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The relevance of perceived work environment and work activities for personality trajectories in midlife

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Abstract

Objectives: Work is an important developmental context in adulthood, yet little is known about how it contributes to personality trajectories in midlife. The present study examines how subjectively perceived work environment (autonomy, innovation, social integration, stress) and objectively measured work activities (activities related to information and people, physical/manual activities) are related to levels of Big Five personality traits at age 44 and to change over 20 years.

Methods: We analyzed four-wave longitudinal data from $N = 374$ participants (born 1950–1952; M_{age} T1 = 44 years, $SD = 1$; 44% women) from the Interdisciplinary Longitudinal Study of Adult Development and Aging (ILSE) within the structural equation modeling framework.

Results: At baseline, subjective perceptions of work environments showed a higher number of significant associations with personality than objective work activities. Over time, small declines in neuroticism and extraversion and small increases in agreeableness and conscientiousness were observed, which were largely independent of work characteristics.

Conclusions: Our findings show slight changes in most Big Five traits from age 44 to 64, which were mostly unrelated to work characteristics. More research is needed to uncover the sources and dynamics of personality trait change in midlife and the role of work for personality trajectories.

KEYWORDS

midlife, personality development, trait change, work activities, work environment

1 | INTRODUCTION

Although personality traits have traditionally been conceptualized as stable constructs, a growing body of research over the last two decades shows that personality traits can and do change throughout the entire lifespan (Bleidorn et al., 2021; Graham et al., 2020; Kandler et al., 2015; Lucas & Donnellan, 2011). Personality traits are linked to many important outcomes in multiple life domains (Soto, 2021), such as education (Noftle & Robins, 2007; Spengler et al., 2016), work (Hudson et al., 2012; Wille et al., 2014; Wu, 2016), interpersonal relationships

(Neyer & Lehnart, 2007; Selfhout et al., 2010), health (Kern & Friedman, 2008; Malouff et al., 2005; Wettstein et al., 2017), and well-being (Lucas & Diener, 2015; Tauber et al., 2016).

While research provides evidence that stability and change both characterize personality development over the lifespan, the dynamics of personality development across adulthood are less clear. To date, the sources and the underlying processes of personality trait change are not well understood (Bleidorn et al., 2021). Most research in this field focuses on adolescence and young adulthood, while less is known about personality trajectories in midlife. Studies suggest that change of personality traits primarily occurs in younger and older adults, but there is also evidence of personality changes in middle-aged adults (Graham et al., 2020; Kandler et al., 2015; Lucas & Donnellan, 2011). Contextual influences have found only limited attention in the previous midlife and personality change literature. One major developmental context in adulthood is work.

While researchers have long been interested in whether work environments affect or merely are affected by personality, evidence for a reciprocal relationship of work characteristics and personality traits has been accumulating in the recent decade (e.g., Kohn & Schooler, 1978, 1982; Li et al., 2014; Wille et al., 2014; Wu, 2016). Still, the sources and mechanisms of personality change in relation to work are unclear. The literature regarding personality development at work provides mixed findings, which may be partially based on differences regarding work-related constructs considered, intervals between measurement occasions and participants' age (Woods et al., 2019; Wu, 2016). Previous studies often analyzed only one or few work-related constructs at two measurement occasions and solely relied on subjective self-reports of work characteristics.

The present study makes an attempt to address these limitations, while focusing two aims: First, at the more general level, we strive to address the research gap concerning midlife, which is a central life period shaped by growth and decline mechanisms at the same time. The understanding of personality development in this life period helps to advance theoretical and empirical models of developmental processes. Findings may also inform interventions to ultimately promote health, well-being, and subsequent successful aging of middle-aged adults, while indirectly also contributing to the well-being of the younger and older generations who they care for (Infurna et al., 2020; Lachman, 2015). Second, we extend previous research by broadening the scope of examined subjective as well as objective work characteristics in association with personality development by taking advantage of a 20-year longitudinal study with four measurement occasions. The findings of the present study contribute to the groundwork for future research to delve deeper into sources and processes of personality development at work.

1.1 | Personality development across middle adulthood

Following Allport (1961), personality traits represent relatively enduring patterns of thoughts, feelings and behaviors, which are relatively consistent over a wide range of situations and contexts and differ between individuals. Personality traits manifest through momentary thoughts, feelings and behaviors in specific situations, referred to as personality states (Fleeson, 2001). The Big Five or Five-Factor Model of personality (Goldberg, 1990; McCrae & Costa, 2008) holds extensive empirical support and is widely used to examine personality and its development. In this framework personality is described based on the five traits neuroticism (emotional stability), extraversion, openness to experience, agreeableness, and conscientiousness.

Costa and McCrae (1992, 2008; McCrae and Costa, 2008) characterize these traits as follows: High scores on the neuroticism factor represent high anxiety, nervousness, and sadness as well as the tendency to worry. People scoring high on extraversion can be described as active, assertive, and sociable. Openness is associated with eagerness for knowledge, imaginativeness, creativity, and independent judgment. People scoring high on agreeableness are altruistic, empathetic, understanding, compliant, modest and caring. High scores on conscientiousness come along with a high achievement motivation and self-discipline. Conscientious people are organized, dutiful, reliable, and deliberate.

From a lifespan developmental perspective (Baltes et al., 2006) personality is seen as a dynamic system, which develops through the interaction of biological, socio-cultural and psychological characteristics. Although the Big Five personality trait domains have a genetic foundation (Bleidorn et al., 2009; Bouchard & Loehlin, 2001; Hopwood et al., 2011; Johnson et al., 2005), environmental influences, such as specific demands, life events or interventions (Roberts et al., 2017), can drive change at every age (Bleidorn et al., 2020; Specht et al., 2014). While a stable personality can be the base for continuous development and foster psychological well-being, changes in personality traits can reflect increased resilience and adjustment caused by adaptive processes in dealing with and mastering of normative developmental challenges as well as non-normative life events in adulthood (Baltes et al., 2006; Pocnet et al., 2021; Staudinger & Kunzmann, 2005).

According to the corresponsive principle of personality change, personality traits affect the selection of environments and activities which in turn influence personality traits and lead to their strengthening (Caspi et al., 2005; Roberts et al., 2003). In general, individuals often select and maintain environments and situations that are compatible with their personality dispositions independent of their age (Wrzus et al., 2016). Accordingly, people mostly

select, for example, specific work environments, which are consistent with their interests, skills, and personality. These environments offer opportunities to apply and develop the respective skills and motives, which in turn can strengthen the corresponsive personality traits (Li et al., 2014). Differences in those corresponsive processes in the work context could lead to differences in personality changes because people, who have achieved high corresponsiveness early in their working lives, might experience higher stability later on as compared to those in constant search for corresponsiveness.

Studies investigating differential stability as well as mean-level changes of personality traits show more plasticity in younger and older adults (Graham et al., 2020; Kandler et al., 2015; Lucas & Donnellan, 2011; Roberts et al., 2006; Roberts & Mroczek, 2008; Specht et al., 2011; Wortman et al., 2012). This pattern is often explained by the need for stronger adaptation to transitions to new roles and life circumstances during these life phases, which reflect complex interactions of biological, psychological and social changes (Kandler et al., 2015; Lucas & Donnellan, 2011; Wrzus & Roberts, 2017). In middle adulthood, average changes of personality traits are less pronounced. Higher rank-order stability and fewer or smaller mean-level changes of personality traits in middle adulthood can be explained by the cumulative continuity principle. The higher continuity is presumably conditioned by the relative stability of individual environments and social roles, the strengthening of one's identity and self-selection of activities and experiences (Caspi et al., 2005; Roberts & Wood, 2006). Many bigger life transitions, e.g., assuming new social roles and entering new (work) environments, are typically completed before middle adulthood. Consequently, daily situations, life routines, and environmental demands are more stable compared to young adulthood (Hutteman et al., 2014; Specht et al., 2014; Wrzus et al., 2012).

