Personality and Self-Perceptions of Aging in Later Life

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List of Abbreviations

AgeCog	Aging-related cognitions
CAPI	Computer-assisted personal interview
DEAS	Deutscher Alterssurvey (German Ageing Survey)
LPA	Latent profile analysis
MMSE	Mini Mental State Examination
SPA	Self-perceptions of aging
SPPB	Short Physical Performance Battery
WHO	World Health Organization

Summary

Background: A large body of research indicates that the cognitions individuals have about their own age and aging, so called self-perceptions of aging (SPA), predict health and wellbeing in later life. However, much less is known about associations of SPA with developmental correlates such as personality. Some initial studies have found cross-sectional and longitudinal associations of the Big Five traits (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism) with SPA. Building on these findings, this thesis aimed at advancing knowledge on associations of personality with SPA. To this end, cross-sectional associations of the meta-traits of agency, i.e., a focus on the self, and communion, i.e., a focus on others, with SPA were examined in study 1, and longitudinal associations of agentic and communal personal values with SPA were examined in study 2. Study 3 aimed at expanding findings of previous studies on associations of SPA with self-reported physical function to an objective indicator of physical function, namely, gait pattern. In all studies, SPA were treated as a multidimensional construct comprising gains and losses.

Methods: Study 1 was based on data of 154 adults aged 75 and older that were recruited in hospital. Data was collected one month after recruitment. In regression analyses, associations of agentic and communal traits with SPA beyond health were examined. Study 2 was based on data of 6,089 adults aged 40 and older enrolled in the German Ageing Survey (DEAS). Multiple regression analyses were used to test whether personal value priority predicted change in SPA over three years beyond age stereotypes. For study 3, latent profile analysis was employed to detect gait patterns based on data of 150 adults aged 70 and older collected via an automated walkway at participants' regular speed and individual maximum speed. In a next step, associations of SPA with gait patterns beyond personality traits were investigated in binary logistic regressions.

Results: Agentic and communal personality traits were associated with gain-, but not loss-related SPA when controlling for health (study 1). In study 2, the value priority of openness to change (self-direction, stimulation) predicted more gain-related SPA three years later, while the value priority of conservation (tradition, security) was negatively associated with gain-related SPA. The value priority of self-enhancement (achievement, power) was associated with more loss-related SPA three years later. Finally, the value priority of self-transcendence (universalism, benevolence), i.e. a concern for the well-being of others, was associated with more gain- and less loss-related SPA at follow-up. In study 3, latent profile analyses distinguished two groups with different gait patterns in both gait speed conditions. One group exhibited a slower and less well-coordinated gait pattern, which reflected

functional limitations. The other group exhibited a faster and well-coordinated gait pattern, which reflected better physical function. More loss-, but not gain-related SPA were associated with higher likelihood to exhibit a functionally limited gait pattern at regular speed. Conversely, gain- but not loss-related SPA were associated with higher likelihood to exhibit a fit gait pattern at individual maximum speed.

Conclusion: Results of this thesis have three main implications for research on SPA. First, agency and communion may constitute useful dimensions for further investigating SPA domains, as both were associated with SPA in study 1. Second, findings of study 2 point to the role of motivation for SPA that needs to be further explored. Third, findings of study 3 indicate that SPA are not only associated with self-reported, but also objectively measured physical function, which stresses the importance of SPA for health in later life. As a practical implication, the findings presented here suggest that interventions on SPA should consider participants' personality, both on the level of traits and values.

Zusammenfassung

Hintergrund: Viele Studien zeigen, dass die Art und Weise, wie Personen ihr Älterwerden wahrnehmen (sogenannte individuelle Altersbilder), eine bedeutende Rolle für Gesundheit und Wohlbefinden im Alter spielt. Man weiß jedoch noch wenig darüber, wie individuelle Altersbilder mit anderen entwicklungstreibenden Faktoren wie Persönlichkeit zusammenhängen. Erste Studien fanden quer- und längsschnittliche Zusammenhänge zwischen den Big Five Persönlichkeitsfaktoren (Offenheit für Erfahrungen, Gewissenhaftigkeit, Extraversion, Verträglichkeit und Neurotizismus) und individuellen Altersbildern. Ziel der vorliegenden Dissertation war es daher, das Wissen über Zusammenhänge von Persönlichkeit mit individuellen Altersbildern zu erweitern. Dazu wurde in Studie 1 untersucht, wie die beiden übergeordneten Persönlichkeitsfaktoren Agency (Fokus auf die eigene Person) und Communion (Fokus auf andere) mit individuellen Altersbildern zusammenhängen. In Studie 2 wurde untersucht, inwieweit agentische und kommunale persönliche Wertvorstellungen individuelle Altersbilder über einen Zeitraum von drei Jahren hinweg vorhersagen. Aufbauend auf Befunden früherer Studien, die Zusammenhänge zwischen individuellen Altersbildern mit selbstberichteter Gesundheit zeigten, untersuchte Studie drei zudem, inwieweit individuelle Altersbilder mit objektiver körperlicher Funktion – in diesem Fall Gangmuster – zusammenhängen. In allen Studien wurden gewinn- und verlustorientierte Altersbilder untersucht.

Methoden: Studie 1 basierte auf Daten von 154 Erwachsenen (75 Jahre alt und älter), die in einem Krankenhaus rekrutiert wurden. Die Daten wurden einen Monat nach der Rekrutierung erhoben. Um zu testen, ob Agency und Communion über Gesundheit hinaus mit Altersbildern zusammenhängen, wurden Regressionsanalysen durchgeführt. Studie 2 basierte auf Daten von 6.089 Teilnehmenden des Deutschen Alterssurveys (40 Jahre alt und älter). In multiplen Regressionsanalysen wurde getestet, ob Wertvorstellungen die Entwicklung individueller Altersbilder über den Einfluss von Altersstereotypen hinaus vorhersagen können. In Studie 3 wurde mittels latenter Profilanalyse untersucht, ob sich in einer Gruppe von 150 älteren Erwachsenen (70 Jahre alt und älter) Gangmuster identifizieren lassen, die auf objektiv gemessenen Gangparametern basieren. Die Daten wurden mittels Sensoren gemessen, die in einen Gangteppich eingearbeitet waren. Die Teilnehmer gingen in normaler Geschwindigkeit sowie in persönlicher Maximalgeschwindigkeit über den Teppich. Mittels binärer logistischer Regression wurde im Anschluss untersucht, wie individuelle Altersbilder über die Persönlichkeit hinaus mit den Gangmustern zusammenhängen.

Ergebnisse: Höhere Agency und Communion waren unter Kontrolle des Einflusses von Gesundheit mit einem gewinn-, jedoch nicht mit einem verlustorientierten Altersbild assoziiert (Studie 1). Die Ergebnisse von Studie 2 zeigten, dass Personen, denen Offenheit für neue Erfahrungen (Selbstbestimmung, Stimulation) besonders wichtig war, drei Jahre später ein stärker gewinnorientiertes Altersbild hatten, wohingegen Personen, denen Bewahrung (Tradition, Sicherheit) besonders wichtig war, ihr Älterwerden nach drei Jahren weniger stark mit Gewinnen verbanden. Personen, denen Selbststärkung (Leistung, Macht) besonders wichtig war, hatten nach drei Jahren ein stärker verlustorientiertes Altersbild. Personen, denen Selbsttranszendenz (Universalismus, Benevolenz), also das Wohl von anderen Personen, besonders wichtig war, berichteten nach drei Jahren ein stärker gewinn- und weniger verlustorientiertes Altersbild. In Studie 3 konnten sowohl bei normaler als auch individueller Maximalgeschwindigkeit zwei Gruppen mit unterschiedlichem Gangmuster unterschieden werden. Eine Gruppe wies ein langsamer und schlechter koordiniertes Gangmuster auf, repräsentierte also eher körperliche Einschränkungen als die andere Gruppe, deren Gangmuster auf eine gute körperliche Funktion schließen ließ. Ein stärker verlustorientiertes Altersbild war bei normaler Ganggeschwindigkeit mit stärkeren körperlichen Einschränkungen assoziiert. Im Gegensatz dazu war bei individueller Maximalgeschwindigkeit ein stärker gewinnorientiertes Altersbild mit besserer körperlicher Funktion assoziiert.

Schlussfolgerung: Die Ergebnisse dieser Dissertation haben drei Hauptimplikationen für die Forschung zu Altersbildern. Erstens scheinen Agency und Communion geeignete Dimensionen zu sein, um Altersbilder inhaltlich weiter zu untersuchen, da sich in Studie 1 Zusammenhänge zwischen Agency, Communion und Alterbsildern zeigten. Zweitens zeigen die Befunde von Studie 2, dass Wertvorstellungen als motivationale Persönlichkeitsfacette eine Rolle für individuelle Altersbilder spielen; die Rolle von Motivation sollte daher weiter untersucht werden. Drittens zeigt Studie 3, dass individuelle Altersbilder nicht nur mit selbstberichteter, sondern auch differenziell mit objektiv gemessener körperlicher Funktion zusammenhängen, und zwar über den Einfluss von Persönlichkeit hinaus. Dies unterstreicht die Bedeutung von Altersbildern für die Gesundheit. Eine praktische Implikation der Ergebnisse könnte sein, dass Interventionen zur Veränderung von Altersbildern verschiedene Ebenen der Persönlichkeit der Teilnehmer*innen adressieren sollten – Eigenschaften und Werte.

1   Introduction

As a famous saying goes, one's goal should not be to simply add years to life, but to add life to years. In the same spirit, aging research not only investigates factors associated with living longer, but is increasingly concerned with factors prolonging healthy life expectancy, i.e. the number of years lived in good health. With increasing numbers of older adults worldwide, this is of major public health relevance (Klar et al., 2021). To raise awareness on the topic in public discourse, the World Health Organization called out a decade of healthy aging beginning in 2021 (World Health Organization [WHO], 2020). The WHO defines healthy aging as "the process of developing and maintaining the functional ability that enables wellbeing in older age. Functional ability is about having the capabilities that enable all people to be and do what they have reason to value. This includes a person's ability to meet their basic needs, learn, grow and make decisions, be mobile, build and maintain relationships, and contribute to society" (WHO, 2015, p. 28). Thus, healthy aging encompasses not just physical and mental health, but is essentially about a person's ability to express themselves as active agents as well as active members of society.

One indicator of healthy or successful aging is what people think about their own age and aging, so-called self-perceptions of aging (SPA; Kleinspehn-Ammerlahn et al., 2008). Thereby, SPA can work as a self-fulfilling prophecy, as has been shown in a large body of research: those who view their aging in a positive light are more likely to experience positive health outcomes like, for example, better physical function (Sargent-Cox et al., 2012), and fewer depressive symptoms (Freeman et al., 2016) than those with more negative SPA (for an overview see Westerhof & Wurm, 2018; Wurm et al., 2017). Given the importance of SPA for health in later life, it is vital to better understand which other factors are associated with SPA. First studies have started to investigate personality as a developmental correlate of SPA, since personality also shapes development and health across the life span (Mroczek, 2020; Strickhouser et al., 2017); it thus seems promising to further explore associations of personality and SPA in the context of health in later life. Hence, the present thesis aims at advancing knowledge on associations of different levels of personality with SPA. In addition, acknowledging the importance of physical function for healthy aging, associations of SPA and personality with objectively measured physical function will be examined.

The following introductory paragraphs will describe SPA in later life in more detail and review recent findings on associations of personality with SPA and their role for health in old age. Chapter 1.3 comprises the issues of the present thesis. Chapter 2 covers the methods used in the studies and chapter 3 reports their main results. In chapter 4, results, implications and questions for future research are discussed.

1.1 Self-Perceptions of Aging in Later Life

Starting in the 1950s, SPA have gained much attention in aging research (Tuckman & Lorge, 1954). While early studies conceptualized SPA as a unidimensional construct ranging from positive to negative (e.g., as assessed by the Attitudes Toward Own Aging Scale [ATOA]; Lawton, 1975), more recent measures acknowledge the proposition of life span developmental theories that development is a multidimensional and multidirectional process, encompassing simultaneously gains and losses in different life domains (Baltes, 1987; Baltes & Smith, 2003). For example, the Agecog Scale (Steverink et al., 2001; Wurm et al., 2007) assesses the gain-related view that one's aging is associated with ongoing personal development such as making new plans and following ideas, and the loss-related views that one's aging is associated with declining physical health, fitness and vitality (physical losses) or with social losses such as being less respected and becoming lonelier with aging. With regard to health, primarily the domains of ongoing development and physical losses were found to be important (Boeder & Tse, 2021; Diehl et al., 2021; Wurm et al., 2017).

With advancing age, individuals tend to perceive their aging increasingly as associated with physical and social losses and less with gains regarding ongoing personal development (Diehl et al., 2021). This finding resonates with life span theories' assumption that the ratio of gains to losses shifts towards more losses due to an age-related decline in physiological and mental resources (Baltes, 1987, 1997). Accordingly, with age, older adults' motivation shifts from achievement of growth to maintenance of the status quo and prevention of losses (Baltes, 1987; Ebner et al., 2006). Several theoretical frameworks such as the model of selection, optimization and compensation (Baltes, 1997; Freund & Baltes, 2000), and the model of primary and secondary control (e.g., Heckhausen et al., 2010) aim at providing explanations for the way older adults manage to maintain control in navigating the shifting balance in gains and losses. Although in general these theories do not explicitly address SPA (cf. Dutt et al., 2016; Kornadt et al., 2020), SPA do play an important role for life span development by shaping an individual's motivation, goals, expectations, and choices (cf. Kornadt et al., 2020). Thus, it is important to better understand factors associated with gain- and loss-related SPA.

While much is known about outcomes of SPA, their antecedents, that is, factors shaping SPA, are less frequently studied. Stereotype Embodiment Theory argues that the major source of SPA is age stereotypes, that is, socially shared beliefs about older adults, age, and aging. These become internalized when a person self-identifies as old and impact health by affecting behavior, psychological, and also physiological factors (Levy, 2009). For example, if an older person experiences functional limitations, they might not go to the doctor because they internalized the age stereotype that old age means to be physically limited; thus, they might attribute their limitations to age and not illness and, as a result, not seek medical help. Because of that, physical limitations might become chronic, thus corroborating the age stereotype. With advancing age, a persons' SPA also increasingly reflect their actual experience with aging (Wurm et al., 2017). In addition, first studies have also found health events to contribute to change in SPA (Wurm et al., 2020).

Yet, further research on correlates of SPA is needed. Several frameworks on SPA propose personality as a correlate of SPA: For instance, Wurm et al. (2017) suggest that personality may bring a more conscious element to the relationship of SPA and health, and Diehl et al. (2014) even include personality as a psychological resource for the perception of aging-related gains and losses. Similarly, Kornadt et al. (2019) called for more research examining associations of SPA with psychological constructs that drive developmental regulation, thus gaining knowledge on the place of SPA in the broader personality system. Hence, the next paragraph summarizes research on personality and SPA and points to open research questions addressed in the present thesis.

1.2   Associations of Personality with Self-Perceptions of Aging

Personality is defined as the sum of relatively stable, characteristic ways of thinking, feeling and behaving that distinguish individuals from one another (Kandler et al., 2014). First studies have investigated *cross-sectional* associations of the Big Five personality traits of openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Goldberg, 1990) and SPA in later life. In a sample of older adults with a mean age of 75 years, higher extraversion and conscientiousness were associated with more positive SPA as assessed by the unidimensional ATOA scale (O'Shea et al., 2017). Regarding multidimensional measures, openness, conscientiousness and, interestingly, neuroticism were positively associated with the awareness of aging-related gains, while neuroticism was also positively associated with the awareness of aging-related losses in a sample of adults aged 40 – 98 years (Rupprecht et al., 2019). Another study conducted in older carers with a mean age of 70.8 years found lower neuroticism and higher extraversion to be associated with more

positive SPA in the domain of psychological growth. Higher extraversion was additionally associated with more positive SPA in the domain of physical change, and lower agreeableness and higher neuroticism were associated with more negative SPA in the domain of social loss (Loi et al., 2015).

