement of well-being and other aspects of mental health. *Journal of Occupational Psychology*, 63, 193–210. doi:10.1111/j.2044-8325.1990.tb00521

Warr, P. (1994). Research into the work performance of older employees. *Geneva Papers on Risk & Insurance—Issues & Practices*, 19(73), 472–480. doi:10.1057/gpp.1994.29

Warr, P. (2000). Job performance and the ageing workforce. In: N. Chmiel (Ed.). *Introduction to work and organisational psychology: A European perspective* (pp. 407–423). Blackwell Publishers.

Warr, P., & Fay, D. (2001). Age and personal initiative at work. *European Journal of Work & Organizational Psychology*, 10(3), 343–353. doi:10.1080/13594320143000717

Wolters, C. A., & Daugherty, S. G. (2007). Goal structures and teachers' sense of efficacy: Their relation and associated to teaching experience and academic level. *Journal of Educational Psychology*, 99(1), 181–193. doi:10.1037/0022-0663.99.1.181

Wright, T. A., & Bonnet, D. G. (2007). Job satisfaction and psychological well-being as nonadditive predictors of workplace turnover. *Journal of Management*, 33(2), 141–160. doi:10.1177/0149206306297582

Zacher, H. (2015). Successful aging at work. *Work, Aging & Retirement*, 1(1), 4–25. doi:10.1093/workar/wau006

Zacher, H., Degner, M., Seevaldt, R., Frese, M. & Luedde, J. (2009). What do younger and older workers want to accomplish? Age-related differences in content and characteristics of occupational goals. *Zeitschrift für Personalpsychologie*, 8, 191–200. doi:10.1026/1617-6391.8.4.191

Zacher, H., Heusner, S., Schmitz, M., Zwierzanska, M. M., & Frese, M. (2010). Focus on opportunities as a mediator of the relationships between age, job complexity, and work performance. *Journal of Vocational Behavior*, 76(3), 374–386. doi:10.1016/j.jvb.2009.09.001

Zacher, H., & Kooij, D. T. A. M. (2017). Aging and proactivity. In S. K. Parker & U. K. Bindl (Eds.). *Proactivity at work*. Routledge.

Zacher, H., Kooij, D. T., & Beier, M. E. (2018). Successful aging at work: Empirical and methodological advancements. *Work, Aging and Retirement*, 4(2), 123–128. doi:10.1093/workar/way002