Nevertheless, there is evidence for changes of personality in midlife. Differential or rank-order stability of personality traits in middle adulthood ranges between 0.6 and 0.9 in most studies depending on the specific trait, participants' age, and the time interval between measurement occasions (Ferguson, 2010; Lucas & Donnellan, 2011; Roberts & DelVecchio, 2000; Specht et al., 2011; Wortman et al., 2012). Studies investigating mean-level changes in personality traits across midlife predominantly found decreases or stability in neuroticism, extraversion and openness, whereas mainly increases or stability were found for agreeableness and conscientiousness (Graham et al., 2020; Lucas & Donnellan, 2011; Roberts et al., 2006; Specht et al., 2011; Terracciano et al., 2005; Wortman et al., 2012). It is important to emphasize that besides these average personality trait changes, in many studies interindividual differences in intraindividual personality trait changes over the lifespan were found (Graham et al., 2020; Schwaba & Bleidorn, 2018). One aspect about midlife that might influence personality traits could be the increasing perception of the aging process because of emerging physical and cognitive changes (Pocnet et al., 2021; Stephan et al., 2015). Additionally, there are changes regarding the future time perspective and changes in goal orientations (e.g., a shift from growth to maintenance goals; Kairys & Liniauskaite, 2015; Kooij, 2015; Zacher, 2015). Hence, the already established adaptations to the work environment might find new challenges in midlife and result in personality trait changes. The influences on personality and the emerging change might also translate to the post-retirement phase, paving the way for (un)successful aging (Pocnet et al., 2021).

1.2 | The relevance of work for personality development

In industrial, work and organizational psychology, personality has long been used as independent variable to predict a wide range of work-related outcomes and to differentiate between individuals in personnel selection processes (Tett & Fisher, 2021). In recent years, developmental and personality psychology added to this body of research by using personality traits as dependent variables and focusing on longitudinal associations between work and personality (Woods et al., 2013). Work plays an important role for personality development because it is a central and time-consuming part of most adults' lives (Fisher & Robinson, 2011). Major explanatory pathways at a rather global level may be that work environments and experiences influence a person's social roles, values, activities, and behavior (Frese, 1982). However, focused research on associations between work characteristics and personality change, especially in midlife, is still scarce.

At the conceptual level, there are several theories that offer explanations for a systematic link between work and personality development. Following the social investment principle (Roberts et al., 2005), personality changes are driven by the investment in and commitment to age-graded social roles, for example, at work. These roles are linked to certain expectations and reward structures for developing in the direction of more functional maturity, reflected by higher conscientiousness, agreeableness, and social dominance as well as lower neuroticism (maturity principle, Roberts & Wood, 2006), which most often takes place in young adulthood. Trait Activation Theory (TAT, Tett & Burnett, 2003) states that different work situations and demands activate specific personality traits and related behavior, which can then lead to their strengthening. Another mechanism of personality development at work is described by the theory of work adjustment (Dawis & Lofquist, 1984). The theory posits that individuals try to

achieve correspondence with their work environment. Thus, trait changes can be caused by adjustment processes to fulfill work requirements, for example, by learning new skills or changing behavior and attitudes.

Woods et al. (2019) made an attempt to integrate several theories and concepts in this field and presented the Demands-Affordances TrAnsactional Model (DATA), a coherent framework for personality development at work: The work environment poses demands and creates individual affordances for personality-related behaviors. The individual engages in a continuous process of achieving fit between work demands and behaviors by corresponsive or adjustment processes to reach personal goals, which are also formed by demands and affordances, and to attain positive work outcomes like rewards or satisfaction. The practice of new behaviors in different situations and changes in attitudes, priorities, and values can finally lead to personality trait changes.

Importantly, work characteristics need a highly differentiated view: Work characteristics and respective demands can be categorized at the four levels of job, vocation, team/group, and organization (Su et al., 2015). The present study aims at illuminating the association of work characteristics on the job and group level, which regard (characteristics of) activities and tasks required to meet job demands as well as demands emerging in the team context (Woods et al., 2019), with personality development. Woods et al. (2019) argue that the examination of a greater variability of work characteristics is important to advance the understanding of the effect of work on personality development. Thus, we selected a broad set of work environment characteristics for which previous studies have reported associations with personality trait levels and changes. We focused on multiple constructs regarding the subjectively perceived work environment as well as several objective work activities. This approach allows to understand the role that work plays in personality development in midlife and to examine if specific work characteristics are more relevant for personality trait changes than others.

At the job level we focused on three central constructs of perceived work environment in industrial, work and organizational psychology: job stress, autonomy and innovation. Wu (2016) identified job stress as a key factor for personality trait change in relation to work. The relevance of autonomy as well as innovation at work was already recognized in early studies of work and personality relations (e.g., Kohn & Schooler, 1978, 1982). Additionally, we included social integration as a group level characteristic of perceived work environment because social interactions in the work group bear great potential to influence personality development through shared norms and role expectations, but previous research on personality changes at work has neglected group level characteristics (Woods et al., 2019).

1.2.1 | Personality and work stress

Previous research from different areas provides insight into work-related factors that might influence personality development. One of these research fields is related to the reciprocal interaction between personality and stress. Personality influences different aspects of stress processes, like appraisals of potentially stressing situations and stimuli, coping and stress reactivity. Especially high neuroticism has a negative impact on these stress-related processes, whereas for high extraversion, openness, conscientiousness, and agreeableness mostly positive impacts were found (Brose, 2021; Connor-Smith & Flachsbart, 2007; Leger et al., 2016; Luo et al., 2017). Stress in turn influences personality development, for example, by evoking adaptational processes in reaction to critical life events (Bleidorn et al., 2018; Brose, 2021). In the work context, job stress is a central part of personality change processes related to specific work characteristics (Smallfield & Kluemper, 2022). Consequently, higher emotional stability facilitates fulfilling work demands effectively, even when confronted with changes and stress (Huang et al., 2014; Tett & Fisher, 2021). Additionally, Le et al. (2014) found that stressful work environments were associated with increases in negative emotionality. Wu (2016) examined time-ordered associations between personality changes and changes of work characteristics and experiences. She found that level of time demands and level of job control were associated with job stress and that increases in time demands predicted increases in job stress. Level and change of job stress in turn predicted increases in neuroticism and decreases in extraversion and conscientiousness. Additionally, higher initial levels of neuroticism were associated with increases in job stress, whereas higher levels of conscientiousness and openness were associated with decreases in job stress.

1.2.2 | Personality and autonomy at work

In the same study (Wu, 2016), initial levels of job control, which describes the degree of autonomy, predicted decreases in agreeableness and increases in openness. Increases in job control predicted increases in agreeableness, openness, and conscientiousness. At the same time, high initial levels of neuroticism and agreeableness predicted decreases in job control, whereas high initial levels of openness predicted increases in job control (Wu, 2016). In other studies, work autonomy was positively associated with levels of and increases in agentic positive emotionality, which i.a. includes ambitiousness and forcefulness and overlaps with facets of conscientiousness and extraversion (Le et al., 2014; Roberts et al., 2003). Also, level and change of self-direction have been shown to be associated with level and change of ideational flexibility (openness) (Kohn & Schooler, 1978, 1982).

Furthermore, openness predicted upward mobility into managerial professions offering higher autonomy, which in turn predicted increases in openness (Nieß & Zacher, 2015). Additionally, Sutin and Costa (2010) showed that level and change of decision latitude were negatively correlated with neuroticism and positively correlated with extraversion, openness, and conscientiousness.

1.2.3 | Personality and innovation at work

Jobs characterized by high innovation, and thus variety and novelty, can be considered as more complex and stimulating compared to monotonous jobs (Oltmanns et al., 2017; Staudinger et al., 2016). Cognitively stimulating activities are associated with higher levels of openness across the lifespan (Ihle et al., 2016; Jackson et al., 2020). Accordingly, more complex and innovative work environments and changes in complexity and innovation have been found to be linked to levels and changes of openness (Kohn & Schooler, 1978, 1982; Nieß & Zacher, 2015).