A number of longitudinal studies yielded support for the hypothesis that SPA are predicted by the Big Five traits (Bryant et al., 2016; Rupprecht et al., 2019; Shenkin et al., 2014). This was also corroborated in a study by Kornadt et al. (2019), who investigated reciprocal associations of the Big Five traits and unidimensional SPA. In that study, lower neuroticism, higher conscientiousness, and higher openness predicted more positive SPA over a period of up to 20 years, while SPA only marginally affected the Big Five traits over the same period. This finding supports the idea that personality constitutes the basis on which people perceive and evaluate their own experience of aging (cf. Rupprecht et al., 2019).

While an abundance of studies have investigated the role of either SPA or personality for health, it seems surprising that only very few studies have investigated the role of personality and SPA for health in one model. To the author's knowledge, only three studies have investigated SPA as mediators between the Big Five traits and different health indicators (Deshayes et al., 2021; Moor et al., 2006; Park & Hess, 2020). Yet, as these studies rely on cross-sectional data, a causal pathway cannot be determined. In a recent longitudinal study, Wettstein et al. (2020) contrasted the effects of the Big Five personality traits (conscientiousness and neuroticism) and SPA on 20-year trajectories of physician-rated health in middle-aged (baseline age: 43–46 years) and older adults (baseline age: 61–65 years) and found positive SPA to be associated with better health in both age groups. In addition, higher conscientiousness was associated with better health, yet only in the older age group.

Taken together, empirical evidence indicates cross-sectional as well as longitudinal associations between personality traits and SPA and suggests a differential role of the two constructs for health. Most of these studies used the Big Five traits as their operationalization of personality and, in sum, yielded inconsistent results about which of these traits relate to global and domain-specific SPA. Only neuroticism seems to be consistently associated with more negative or loss-oriented SPA; for the other traits, findings differ across studies. In addition, many of these studies were conducted in young-old, rather healthy samples or large surveys covering several decades of adulthood.

Yet, personality comprises more than just the Big Five traits. While the Big Five traits are certainly a very useful and the most widely used conception of personality, considering other levels of personality such as personal values is integral to understanding the whole

person (e.g., Hooker and McAdams, 2003; McAdams and Pals, 2006; for an overview, see Blawert and Wurm, 2019). On a metal-level, personality can be organized by two dimensions (also termed the "Big Two"; e.g., Martin & Slepian, 2020) that emerge as higher order factors of different levels of personality, including Big Five traits and personal values (Vecchione et al., 2011). Thus, the Big Two serve an integrating function for the personality system (Blawert & Wurm, 2019; Paulhus & Trapnell, 2008). These two dimensions can be referred to as agency and communion (Bakan, 1966). Thereby, agency refers to a focus on the self and the experience of being an active agent shaping one's environment. It is associated with qualities such as independence, dominance, and active goal pursuit. Communion refers to a focus on others and the experience of being part of a group. It is associated with warmth, friendliness and cooperativeness. Agency and communion do not only organize personality: the idea that these two meta-concepts constitute the fundamental dimensions of human experience is over 2000 years old. From ancient Greek philosophers to modern day researchers, these two dimensions were deemed organizing principles of human life (McAdams et al., 1996). Despite their diverging focus, agency and communion are not mutually exclusive; a person can score high in agency and communion, low in both or high in one and low in the other (Bakan, 1966).

In empirical studies, both higher agentic and higher communal traits were associated with higher well-being (Matud et al., 2020) and life satisfaction (Dean-Church & Gilroy, 1993; Welzel & Inglehart, 2010) in later life. Moreover, agentic as well as communal motives are considered central components of generativity, that is, a drive and concern for guiding the next generation (Ackerman et al., 2000; McAdams & de St Aubin, 1992). Given these findings, agency and communion can both be considered prerequisites of successful or healthy aging (Perrig-Chiello & Hutchison, 2010).

Yet, later life is typically characterized by a decrease in agency an increase in communion (Ritter & Freund, 2014; Strough et al., 2007). This dynamic is addressed in theories of life span development; for example, the SOC model proposes an increasing need for culture (defined as "the entirety of psychological, social, material, and symbolic (knowledge-based) resources" (Baltes, 1997, p. 368) when agentic resources to pursue one's goals decline in later life. Thus, when it gets more difficult for a person to care for themselves autonomously (agency), being able to draw on resources such as personal relationships or nursing infrastructure for support (communion) becomes more important (Wahl et al., 2012). In a similar vein, the life span theory of control (Heckhausen, 1999; Heckhausen et al., 2019) stresses the importance of the agentic capacity (primary control) to pursue one's goals, but

acknowledges communion-related secondary control strategies as increasingly important to maintaining primary control in later life. In addition, socioemotional selectivity theory stresses the importance of close and meaningful relationships for positive emotions in old age (Carstensen, 1992).

Associations of agency and communion with SPA have seldom been investigated explicitly; yet, some initial studies have addressed agentic constructs in the context of SPA. For example, Wurm et al. (2007) found gain-related SPA to predict less physical illnesses, while loss-related SPA in the physical domain predicted more physical illnesses; both associations emerged despite controlling for general control beliefs, which were also referred to as personal agency and did not reach significance. This finding suggests that domain-specific SPA may be better suited to predict physical health than general agency. Support for a relation of agency with unidimensional SPA comes from Luo et al. (2020), who found negative SPA to be longitudinally and reciprocally associated with lower control of life (an agentic construct). In a similar vein, Steverink et al. (2001) found general control beliefs (again referred to as personal agency) to be positively associated with the gain-related SPA domain of ongoing personal development, and negatively associated with the loss-related SPA domains of physical and social losses. Tovel et al. (2017) found positive SPA to increase agency (in this case, self-efficacy), which in turn predicted better physical function. In contrast, research on associations of communal constructs with SPA is largely missing. This constitutes a significant research gap, given that a recent study found a "spillover" effect of SPA; in married couples aged 51 and older, Luo et al. (2021) found SPA not only to affect a persons' own health, but also the health of their spouse. Thus, it seems timely to expand research on SPA from an ego-focused, agentic perspective to also include an other-focused, communal element.

1.3 Issues of the Present Thesis

The studies reviewed above provide a valuable starting point for further exploration of associations of personality and SPA and point to three research questions that will be addressed in the present thesis. These will be outlined in more detail in the following paragraphs.

1.3.1 Agentic and Communal Traits and Self-Perceptions of Aging

As suggested above, research on personality and SPA might benefit from examining personality from the perspective of agency and communion and from a domain-specific approach to SPA. Agentic and communal traits are both positive in valence and relate to positive developmental outcomes. In addition, people high in agency and communion tend to view their future in a more optimistic light (Austin & Costabile, 2017). Thus, high agency as well as high communion might contribute to the gain-related notion that one's aging is associated with ongoing personal development. However, since health is an important correlate of SPA and health issues increase in later life, personality might not be as important for SPA in the health domain when health status is taken into account. Kornadt et al. (2020) propose that personality traits become especially important for SPA in young-old age; however, when resources decline in old age and SPA become more loss-oriented, personality might be a vital resource for still perceiving aging-related gains. This might be especially important in the context of poor health. Thus, the research question of study 1 was: Are agentic and communal personality traits associated with domain-specific SPA?

1.3.2 Agentic and Communal Values and Self-Perceptions of Aging

While several studies investigated associations of *personality traits* with SPA, examination of associations of motivational personality constructs such as *personal values* with SPA is still largely missing. Given that motivation is considered central to healthy aging by guiding behavior and goal selection (Freund et al., 2021), this constitutes a substantial research gap. In general, personal values may be potentially better suited than traits to predict cognitively based outcomes like SPA (Roccas et al., 2002). Whereas personality traits describe what a person is like, personal values refer to what is important to them (Roccas et al., 2002). Thus, personal values represent desirable end states that the individual wants to reach and serve as guiding principles in life. They represent central criteria of evaluation of the self and self-related issues (Schwartz et al., 2000). The more important a value is to a person, the more it directs attention to and interpretation of objective states, which is reflected in more or less worries about self-related issues (Schwartz et al., 2000). This value-directed attention and interpretation might also transfer to SPA.

The most well-known taxonomy of personal values is that of Shalom Schwartz (Schwartz, 1992; Schwartz & Bilsky, 1987). It encompasses ten personal values that form four higher-order values. These can be further subsumed under agentic and communal as well as gain/growth- and loss/deficiency-related themes. The agentic, growth-related value openness to change emphasizes independent thoughts and actions, curiosity and a readiness for new experiences. It might thus contribute to the notion that one's aging is associated with ongoing personal development. The agentic, loss-related value of self-enhancement emphasizes a desire for high social status, dominance over others and socially acknowledged success. It deals with the prevention of losses by exerting control over others. Since it is also associated with increased worrying (Schwartz et al., 2000), a person for whom self-enhancement is very important might perceive their aging as increasingly associated with social losses. For communal values, the growth-related value of self-transcendence emphasizes a desire for the wellbeing of others, distant and close, which might contribute to the perception that aging is overall associated with ongoing development and gains and less with losses. Conversely, the loss-related value of conservation emphasizes a desire for stability, continuity and following traditions and social norms. It deals with the prevention of losses through conformity. This focus on maintenance might be negatively associated with the perception that aging is a time of personal gain-related development.

In sum, research on personality and SPA might profit from a closer examination of the associations of personal values with SPA, since the role of motivational constructs for SPA is not yet well understood. Thus, the research question of study 2 was: Are personal values associated with change in domain-specific SPA?

1.3.3 Self-Perceptions of Aging and Physical Function

A large body of research provides a strong theoretical and empirical basis for the importance of SPA for health (Wurm et al., 2017), including physical function. However, most of these findings rely on self-report data for physical function, which has been found to only share about half the variance with objectively measured physical function (Daltroy et al., 1999). Thus, it seems timely to expand knowledge on associations of SPA with physical function to objective indicators. First studies have started to investigate associations of SPA with physical function regarding the lower extremities. For example, Sargent-Cox et al. (2012) found associations of more positive SPA with higher physical function measured by the Short Physical Performance Battery, a composite measure of gait speed, balance, and leg strength. In addition, negative SPA have been found to be related to a decline in walking speed (Robertson et al., 2015).

In old age, gait speed is considered a good marker of overall physical function, disability and mortality and has even been termed the "functional vital sign" (Middleton et al., 2015). Being relatively easy to measure, it is widely used to assess physical function in older adults. Yet, gait is a complex task that requires coordination of various simultaneous movements, so considering additional gait parameters like step-width or stride-variability might give further information on physical performance and allow for the distinction of gait patterns. It thus seems of additional value to investigate whether SPA are associated with objectively measured gait patterns, thereby taking the complexity of gait into account. While associated one's aging with physical losses might be associated with functional limitations already notable at normal gait speed, the gain-related perception that one's aging is associated with ongoing development might be associated with better physical function in a more challenging condition, such as when walking at one's maximum speed. Thus, the research question of study 3 was: Are domain-specific SPA differentially related to objectively measured gait patterns as an indicator of physical function?

1.4 Research Aims and Hypotheses

This thesis had three research aims. For each aim, one study was conducted. In all studies, domain-specific SPA were measured with two subscales of the Agecog Scale (Steverink et al., 2001; Wurm et al., 2007). Gain-related SPA were assessed by the subscale *ongoing development* in all studies. In study 1 and 3, loss-related SPA were assessed with the *physical losses* subscale. In study 2, loss-related SPA were assessed by the *social losses* subscale. More details of the AgeCog-Scale are provided in the measures sections of the respective studies. An overview over the studies is provided in Figure 1.

Figure 1

Research Questions Addressed in the Present Dissertation
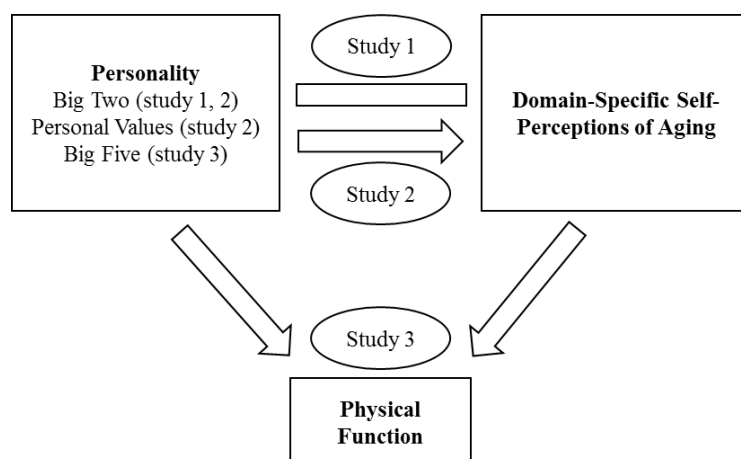
The first aim was to establish basic associations of agency and communion with SPA in a situation where resources are rather low and the perception of aging-related gains may be challenged. To this end, study 1 investigated cross-sectional associations of agentic and communal traits with domain-specific SPA in a sample of old-old adults in poor health while taking emotional and physical health into account. Specifically, the following two hypotheses were investigated:

H1: Agency and communion are positively associated with gain-related SPA beyond health.

H2: Agency and communion are not associated with loss-related SPA beyond health.

This was reported in:

Blawert, A., Schäfer, S. K., Wurm, S. (in press). Associations of agency and communion with domain-specific self-perceptions of aging: A cross-sectional study in old-old adults in poor health. *International Journal of Aging and Human Development.* https://doi.org/10.1177/00914150211050874

The second aim was to expand research on longitudinal associations of personality with SPA to the motivational level of personality. While several predictors of SPA such as societal age stereotypes are well-established, no study has, to the author's knowledge, investigated the role of personal values. Therefore, study 2 investigated personal values as predictors of a gain- and a loss-related domain of SPA in a large sample covering several decades of adulthood while taking domain-matched age stereotypes into account. Specifically, the following four hypotheses were investigated:

H1: Prioritizing openness to change predicts more gain-related SPA over time, but not loss-related SPA over time beyond age stereotypes.

H2: Prioritizing self-enhancement predicts more loss-related SPA over time, but not gain-related SPA over time beyond age stereotypes.

H3: Prioritizing conservation predicts more gain-related SPA over time, but not loss-related SPA over time beyond age stereotypes.

H4: Prioritizing self-transcendence predicts more gain-related SPA and less loss-related SPA over time beyond age stereotypes.

This was reported in:

Blawert, A., & Wurm, S. (2021). Shifting self-perceptions of ageing: differential effects of value priorities on self-perceptions of ageing beyond age stereotypes. *European Journal of Ageing, 18*(2), 257-267. https://doi:10.1007/s10433-020-00578-3

The third aim was to add further knowledge on associations of SPA with objectively measured physical function. While other studies mostly investigated associations of SPA with self-reported physical function, the aim of this study was to examine effects of a gain- and a loss-oriented domain of SPA on objectively measured gait patterns. Since walking performance is usually altered with aging (Aboutorabi et al., 2016), this was investigated in a sample of old-old adults. As personality has been found to be associated with gait (Stephan et al., 2017), Big Five traits were added as covariates. Specifically, the following two hypotheses were investigated:

H1: Higher loss-related SPA are associated with a higher likelihood to exhibit a functionally limited gait pattern when walking at usual gait speed beyond personality traits.

H2: Higher gain-related SPA are associated with a higher likelihood of exhibiting a more favorable gait pattern when walking at individual maximum gait speed beyond personality traits.

This was reported in:

Blawert, A., Krumpoch, S., Freiberger, E., & Wurm, S. (2021). Domain-specific self-perceptions of aging are associated with different gait patterns in older adults: a cross-sectional latent profile analysis. *BMC Geriatrics, 21*(1), 392. https://doi:10.1186/s12877-021-02320-9

2 Methods

The studies conducted for this thesis are based on three different datasets: the study *Transsectoral Intervention Program for the Improvement of Geriatric Care in Regensburg* (TIGER; study 1), the *German Ageing Survey* (DEAS; study 2), and the study *Analysis of Mobility and Gait in Independently Living Adults Aged 70+* (MOGA; study 3). This section summarizes the methods used in the different publications; they are described in more detail in the related scientific papers. The author's contributions to these papers are presented in the Appendix.

2.1 Study 1: Agentic and Communal Traits and Self-Perceptions of Aging

The following paragraphs will describe the sample, measures and data analyses used in study 1.

2.1.1 Sample

This study was based on a sample of initially 244 participants of the intervention study TIGER. The study was funded by the Innovation Fund at the Federal Joint Committee of Germany and took place in the German city of Regensburg. From April 25, 2018 to December 31, 2019, older adults were recruited in a hospital and were randomized into intervention and control group. The intervention group received support for their transition to home/ ambulatory care by specialized nurses over the course of one year, while the control group received personalized feedback on their functional development at the end of the study (for details see Rimmele et al., 2021). Both groups answered questionnaires at five measurement occasions, beginning in hospital (baseline). The present study represents a cross-sectional secondary analysis of data gathered in both groups one month after recruiting, except for sociodemographic information, which was collected at baseline. Since the intervention was not designed to address any of the variables of interest for the present study, both groups were combined for the present analyses. Inclusion criteria for the TIGER study were the following: 1) aged 75 and older, 2) living in a radius of 50 km around Regensburg, 3) scoring at least 22 points in the Mini-Mental State Examination (MMSE), 4) insurance by the statutory health insurance AOK Bayern, 5) admission to the hospital Barmherzige Brüder in Regensburg, and 6) discharge to their own homes. Participants were excluded if they were discharged to a nursing home, were in a palliative care situation or had a planned readmission to hospital within the next four weeks.

2.1.2 Measures

In this study, SPA were assessed with two subscales of the AgeCog-scales (Steverink et al., 2001; Wurm et al., 2007). These were SPA related to ongoing development, which refers to making new plans and following ideas, and SPA related to physical losses, which refers to being less vital and fit. Each of the four items per subscale began with the item stem "Aging means to me…" and participants rated their agreement on a four-point Likert-scale (1 = *definitely true* to 4 = *definitely false*). Scores were reversed and averaged, so that a higher score represents greater endorsement of the respective SPA domain. Agentic and communal personality traits were assessed with two subscales of the German Extended Personal Attributes Questionnaire (Runge et al., 1981). Participants rated on a five-point Likert-scale how much they identified with eight agentic (e.g., independent, active) and eight communal (e.g., helpful, friendly) attributes (0 = *not at all* to 4 = *very much*).

Covariates in this study were emotional and physical health as assessed with the SF-12 Health Survey (Ware et al., 1996); A higher score on the SF-12 subscale indicates better physical function (range: 1 – 100), age, education according to the ISCED classification, and gender.

2.1.3 Data Analysis

Data analysis for this study was performed using RStudio (R Core Team, 2019) and the lavaan package (Rosseel, 2012). The variables of interest in this study were SPA ongoing development, SPA physical losses, agency, and communion. Accordingly, participants were included in the analyses if they provided information on at least one of these variables. T-tests for independent samples were performed to compare study variables between intervention and control group, as well as to compare the study sample and participants that did not provide sufficient data on variables of interest to be included in the analyses. Zero-order correlation analysis was conducted to investigate associations of age, agency, communion, SPA, and physical as well as mental health. Two regression analyses were performed to investigate associations of agency and communion with SPA ongoing development and SPA physical losses controlling for covariates.

To account for missing data and to ensure sufficient statistical power, multiple imputations were conducted using the packages mice (van Buuren & Groothuis-Oudshoorn, 2011) and miceadds (Robitzsch & Grund, 2021).

2.2 Study 2: Agentic and Communal Values and Self-Perceptions of Aging

The following paragraphs will describe the sample, measures and data analyses used in study 2.

2.2.1 Sample

Data for this study came from the German Ageing Survey (DEAS; Klaus et al., 2017), a register-based, cohort-sequential longitudinal study representative for the community-dwelling German population aged 40 and older that started in 1996. The DEAS consists of a computer-assisted personal interview (CAPI) and a drop-off questionnaire. In this study, data of 6,098 adults who participated in both the CAPI and the drop-off-questionnaire in 2008 (T1) and the follow-up in 2011 (T2) were used.

2.2.2 Measures

As in the former study, SPA were assessed with two subscales of the AgeCog-scales (Steverink et al., 2001; Wurm et al., 2007). In this study, these were SPA related to ongoing development, and SPA related to social losses, which refers to associating aging with being less respected, less needed, and increasing boredom and loneliness. The four personal values openness to change, self-enhancement (agentic values), conservation, and self-transcendence (communal values), were assessed with the Portrait Values Questionnaire (Schwartz, 2003) that provides short descriptions of persons gender-matched to the respondent. Participants then rated how much these persons were similar to themselves on a 6-point Likert-scale (1 = *not at all like me*, 6 = *very much like me*). Scores were averaged over the corresponding items for each value. Then, each respondent's mean score across all values was subtracted from each single value, thus correcting for interindividual differences in scale use tendencies and creating scores for value priorities (Schwartz, 1992). Thus, the score represents the *relative* importance of a specific value in relation to the whole value system. The higher the score, the more important that value is to a person in relation to all other values.

Age stereotypes were assessed with a modified version of the AgeCog-scales. Here, items began with the item stem "Aging means to most people…". Analogous to SPA, the subscales ongoing development and social losses were used. As covariates, age, gender, place of residence (former West/East Germany), education according to ISCED (UNESCO, 1997), a variable indicating if a person belonged to the longitudinal part of the DEAS or the newly drawn subsample in 2008, and physical function measured with the 10-item physical functioning subscale of the SF-36 Health Survey (Bullinger & Kirchberger, 1998) were included. A higher score on the SF-36 Health Survey subscale indicates better physical function (range: 1 – 100).

2.2.3 Data Analysis

Descriptive statistics as well as correlations and dropout analysis were performed using IBM SPSS 25. Dropout analyses were performed using independent sample t-tests and calculating the effect size Hedge's g. To investigate associations of predictors and outcomes, multiple regression analysis were performed using Mplus 8 with Full Information Maximum Likelihood Estimation. Overall, four regression models were computed that investigated the predictive value of agentic and communal values in 2008 separately for each of the two SPA domains in 2011. All analyses were controlled for age, gender, education, place of residence, physical function, the corresponding age stereotype and the corresponding SPA domain in 2008. All predictors were z-standardized prior to analysis to account for different scaling in the measures.

2.3 Study 3: Self-Perceptions of Aging and Gait Patterns

The following paragraphs will describe the sample, measures and data analyses used in study 3.

2.3.1 Sample and procedure

This study was based on a sample of 150 rather healthy community-dwelling adults aged 70 and older from the German city of Nuremberg that participated in the MOGA-study. Study participants were recruited via an existing address pool and distribution of flyers. The following inclusion criteria were employed: 1) aged 70 and older, 2) living independently, 3) ability to walk 10 m without a wheeled walker and 4) ability to understand and follow the test protocol. Serious orthopedic and/or neurological disorders that impeded walking were criteria for exclusion from the study. In addition, participants needed to come to the study site by themselves. There, participants completed several walks on an electronic walkway at normal and individual maximum speed. Participants also completed a structured personal interview at the study site and the Short Physical Performance Battery (Guralnik et al., 1994).

2.3.2 Measures

As in study 1, SPA were measured with the AgeCog-subscales ongoing development and physical losses. Big Five personality traits were assessed using the 10-item short version of the Big Five Inventory (Rammstedt & John, 2007), were participants rated their agreement to the items on a five-point Likert-scale (1 = *do not agree* to 5 = *totally agree*). Scores were averaged over the corresponding items for each trait. As covariates, number of illnesses as assessed with the Functional Comorbidity Index (Groll et al., 2005), age, gender, and years of education were used.

Gait parameters were obtained with the GAITRite system, an electronic walkway with embedded pressure sensors. Two cones were placed 2.5m before and behind the GAITRite system to indicate start and finish area of the assessment to obtain a steady-state walk (Figure 2). Participants walked once in their usual speed and once in their individual maximum speed across the walkway. Gait parameters were recorded automatically.

Figure 2

Setup of the GAITRite System
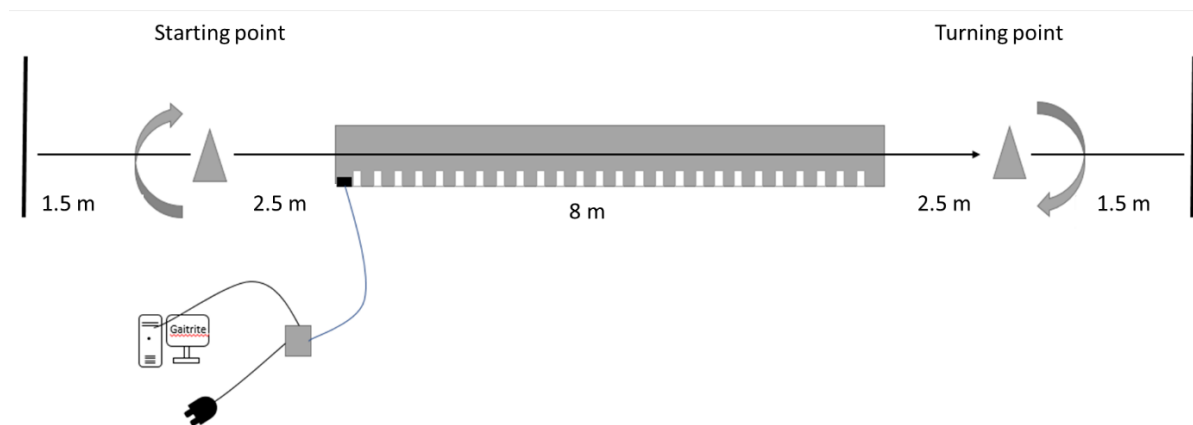
2.3.3 Data Analysis

Descriptive analyses were conducted using IBM SPSS 25. Outliers were identified based on Cook's distance, and cases with a distance > 1 were excluded from the analysis (Field, 2013).

To account for the complex nature of gait, a composite measure of gait was developed using latent profile analysis (LPA) in Mplus7. LPA identifies groups that are most homogenous within and most heterogeneous between one another based on indicator variables chosen by the researcher. The following gait parameters were used as indicator variables in the analysis, each representing one distinct gait domain (Lindemann, 2019): Gait speed (m/s) to represent walking capacity, variability of step-width and stride-length (coefficient of variation: CoV= SD/mean (in cm)*100 [%]) to represent regularity and adaptability of gait, and walk-ratio (cm/steps/min) to represent the spatiotemporal coordination of walking. A higher walk ratio represents better walking coordination. The LPA thus identified gait patterns based on these four variables. Based on the maximum posterior probability of group membership, participants were assigned to the group they most likely belonged to. LPA were performed separately for normal and maximum speed conditions.

The emerging groups were further characterized by comparing their SPPB-scores in a *t*-test for independent samples in each condition using IBM SPSS 25.

In a second step, two binary logistic regressions were conducted in IBM SPSS 25 to test associations of SPA, personality and covariates with gait patterns for each gait speed condition. In both regression analyses, SPA ongoing development, SPA physical losses, and Big Five personality traits were added as predictors, and age, gender, education and the number of illnesses were added as covariates.

3   Results

This section summarizes the results of the three empirical studies.

3.1   Study 1: Agentic and Communal Traits and Self-Perceptions of Aging

Sample characteristics and results of the analyses for study 1 are presented in the following paragraphs.

3.1.1   Sample Characteristics

Of the initial 244 participants of the TIGER study, only 208 took part in the T1 assessment. Non-participation in the T1 assessment was either due to transition to a nursing home (exclusion criterion; 13.9%), death (8.3%), or a reported momentary break from the study (5.6%). The remaining 72.2% did not return questionnaires for the T1 assessments without providing any reason. Of the 208 T1-participants, only 154 provided information for at least one of the variables of interest and thus constitute the study sample for the present analysis. Drop-out analyses revealed that those not providing information at T1 did not differ from the study sample in age, $t(242) = 1.18$, $p = .241$, gender, $\chi^2(1) = 0.19$, $p = .660$, and educational level, $t(188) = -0.15$, $p = .880$. A non-significant Little's MCAR Test supported the assumption that data was missing completely at random, $\chi^2(99) = 108.00$, $p = .258$.

Since control group and intervention group did not differ in variables of interest, $p \geq .071$, both groups were combined for the analyses.

The final study sample (n = 154) reported a mean age of 81.7 years (range 75 – 93; $SD = 4.6$) and 58.4% of them were women. Compared with normative values on the SF-12 from the German general population (Wirtz et al., 2018), their physical health was rather low, $t(110) = -8.94$, $p < .001$. Their emotional health did not differ from normative values, $p = .610$.

3.1.2 Associations of Agentic and Communal Traits with Domain-Specific Self-Perceptions of Aging

It was hypothesized that agency and communion would be associated with SPA ongoing development, yet not with SPA physical losses when controlling for health. In multiple regression analysis (see Table 1), higher agency and higher communion were associated with higher SPA ongoing development, while health was not significantly associated with this SPA domain. In bivariate correlation analysis, agency and communion were negatively associated with SPA physical losses, $r_{agency} = -.36$, $p < .001$, $r_{communion} = -.31$, $p = .001$. However, when controlling for emotional and physical health in the regression analysis, agency and communion were no longer significantly associated with this SPA domain. Thus, results supported both hypotheses.

Table 1

Regression Models of SPA Ongoing Development and SPA Physical Losses

Predictors	DV = SPA ongoing development	DV = SPA physical losses
	β (SE)	β (SE)
Agency	0.28 (.07)**	-0.08 (.07)
Communion	0.23(.07)*	-0.09 (.06)
Physical Health	0.09 (.07)	-.0.15 (.06)*
Emotional Health	0.08 (.07)	-0.12 (.05)*
R^2	.412	.263

Notes. $n = 154$. SPA = self-perceptions of aging; DV = dependent variable; all analyses were controlled for gender, age, and educational level.

*$p < .05$. **$p < .01$.

3.2 Study 2: Personal Values and Self-Perceptions of Aging

Sample characteristics and results of the analyses for study 2 are presented in the following paragraphs.

3.2.1 Sample characteristics

At T1 in 2008, the 6089 participants of the DEAS that were included in the study reported a mean age of 62.9 years (range 40 – 93; $SD = 11.6$), 48.7% were women and 35.7% lived in former East Germany. Of these, 3044 took part in the follow-up assessment at T2. Drop-out analyses revealed that those who discontinued the study were significantly older, $t(5297.27) = 3.53$, $p < .001$, and less educated, $t(5586.6) = -11.81$, $p < .001$, and reported worse physical function than those who continued to take part in the study, $t(4923.56) = -6.27$, $p < .001$. Regarding SPA, drop-outs associated their own ageing more with social losses, $t(5247.90) = 3.25$, $p = .01$, and less with ongoing development, $t(5123.28) = -8.46$, p $< .001$. They also reported less gain-related age stereotypes, t$(5330.80) = -6.86$, $p < .001$. For values, people for whom conservation and self-enhancement values were relatively important were more likely to drop out, $t(6002) = 4.91$, $p < .001$, and $t(5356.24) = 6.96$, $p < .001$, respectively. Those with a value priority of openness to change and self-transcendence were more likely to participate in the second measurement in 2011, $t(5359.88) = -4.64$, $p < .001$ and $t(6005) = -8.39$, $p < .001$, respectively. In sum, the effects due to sample attrition were small as indicated by Hedge's g ranging from $g = .09$ to $g = .31$.

3.2.2 Associations of Personal Values with Domain-Specific Self-Perceptions of Aging

It was hypothesized that agentic and communal value priorities would differentially predict SPA ongoing development and SPA social losses beyond sociodemographic information, physical function, age stereotypes and corresponding SPA domain in multiple regression analyses at T2 in 2011 (see Table 2). As expected, the agentic value priority of openness to change predicted an increase in SPA ongoing development over the course of three years, while not being associated with SPA social losses. On the contrary, the agentic value priority of self-enhancement was associated with increased SPA social losses at follow-up. For communal values, a value priority of conservation predicted a decrease in SPA ongoing development, while a value priority of self-transcendence predicted a decrease in SPA social losses, as well as an increase in SPA ongoing development. Thus, results supported the hypotheses.