1.2.4 | Personality and social integration at work

Regarding social integration at work, especially neuroticism can have a negative influence. High neuroticism can hinder forming lasting and trusting relationships because of hostile interpretations and dysregulated emotions (Pocnet et al., 2021). Accordingly, Allemand et al. (2015) found that level and change of neuroticism were negatively, and levels and changes of extraversion, openness, agreeableness, and conscientiousness were positively associated with levels and changes of perceived social support. In the work context, high negative emotionality, low agreeableness, and low conscientiousness are related to counterproductive behaviors and less positive relationships with co-workers and supervisors (Roberts et al., 2007).

1.2.5 | Personality and work activities

Previous research on work characteristics and personality change primarily focused on people's subjective perceptions of their work environment. As Woods et al. (2019) suggest based on their review of pertinent research, it is important to include more specific descriptions of work demands in studies of personality development. It is necessary to further the range of studied work characteristics and examine contents and work activities more intensively. One useful taxonomy in that regard is the O*NET categorization of work tasks and activities, which facilitates linking work demands and affordances to personality traits (Peterson et al., 2001). The O*NET database measures the extent of work activities related to information, to people, and to physical and manual activities (Burrus & Way, 2017; Pool et al., 2016; Then et al., 2015).

The association between specific work activities and personality trait levels and changes is not yet well understood. Roberts et al. (2003) found that higher work stimulation was linked to increases in positive emotionality. As stated above, especially openness is linked with more complex work environments (Kohn & Schooler, 1978, 1982; Nieß & Zacher, 2015). Concerning physical and manual activities, low agreeableness was associated with higher levels of and increases in physical work demands (Sutin & Costa, 2010). Furthermore, Wille and De Fruyt (2014) examined longitudinal associations between work activities related to people and personality traits in both directions. Higher extraversion and openness correlated with higher levels of work activities related to people. Higher neuroticism, openness, and agreeableness predicted increases in levels of work activities related to people and changes in extraversion correlated with changes in the level of work activities related to people.

In associations between work characteristics and personality, a number of additional personal and environmental factors need to be considered, which are related to both constructs. Gender, education, and income have been linked to levels and change of both personality traits and work characteristics (Denissen et al., 2018; Jaconelli et al., 2013; Kajonius & Johnson, 2018; Mac Giolla & Kajonius, 2019; Noftle & Robins, 2007; Sutin et al., 2009; Woods et al., 2013). Furthermore, retirement can be a transitional phase potentially triggering personality development (Löckenhoff et al., 2009; Robinson et al., 2010; Schwaba & Bleidorn, 2019). Regional differences should also be taken into account because socialization in different contexts may potentially affect both work environments and personality (Allik et al., 2017; Khwaja et al., 2019; Murphy et al., 2021).

Personality changes in midlife are less pronounced compared to young and old adulthood. Still, there is evidence for personality trait changes in middle adulthood and it is worthwhile investigating personality trajectories in midlife to learn more about their sources and dynamics. One major developmental context in adulthood is work and trait changes can be triggered by demands and affordances of specific work environments and activities.

1.3 | The present study[1]

The objective of the present study is to extend previous research on personality development in midlife. As research regarding this life period is scarce and dynamics of personality trajectories need more investigation (Bleidorn

et al., 2021; Lachman, 2015), we examine how work characteristics, as environmental factors, are linked to levels of and changes in personality through middle adulthood using longitudinal data from the Interdisciplinary Longitudinal Study of Adult Development and Aging (ILSE) (Hildesheim et al., 2019). The current study does not only consider subjective work environment, but also objective data from the O*NET database (Peterson et al., 2001). To further the understanding of the associations between work characteristics and personality development in midlife, the present study focuses on autonomy, innovation, social integration, and job stress as aspects of perceived work environment as well as on objective data on work activities related to information, people, and physical or manual activities. We examine whether perceived work environment and work activities are related to levels of Big Five personality traits at age 44 and to change in personality over 20 years.

Based on earlier research (Wu, 2016), we expected that higher work stress will be related to an increase in neuroticism and a decline in extraversion and conscientiousness, and that higher work autonomy will be related to decreases in agreeableness and increases in openness. As cognitively stimulating activities are linked to higher levels and changes of openness (Ihle et al., 2016; Jackson et al., 2020; Kohn & Schooler, 1978, 1982; Nieß & Zacher, 2015), we expected cognitively stimulating work (characterized by high levels of innovation and activities related to information and people) to be related to an increase in openness over time.

2 | METHOD

2.1 | Participants and procedure

In this study, we analyzed longitudinal data from the Interdisciplinary Longitudinal Study of Adult Development and Aging (ILSE) (for a detailed description see Hildesheim et al., 2019). ILSE includes four measurement waves (T1: 1993–1996, T2: 1997–2000, T3: 2005–2008, T4: 2014–2016) over approximately 20 years. The study conforms to the ethical standards of the Declaration of Helsinki (1989). Approval by the ethics committee of Heidelberg University's medical faculty was obtained for all four measurement waves. An initial sample of two cohorts of community-dwelling adults born between 1930 and 1932 and between 1950 and 1952 was drawn randomly from population registries in Heidelberg (former West Germany) and Leipzig (former East Germany). The sample was stratified by gender and birth cohort to establish equal distribution of male and female as well as younger and older participants. Sociodemographic data of both cohorts were similar to the general German population except for a slightly higher educational level. All potential participants received an invitation to take part in the study. Everyone who agreed to participation received detailed information about the study and gave their written consent. Data were collected on a wide range of variables related to successful aging using semi-standardized biographical interviews, structured questionnaires, and medical as well as psychological examinations.

The present study focuses on associations between work characteristics and personality. As only 13% of the 1930–1932 cohort were working at T1 compared to 80% of the 1950–1952 cohort, only the data from the latter subsample were analyzed. We used data from 374 participants in the midlife subsample (born 1950–1952) who were working at T1 and provided data on the variables of interest (age at T1: $M = 44$ years; $SD = 1$; range = 42–46, 44% women). For the analyses, T1 data on perceived work environment, work characteristics, and control variables were used as well as personality data obtained at all four measurement waves. For 196 participants (52%) four waves of data were available, for 85 participants (23%) three waves of data were available, for 61 participants (16%) two waves of data were available, and for 32 participants (9%) one wave of data was available. The average time interval between T1 and T2 was 3.83 years, between T1 and T3 11.27 years, and between T1 and T4 19.69 years. One-way ANOVAs with number of available observations as the independent variable and each study variable at T1 as the dependent variable revealed only one significant difference in education ($p < .01$). Participants who provided more waves of data had a higher educational level.

2.2 | Measures

2.2.1 | Personality

The Big Five personality traits were measured with the German Revised NEO Five-Factor Inventory (NEO-FFI; Borkenau & Ostendorf, 1993; see also Allemand et al., 2007, 2008). The NEO-FFI consists of 60 items representing the personality traits neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness with 12 items each. Item-level analyses of the instrument have shown superior psychometric properties for a shorter version (Körner et al., 2008), which was also the case in the present study. Therefore, our analyses are based on 30 items that were included in the short version (Körner et al., 2008). In the present study, participants rated the statements on a 5-point Likert scale (0 – *strongly disagree* to 4 – *strongly agree*). The internal consistency estimates (McDonald's omega) for all measurement occasions range from $\omega = 0.77$ to $\omega = 0.82$ for neuroticism,

$\omega = 0.62$ to $\omega = 0.64$ for extraversion, $\omega = 0.60$ to $\omega = 0.68$ for openness to experience, $\omega = 0.62$ to $\omega = 0.65$ for agreeableness, and $\omega = 0.64$ to $\omega = 0.65$ for conscientiousness.

2.2.2 | Perceived work environment

Perceived work environment was assessed at T1 by trained interviewers in a semi-structured interview based on participants' responses to open-ended questions. Work autonomy, the degree to which a person can handle work activities independently, was measured by two items based on participants' response to the question: "Can you organize work tasks / work time independently?", indicating flexibility of working time (1 – *very little* to 5 – *very high*) and independence (1 – *dependent* to 5 – *independent*; Cronbach's alpha = .76). Work innovation describes the degree to which one's work activities offer variety and was assessed with a single item based on participants' response to the question: "What are your work tasks?" (1 – *monotonous* to 5 – *varied*). Social integration at work, the extent of social contacts and affiliations, was measured by three items based on participants' response to the questions: "Do you work by yourself or with colleagues? How do you perceive the teamwork? How do you perceive the work with your supervisor?", indicating the frequency of contacts with co-workers (1 – *very low* to 5 – *very high*), the valence of these contacts (1 – *very negative* to 5 – *very positive*), and social integration (1 – *very isolated* to 5 – *very integrated*; Cronbach's alpha = .74). Work stress indicates the degree to which work is perceived as straining and was assessed with a single item based on participants' response to the question: "Do you have any problems or difficulties with regard to your current work?" (1 – *very little* to 5 – *a lot*).

2.2.3 | Work activities

Job descriptions were obtained at T1 based on a questionnaire. The participants' verbal descriptions were translated into English and then matched to an occupational code in the Occupational Information Network database (O*NET 24.2; for more details see Hülür et al., 2020). For each occupational code, the level of 41 work activities is rated on a scale from 0 to 7. Based on previous research (Burrus & Way, 2017; Pool et al., 2016; Then et al., 2015) the level of work activities was categorized into work activities related to information (e.g., getting, processing, or evaluating information; Cronbach's alpha = .97), work activities related to people (e.g., establishing and maintaining interpersonal relationships, assisting and caring for others, selling, or influencing others; Cronbach's alpha = .94), and physical and manual activities (e.g., performing physical activities, handling and moving objects, controlling machines and processes; Cronbach's alpha = .95). The resulting averages across the respective activities in these three domains indicate each participant's level of work activities in their day-to-day work.

2.2.4 | Control variables

Gender, education, retirement at T4, income, and region were included as control variables. Gender (0 = men, 1 = women), region (0 = Leipzig, former East Germany, 1 = Heidelberg, former West Germany), and retirement at T4 (0 = not retired, 1 = retired) were assessed as binary variables. Only retirement at T4 was used as control variable because at T4 42% of participants were retired, whereas this was the case only for 1% at T2 and 4% at T3. Education was measured by the number of years spent in formal education. Income was assessed at T1 in German Mark (0 = no income, 1 = below 300 DM, 2 = 300–500 DM, 3 = 500–1000 DM, 4 = 1000–1500 DM, 5 = 1500–2000 DM, 6 = 2000–2500 DM, 7 = 2500–3000 DM, 8 = 3000–3500 DM, 9 = 3500–4000 DM, 10 = 4000–5000 DM, 11 = 5000–6000 DM, 12 = above 6000 DM).

2.2.5 | Statistical analysis

We used structural equation models to examine how perceived work environment and work activities are linked to levels of and change in personality in middle adulthood. All analyses were conducted with R (R Core Team, 2021). R-scripts are available at https://osf.io/m3nw4/. The lavaan package (Rosseel, 2012) was used to estimate the models with full information maximum likelihood estimation with robust (Huber-White) standard errors. In the following robust fit indices are reported. Incomplete data were treated as missing at random (Little & Rubin, 1987). Statistical significance was accepted for $p < .05$. To evaluate model fit, the Comparative Fit Index (CFI; Bentler, 1990), the Root Mean Square of Approximation (RMSEA; Steiger, 1990), and the Standardized Root Mean Square Residual (SRMR; Kline, 2016) were used. CFI values above 0.90 indicate an acceptable and values over 0.95 a good model fit. For RMSEA and SRMR good model fit is indicated by values lower than 0.08 (Hu & Bentler, 1999).

Separate measurement models were set up for the five personality factors at the item-level for each measurement occasion. Unidimensional measurement models for agreeableness and conscientiousness showed good model fit. Introducing a residual correlation in the unidimensional measurement models for neuroticism (items 11 and 21, see

Körner et al., 2008) and openness (items 48 and 58) was necessary to achieve good model fit. Additionally, one extraversion item (item 07) was excluded because it led to misfit and one openness item (item 08) had to be excluded because of a non-significant factor loading. This allowed us to achieve acceptable to good model fit at baseline (neuroticism: CFI = 0.962, RMSEA = 0.081, SRMR = 0.038; extraversion: CFI = 0.933, RMSEA = 0.083, SRMR = 0.036; openness: CFI = 0.889, RMSEA = 0.077, SRMR = 0.043; agreeableness: CFI = 1.000, RMSEA = 0.000, SRMR = 0.019; conscientiousness: CFI = 0.986, RMSEA = 0.033, SRMR = 0.031).

Subsequently, we tested longitudinal measurement invariance (Widaman et al., 2010) for the five personality factors across all four measurement waves to ensure that items measure the personality traits in the same way over time. Strong measurement invariance (invariant factor loadings and intercepts across time) is required for comparisons of factor means (Widaman et al., 2010). We started with less restrictive models and successively implemented constraints on intercepts and loadings. Residual correlations of the same items across different measurement occasions were allowed (Little, 2013). For the evaluation of model deterioration, criteria for sample sizes of at least 300 by Chen (2007) were used. Regarding the invariance of factor loadings, a meaningful worsening of model fit is indicated by a difference in CFI of at least 0.010 and a simultaneous difference in RMSEA of at least 0.015 or a difference in SRMR of at least 0.030. Regarding the invariance of intercepts, a meaningful worsening of model fit is indicated by a difference in CFI of at least 0.010 and a simultaneous difference in RMSEA of at least 0.015 or a difference in SRMR of at least 0.010.

Next, we fitted linear growth curve models for the personality factors. Loadings of the latent variables at T1 to T4 on the latent factor, representing the level of a given personality trait, were set at 1. The linear change factor represented change in a given personality trait per decade. Accordingly, loadings on the change factor at T1 were constrained to 0, at T2 to 0.383, at T3 to 1.127, and at T4 to 1.969 based on the average time interval between measurement occasions. Figure 1 illustrates the models for levels and change of the five personality traits.

Finally, we analyzed associations of manifest work-related variables at baseline with levels of and changes in each personality trait. Additionally, we examined how the inclusion of control variables affected the associations between perceived work environment, work activities, and personality. Work-related and control variables were centered at sample means to facilitate interpretation of our findings. Table 1 shows descriptive statistics and intercorrelations of all study variables at T1.

3 | RESULTS

3.1 | Tests of longitudinal measurement invariance

Before comparing latent factor means, we established measurement invariance for the five personality trait

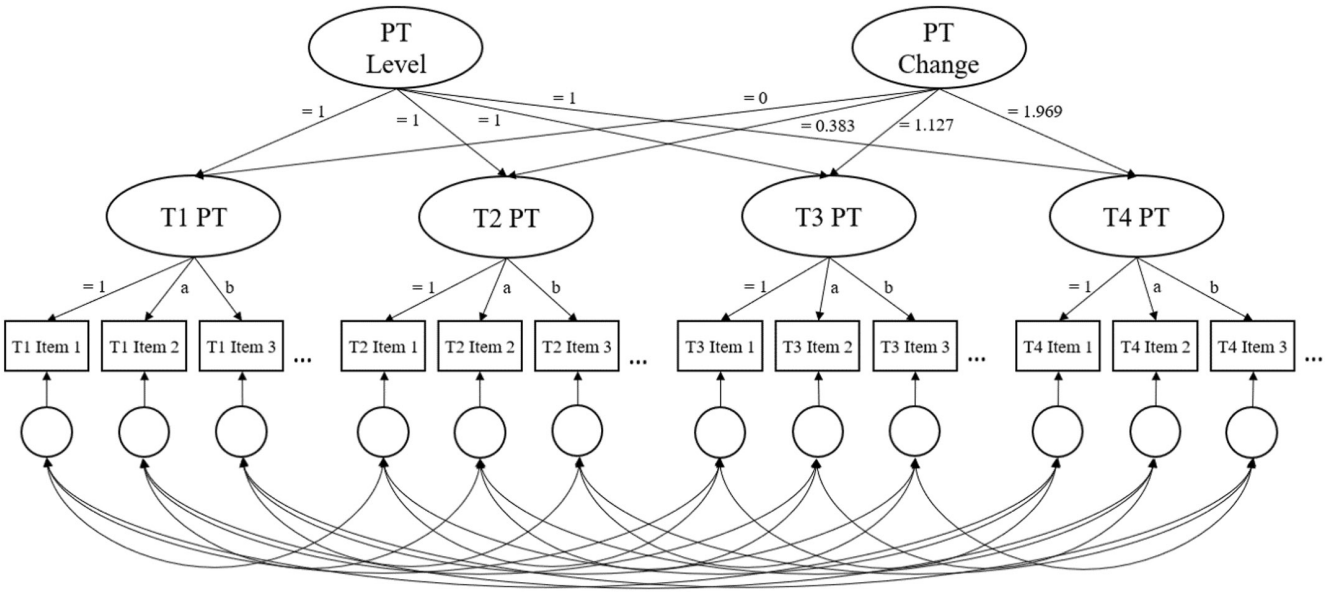

FIGURE 1 Latent growth curve models for the five personality traits (PT) measured across four time points (T1–T4). Factor loadings and intercepts were constrained to be equal over time. Residual correlations of the same items across different measurement occasions were allowed.