Table 2

Regression Models of SPA Social Losses and SPA Ongoing Development at T2

Predictors	DV = SPA Social Losses T2		DV = SPA Ongoing Development T2	
	β (SE)	β (SE)	β (SE)	β (SE)
SPA social losses	0.30 (.01)***	0.30 (.01)***		
SPA ongoing development			0.31 (.01)***	0.31 (.01)***
Age	-0.05 (.01)***	0.04 (.01)***	-0.10 (.01)***	-0.09 (.01)***
Gender	0.000 (.01)	0.01 (.01)	0.01 (.01)	0.005 (.009)
Panel	-0.03 (.02)	-0.03 (.02)	0.01 (.02)	0.003 (.01)
Region	0.003 (.01)	-0.001 (.01)	-0.04 (.01)***	-0.03 (.01)***
Education	-0.04 (.01)***	-0.03** (.01)	0.04 (.01)***	0.03 (.01)**
Physical function	-0.04 (.01)**	-0.04 (.01)**	0.05 (.01)***	0.05 (.01)***
Age stereotype social losses	0.02 (.01)*	0.02 (.01)*		
Age stereotype ongoing development			0.03 (.01)**	0.03 (.01)**
Openness to change	-0.001 (.01)		0.03 (.01)***	
Self-enhancement	0.03 (.01)***		-0.01 (.01)	
Conservation		0.004 (.01)		-0.04 (0.01)***
Self-transcendence		-0.04 (.01)***		0.02 (0.01)*
R^2	.341***	.342***	.461***	.462***

Notes. n_{T0} = 6089; SPA = self-perceptions of aging; DV = dependent variable

*p < .05. **p < .01. ***p < .001.

3.3 Study 3: Self-Perceptions of Aging and Gait Patterns

Sample characteristics and results of the analyses for study 3 are presented in the following paragraphs.

3.3.1 Sample Characteristics

The final sample of the MOGA study comprised 150 older adults with a mean age of 80.5 years (range 71 – 93; $SD = 4.5$) and 61% were women. Their mean education was 13.7 years ($SD = 3.3$), thus, the sample can be considered highly educated. Three cases in the usual speed condition and one case in the maximum gait speed condition were identified as outliers and therefore excluded from the analyses.

3.3.2 Analysis of Gait Patterns

The LPA distinguished two heterogeneous groups each in the usual as well as in the maximum gait speed condition that are displayed in Figure 3. In both conditions, a large, rather fit group with a faster and well-coordinated gait pattern and a much smaller, functionally rather limited group with a slower and less coordinated gait pattern emerged.

Figure 3

The Two Gait Patterns in the Usual (Left Side) and Maximum (Right Side) Gait Speed Condition
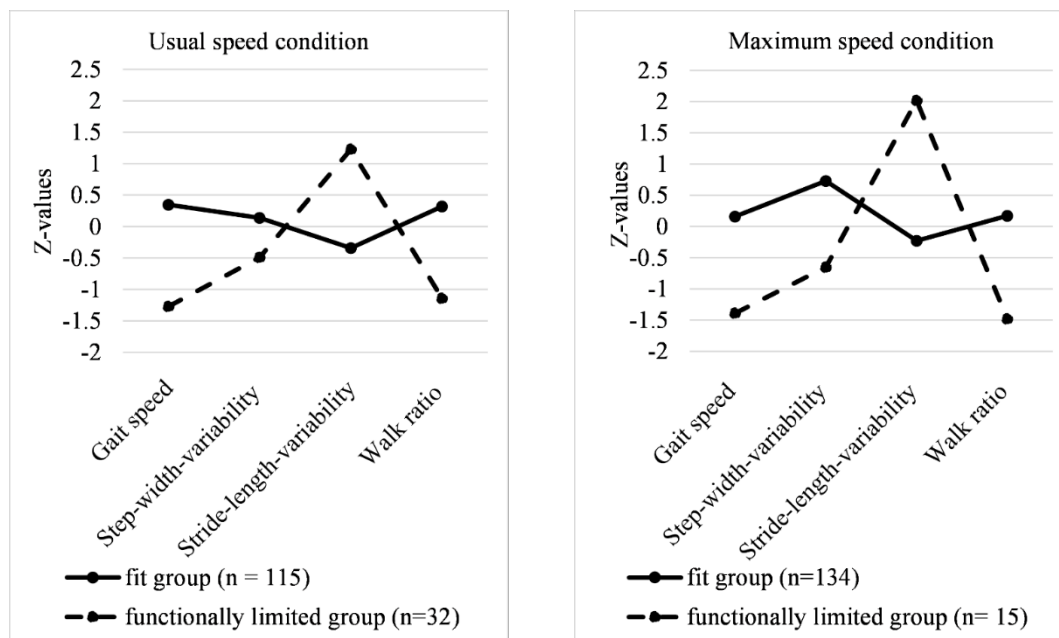
Note. To facilitate the display of the results, variables were z-standardized for the figures.

In the usual gait speed condition, mean values for the fit group (represented by the straight line on the left side in Figure 3) were a mean gait speed of 1.30 ($SD = 0.18$), a mean step-width-variability of 29.09 ($SD = 14.58$), a mean stride-length variability of 2.46 ($SD = 0.91$), and a mean walk ratio of 0.58 ($SD = 0.07$). For the functionally limited group (represented by the dotted line on the left side in Figure 3), the values were a mean gait speed of 0.91 ($SD = 0.15$), a mean step-width-variability of 20.16 ($SD = 9.89$), a mean stride-length variability of 4.66 ($SD = 1.49$), and a mean walk ratio of 0.46 ($SD = 0.06$). Average latent class probabilities for most likely latent class membership of .922 in the fit group and .974 in the functionally limited group indicated that participants could be well distinguished as belonging to a specific class.

In the maximum gait speed condition, the values for the fit group (represented by the straight line on the right side in Figure 3) were a mean gait speed of 1.58 ($SD = 0.29$), a mean step-width-variability of 28.06 ($SD = 13.94$), a mean stride-length variability of 2.80 ($SD = 1.32$) and a mean walk ratio of 0.55 ($SD = 0.08$). For the functionally limited group (represented by the dotted line on the right side in Figure 3), the values were a mean gait speed of 1.05 ($SD = 0.45$), a mean step-width-variability of 17.81 ($SD = 12.37$), a mean stride-length variability of 7.18 ($SD = 2.31$) and a mean walk ratio of 0.40 ($SD = 0.07$). As in the usual gait speed condition, participants could be well distinguished as belonging to a specific class as indicated by average latent class probabilities for most likely latent class membership of .989 in the fit group and .893 in the functionally limited group.

In a next step, data was exported to SPSS 25, including an indicator of class membership based on maximum posterior probability of class membership. To further qualify labelling of the groups as "fit" and "functionally limited", the groups' SPPB-scores were compared in a t-test for independent samples. In each condition, the two groups differed significantly in their SPPB-scores: In the usual speed condition, the mean SPPB scores were 11.44 ($SD = 0.91$) in the fit group and 9.41 ($SD = 2.06$) in the functionally limited group, $t(34.43) = -5.45, p < .001$. In the maximum speed condition, the mean SPPB scores were 11.22 ($SD = 1.12$) in the fit group compared to 8.13 ($SD = 3.02$) in the functionally limited group, $t(14.43) = -3.92, p \leq .001$.

3.3.3 Associations of Self-Perceptions of Aging with Gait Patterns

To investigate associations of the two SPA domains with gait patterns, the latent class indicator was used as the outcome variable in the binary logistic regression analyses. For each gait speed condition, it was examined whether SPA increase or decrease the odds of belonging to the functionally limited group, controlling for the Big Five personality traits,

age, gender, education, and number of illnesses (see Table 3). It was hypothesized that higher SPA physical losses would be associated with worse gait performance in the usual gait speed condition, while higher SPA ongoing development would be associated with better gait performance in the maximum gait speed condition.

In the usual gait speed condition, higher SPA physical losses, extraversion and chronological age increased the odds of belonging to the functionally limited group. SPA ongoing development were unrelated to group membership in the usual gait speed condition.

In the maximum gait speed condition, higher SPA ongoing development decreased the odds of belonging to the functionally limited group, while number of illnesses increased these odds. SPA physical losses were unrelated to belonging to either group in the maximum gait speed condition. Thus, the results supported the hypotheses.

Table 3

Results of the Binary Logistic Regression Analyses of Gait Pattern Group on SPA

Predictors	Usual gait speed condition	Maximum gait speed condition
	OR (95% CI)	*OR (95% CI)*
SPA physical losses	2.69 (1.23 – 5.85)**	1.40 (0.51 – 3.85)
SPA ongoing development	.66 (0.29 – 1.15)	0.38 (0.15 – 0.98)*
Extraversion	1.85 (1.15 – 2.89)*	1.31 (0.73 – 2.35)
Neuroticism	0.88 (0.53 – 1.45)	0.60 (0.32 – 1.12)
Openness	1.48 (0.79 – 2.77)	1.46 (0.70 – 3.05)
Conscientiousness	0.73 (0.40 – 1.32)	0.88 (0.45 – 1.70)
Agreeableness	1.08 (0.61 – 1.93)	0.72 (0.35 – 1.47)
Age	1.29 (1.14 – 1.47)***	1.14 (0.99 – 1.31)
Gender	2.37 (0.63 – 8.93)	2.94 (0.55 – 14.69)
Education (years)	1.12 (0.93 – 1.35)	1.06 (0.86 – 1.32)
No. of illnesses	1.30 (1.00 – 1.68)	1.45 (1.04 – 2.04)*

Notes. SPA = Self-perceptions of aging. Reference group: fit group. Values above 1 imply an increased likelihood of belonging to the functionally limited group. Values below 1 imply an increased likelihood of belonging to the fit group.
*p < .05; **p < .01; ***p ≤ .001

4   Discussion

This thesis aimed at advancing the understanding of associations between personality and SPA in later life and to extend knowledge on SPA and objective physical function. To this end, study 1 investigated associations of agentic and communal traits with domain-specific SPA, study 2 investigated longitudinal associations of personal values with domain-specific SPA, and study 3 examined associations of domain-specific SPA with objectively measured gait patterns as indicator of physical function. The discussion of the present findings will be summarized in the following sections (more details can be found in the related papers). Then, strengths and limitations are addressed. In chapter 4.5, implications and future research questions are derived from the present findings, followed by the conclusion.

4.1   Agentic and Communal Traits and Self-Perceptions of Aging

This study examined the relationship between agentic and communal personality traits and SPA related to ongoing development and SPA related to physical losses in old-old adults in poor health. All analyses were controlled for age, gender, and education as well as self-reported physical and mental health. Findings supported the hypotheses by revealing differential associations of agency and communion with domain-specific SPA: Both higher agency and higher communion were positively associated with SPA related to ongoing development, even when controlling for health. Regarding SPA related to physical losses, on the other hand, agency and communion were not associated with this SPA domain when including physical and mental health in the model.

The finding that higher agency as well as higher communion were positively related to the perception of aging as associated with ongoing development such as making new plans and putting ideas into practice might indicate that this SPA domain contains agentic and communal aspects. Both agency and communion might pose prerequisites to actively engage in behavior that fosters SPA related to ongoing development, be it through agentic pursuit of, for example, independently organizing one's everyday life, or communal pursuit of, for example, going to a senior center and making friends there. Given the cross-sectional study design, it may also be the case that those who perceive their aging as ongoing development feel freer to openly express their personality and let themselves not be restricted by perceived age appropriateness or age stereotypes: Higher SPA related to ongoing development might, for example, allow a person to agentically dress the way they like, even if others might consider this not suited for their age. In a similar vein, a person with higher SPA related to ongoing development might more actively engage in interactions with new acquaintances, thus expressing their communal traits.

On a bivariate level, higher agency and communion were negatively associated with SPA related to physical losses. However, when controlling for physical and emotional health, agency and communion did not explain significant unique amounts of variance, whereas both health variables did. This domain-specific effect of health might reflect recent findings indicating that physical health is more strongly associated with SPA physical losses than SPA ongoing development (Boeder & Tse, 2021; Diehl et al., 2021).

Overall, this study corroborates findings indicating that personality traits and SPA are related cross-sectionally (Loi et al., 2015; Rupprecht et al., 2019). Beyond previous studies, the findings presented here add to a more general understanding of this association by firstly investigating agentic and communal traits in their relation to gain- and loss-related SPA. These findings enrich research on the role of agency and communion for successful adaptation and well-being in later life (Perrig-Chiello & Hutchison, 2010) by examining their relationship with SPA as indicators of successful or healthy aging. Austin and Costabile (2017) argue that agency and communion provide "two routes to optimism"; the findings presented here indicate that agentic and communal traits might also pose two perspectives on the perception of age-related gains.

Moreover, this study shows that in the aftermath of hospitalization, the perception that aging is associated with physical losses is primarily related to actual health. Nevertheless, in the same situation, older adults also perceive their aging as associated with gains, with personality as a resource. Thus, this study helps to disentangle the role of personality and health for domain-specific SPA, at least in old age and poor health.

4.2 Agentic and Communal Values and Self-Perceptions of Aging

The goal of this study was to investigate longitudinal associations of four personal value priorities, namely openness to change, self-enhancement, conservation, and self-transcendence with SPA related to ongoing development and SPA related to social losses. The analyses were controlled for age, gender, place of residence, belonging to the panel, education, self-reported physical health and domain-matched age stereotypes. The findings provide first evidence that personal values shape the way people perceive their own aging.

The agentic value of *openness to change* was associated with higher SPA related to ongoing development three years later. If openness is important to individuals, they might more easily engage in activities and embrace opportunities for new experiences, thus perceiving their aging as associated with ongoing development. Moreover, in case of limited resources, a value priority of openness to change might facilitate adjustment to changing capabilities in old age. For example, older persons might encounter difficulties walking and

thus can no longer join their weekly walking group. If these persons have a value priority of openness to change, they might more easily find a new, more attainable activity such as sitting gymnastics. This newfound activity might contribute to the perception of ongoing development despite functional limitations.

A value priority of *self-enhancement* (also an agentic value) was associated with higher SPA related to social losses over time. Thus, a person valuing achievement and power perceives their aging as increasingly associated with loneliness, boredom and loss of respect. One explanation might be that valuing self-enhancement implies a strong focus on external validation and social approval. With age and changing roles such as becoming a retiree, opportunities for social approval and exertion of power might diminish and thus lead to increased perceptions of social losses that are attributed to aging. In addition, this value orientation is associated with stress, depression (Hanel & Wolfradt, 2016) and increased worrying (Schwartz et al., 2000), which might accumulate over the life span and contribute to this negative view on aging.

The communal value priority of *conservation* was negatively associated with the perception of ongoing development over time. Valuing conservation implies a strong focus on tradition and maintenance of the status quo; it thus seems reasonable that those valuing conservation do less associate their aging with new plans and goals, because focusing on new experiences would contradict their values. Yet, valuing conservation might also be indicative of limited resources (Schwartz, 2012). This preoccupation with maintaining the current status might reflect missing psychological resources to adapt successfully to age-related changes, and the overall changing motivation from a focus on gains to maintenance and prevention of losses across adulthood (Ebner et al., 2006).

Lastly, the value priority of *self-transcendence*, i.e. benevolence and universalism, was associated with the perception of more ongoing development and less social losses at follow-up. This finding is remarkable, since it shows that a concern for the well-being of others as well as nature and the world in general contributes to more gain-related perceptions of one's own aging. It has been argued that a shift in perspective away from an egocentric value perspective to a more universal and prosocial view might be indicative of successful adaption to the aging process and constitute the ultimate goal of development, as expressed, for example, in Gerotranscendence Theory (Tornstam, 1997) and also evident in theories on generativity (McAdams & de St Aubin, 1992).

Taken together, this study showed in more detail that depending on their focus on growth or deficiency, agentic and communal values relate differently to gain- and loss-related SPA domains.

4.3 Self-Perceptions of Aging and Gait Patterns

This study aimed at advancing the understanding of associations of SPA with physical function. To this end, associations of two SPA domains with gait patterns based on objectively measured gait parameters were investigated in two gait speed conditions. All analyses were controlled for the Big Five personality traits, age, gender, education, and number of diseases.