TABLE 1 Means, standard deviations and intercorrelations of study variables at T1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Neuroticism																	
(2) Extraversion	−0.15*																
(3) Openness	−0.07	0.18*															
(4) Agreeableness	−0.26*	0.00	−0.01														
(5) Conscientiousness	−0.17*	0.22*	−0.03	0.39*													
(6) Autonomy	−0.05	0.07	0.12*	−0.06	−0.05												
(7) Innovation	−0.17*	0.01	0.03	0.06	−0.02	0.36*											
(8) Social integration	−0.07	0.14*	−0.05	0.23*	0.17*	−0.09	0.13*										
(9) Stress	0.08	−0.06	−0.03	−0.08	0.00	0.00	0.07	−0.17*									
(10) Work activities information	−0.14*	0.00	0.08	0.02	−0.04	0.21*	0.17*	−0.03	0.01								
(11) Work activities people	−0.14*	0.03	0.09	−0.01	0.01	0.23*	0.14*	0.02	0.05	0.81*							
(12) Physical work activities	−0.07	0.00	−0.17*	0.07	0.10	−0.27*	−0.10	0.08	−0.02	0.00	−0.11*						
(13) Gender	0.33*	0.02	−0.06	0.05	0.01	−0.07	−0.08	0.05	−0.13*	−0.15*	−0.10	−0.32*					
(14) Education	−0.06	−0.04	0.23*	−0.09	−0.16*	0.36*	0.29*	−0.11*	0.14*	0.45*	0.40*	−0.37*	−0.03				
(15) Income	−0.18*	−0.01	0.18*	−0.08	−0.12*	0.34*	0.22*	0.02	0.01	0.41*	0.36*	−0.08	−0.35*	0.38*			
(16) Retirement at T4	0.05	−0.05	−0.12	0.12	0.17*	−0.20*	−0.13	0.14*	−0.08	−0.17*	−0.22*	0.20*	−0.04	−0.23*	−0.12		
(17) Region	−0.04	−0.07	0.13*	−0.14*	−0.11*	0.11*	−0.14*	−0.10	−0.17*	0.11*	0.09	−0.08	−0.05	−0.03	0.35*	−0.18*	
M	1.55	2.37	2.42	2.89	3.17	3.21	4.21	3.59	3.07	3.57	3.18	2.16	44%	14.30	7.26	42%	49%
SD	0.55	0.58	0.63	0.52	0.44	1.18	0.92	0.81	1.04	0.75	0.79	1.07		2.45	2.36		

Note: $N = 374$, Gender: 0 = men, 1 = women, education: number of years spent in formal education, income: scale from 0 to 12, retired at T4: 0 = no, 1 = yes, region: 0 = East Germany, 1 = West Germany.

*$p < .05$.

TABLE 2 Fit indices of tests of longitudinal measurement invariance

Model	CFI	RMSEA	SRMR	Δ CFI	Δ RMSEA	Δ SRMR
Neuroticism						
Configural invariance	0.997	0.009	0.047			
Weak invariance	0.998	0.007	0.050	0.001	0.002	0.004
Strong invariance	0.993	0.014	0.051	0.005	0.007	0.000
Extraversion						
Configural invariance	0.982	0.027	0.051			
Weak invariance	0.984	0.024	0.053	0.002	0.003	0.002
Strong invariance	0.965	0.034	0.058	0.019	0.010	0.005
Openness						
Configural invariance	0.964	0.037	0.068			
Weak invariance	0.961	0.037	0.073	0.003	0.000	0.006
Strong invariance	0.956	0.038	0.074	0.005	0.001	0.001
Agreeableness						
Configural invariance	0.970	0.027	0.050			
Weak invariance	0.967	0.027	0.057	0.002	0.000	0.008
Strong invariance	0.962	0.028	0.060	0.005	0.001	0.003
Conscientiousness						
Configural invariance	0.980	0.022	0.049			
Weak invariance	0.978	0.022	0.056	0.003	0.001	0.008
Strong invariance	0.969	0.025	0.058	0.009	0.003	0.001

Note: $N = 374$.

factors. We started with tests of configural invariance constraining items to load on the same personality factors over the four measurement occasions. All models showed good model fit (see Table 2). Next, we constrained factor loadings to be equal across all measurement occasions testing for weak measurement invariance. In a final step, we tested for strong measurement invariance by also constraining item intercepts to be equal across all measurement occasions. In both steps, these more restrictive models did not lead to any meaningful deteriorations of model fit (see Table 2). Fit indices showed that the assumption of strong measurement invariance held in this sample over all measurement occasions. Consequently, we used the strong measurement invariance models in the subsequent analyses.

3.2 | Latent growth curve models of personality traits

Linear growth curve models for the five personality traits showed a good fit (neuroticism: CFI = 0.990, RMSEA = 0.017, SRMR = 0.055; extraversion: CFI = 0.964, RMSEA = 0.034, SRMR = 0.058; openness: CFI = 0.954, RMSEA = 0.038, SRMR = 0.078; agreeableness: CFI = 0.964, RMSEA = 0.027, SRMR = 0.061; conscientiousness: CFI = 0.964, RMSEA = 0.027, SRMR = 0.061). There were interindividual differences in all five personality trait levels at T1, indicated by significant level variances (all $p < .001$; neuroticism: $\sigma^2 = 0.210$, $SE = 0.037$, 95% CI [0.137, 0.283]; extraversion: $\sigma^2 = 0.269$, $SE = 0.054$, 95% CI [0.162, 0.375]; openness: $\sigma^2 = 0.213$, $SE = 0.037$, 95% CI [0.141, 0.285]; agreeableness: $\sigma^2 = 0.096$, $SE = 0.023$, 95% CI [0.051, 0.142]; conscientiousness: $\sigma^2 = 0.162$, $SE = 0.032$, 95% CI [0.098, 0.225]). The intercept of the change variable indicated a decrease in neuroticism (0.045 points per decade, $SE = 0.019$, $p = 0.020$, 95% CI [−0.083, −0.007], 10% of a standard deviation unit) and extraversion (0.092 points per decade, $SE = 0.022$, $p < .001$, 95% CI [−0.136, −0.048], 18% of a standard deviation unit) as well as an increase in agreeableness (0.051 points per decade, $SE = 0.012$, $p < .001$, 95% CI [0.026, 0.075], 17% of a standard deviation unit) and conscientiousness (0.038 points per decade, $SE = 0.017$, $p = .030$, 95% CI [0.004, 0.071], 9% of a standard deviation unit). Openness showed no significant change over time (0.026 points per decade, $SE = 0.018$, $p = .133$, 95% CI [−0.008, 0.061]). Individuals significantly differed in their rate of change in neuroticism ($\sigma^2 = 0.035$, $SE = 0.018$, $p = .043$, 95% CI [0.001, 0.070]) whereas for the other personality traits no differences in the rates of change were found (extraversion: $\sigma^2 = 0.033$, $SE = 0.020$, $p = .091$, 95% CI [−0.005, 0.072]; openness:

$\sigma^2 = 0.001$, $SE = 0.012$, $p = .959$, 95% CI [−0.022, 0.024]; agreeableness: $\sigma^2 = 0.006$, $SE = 0.006$, $p = .366$, 95% CI [−0.007, 0.018]; conscientiousness: $\sigma^2 = 0.010$, $SE = 0.008$, $p = .212$, 95% CI [−0.006, 0.025]).

Linear growth curve models of personality traits additionally including work characteristics showed a good fit (neuroticism: CFI = 0.983, RMSEA = 0.019, SRMR = 0.053; extraversion: CFI = 0.958, RMSEA = 0.031, SRMR = 0.056; openness: CFI = 0.951, RMSEA = 0.034, SRMR = 0.070; agreeableness: CFI = 0.953, RMSEA = 0.028, SRMR = 0.058; conscientiousness: CFI = 0.947, RMSEA = 0.030, SRMR = 0.059). Table 3 presents the correlations between perceived work environment and work activities with levels of and changes in personality traits. Level of neuroticism correlated negatively with levels of innovation ($r = -0.118$, $p < .001$, 95% CI [−0.179, −0.058]) and work activities regarding information ($r = -0.069$, $p = .001$, 95% CI [−0.110, −0.029]) and people ($r = -0.077$, $p = .001$, 95% CI [−0.122, −0.033]). Higher levels of openness were associated with higher levels of autonomy ($r = 0.079$, $p = .028$, 95% CI [0.008, 0.149]) and lower levels of physical and manual work activities ($r = -0.150$, $p < .001$, 95% CI [−0.211, −0.089]). Higher levels of social integration at work were linked to higher agreeableness ($r = 0.068$, $p < .001$, 95% CI [0.031, 0.105]) and conscientiousness ($r = 0.077$, $p < .001$, 95% CI [0.035, 0.119]).

The models additionally including control variables also showed an acceptable to good fit (neuroticism: CFI = 0.967, RMSEA = 0.025, SRMR = 0.054; extraversion: CFI = 0.950, RMSEA = 0.031, SRMR = 0.056; openness: CFI = 0.903, RMSEA = 0.045, SRMR = 0.076; agreeableness: CFI = 0.950, RMSEA = 0.027, SRMR = 0.057; conscientiousness: CFI = 0.917, RMSEA = 0.035, SRMR = 0.061). Due to the stability of the latent openness factor over time, a change factor could not be estimated. The correlations between study variables when controlling for gender, education, income, retirement at T4 and region can also be seen in Table 3. Most of the statistically significant correlations with work characteristics were still significant after including control variables. Additionally, higher levels of social integration were related to lower levels of neuroticism ($r = -0.052$, $p = .037$, 95% CI [−0.100, −0.003]), higher levels of innovation were related to less decline in neuroticism ($r = 0.035$, $p = .025$, 95% CI [0.004, 0.066]) and higher levels of extraversion were associated with higher levels of innovation ($r = 0.057$, $p = .038$, 95% CI [0.003, 0.111]). The associations between level of neuroticism and level of work activities regarding information ($r = -0.031$, $p = .072$, 95% CI [−0.065, 0.003]) as well as between level of openness and level of autonomy ($r = 0.012$, $p = .657$, 95% CI [−0.041, 0.065]) were no longer statistically significant.

Table 4 shows the regression weights of personality traits and work characteristics on control variables. Women reported higher baseline levels of neuroticism and openness as well as lower levels of work stress and physical and manual activities. Higher formal education was associated with higher levels of openness, lower levels of agreeableness, more increases in agreeableness and lower levels of conscientiousness. Furthermore, education was positively linked to levels of autonomy, innovation, stress, work activities regarding information and people and negatively linked to levels of social integration as well as physical and manual activities. Higher income was related to less decline in extraversion and to higher levels of autonomy, innovation, social integration, and work activities related to information and people. Individuals living in former West Germany reported less decline in neuroticism and more decline in extraversion as well as lower levels of agreeableness. Additionally, they reported lower levels of innovation, social integration, stress and physical and manual work activities.

4 | DISCUSSION

Research on personality development has been accumulating over the last 20 years with several studies showing a reciprocal relationship between personality and work (e.g., Bleidorn et al., 2018; Brose, 2021; Connor-Smith & Flachsbart, 2007; Le et al., 2014; Leger et al., 2016; Luo et al., 2017; Wu, 2016). Nevertheless, sources and dynamics of personality trait changes are not yet well understood and studies on the association between work characteristics and personality development covering longer periods of time, especially in middle adulthood, are scarce. The present study addresses this research gap by examining the relevance of subjectively perceived work environment and objective work activities for personality trajectories in midlife. We analyzed four waves of longitudinal data over 20 years drawn from 374 participants from the ILSE study (Hildesheim et al., 2019) with an average age of 44 years ($SD = 1$) at baseline.

The average trajectories of the five personality traits in the current study were consistent with previous research (Graham et al., 2020; Lucas & Donnellan, 2011; Roberts et al., 2006; Specht et al., 2011; Terracciano et al., 2005; Wortman et al., 2012). Latent growth curve models showed slight decreases in neuroticism and extraversion, slight increases in agreeableness and conscientiousness, and no significant change in openness from age 44 to 64 years. Considerable interindividual differences in the rate of change were found only for neuroticism. These findings correspond to the cumulative continuity principle (Caspi et al., 2005; Roberts & Wood, 2006), which attributes less

TABLE 3 Correlations (and 95% confidence intervals) of perceived work environment and work activities at T1 with levels of and changes in personality traits