In the usual as well as in the maximum speed condition, two gait patterns based on four gait parameters emerged. In both conditions, one pattern represented a rather fit group as indicated by a fast, stable and well-coordinated gait pattern. The other gait pattern represented a group that was more functionally limited as indicated by a slower, less stable and less well-coordinated pattern. So far, studies mostly focused on investigating associations of single gait parameters such as gait speed with psychological variables. This study extended these approaches by extracting gait patterns based on *certain combinations* of gait parameters each representing a distinct gait feature, thereby accounting for the complex nature of gait.

In contrast to previous studies on SPA and physical function, this study employed a multidimensional perspective on SPA by examining SPA related to ongoing development and SPA related to physical losses. Furthermore, with SPA and personality, two distal psychological variables were examined in their association to physical function as opposed to a focus on proximal psychological variables such as conscious movement processing in other studies (e.g., Young et al., 2020).

SPA related to physical losses increased the odds of belonging to the functionally limited group in the normal gait speed condition. Thus, those exhibiting a functionally limited gait pattern when walking at normal pace associated their aging more strongly with physical losses. This corroborates previous research indicating that SPA physical losses are associated with overall worse self-reported physical function (Westerhof et al., 2014). Since this study was cross-sectional, causality cannot be determined; it may be the case that those who perceive aging as associated with physical losses are less physically active, which might result in a less well-coordinated gait pattern, or that the experience of walking difficulties might lead to the perception that aging is associated with physical losses.

In the maximum gait speed condition, SPA related to ongoing development increased the odds of belonging to the fit group; i.e., those who were able to walk fast and well-

coordinated at individual maximum speed perceived their aging more strongly as associated with ongoing development, and conversely, those with higher SPA related to ongoing development showed a more stable gait pattern. This is in line with research suggesting better health in individuals with more positive or gain-related SPA (Chang et al., 2020; Wurm et al., 2017). The fact that this SPA domain only was associated with gait patterns in the maximum speed condition suggests that individuals who perceive their aging as associated with ongoing development have spare resources to invest, that help them to invest effort in a condition that requires mobilization of resources.

Of the Big Five personality traits, only extraversion emerged as a significant predictor of group membership, yet only when walking at usual speed. Older adults with higher extraversion were more likely to belong to the functionally limited group in this condition. This finding is somehow counterintuitive, since extraversion was associated with better and faster walking speed in other studies with older adults (Deshayes et al., 2021; Kekäläinen et al., 2020). Yet, a recent meta-synthesis comprising 36 meta-analyses on associations of Big Five traits with different health outcomes suggested that the overall effect of Big Five personality traits on objective indicators of physical health is close to zero (Strickhouser et al., 2017). This might indicate that the emergence of associations between Big Five traits and physical function may depend on specific sample characteristics. Strickhouser et al. (2017) found stronger associations of personality traits and health in clinical vs. nonclinical samples and with self-reported vs. objective physical function, which might help to explain the virtual absence of personality effects found in the present study using a non-clinical sample and objective measures of physical function. It may also be the case that sample selection effects were active: a part of the sample was recruited via an existing address pool of adults interested in participation in biomedical studies, which may have preselected older adults high in extraversion that were experiencing functional limitations. It might further be the case that SPA acted as a confounder and accounted for the amount of variance usually explained by personality traits, which indicates that domain-specific SPA may be better suited to predict physical function than personality traits. This may support findings on the mediating role of SPA for the impact of personality on health (Deshayes et al., 2021; Moor et al., 2006).

Chronological age increased the odds of exhibiting the functionally limited gait pattern in the usual speed condition, yet just failed to reach significance in the maximum speed condition. This might be due to the small number of people exhibiting the functional limited gait pattern (n = 15) vs. the fit gait pattern (n = 134). In a sample more diverse in physical

function, age (and maybe other variables) might emerge as a significant predictor also in this gait speed condition.

Taken together, in addition to supporting previous research on associations of these SPA domains with health and physical function, this study was also able to show that there are domain-specific associations with SPA and objectively measured gait patterns in different gait speed conditions when controlling for Big Five traits.

4.4 Strengths and Limitations

The studies presented in this thesis have several strengths. First, for study 1, a sample of old-old adults in poor health could be recruited, a group of the population that is often underrepresented in other studies. Second, associations of personality and SPA emerged in all three studies, thus further establishing this association across age groups and different health statuses. Third, this thesis expands knowledge about associations of personality and SPA to the Big Two, namely, agency and communion – on the trait level (study 1) as well as on the level of personal values (study 2). Fourth, findings of study 3 expanded knowledge on differential effects of SPA and personality on objectively measured physical function and also suggested that SPA may be better suited than personality to predict physical function. Fifth, differential associations of agency and communion with gain- and loss-related SPA emerged, thus supporting the multidimensionality of SPA and suggesting that agency and communion may be useful for better understanding SPA domains. Sixth, findings might help to disentangle the roles of SPA and personality for health in later life.

However, several limitations must be considered. First, direction of effects cannot be determined in the studies reported here; studies 1 and 3 are cross-sectional in nature and in study 2, since personal values and age stereotypes were only assessed in 2008, potential change in personal values and age stereotypes and bidirectional relationships with SPA could not be examined. Second, sample size and sample selectivity may limit generalizability to other populations. The samples in study 1 (N = 154) and study 3 (N = 150) were rather small. However, a post-hoc power analysis for study 1 indicated that the analyses were sufficiently powered. For study 3, power analyses for LPA is not yet established. Regarding sample selectivity, the high dropout rate (36.9%) of study 1 reflects the fact that participants were rather old (75 and older) and in relatively poor health after hospitalization, which contributed to drop-out due to death, admission to a nursing home or unwillingness or inability to fill out the extensive questionnaires. For study 2, the sample was very large (N = 6,089). Yet as common in panel studies (Enzenbach et al., 2019), there was significant drop-out associated with higher age, lower education, poor health and other factors, thus potentially inducing bias.

In study 3, although all 150 participants provided data on all variables, the sample was selective in terms of health and education. Participants were extraordinarily fit and healthy for their age (70 and older), which might have affected the gait patterns found by LPA. Since education can be seen as a proxy for social status (Kirsch et al., 2019), the same analysis should be repeated in larger samples more diverse in terms of social status and health. Third, gait parameters assessed in study 3 may not be reliable due to a limited number of walks, which might have affected LPA and, accordingly, the regression analyses. As the studies reported here provide new approaches to the investigation of associations between personality, SPA, and physical function, future studies should build on these findings by replicating and further exploring them in larger, more diverse samples using longitudinal design.

4.5   Implications and Future Directions

Results of studies 1 and 2 suggest that agency and communion may be useful dimensions not only for organizing personality, but also for SPA. This becomes evident in the differential effects of agency and communion on SPA domains: in study 1, agentic and communal traits that are positive in valence were associated with gain-related SPA, which was also the case in study 2 for the agentic value priority of openness and the communal value priority of self-transcendence that are both inherently growth-related (Schwartz, 2012). Study 2 expanded these findings by also investigating associations of the two deficiency-related values of conservation and self-enhancement with SPA, that is, values that focus on the prevention of losses and controlling threat rather than attainment of gains. While individuals focusing on maintaining the status quo (i.e., a value priority of conservation) simply did not perceive aging-related gains, those with a focus on self-enhancement, that is, power and achievement, perceived their aging as stronger associated with social losses. This has several implications for research on SPA. First, building on findings of study 2, future studies might further investigate the role of the deficiency-related or negative aspects of agency and communion for SPA, both on the level of personal values and traits. On the trait-level, these are unmitigated agency (a focus on the self to the exclusion of others, e.g., hostility) and unmitigated communion (a focus on others to the exclusion of the self, e.g., overinvolvement with others' problems; Helgeson & Fritz, 1999). These traits may amplify the perception of aging-related losses in different domains. Secondly and in a similar vein, future studies might investigate the role of (positive and negative facets of) agency and communion for a larger variety of SPA domains such as financial security or family life. Third, and following from these implications, studies might investigate more specifically the nature of agentic and

communal aging-related gains and losses, possibly using qualitative methods suggested by McAdams et al. (1996) to extract agentic and communal themes from interviews on the way older adults perceive their own aging. Thus, an agency-communion measure for SPA could be developed that might allow for a better comparison of research on SPA with research from social psychology, were the dimensions of agency and communion are well established in research on stereotypes. Stereotypes about groups of people can be mapped on these two dimensions. Older adults are commonly stereotyped as low in agency and high in communion, which has been vividly termed "doddering but dear" by Cuddy and Fiske (2002). Given that age stereotypes become internalized and thus impact a person's self-perceptions (stereotype embodiment; Levy, 2009), adopting an agency-communion-perspective on SPA might prove useful to connecting these lines of research. Future studies should investigate how this pathway of age stereotype to SPA relates longitudinally to the actual decline in agency and increasing communion in later life (Baltes, 1987; Strough et al., 2007). First evidence for a pathway from age stereotypes to changes in personality stems from Kornadt (2016), who found that people in middle adulthood with more positive age stereotypes in the domain of social relationships (a communal domain) became more agreeable (a communal trait) over time, indicating that age stereotypes can act as social role expectations for older adults that these tend to meet.

In addition, mechanisms underlying the association of personality and SPA should be further investigated in future studies; sociodemographic factors or life events might moderate the association of personality and SPA. Moreover, and building on findings of study 2, future studies should focus on investigating the longitudinal interplay of motivational variables like personal values and SPA and the role of goal pursuit and goal disengagement in this relationship. Values guide the selection of more concrete goals; the attainability of these goals, however, may change with increasing age and increasing physical or cognitive limitations (Freund et al., 2021), which may result in loss-related SPA. Regarding analysis of gait parameters, study 3 provides a valuable starting point for future studies that might include other or more gait parameters. Also, it might be worthwhile to compare effects of personality and SPA on different types of physical function (Deshayes et al., 2021). In addition, future research might compare effects of personality and SPA on subjective vs. objective physical function. To further strengthen the findings reported in this thesis, future studies should replicate findings in larger samples, and groups differing in age, social status, and physical function. This might help to better understand causality, mechanisms and pathways of the associations of personality, SPA and health.

Regarding practical implications, knowledge on age-related agentic and communal gains may inform interventions to foster gain-related SPA and reduce loss-related SPA in older adults. More research in this area might help to elucidate ways in which older adults cope with loss in agency, and in which aspects of the aging process they still perceive themselves as agentic. These could be explicitly addressed in interventions. Yet, given the shift towards higher communion in later life, interventions should also focus on ways to improve pursuit of communal goals, since these may be more easily attainable for older adults (see also Isaacowitz et al., 2021) and thus contribute to gain-related SPA. The findings of this thesis suggest that interventions on SPA should consider personality and personal values of the participants, which might allow for a more individualized approach and accordingly facilitate change in SPA.

5   Conclusion

Overall, the findings presented in this thesis help to better understand associations of personality and SPA in the context of healthy aging, thus contributing to models that include personality as a relevant resource in the context of SPA and health in later life (Diehl et al., 2014; Wurm et al., 2017) and therefore addressing a substantial research gap described in recent reviews (Kornadt et al., 2020; Wurm et al., 2017). Findings showed cross-sectional associations of agentic and communal traits and longitudinal associations of agentic and communal values with domain-specific SPA. This suggests that personality traits with a positive valence and gain-related SPA may both be resources for older adults to be and do what they value, as stated in the WHO's definition of healthy aging. In addition, SPA were found to relate to objectively measured physical function, thus stressing the importance of addressing SPA in interventions in order to promote healthy aging. In sum, the findings further emphasize the importance of addressing both agentic and communal aspects in theories and research on aging (Wahl et al., 2012). Current theories on aging are rather agency-focused; yet, better understanding the role of agency *and* communion might help to further describe the meaning of healthy aging in the life period of old age.

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Appendix

Scientific papers

Author's Contribution to the Scientific Papers

Eidesstattliche Erklärung

List of Publications

Danksagung/Acknowledgement

Paper 1

Blawert, A., Schäfer, S. K., & Wurm, S. (2021). Associations of Agency and Communion With Domain-Specific Self-Perceptions of Aging: A Cross-Sectional Study In Old-Old Adults in Poor Health. *The International Journal of Aging and Human Development*, 00914150211050874. https://doi.org/10.1177/00914150211050874

Original Research Article

Associations of Agency and Communion With Domain-Specific Self-Perceptions of Aging: A Cross-Sectional Study In Old-Old Adults in Poor Health

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and Susanne Wurm ⓘD

Abstract

A large body of research indicates that self-perceptions of aging (SPA) play an important role for health in later life. Hence, more research on SPA and correlates is needed, especially in old age and poor health, where negative SPA tend to prevail. Recent studies identified personality as an important correlate of SPA in young-old and relatively healthy samples. Thus, we investigated cross-sectional associations of agency and communion with two SPA domains in a sample of old-old adults in poor health ($n = 154$; $M_{age} = 81.55$, $SD = 4.56$, 58.4% women). In multiple regression analyses, agency and communion were associated with SPA related to ongoing development beyond health. In contrast, only health as a covariate was significantly associated with SPA related to physical losses. Thus, personality may be a resource associated with gain-related SPA, at least for those in poor health and old age.

Keywords

personality, agency, communion, views on aging, self-perceptions of aging, old age

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In recent years, self-perceptions of aging (SPA), that is, what people think about their own age and aging, have emerged as an important concept in research on health in later life (for an overview, see e.g. Wurm et al., 2017). Thus, it is important to better understand which constructs are associated with SPA. Recent studies have suggested that SPA is related to personality (e.g., Kornadt et al., 2019, 2020; Rupprecht et al., 2019), which is defined as characteristic ways of thinking, feeling and behaving that distinguish people from one another (Kandler et al., 2014). However, these studies have focused almost exclusively on the Big Five personality traits and mostly considered young-old samples in relatively good health (e.g., O'Shea et al., 2017; Rupprecht et al., 2019). Yet, investigating correlates of SPA is especially important in situations where positive SPA are challenged and negative SPA are confirmed; this is particularly the case in old age and poor health, where people tend to associate their aging more strongly with physical losses and less with ongoing psychological development (Diehl et al., 2021; Wurm et al., 2020). To advance understanding of the relationship between personality and SPA in this setting, the present study explored associations of the "Big Two" meta-traits of personality, namely agency and communion (Martin & Slepian, 2020), with SPA in a sample of old-old adults in poor health.

SPA in Old Age

The concept of SPA gained in interest in the 1970s with the development of the Attitudes Toward Own Aging Scale (ATOA; Lawton, 1975), a unidimensional measure ranging from negative to positive SPA. Since then, the number of studies on the role of SPA in later life has increased immensely (cf. Westerhof et al., 2014; Wurm et al., 2017), suggesting that SPA may constitute an indicator of health and well-being, adjustment to age-related changes and overall successful aging across the second half of life up to old age (Baltes & Smith, 2003; Kleinspehn-Ammerlahn et al., 2008; Levy, 2003).

More recent measures like the Attitudes to Aging Questionnaire (Laidlaw et al., 2007), the Expectations Regarding Aging Scale (Sarkisian et al., 2002) and the AgeCog Scale (Steverink et al., 2001; Wurm et al., 2007) differentially assess perceptions of age-related gains and losses, thus acknowledging the multidimensional and multidirectional nature of adult development (Baltes, 1987; Kornadt et al., 2019, 2020). Two domains that have been found to be relevant for health in later life are the SPA domains of physical losses (i.e., declining health and fitness) and ongoing development (i.e., expanding capabilities and pursuing plans) as assessed by the well-established Agecog Scale (Diehl et al., 2021; Westerhof et al., 2014; Wolff et al., 2014; Wurm et al., 2017).

With advancing age, individuals perceive their aging more strongly as associated with physical losses and less with ongoing development (Diehl et al., 2021). This change in subjective perceptions of aging reflects, in part, objective age-related

changes: The likelihood of experiencing disease, physical losses and limitations in one's activities increases in old age (Baltes & Smith, 2003). Yet, older adults can simultaneously perceive their aging as associated with ongoing development. It is thus important to shed light on factors that help to explain interindividual differences in the way people perceive their own aging.