	Neuroticism		Extraversion		Openness		Agreeableness		Conscientiousness	
Variables	**Level**	**Change**	**Level**	**Change**	**Level**	**Change**	**Level**	**Change**	**Level**	**Change**
Model without control variables										
WE: Autonomy	−0.065	−0.010	0.046	0.001	0.079*	0.010	−0.041	0.004	−0.022	0.021
	(−0.132, 0.002)	(−0.052, 0.033)	(−0.032, 0.124)	(−0.045, 0.046)	(0.008, 0.149)	(−0.029, 0.049)	(−0.086, 0.005)	(−0.022, 0.030)	(−0.076, 0.033)	(−0.014, 0.056)
WE: Innovation	−0.118*	0.018	0.056	−0.015	0.029	−0.010	0.009	0.005	0.007	0.010
	(−0.179, −0.058)	(−0.013, 0.049)	(−0.002, 0.113)	(−0.048, 0.018)	(−0.022, 0.081)	(−0.040, 0.020)	(−0.026, 0.045)	(−0.014, 0.023)	(−0.040, 0.055)	(−0.017, 0.036)
WE: Social integration	−0.046	0.016	0.054	−0.017	−0.039	0.001	0.068*	−0.008	0.077*	−0.009
	(−0.100, 0.008)	(−0.017, 0.049)	(−0.001, 0.109)	(−0.050, 0.015)	(−0.091, 0.012)	(−0.023, 0.026)	(0.031, 0.105)	(−0.027, 0.011)	(0.035, 0.119)	(−0.033, 0.016)
WE: Stress	0.025	−0.024	−0.035	0.008	−0.017	0.026	−0.036	0.014	−0.004	0.028
	(−0.031, 0.081)	(−0.060, 0.012)	(−0.105, 0.035)	(−0.033, 0.049)	(−0.079, 0.045)	(−0.009, 0.061)	(−0.078, 0.005)	(−0.011, 0.039)	(−0.054, 0.046)	(−0.006, 0.063)
WA: Information	−0.069*	0.003	0.020	0.007	0.035	0.000	0.001	0.007	−0.008	0.012
	(−0.110, −0.029)	(−0.022, 0.027)	(−0.029, 0.068)	(−0.021, 0.035)	(−0.010, 0.079)	(−0.024, 0.025)	(−0.029, 0.032)	(−0.009, 0.023)	(−0.045, 0.030)	(−0.013, 0.036)
WA: People	−0.077*	0.000	0.031	0.009	0.030	0.002	−0.011	0.009	0.001	0.006
	(−0.122, −0.033)	(−0.027, 0.027)	(−0.023, 0.084)	(−0.021, 0.039)	(−0.017, 0.077)	(−0.022, 0.027)	(−0.042, 0.020)	(−0.007, 0.025)	(−0.039, 0.041)	(−0.019, 0.030)
WA: Manual	−0.022	0.008	−0.015	0.019	−0.150*	−0.005	0.031	−0.007	0.050	−0.003
	(−0.083, 0.038)	(−0.033, 0.050)	(−0.089, 0.059)	(−0.023, 0.061)	(−0.211, −0.089)	(−0.039, 0.030)	(−0.011, 0.073)	(−0.034, 0.020)	(−0.003, 0.104)	(−0.034, 0.029)
Model with control variables (Gender, education, income, retirement at T4, region)										
WE: Autonomy	−0.022	0.004	0.051	−0.010	0.012		−0.014	−0.005	0.020	0.013
	(−0.076, 0.032)	(−0.037, 0.045)	(−0.022, 0.123)	(−0.052, 0.032)	(−0.041, 0.065)		(−0.055, 0.027)	(−0.030, 0.020)	(−0.028, 0.069)	(−0.017, 0.044)
WE: Innovation	−0.089*	0.035*	0.057*	−0.029	−0.011		0.013	−0.003	0.024	0.001
	(−0.137, −0.041)	(0.004, 0.066)	(0.003, 0.111)	(−0.063, 0.005)	(−0.050, 0.028)		(−0.019, 0.045)	(−0.021, 0.016)	(−0.019, 0.068)	(−0.024, 0.025)
WE: Social integration	−0.052*	0.019	0.050	−0.026	−0.025		0.057*	−0.005	0.063*	−0.007
	(−0.100, −0.003)	(−0.012, 0.049)	(−0.003, 0.103)	(−0.056, 0.005)	(−0.067, 0.016)		(0.023, 0.091)	(−0.024, 0.013)	(0.023, 0.103)	(−0.030, 0.017)
WE: Stress	0.048	−0.011	−0.030	0.002	−0.003		−0.035	0.007	0.006	0.018
	(−0.005, 0.101)	(−0.046, 0.025)	(−0.099, 0.039)	(−0.038, 0.042)	(−0.053, 0.047)		(−0.072, 0.002)	(−0.018, 0.031)	(−0.041, 0.052)	(−0.017, 0.054)
WA: Information	−0.031	0.010	0.024	0.001	−0.014		0.022	−0.000	0.026	0.004
	(−0.065, 0.003)	(−0.011, 0.032)	(−0.016, 0.065)	(−0.021, 0.024)	(−0.045, 0.016)		(−0.004, 0.047)	(−0.014, 0.013)	(−0.004, 0.056)	(−0.017, 0.025)
WA: People	−0.046*	0.009	0.034	0.005	−0.015		0.007	0.002	0.031	−0.001
	(−0.084, −0.008)	(−0.015, 0.032)	(−0.014, 0.082)	(−0.020, 0.031)	(−0.048, 0.018)		(−0.019, 0.034)	(−0.012, 0.016)	(−0.003, 0.066)	(−0.024, 0.021)
WA: Manual	0.015	−0.009	−0.017	0.017	−0.057*		0.019	−0.003	0.023	0.002
	(−0.035, 0.065)	(−0.046, 0.028)	(−0.076, 0.043)	(−0.018, 0.053)	(−0.099, −0.014)		(−0.016, 0.055)	(−0.024, 0.018)	(−0.021, 0.068)	(−0.026, 0.030)

Note: $N = 374$.

Abbreviations: WA, work activities; WE, work environment.

*$p < .05$.

(Continues)

TABLE 4 Regressions of personality traits and work characteristics on control variables

	Gender		Education			Income			Retired at T4		Region	
Outcomes	***b***	***SE***	***b***	***SE***	***β***	***b***	***SE***	***β***	***b***	***SE***	***b***	***SE***
N: Level	0.270*	0.063	−0.002	0.013	−.008	−0.032	0.017	−.163			0.030	.065
N: Change	−0.042	0.037	−0.016	0.008	−.219	0.000	0.010	.000	0.010	0.038	0.101*	.043
E: Level	0.050	0.075	−0.012	0.017	−.057	0.013	0.018	.060			−0.027	.079
E: Change	0.033	0.041	−0.006	0.009	−.086	0.023*	0.011	.299	0.018	0.041	−0.091*	.042
O: Level	0.171*	0.062	0.052*	0.012	.296	0.015	0.013	.082			0.041	.055
O: Change												
A: Level	0.073	0.046	−0.020*	0.010	−.160	0.008	0.011	.058			−0.121*	.046
A: Change	−0.036	0.025	0.012*	0.006	.390	−0.006	0.006	−.174	−0.001	0.024	−0.010	.022
C: Level	0.075	0.060	−0.039*	0.012	−.235	0.009	0.014	.052			−0.097	.057
C: Change	−0.041	0.035	0.015	0.008	.322	−0.006	0.008	−.127	−0.001	0.033	−0.032	.031
WE: Autonomy	0.051	0.120	0.136*	0.026	.282	0.117*	0.031	.233			0.096	.126
WE: Innovation	−0.011	0.095	0.072*	0.022	.192	0.087*	0.022	.223			−0.395*	.092
WE: Social integration	0.164	0.090	−0.061*	0.020	−.182	0.063*	0.023	.181			−0.278*	.095
WE: Stress	−0.302*	0.114	0.060*	0.024	.141	−0.014	0.030	−.032			−0.337*	.120
WA: Information	−0.079	0.071	0.110*	0.015	.360	0.079*	0.018	.249			0.040	.072
WA: People	−0.018	0.078	0.103*	0.018	.319	0.076*	0.020	.225			0.024	.080
WA: Manual	−0.748*	0.099	−0.162*	0.021	−.372	−0.012	0.023	−.027			−0.213*	.101

Note: $N = 374$. Gender: 0 = men, 1 = women, education: number of years spent in formal education, income: scale from 0 to 12, retired at T4: 0 = no, 1 = yes, region: 0 = East Germany, 1 = West Germany.

Abbreviations: A, agreeableness; C, conscientiousness; E, extraversion; N, neuroticism; O, openness; WA, work activities; WE, work environment.

*$p < .05$.

pronounced personality trait changes in middle adulthood to a higher stability of individual environments, social roles and daily routines.

With the exception of an association between higher innovation at baseline and a less pronounced decrease in neuroticism after including control variables, work characteristics were unrelated to personality change in the Big Five traits, but a number of associations with baseline levels of personality traits were found. Individuals who worked in environments characterized by higher levels of innovation and work activities regarding information and people reported lower levels of neuroticism than others. Higher autonomy at work and lower levels of physical and manual work activities were associated with higher levels of baseline openness. In addition, individuals who felt more socially integrated at work reported higher levels of agreeableness and conscientiousness at baseline. Most of these associations remained significant after including control variables (gender, education, income, retirement at T4, region), with two exceptions including the association between work activities regarding information and baseline neuroticism and the association between work autonomy and baseline openness. Additionally, there was a significant positive association between innovation at work and baseline levels of extraversion and a significant negative association between social integration and baseline levels of neuroticism after including control variables.

As participants in our study had already been in the workforce for a considerable time at baseline, it is possible that associations between personality and work characteristics at baseline may reflect both selection and socialization processes that took place until the age of 44 years (Roberts et al., 2003). In terms of selection effects, people may actively choose or be chosen for specific work environments depending on their personality. Alternatively, work environments may shape personality traits over time (Woods et al., 2013). The lack of associations of baseline work characteristics with subsequent personality change (with the exception of an association between higher innovation at baseline and a less pronounced decrease in neuroticism) suggests that after the age of 44, it is unlikely that socialization at work plays a major role in personality development.