Personality and SPA

Several studies point to associations of personality and SPA. A study on personality and subjective age, a construct related to SPA, found that this association seems to become stronger with age (Stephan et al., 2012), making the investigation of the relationship between personality and SPA in old age even more important. However, studies investigating personality and SPA have been mostly conducted in young-old, relatively healthy samples or large surveys of the general population. Such survey samples are known to be biased in terms of health, age, and socioeconomic status (Enzenbach et al., 2019).

A further conceptual limitation of previous studies on personality and SPA is that they primarily endorsed personality on the level of the Big Five traits. In these studies, neuroticism seems to be consistently associated with negative or loss-related SPA (e.g., Loi et al., 2015; Moor et al., 2006). Regarding the other traits, however, findings are inconsistent across studies and measures of SPA (e.g., Moor et al., 2006; Rupprecht et al., 2019). To add to the conceptual understanding of associations of personality and SPA, we thus examined the most basic level of personality, namely, the meta-traits of agency and communion. These two meta-traits emerge as higher-order factors of different personality levels such as the Big Five traits and personal values (e.g., Vecchione et al., 2011; for an overview see e.g., Blawert & Wurm, 2019).

Since the 1970s, agency and communion were first investigated as gender-related traits labeled masculinity and femininity (Bem, 1974; Spence et al., 1974), later as instrumental and expressive traits or agency and communion in order to overcome the strong focus on gender of earlier work on these traits. Agency (or masculine/instrumental traits) reflects a focus on the self and is associated with qualities such as dominance, decisiveness, and pursuing one's own goals. Communion (or feminine/expressive traits) reflects a focus on others and is associated with qualities such as warmth, the ability to build up and sustain positive social relationships, and helping others.

Despite their diverging focus, agency and communion are not mutually exclusive; a person can be highly agentic and at the same time highly communal, while another person might score low on both traits or high on one and low on the other. Agency and communion are inherently positive qualities and ideally, a person incorporates both agentic and communal traits, thus caring for the well-being of others without losing sight of personal needs (Bakan, 1966).

In early studies mainly conducted in young adults, this was expressed in the androgyny hypothesis suggesting that those high in both agency and communion

(termed androgynous) could adapt most flexibly and successfully to situational demands (Bem & Lewis, 1975). However, some initial studies found agency (but not communion) to be associated with successful adaptation as reflected in mental health outcomes (masculinity model; for an overview, see Lefkowitz & Zeldow, 2006). In contrast, several more recent studies suggest that in later life, higher agency and communion are both associated with higher well-being (Helgeson, 1994; Matud et al., 2020) and life satisfaction (Dean-Church & Gilroy, 1993; Welzel & Inglehart, 2010). In addition, androgynous individuals report lower scores of depressive symptoms (Vafaei et al., 2016). High agency and communion may thus represent a prerequisite for successful aging (Perrig-Chiello & Hutchison, 2010). The integration of agency and communion is also considered a central component of generativity (Ackerman et al., 2000; Mansfield & McAdams, 1996; McAdams & de St Aubin, 1992), which might be perceived as a positive part of the aging experience. Moreover, the finding that agentic and communal themes in autobiographical memories foster optimism for the future (Austin & Costabile, 2017) might further translate into the perception of age-related ongoing development, given that optimism is associated with more positive SPA (Turner & Hooker, 2020).

Finally, agency is associated with positive self-evaluation (Abele & Hauke, 2020) and both agentic and communal themes emerge when older adults are asked to describe themselves freely (Diehl et al., 2004), pointing to the relevance of both meta-traits for the perception of the self (Paulhus & Trapnell, 2008). While, to our knowledge, associations of SPA with agentic and communal *traits* have never been examined, we found associations with agentic and communal *personal values* in an earlier study. Using population-based, longitudinal data of adults aged 40 + from Germany, that study demonstrated that agentic and communal personal values are differentially related to change in SPA domains (Blawert & Wurm, 2021): The growth-related agentic value of openness to change as well as the growth-related communal value of self-transcendence were found to predict increases in SPA related to ongoing development over the course of three years, while self-transcendence additionally predicted decreases in SPA related to social losses during the same period. These findings suggest domain-specific associations of agency and communion with SPA.

The Present Study: Agency, Communion and SPA in Old-Old Adults in Poor Health

In this study, we considered domain-specific associations of agentic and communal traits with SPA related to ongoing development and SPA related to physical losses. Given the findings reviewed above, we expected agency and communion to be related to SPA ongoing development beyond health. Regarding SPA physical losses, we hypothesized that – due to its more explicit focus on physical decline – agency and communion are not associated with this SPA domain when controlling for health.

Methods

Participants and Procedure

Data came from the intervention study TIGER (Transsectoral Intervention Program to Improve Geriatric Care in Regensburg). This study took place in the city of Regensburg in Southern Germany. Two hundred and forty-four older adults were recruited in a hospital and randomized into intervention and control groups. Starting in hospital, participants of the intervention group were supported by specialized nurses to prevent readmission to hospital over the course of one year. Details of the intervention are presented in Rimmele et al. (2021). For the present analyses, we combined data from the intervention and control groups that was collected one month after discharge from hospital using self-report questionnaires.

Inclusion criteria for the study were a minimum age of 75, living in a radius of 50 km from the city of Regensburg, a Mini-Mental State Examination (MMSE) result of at least 22 points, insurance by the statutory health insurance AOK Bavaria, admission to the hospital Barmherzige Brüder in Regensburg, and discharge to their own homes.

Exclusion criteria were planned discharge to a nursing home, palliative care situation, and planned readmission to the hospital within the next four weeks.

Measures

Agency and communion were measured with two subscales of the German Extended Personal Attributes Questionnaire (Runge et al., 1981). Participants were asked to rate how they would describe themselves in terms of eight agentic (e.g., independent, active) and eight communal (e.g., helpful, friendly) adjectives on a five-point Likert-scale (0 = *not at all* to 4 = *very much*). Item scores of the respective subscales were averaged and higher scores reflected higher agency or communion.

Self-perceptions of aging were measured with the AgeCog Scales (Steverink et al., 2001; Wurm et al., 2007). We used the two subscales of SPA ongoing development and SPA physical losses, each comprised of four items starting with the item stem "Aging means to me…". An example item for SPA ongoing development is "Aging means to me that I continue to make plans". An example item for SPA physical losses is "Aging means to me that I am less vital and fit". Participants reported their agreement with each item on a four-point Likert-scale (0 = *not at all* to 3 = *very much*). Scores were averaged over the respective subscale. A higher score reflects higher agreement that aging is associated with ongoing development or physical losses.

As covariates we included emotional and physical health as assessed with the 12-item Short-Form Health Survey (Ware et al., 1996) to account for health status after a hospital stay and its known association with SPA. Item examples are "Does your health now limit you in climbing several flights of stairs?" (physical health; three-point Likert-scale; *yes, limited a lot, yes, limited a little* and *no, not limited at all*), and "How much of the time during the past four weeks did you have a lot of energy?" (emotional health; 7-point Likert-scale from *all of the time* to *none of the time*). Scores were

coded so that a higher score indicates better health. All analyses were additionally controlled for age in years, sex (male or female), and education according to the International Standard Classification of Education (ISCED; UNESCO, 1997).

Analytical Procedure

All analyses were conducted using *RStudio* (R Core Team, 2019) and the *lavaan* package (Rosseel, 2012). We conducted *t*-tests for independent samples to compare study variables between our study sample and participants who did not provide sufficient data to be included in our analyses as well as between treatment and control group. To investigate bivariate associations between agency, communion, SPA, physical and mental health, we conducted zero-order correlation analyses. To examine unique relationships between agency, communion, SPA and emotional and physical health, we conducted multiple regression analyses. Multicollinearity was assessed using Variance Inflation Factors (*VIF*), with $VIF \geq 10$ indicating multicollinearity between predictors (O'brien, 2007). For missing data, we used multiple imputations based on the packages *mice* (van Buuren & Groothuis-Oudshoorn, 2011) and *miceadds* (Robitzsch & Grund, 2021) for *R*. Following recommendations (Van Buuren, 2018; Zhang, 2016), 20 datasets were imputed based on the study variables. Pooled results from these datasets are presented as results of the regression and correlation analyses. For post-hoc power analyses, G*Power version 3.1 (Faul et al., 2009) was used.

Results

Sample Characteristics

Participants were included in the analyses if they provided information on at least one of the variables of interest, that is, agency, communion, SPA ongoing development and SPA physical losses. We thus included data of 154 older adults (58.4% women) with a mean age of 81.67 years ($SD = 4.55$) in our analysis. Respondents reported relatively low physical health ($M = 31.71$, $SD = 9.86$) compared with normative values from the German general population (Wirtz et al., 2018), $t(110) = -8.94$, $p < .001$, while not differing in emotional health ($M = 45.29$, $SD = 11.69$), $p = .610$. As expected for a sample of old-old adults in poor health, the dropout rate was relatively high in this study: Of the initially recruited 244 participants, 208 took part in the assessment one month after discharge from hospital and only 154 of these (63.11%) provided data for the cross-sectional statistical models of interest in this study. Of those n = 36 participants who did not take part in the T1 assessment, three (8.3%) died, five (13.9%) moved into a nursing home and thus discontinued the study and two (5.6%) reported a momentary break from the study. The remaining 26 (72.2%) participants did not return questionnaires, thus also counting as non-participants in the T1 assessment. However, participants who dropped out did not differ from our study sample in age, $t(242) = 1.18$, $p = .241$, sex, $\chi^2(1) = 0.19$, $p = .660$, and educational level, $t(188)$

= −0.15, p = .880. Moreover, the treatment and control groups did not differ in variables of interest, $p \geq .071$. Therefore, participants of both groups were included in our analyses.

Multiple Imputations

Multiple imputations were used to handle missing data (see Table 1 for percentages of missing data per variable) to ensure sufficient statistical power (Zha & Harel, 2021). We assumed missing data to be completely at random, which was supported by a non-significant Little's MCAR Test, $\chi^2(99) = 108.00$, $p = .258$. Thus, results of multiple imputations have a low risk of bias.

Relationship Between Study Variables

Table 1 displays pooled intercorrelations of study variables based on 20 imputed data sets. On a bivariate level, agency and communion were highly correlated, $r = .55$, $p < .001$, and both were significantly associated with SPA ongoing development, $r_{agency} = .56$, $p < .001$, $r_{communion} = .51$, $p < .001$, and SPA physical losses, $r_{agency} = -.36$, $p < .001$, $r_{communion} = -.31$, $p = .001$. However, only agency (but not communion) was found to correlate significantly with self-rated physical health, $r_{agency} = .34$, $p = .003$, while correlations of agency or communion with self-reported emotional health were not significant, $p \geq .157$.

Associations of Agency and Communion with SPA Domains

Multiple regression analyses based on imputed data were conducted to investigate the relationship of the two SPA domains ongoing development and physical losses with agency and communion as well as self-rated physical and emotional health (see

Table 1. Pooled Bivariate Pearson Correlations of Study Variables.

	1	2	3	4	5	6	M%
1. Agency	.70						24.0
2. Communion	.55**	.74					20.8
3. SPA ongoing development	.56**	.51**	.87				16.2
4. SPA physical losses	−.36**	−.31*	−.47**	.77			16.2
5. Self−rated physical health	.34*	.14	.27*	−.35*	.78		31.8
6. Self-rated emotional health	.15	.13	.20*	−.28*	.06	.78	31.8

Notes. $n = 154$. All correlations are based on 20 imputed datasets and controlled for age, sex, and educational level. Internal consistencies (Cronbach's α) are displayed in the diagonal. M% = percentages of missing data per variable.
*$p < .05$. **$p < .01$.

Table 2). All analyses were controlled for sex, age, and educational level, and inspection of *VIF* did not reveal collinearity ($VIF \leq 1.74$).

SPA Ongoing Development

SPA ongoing development were significantly associated with agency, communion, self-rated physical and emotional health, $F(4, 516.10) = 15.24$, $p < .001$. Taken together, they accounted for 41.2% of the variance ($R^2_{adjusted} = .40$) in SPA ongoing development. However, only agency, $\beta = 0.28$, $t(516.10) = 3.90$, $p < .001$, and communion, $\beta = 0.23$, $t(516.10) = 3.37$, $p = .001$, but not self-reported physical and emotional health accounted for significant unique proportions of variance in SPA ongoing development, $p \geq .239$.

SPA Physical Losses

SPA physical losses were significantly associated with agency, communion, self-rated physical and emotional health, accounting for 26.3% of the variance ($R^2_{adjusted} = .24$) in SPA physical losses, $F(4, 397.30) = 7.75$, $p < .001$. However, while self-rated physical, $\beta = -0.15$, $t(397.30) = -2.68$, $p = .009$, and emotional health, $\beta = -0.12$, $t(397.30) = -2.35$, $p = .020$ accounted for significant unique amounts of variance in SPA physical losses, agency and communion did not share significant unique amounts of variance with SPA physical losses, $p \geq .116$.

Post-Hoc Power Analyses

Our study represents a secondary analysis of the TIGER study. Thus, sample size was not planned to be sufficiently powered for the current analyses. Since power analyses for multiple imputed data and single regression coefficients are not yet well established (Zha & Harel, 2021), we based our post-hoc power analysis on complete cases ($n = 80$) and calculated the statistical power ($\alpha = .05$) to detect an at least small effect ($d = .20$, Cohen (1992)) of agency, communion, physical or emotional

Table 2. Regression Models for SPA Ongoing Development and SPA Physical Losses.

Predictors	SPA ongoing development β (SE)	SPA physical losses β (SE)	VIF
Agency	0.28 (.07)**	−0.08 (.07)	1.74
Communion	0.23(.07)*	−0.09 (.06)	1.53
Physical Health	0.09 (.07)	-.0.15 (.06)*	1.19
Emotional Health	0.08 (.07)	−0.12 (.05)*	1.05
R^2	.412	.263	

Notes. $n = 154$. SPA = self-perceptions of aging; all analyses were controlled for sex, age, and educational level. VFI = variance inflation factor based on imputed data.
*$p < .05$. **$p < .001$.

health on SPA ongoing development or SPA physical losses. Results indicate that analyses based on complete data would have been sufficiently powered, $\beta - 1 = .80$. Thus, based on simulation studies (Kontopantelis et al., 2017; Zha & Harel, 2021), it is plausible to assume that the achieved power using multiple imputations is considerably higher and that our analyses are sufficiently powered.

Discussion

In this study, we investigated associations of agency and communion as meta-traits of personality with SPA related to ongoing development and physical losses in a sample of old-old adults in poor health. We hypothesized that higher levels of agency and communion are related to higher SPA ongoing development. Regarding SPA physical losses, we hypothesized that agency and communion are not related to this SPA domain when controlling for health. Results supported our hypotheses.

Associations of Agency and Communion with SPA Domains

Results on SPA Ongoing Development

In our study, agency and communion were significantly associated with higher SPA ongoing development. This suggests that old-old adults with a stronger agentic focus on the self as well as those with a stronger communal focus on others perceive their aging more as associated with making plans and learning new things. This finding might be due to the rather general nature of development that is addressed by the items: Making many plans and putting ideas into action can refer to agentic and communal development. For instance, a person high in agency might keep up a hobby like painting even when it becomes more difficult and experience ongoing development through maintenance of or even increasing artistic capabilities. A very communal person may invest effort in contact with family and friends and gain a sense of ongoing development through focusing on social contacts.

Interestingly, physical and emotional health were only associated with SPA ongoing development on a bivariate level, but not in the regression analysis. This suggests that health does not explain unique proportions of variance beyond personality in this SPA domain, indicating that the aspect of health that is associated with SPA ongoing development is accounted for by agency and communion.

Results on SPA Physical Losses

On a bivariate level, agency and communion were both negatively correlated to the perception of aging-related physical losses. These associations disappeared, however, when controlling for health in the regression analysis. This finding was in line with our hypothesis and suggests that personality does not account for a unique amount of variance beyond health in SPA related to physical losses, at least in this sample of old-old adults in poor health.