The results concerning associations between social integration and agreeableness, conscientiousness and neuroticism at baseline are in line with previous research (Allemand et al., 2015; Pocnet et al., 2021; Roberts et al., 2007). For example, people high in agreeableness are typically altruistic, understanding, caring, dutiful and reliable (Costa & McCrae, 1992, 2008; McCrae & Costa, 2008), which makes them appreciated colleagues and facilitates creating lasting and trusting relationships, whereas high neuroticism is characterized by anxiety, hostility, and less effective emotion regulation, which may complicate personal contacts (Pocnet et al., 2021). At the same time, it is possible that a warm and welcoming social environment at work, which makes a person feel socially integrated, triggers more altruistic, caring and reliable, and less anxious and hostile behavior and thus, in the long term influences the respective personality traits. As noted above, our study found little evidence that social integration shapes the development of these traits across midlife, however, it is possible that such processes may have taken place in earlier life phases.

Furthermore, innovative work environments were linked to higher extraversion, lower neuroticism and less decline in neuroticism. Innovative work environments are characterized by variety, novelty, and unpredictable situations, which can be difficult to handle for people high in neuroticism (Huang et al., 2014; Tett & Fisher, 2021). There could be fewer people scoring high on neuroticism in innovative jobs in midlife because of a lower person-environment fit or adaptation to regularly dealing with varying work tasks and new situations. Due to already low levels of neuroticism at baseline for participants in innovative work environments, the potential for further decreasing neuroticism is smaller, which might explain the finding that individuals reporting high innovation show less decline in neuroticism. Highly innovative work environments can be a good fit for people high in extraversion, who can be described as active, stimulation seeking, and often leading groups (Costa & McCrae, 2008), or foster extraversion.

Unexpectedly, there were no significant associations between personality and work stress. This result contradicts the assumptions of a theoretical model proposing that work stress alters personality via biological processes (Smallfield & Kluemper, 2022), and empirical results from a sample with a large age range (Wu, 2016). Maybe the one-item measure of stress was not appropriate to indicate the complexity of stress processes, thereby hindering the uncovering of associations with personality traits. Additionally, stress was only assessed at baseline. Future studies should investigate different aspects of work-related stress processes, like stress appraisals, stress reactivity and coping mechanisms, and their associations with personality traits.

Adding to prior research, our study examined associations between objectively measured work activities and trajectories of personality. Higher levels of work activities regarding information and people were associated with lower levels of neuroticism at baseline. One possible explanation for this association could be that these kinds of work activities are characterized by more complex tasks and work environments, which may not be well-fitting environments for people, who experience anxiety, worry

and nervosity to a greater extent. As such, people high in neuroticism might avoid these kinds of work activities (Woods et al., 2013). Additionally, people who reported higher levels of physical and manual work activities had lower levels of openness at baseline. The openness trait is defined by a distinct cognitive dimension so that people high in openness may prefer more cognitively and less manually demanding jobs.

There were several associations of control variables with work characteristics and personality. Education was strongly related to all examined work characteristics, which is not surprising, given the highly formalized vocational training system in Germany (DiPrete et al., 2017; Kirpal, 2011; Mortimer & Krüger, 2006). Women reported higher levels of neuroticism and openness. The gender difference in neuroticism is in line with previous research; prior findings regarding sex differences in openness are mixed (Kajonius & Johnson, 2018; Mac Giolla & Kajonius, 2019). Women also experienced less work stress and lower levels of physical and manual activities. People living in former West Germany showed less decline in neuroticism, more decline in extraversion and lower baseline levels of agreeableness, innovation, social integration, stress and physical and manual work activities. Differences between people living in former West and former East Germany may reflect economic differences after reunification with higher unemployment rates and the pressure to adapt to new labour market structures in former East Germany. Higher income was related to work characteristics, which mostly characterize higher occupational positions (higher autonomy, innovation, social integration, work activities related to information and people) and to less decline in extraversion. Extraversion comprises facets like assertiveness, activity and positive emotions, all of which can be favorable for and strengthened by leadership and other highly paid positions.

The present findings show that levels of Big Five personality traits and subjective as well as objective work characteristics are interrelated, but there were hardly any associations between work characteristics and trait changes. Generally, we found only slight changes in personality traits over the course of midlife. Following the corresponsive and the cumulative continuity principle (Caspi et al., 2005; Roberts et al., 2003; Roberts & Wood, 2006), it is possible that many of the participants had already selected and settled in jobs that correspond to their personality, interests and skills, so that there was a high fit between their personality traits and daily work demands. High fit in midlife could also have been achieved by adaptation processes in reaction to work demands during young adulthood (Woods et al., 2019). Either way, adaptation and changes in behaviors, values and attitudes, which could have led to personality trait changes, might be triggered less by work-related factors during the studied midlife period.

4.1 | Limitations and future directions

Some limitations to this study must be considered when interpreting the present findings. Drawing causal inferences from passive longitudinal data is problematic concerning the time ordering of study variables and the controlling of potentially confounding influences (Hudson et al., 2012). In the current investigation, participants were already in their mid-forties at baseline, so, they have been in the labour force for a considerable time before the baseline measurement occasion. Thus, the present findings cannot be interpreted regarding a specific direction of causal effects.

Besides, all work characteristics were only measured at baseline, so that there is no knowledge about job changes and changes in work characteristics over the study period of 20 years. This makes inferences about the dynamics of personality development in the work context difficult. Future studies should therefore measure personality and work environment variables repeatedly to gain further insight into sources and processes of personality changes in adulthood. Additionally, more frequent measurement occasions would be helpful to study processes of personality development intensively. Furthermore, future studies should cover larger periods of time by following individuals from their career start over career establishment and maintenance in midlife to retirement (Woods et al., 2013). Another promising approach is to focus on micro mechanisms of personality development and, for example, examine career transitions as a potential driver of trait changes (Baumert et al., 2017).

This study examined personality development in a middle-aged German sample from 1993 to 2016 via self-reports. The findings cannot be generalized to individuals in different countries and, as attrition analyses showed, to people with lower educational levels. Furthermore, the O*NET database (Peterson et al., 2001) was generated in the United States, which may have reduced the accuracy of work activity classifications for German participants. Due to the wide range of constructs measured in ILSE, only global indicators were used to assess perceived work environment. Future research should examine associations between personality trait changes and work characteristics with more detailed measurements of work environments and compare different occupations. Differentiated subgroup analyses, for example, regarding different genders, in addition to examining average mean-level changes in bigger samples could also facilitate the uncovering of considerable personality changes in midlife. It is possible that the present sample of $N = 374$ participants was too small to detect minor effects, especially

because personality trait changes and variability in change were limited as one would expect in this period of lifespan development. Furthermore, in the present study personality traits were only analyzed at the factor level. It is possible that certain facets of the Big Five traits are more relevant in the work context than others. Besides, different personality traits and facets not represented in the Big Five traits (e.g., self-esteem or generativity) might be associated with work characteristics and show variation in midlife. In addition, further insight could be gained by focussing on personality development in the context of co-workers' personalities to learn more about the reciprocal influences of individual and collective team personalities (Gardner & Quigley, 2015).

5 | CONCLUSIONS

The present study examined associations between work, as a major developmental context in most adults' lives, and personality. We addressed the research gap concerning personality trajectories in midlife by analyzing longitudinal data of the ILSE study. Personality traits changed slightly over the 20-year period from age 44 to age 64. Our findings show several associations between personality trait levels and work environment characteristics at baseline. However, there were hardly any associations between work characteristics and personality trait changes. Although it is possible that work characteristics and experiences may have shaped personality traits in earlier life phases, our study shows no evidence that work is a major driver of personality change in midlife. Future studies should focus on reciprocal associations and extend into earlier life phases to understand work as a determinant of personality stability and change in midlife.

AUTHOR CONTRIBUTIONS

Oliver Schilling and Hans-Werner Wahl provided the data. Lena Stahlhofen and Gizem Hülür conceptualized the research question. Johanna Hartung performed the data analysis under the supervision of Gizem Hülür. Lena Stahlhofen drafted the manuscript. All authors contributed critical revisions and approved the final manuscript for submission.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ETHICS STATEMENT

The study conforms to the ethical standards of the Declaration of Helsinki (1989). Approval by the ethics committee of Heidelberg University's medical faculty was obtained for all four measurement waves. All participants gave their written consent.

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ENDNOTE

[1] This study was not preregistered. R-scripts are available at https://osf.io/m3nw4/.

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