Our study corroborates findings from prior studies by indicating that personality and domain-specific SPA are clearly related cross-sectionally. Past research was mostly based on the Big Five approach and yielded inconsistent results on the relationship between specific Big Five personality traits and SPA. Thus, by examining the higher-order factors of agency and communion, our study provides a more general understanding of personality and SPA, which may also be useful to further explore the relationship between the two constructs. Furthermore, our study indicates that agency and communion as fundamental dimensions of personality relate to SPA not only on the level of personal values (Blawert & Wurm, 2021), but also on the level of traits. In addition, our findings add to studies pointing to the role of agency and communion for overall adaptation (i.e., successfully and flexibly meeting situational demands) and well-being in later life by showing that these traits also relate to the way old-old adults perceive their own aging.

In late life, personality and health are closely intertwined (Mueller et al., 2018). Thus, our study helps to disentangle the effects of personality and health for SPA by showing domain-specific associations with SPA in a sample of old-old adults in poor health.

The importance of agency for goal pursuit is also stressed in the motivational theory of life-span development (e.g., Heckhausen et al., 2010). This theory posits that individuals strive to exert control over their environment to reach their goals (primary control/agency), which is increasingly impeded by accumulating health problems in old age (Heckhausen et al., 2019). Our findings on the association of agency and communion with SPA ongoing development might be a sign of successful adaptation to changing health status in old age.

Limitations and Strengths

This study has several limitations. First, the sample is rather small and from the initial sample of 244 participants, we were only able to include data from 154 (63.11%) participants, due to drop-out and a high amount of missing data. However, data was missing completely at random, and dropouts did not differ from those who were included in our analyses in age or educational level. Second, TIGER is an intervention study, which may have affected results; however, intervention and control groups did not differ in study variables. Third, the present study was cross-sectional in design, so we cannot determine whether agency and communion affect SPA or vice versa. Furthermore, given the relatively high bivariate correlations between agency, communion and SPA, we cannot exclude the possibility that these variables are influenced by a third variable and that there is no causal relationship between them. In this regard, the investigation of self-efficacy and resilience factors as internal resources would be of interest. Self-efficacy as the perceived capability to shape one's life and environment is a central component of agency and also highly relevant in social relationships (Bandura, 2018), and higher self-efficacy is also related to more positive SPA (Tovel et al., 2019). In a similar vein, resilience as the capability to adapt successfully

when faced with stressors is related to personality on the level of the Big Five traits (Oshio et al., 2018), and recent studies have found associations of resilience with SPA and attitudes towards aging (Kunuroglu & Yuzbasi, 2021; Losada-Baltar et al., 2021). A further limitation is that we cannot determine the role that the experience of hospitalization might have played in our analysis. Hospitalization could have increased the salience of health-related losses and thus could have masked a potential association of agency and communion with SPA physical losses that might emerge in another setting, survey period or population. Furthermore, we were not able to consider the type of health issue that led to hospitalization, as due to the study design, participants varied greatly in these health issues. It has to be noted that many old-old adults suffer from multiple health issues comorbidly, which makes disentangling effects of specific health issues (e.g., chronic vs. acute) difficult. In the current study, this is further complicated by the fact that chronic conditions could also have resulted in acute health events that led to hospitalization. In general, people are more likely to attribute chronic conditions to aging, while acute conditions are more likely to be attributed to illness (Stewart et al., 2012). For this reason, it would be interesting to investigate in future studies a potential moderating role of acute versus chronic health issues in the relationship of SPA with personality. Such studies should assess larger samples and include patients of a larger age range and from inpatient and outpatient settings as such samples would allow for an appropriate comparison between acute and chronic conditions.

Yet there are also several strengths to our approach. Our findings advance the understanding of the relationship between personality and SPA by first investigating the meta-traits of agency and communion. In addition, we were able to recruit an old-old sample in poor health; people in this group are usually less represented in larger studies and hence our findings give valuable insights on personality and SPA in a population in which positive SPA may be particularly threatened.

Implications for Future Research

Our findings provide starting points for a variety of research questions. For instance, future studies should investigate the relationship between agentic and communal traits and SPA domains longitudinally to examine the nature of a potential causal relationship. It might also be of interest to investigate the role of agency and communion for SPA domains other than the ones considered in this study, e.g., SPA related to family or working life (Kornadt & Rothermund, 2012), but also subjective age or other SPA measures (for an overview of measures, see Klusmann et al. (2020) in future studies. Furthermore, these studies could investigate potential mediators or moderators of the association of agency and communion with SPA. For instance, agency and communion might pose predispositions for differential behaviors that foster the perception of ongoing development. Regarding potential moderators, investigating the role of work and family transitions, e.g., prolonged paid work or premature spousal death, but also sociodemographic factors like gender and social class indicators

such as education or income might well be advantageous. Such studies should use large-scale population-based surveys to allow for valid conclusions on the general population. In addition, including physical activity as a moderator or mediator might help clarify the lack of results for SPA physical losses. It might also be of interest to investigate the role of social activities and social engagement. Moreover, agency and communion might themselves serve as mediators or moderators in the association of health and SPA (Wurm et al., 2017), given the bidirectional associations of personality and health in old and very old age (Mueller et al., 2018). It might also be interesting to investigate associations of agency and communion with SPA in healthier or younger populations to examine whether the association varies by age and/or cohort. Future studies should also investigate associations of SPA with personality traits that relate to negative outcomes, such as unmitigated agency (i.e., a focus on the self to the exclusion of others, e.g., hostility) and unmitigated communion (i.e., a focus on others to the exclusion of the self, e.g., overinvolvement with other's problems and neglect of own needs). Moreover, our findings stress the necessity of investigating multiple domains of SPA, since constructs of interest might be associated with one domain, but not with another (Boeder & Tse, 2020). Using measures of general SPA might thus mask potential associations of important factors with specific SPA domains.

Conclusion

In this study, we advanced the understanding of SPA by showing that the "Big Two" of personality, namely agency and communion, are differentially associated with two SPA domains in a sample of old-old adults in poor health. Higher agency and communion were associated with higher SPA related to ongoing development. Conversely, neither agency nor communion were related to SPA related to physical losses when controlling for physical and emotional health. Our findings suggest that the investigation of agency and communion is effective in examining the relationship between personality traits and SPA domains. Moreover, our study showed that even in very old age and poor health, people still perceive aging-related gains in terms of ongoing development that are associated with their personality.

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Paper 2

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ORIGINAL INVESTIGATION

Shifting self-perceptions of ageing: differential effects of value priorities on self-perceptions of ageing beyond age stereotypes

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Abstract

Self-perceptions of ageing (SPA) are important predictors of health in later life. However, research on antecedents of SPA other than age stereotypes is scarce. To address this gap, this study investigates the impact of personal value priorities beyond age stereotypes on SPA. Can values as the motivational basis of attitudes and evaluations predict gain- and loss-related SPA? To answer this question, we conducted multiple regression analyses of longitudinal data from two waves (2008, 2011) of the German Ageing Survey (DEAS; $N = 6089$, age range in 2008: 40–93 years). Gain- and loss-related SPA as well as age stereotypes were assessed with two AgeCog scales and personal values with the 21-item Portrait Values Questionnaire. Results indicate that value priorities relate to SPA longitudinally in domain-specific ways: People with a value priority of openness to change and self-transcendence reported more gain-related SPA at follow-up, whereas those who prioritized conservation reported less gain-related SPA. In the domain of loss-related SPA, those people with a value priority of self-enhancement reported more and those prioritizing self-transcendence reported less loss-related SPA at follow-up. These results complement and extend recent findings on the role of personality for SPA. They suggest that whether people focus on the gains or losses that occur with age, whether they perceive ageing as a threat or chance, is not only shaped by their age stereotypes, but also by what they find important—their values.

Keywords Personal values · Personality · Value priority · Self-perceptions of ageing · Views on ageing

Introduction

When you think about what is important to you, what springs to mind? Do you think you will still be able to reach your cherished goals when you are growing older? What people think about their own ageing, so-called self-perceptions of ageing (SPA) have been shown to predict a vast variety of outcomes such as health, well-being and even mortality (for an overview see e.g. Westerhof and Wurm 2018; Wurm et al. 2017). So far, only a few studies have examined antecedents of SPA (Bryant et al. 2016). Since the impact of SPA on health and longevity is well-evidenced, the time has now come to understand better how these self-perceptions themselves are formed. Whereas several studies pointed to the role of societally shaped age stereotypes for SPA (e.g. Levy 2003; Rothermund and Brandtstädter 2003), personal characteristics are just beginning to receive attention. Recently, some studies have started to investigate the role of personality for SPA. However, these studies mostly focused on personality traits based on the Five-Factor Model (Costa and McCrae 1992). Other aspects of personality, such as personal values, have not yet been considered despite values being potentially better suited than traits to predict cognitively based outcomes like SPA (Roccas et al. 2002). Thus, the role of personal values for SPA is still an open question and therefore addressed in the present study. The results will add to a more comprehensive understanding of the role of different aspects of personality in the context of SPA.

The role of age stereotypes for SPA

"Old people are senile and inactive"–"old people are wise and share their life experience". These generic statements

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are examples of typical stereotypes of older persons. So-called age stereotypes are defined as socially shared beliefs about older people as a group as well as the process of ageing (Wurm et al. 2017). Age stereotypes have consequences for self-views: Becca Levy's Stereotype Embodiment Theory (Levy 2009) posits that societal age stereotypes are encountered from childhood onwards (e.g. the loving grandma, the forgetful, grumpy old man) and become internalized throughout the life span. At first, societal age stereotypes impact personal age stereotypes directed at "the elderly"; then, with increasing age, these "other"-stereotypes become "self"-stereotypes when they are applied to oneself, thus turning into SPA. Finally, these SPA can develop into a self-fulfilling prophecy as people with negative SPA experience more negative outcomes with ageing (Wurm et al. 2013). Substantial research has provided both cross-sectional and longitudinal evidence for the importance of societally shaped age stereotypes for SPA. However, SPA cannot be equated with age stereotypes; self-perceptions are more strongly characterized by personal experiences, individual biographies and personality (Wurm et al. 2017).

The potential impact of values on SPA

Accumulating evidence points to meaningful longitudinal associations of personality and SPA for time periods up to 20 years, where personality traits seems to shape SPA rather than being shaped by them (Kornadt et al. 2019a). However, studies mostly focused on the "Big Five" traits of openness to experience, conscientiousness, extraversion, agreeableness and neuroticism. For example, Rupprecht et al. (2019) found conscientiousness to predict awareness of age-related gains longitudinally. Other studies found higher extraversion and agreeableness to predict lower perception of age-related losses (Bryant et al. 2016), whereas age-related growth was associated with higher extraversion, openness, agreeableness and conscientiousness (Shenkin et al. 2014). These results indicate that the trait-aspect of personality does contribute to SPA. Nevertheless, it is important to investigate the role of personal value priorities as well, as these two components of personality are associated with each other yet are not the same (e.g. Kandler et al. 2014); one can be open (trait) without finding openness important (value) and a person can value altruism highly without being very altruistic. Because of that, both values and traits are differentially suited for prediction of behaviour and other outcomes (Roccas et al. 2002).

Values are defined as guiding principles in people's lives and express inherently desirable end-states that individuals try to reach. Schwartz's well-known theory of basic human values (Schwartz 1992; Schwartz and Bilsky 1987) distinguishes four higher-order values, two of which express a focus on the self (agentic values: openness to change and self-enhancement) and two that express a focus on others (communal values: conservation and self-transcendence). The *openness to change* value emphasizes independent thoughts, actions and feelings as well as curiosity and readiness for new experiences. It represents pursuit of self-interest and independence of other people. The *self-enhancement* value emphasizes the pursuit of socially acknowledged success and respect as well as dominance over others. It represents a desire for high social status. The *conservation* value emphasizes self-restriction, order, preservation of the past and resistance to change. It represents how much a person believes people in general should adhere to social norms. Lastly, the *self-transcendence* value stresses a concern for the welfare of others and the world. It focuses on how a person wants to treat others and believes people and nature should be treated. It is an inherent feature of value theory that what drives behaviour and attitudes in an individual is not the absolute, but *relative* importance of a single value compared to the other values (Schwartz 2012)—the more important or self-central a value is in relation to the other values, the more it relates to an outcome (Gebauer et al. 2013). Following Schwartz and Rubel (2005), we refer to this relative importance of values as value priority.

Values serve as central criteria of evaluation of other people as well as the self and self-related issues (Schwartz 1992). Value priority directs attention to and interpretation of objective states (Schwartz et al. 2000); age is such an objective state and its evaluation and interpretation should then in part depend on the values that are most essential to a person. For example, an older person for whom openness to change is especially important might feel excited about an invitation to travel with other seniors and meet new people, whereas a person for whom conservation is most important might decline such an opportunity.

Values, age stereotypes and SPA: a domain-specific approach

So far, associations between values and perceptions of ageing have predominantly been examined on a cross-cultural, societal level. A common belief is that individualistic Western cultures have more negative age stereotypes because of their values of youth-orientation, whereas collectivistic Eastern cultures have more positive age stereotypes due to values of filial piety and respect for elders (Löckenhoff et al. 2009). Building on these findings, Zhang et al. (2016) compared the impact of cultural versus personal values on individual age stereotypes, and found communal, "other-oriented" personal values to be significantly associated with individual age stereotypes. This suggests that values do play a role in the context of views on ageing. However, we are not aware of any study to date that examines the role of personal values for perceptions of the *own* ageing process. Yet if communal

personal values are associated with views of others' ageing, we assume agentic values in particular to be related to views of one's own age and ageing, as agentic values focus on the self and interpretation of self-related issues. Since personality traits have been shown to provide additional explanatory power beyond age stereotypes cross-sectionally (Emile et al. 2014) and longitudinally (Levy 2008), we expect personal values to predict SPA beyond the impact of age stereotypes as well.

It is well established that age stereotypes are multi-directional and domain-specific, which means that people can simultaneously hold positive and negative age stereotypes in different life domains such as family (e.g. keeper of traditions) and cognition (e.g. inevitable decline); this also applies to SPA (e.g. Kornadt and Rothermund 2015). Thus, studies should examine differential effects of predictors for different domains of SPA (Spuling et al. 2019).

In the present study, we investigated the differential effects of personal value priorities in a loss- and a gain-related domain of SPA: The gain-related domain is that of ongoing psychological development. This SPA facet represents perceptions of ageing as a time of new plans and activities, of new skills and ideas. The loss-related domain is perception of age-related social losses. This facet does not refer to actual losses of relationships with close others, but to perceptions of social status loss such as being less respected, less needed and more socially isolated and lonely. We expected that each value priority uniquely predicts gain- and loss-related SPA.

Openness to change

The openness to change value is quite strongly related to the Big Five trait openness to experience (Fischer and Boer 2015; Parks-Leduc et al. 2015) which predicts more positive global (Emile et al. 2014) and, more specifically, gain-, but not loss-related SPA in longitudinal analyses (Bryant et al. 2016; Shenkin et al. 2014). Furthermore, Schwartz (2012) links this value to the promotion of gain-related goals as well as self-expansion and growth: A person who values new ideas and expressing the self should generally be more prone to perceiving opportunities to pursue this value even in old age or when confronted with age-related limitations.

Self-enhancement

A person valuing self-enhancement desires a high social status and strives for the respect and admiration of others. These aspects are negatively reflected in the SPA facet of ageing as associated with social losses. Ageing is often accompanied by loss of social status in certain areas: in midlife, children leave home and lead independent lives, thus no longer requiring parental care; with retirement, working

life as a source for achievement and exertion of power vanishes. We assumed that a person for whom social status is relatively important would perceive these age-related changes in status as a threat to his or her cherished values. Furthermore, prioritizing self-enhancement and especially power is associated with higher worrying about self-related issues (Schwartz et al. 2000) and lower wellbeing (Sortheix and Schwartz 2017), which might also foster a loss-related view on ageing.

Conservation

Prioritizing stability, conformity and tradition implies resistance to change and a focus on preserving the past rather than looking for new experiences (Schwartz 2012). We supposed that this focus towards maintenance rather than development impedes gain-related SPA, that is, viewing ageing as a time of new plans and experiences: people who prioritize the value conservation might notice new opportunities, yet reject them.

Self-transcendence

Self-transcendence is an important component of wisdom (Curnow 1999) and has been theorized as the ultimate stage of human development and maturation, termed gerotranscendence (Tornstam 1994). As such, it can be seen as a more holistic view on life that emphasizes age-related change and development in a positive way (Tornstam 1997). The self-transcendence value is also related to the Big Five trait agreeableness (Fischer and Boer 2015; Parks-Leduc et al. 2015), which predicts lower perception of age-related losses over time (Bryant et al. 2016; Loi et al. 2015), and more perception of age-related gains in recent studies (Shenkin et al. 2014). Higher priority of self-transcendence is also associated with less worrying about the self (Schwartz et al. 2000), which could be reflected in more gain-related SPA. Therefore, we expected self-transcendence value priority to predict the perception of more age-related gains and less age-related losses at follow-up.

In short, the present study investigated these four hypotheses:

H1 Prioritizing openness to change predicts more gain-related SPA at follow-up, but not loss-related SPA at follow-up.

H2 Prioritizing self-enhancement predicts more loss-related SPA at follow-up, but not gain-related SPA at follow-up.

H3 Prioritizing conservation predicts less gain-related SPA at follow-up, but not loss-related SPA at follow-up.

H4 Prioritizing self-transcendence predicts more gain-related SPA and less loss-related SPA at follow-up.

Methods

Sample

Data was derived from the German Ageing Survey (DEAS; Klaus et al. (2017)), a representative, register-based, cohort-sequential longitudinal study of community-dwelling persons aged 40–85 that started in 1996. The analyses in this paper are based on the data of 6089 participants aged 40 and older that participated in the computer-assisted personal interviews (CAPI) and self-report questionnaire in 2008 (T1) and follow-up in 2011 (T2; $N = 3044$). Mean age at T1 was 62.9 years (40–93; SD = 11.6), 48.7% were female and 35.7% of participants lived in former East Germany. Assessment year 2008 was used as T1 as this is the only year in which the German Ageing Survey assessed age stereotypes and personal values.

Dropout analyses

For dropout analyses, we conducted independent sample t-tests and calculated the effect size Hedges' g, which takes unequal sample sizes into account. Hedge's $g = .2$ can be considered a small effect, $g = .5$ a medium and $g > .8$ a large effect (Cohen 1988). Analyses of T1 variables showed that participants were more likely to participate in 2011 when they were already part of the panel ($t(6044.01) = -12.73$, $p < .001$; $g = .32$). Participants dropping out between 2008 and 2011 were significantly older ($t(5297.27) = 3.53$, $p < .001$; $g = .09$) and less educated ($t(5586.6) = -11.81$, $p < .001$; $g = .31$) than those who continued to take part in the study. Drop-outs reported worse physical function ($t(4923.56) = -6.27$, $p < .001$; $g = .17$) and associated their own ageing more with social losses ($t(5247.90) = 3.25$, $p = .01$; $g = .09$) and less with ongoing development ($t(5123.28) = -8.46$, $p < .001$; $g = .22$). They also reported less gain-related age stereotypes ($t(5330.80) = -6.86$, $p < .001$; $g = .18$). For values, people for whom conservation and self-enhancement values were relatively important were more likely to drop out ($t(6002) = 4.91$, $p < .001$; $g = .13$ and $t(5356.24) = 6.96$, $p < .001$; $g = .18$, respectively). Those with a value priority of openness to change and self-transcendence were more likely to participate in the second measurement in 2011 ($t(5359.88) = -4.64$, $p < .001$; $g = .12$ and $t(6005) = -8.39$, $p < .001$; $g = .22$, respectively). Overall, the effects due to sample attrition were small.

Measures

Self-perceptions of ageing (SPA)

We used two subscales of the AgeCog scales (Steverink et al. 2001; Wurm et al. 2007) to measure SPA. The social losses subscale refers to the perception of ageing as accompanied by loss of social status. One example item is "Ageing means to me that I am less respected". Reliability for this subscale is Cronbach's $\alpha = .75$. The second subscale, ongoing development, refers to ageing as a time of continuing psychological growth (e.g. "Ageing means to me that I continue to make plans"). Reliability is good with Cronbach's $\alpha = .82$. Each subscale contains four items with a 4-point Likert-scale from 1 "definitely true" to 4 "definitely false". For the analysis, scores were reverse coded and then averaged for the separate subscales, so that a higher score in AgeCog social losses indicates a higher notion of ageing being accompanied by social losses (loss-related SPA), and a higher score in AgeCog ongoing development indicates stronger perception of ageing as a time of ongoing development (gain-related SPA).

Age stereotypes (AS)

In the 2008-wave, the DEAS additionally used an adapted form of the AgeCog scales to measure age stereotypes. The items and scaling procedure were the same as for SPA, except for the item-stem which began with "Ageing means to *most people*…" instead of "Ageing means to *me*…". These scales showed satisfactory internal consistency (Age stereotype social losses: Cronbach's $\alpha = .78$; Age stereotype ongoing development: Cronbach's $\alpha = .73$).

Personal values

Values were measured with the 21-item Portrait Values Questionnaire (Schwartz 2003). The items consist of short descriptions of a person gender-matched to the respondent. "Thinking up new ideas and being creative is important to her. She likes to do things in her own original way" is an example of the openness to change value. Participants indicated the extent to which they considered the described person to be similar to themselves on a Likert-scale ranging from 1 (not at all like me) to 6 (very much like me). Scores for the openness to change, self-enhancement, conservation and self-transcendence values were averaged over the corresponding items. Cronbach's α are .71, .71, .73, and .70, respectively. We subtracted each respondent's mean score across all values from each single value, as proposed by Schwartz (1992), thus correcting for interindividual differences in scale use tendencies and creating scores for value priorities. Thus, the score for each

value represents not its absolute, but *relative* importance compared to the other values in the value system of each individual. For instance, a score of 2 would signify that this value is of relatively higher importance to a person than other values, a score of − 1 would signify that other values are more important.

Covariates

Since the DEAS is stratified by age, gender and place of residence (former East or West Germany), we used these covariates in all analyses. We also controlled for level of education according to the International Standard Classification of EDucation (ISCED; low (without completed vocational training), medium (with completed vocational training and/or high school Diploma) and high education (e.g. graduation from a technical school, vocational academy, school of business administration, or university) (Unesco 1997), as these variables are related to SPA in the DEAS sample (Wurm and Huxhold 2012). To control for sample selection, we added a covariate indicating whether a person belongs to the longitudinal part of the DEAS or the newly drawn subsample in 2008. As previous studies showed that SPA are interrelated with physical function (e.g. Sargent-Cox et al. 2012), the analyses were additionally controlled for the 10-item physical functioning subscale of the SF-36 Health Survey (Bullinger and Kirchberger 1998). Participants rated the extent of their limitations in everyday tasks on a three-point scale (not limited, limited to some extent, limited). Scores were transformed to a scale ranging from 1 to 100 with a higher score indicating better physical functioning (Cronbach's $\alpha = .93$).

Analytical procedure

We used SPSS 25 for descriptive statistics, correlations, and dropout analyses. The hypotheses were tested via multiple regression analyses using Mplus 8 with robust Full Information Maximum Likelihood Estimation. The benefit of this method is that it uses all available data for the estimation, including the data of persons missing one measurement occasion, thus reducing potential bias caused by missing data. For each of the two SPA domains, we conducted two separate regression analyses to investigate which differential aspects of agentic (openness to change and self-enhancement) and communal (conservation and self-transcendence) value priorities would predict gain- and loss-related SPA. This resulted in four regression models.

In each analysis, we controlled for covariates, the dependent variable (SPA) at T1 and the corresponding

domain-matched age stereotype. All predictors were z-standardized before the analyses to account for different scaling in the measures.

Results

Descriptive analyses

Table 1 gives an overview of sample characteristics of baseline variables at T1. Overall, age stereotypes were more negative than SPA: Participants perceived the ageing of most other people (age stereotypes) as significantly associated with more social losses ($t(6019) = -42.80$, $p < .001$; Cohen's $d = .58$) and less psychological gains ($t(6022) = -22.58$, $p < .001$; Cohen's $d = .29$) compared to their own ageing (SPA). Still, participants associated both their own ageing and the ageing of most other people more strongly with gains than losses as reflected in higher means for both gain-related SPA ($M = 2.88$; $SD = 0.61$) and age stereotypes ($M = 2.71$; $SD = 0.58$) than loss-related SPA ($M = 1.86$; $SD = 0.59$) and age stereotypes ($M = 2.23$; $SD = 0.68$). Concerning value priorities, self-transcendence ($M = 0.84$; $SD = 0.54$) and conservation values ($M = 0.17$; $SD = 0.64$) were considered relatively more important than openness ($M = -0.24$; $SD = 0.60$) and self-enhancement values ($M = -0.92$; $SD = 0.71$). A table with bivariate correlations of the study variables can be found in the Appendix (Table 3).

Table 1 Descriptive statistics for study variables in 2008 (T1)

	M or %	SD	Range
Age	62.89	11.64	40–93
Gender (1 = female) (%)	48.66		
Panel (1 = yes) (%)	27.05		
Region (1 = former East Germany) (%)	35.67		
Education (1 = low, 2 = middle, 3 = high)	2.27	0.62	1–3
Physical function	84.13	22.24	0–100
SPA social losses	1.86	0.59	1–4
SPA ongoing development	2.88	0.61	1–4
Age stereotype social losses	2.23	0.68	1–4
Age stereotype ongoing development	2.71	0.58	1–4
Value priority of openness to change	−0.24	0.60	− 2.5 to 2.48
Value priority of self-enhancement	−0.92	0.71	− 3.25 to 2.24
Value priority of conservation	0.17	0.64	− 2.55 to 3.05
Value priority of self-transcendence	0.84	0.54	− 1.19 to 2.76

SPA self-perceptions of ageing

Table 2 Regression models of SPA related to social losses and ongoing development at *T*2

Predictors	DV = SPA social losses *T*2		DV = SPA ongoing development *T*2	
	B (SE)	*B* (SE)	*B* (SE)	*B* (SE)
Loss-related SPA	0.30 (.01)***	0.30 (.01)***		
Gain-related SPA			0.31 (.01)***	0.31 (.01)***
Age	− 0.05 (.01)***	0.04 (.01)***	− 0.10 (.01)***	− 0.09 (.01)***
Gender (1 = female)	0.000 (.01)	0.01 (.01)	0.01 (.01)	0.005 (.009)
Panel (1 = yes)	− 0.03 (.02)	− 0.03 (.02)	0.01 (.02)	0.003 (.01)
Region (1 = former East Germany)	0.003 (.01)	− 0.001 (.01)	− 0.04 (.01)***	− 0.03 (.01)***
Education (1 = low, 2 = middle, 3 = high)	− 0.04 (.01)***	− 0.03** (.01)	0.04 (.01)***	0.03 (.01)**
Physical function	− 0.04 (.01)**	− 0.04 (.01)**	0.05 (.01)***	0.05 (.01)***
Age stereotype social losses	0.02 (.01)*	0.02 (.01)*		
Age stereotype ongoing development			0.03 (.01)**	0.03 (.01)**
Value priority of openness to change	− 0.001 (.01)		0.03 (.01)***	
Value priority of self-enhancement	0.03 (.01)***		− 0.01 (.01)	
Value priority of conservation		0.004 (.01)		− 0.04 (.01)***
Value priority of self-transcendence		− 0.04 (.01)***		0.02 (.01)*
	$R^2 = 0.341$***	$R^2 = 0.342$***	$R^2 = 0.461$***	$R^2 = 0.462$***

DV dependent variable, *SPA* self-perceptions of ageing

*$p < .05$; **$p < .01$; ***$p \leq .001$

Age stereotypes and SPA

We used multiple regression analyses to investigate the importance of value priorities beyond age stereotypes and other covariates at *T*1 for SPA at *T*2. Table 2 shows the coefficients of the regression analyses based on z-standardized predictors. Loss- and gain-related SPA at *T*2 were most strongly predicted by the corresponding SPA at *T*1 ($B = .30$, SE = .01, $p < .001$ for social losses and $B = .31$, SE = .01, $p < .001$ for ongoing development), indicating that SPA are rather stable over the time span of 3 years. Domain-matched age stereotypes significantly predicted SPA at *T*2 in all analyses, showing in line with previous studies that age stereotypes on social losses contribute to SPA social losses ($B = .02$, SE = .02, $p < .001$ for both agentic and communal values), whereas age stereotypes on ongoing development significantly predicted SPA in this domain ($B = .03$, SE = .01, $p < .01$ for both analyses).

Agentic values and SPA

As for the role of agentic values, we hypothesized that a person for whom *openness to change* is relatively important perceives his or her ageing as related to more ongoing development at follow-up. As expected, openness to change predicted this SPA facet ($B = .03$, SE = .01, $p < .001$), yet was, also in line with the hypothesis, not associated with SPA related to social losses. The second hypothesis was that

prioritizing *self-enhancement* was associated with more SPA as related to social losses at follow-up. This hypothesis was also supported ($B = .03$, SE = .01, $p < .01$). In addition, self-enhancement was unrelated to the perception of ongoing development. These results indicate domain-specific effects of both agentic values on SPA.

Communal values and SPA

We tested the impact of communal value priorities on SPA in a separate set of regression analyses. Corroborating our hypotheses, communal value priorities differentially predicted domain-specific SPA: The more a person prioritized *conservation*, the less they perceived ageing to be associated with ongoing development 3 years later ($B = − .04$, SE = .01, $p < .001$). Conservation value priority was unrelated to the perception of social losses. *Self-transcendence* value priority, on the other hand, was a significant predictor of both domains: It predicted less loss-related SPA ($B = − .04$, SE = .01, $p < .001$) and more gain-related SPA ($B = .02$, SE = .01, $p = .032$) at follow-up.

Discussion

The goal of this study was to examine whether the priority of certain personal values plays a role for SPA beyond the impact of domain-matched age stereotypes. We focused on two domains of self-perceptions of age-related gains and

losses: psychological development (making new plans and realizing ideas) and social losses (receiving less respect and feeling lonelier). We hypothesized differential effects of the four value priorities of openness to change, self-enhancement, conservation and self-transcendence on gain- and loss-related SPA. Results supported the hypotheses. All four value priorities emerged as independent predictors of domain-specific SPA despite controlling for domain-specific age stereotypes and other covariates, thus providing first evidence that value priorities do play a role for SPA.

A higher value priority of openness to change predicted higher gain-related SPA, that is, a more positive perception of ageing as a time of new opportunities and psychological growth at follow-up. This might be due to a generally more optimistic focus on existing opportunities for development in older age and thus might point to better adjustment capability. People for whom openness to change is especially important might more readily accept and integrate changing capacities. This value priority might also facilitate a shift of focus from unattainable to more reachable goals. On the contrary, higher priority of self-enhancement at baseline predicted the perception of more social losses at follow-up. This means that if power and achievement was most important to a person, he or she perceived ageing more as associated with loss of respect, boredom and loneliness. One explanation might be that individuals who define themselves by their socially acknowledged achievement and power over others are especially prone to perceiving age-related loss of control in a negative way. Opportunities for social appreciation are likely to decline with age, when, for example, work-related success is no longer available as a source of validation. Value priority of achievement might generally be associated with increased stress and depression, as Hanel and Wolfradt (2016) found in a student sample. This value-associated stress might accumulate over the life span and result in a loss-related evaluation of the ageing process.

People with a priority of the value conservation reported less gain-related SPA after 3 years; i.e. someone for whom it is relatively important to stick to tradition and maintain the status quo perceives ageing less as a time of new plans and activities. Conservation implies a stronger focus on the maintenance of what has already been achieved and is thus less a driver for new plans. On the other hand, a value priority of conservation might be a sign of limited resources. According to Schwartz (2012), conservation is a value that addresses coping with uncertainties and anxiety in a rather passive way through avoiding conflict and maintaining the current order; this preoccupation might reflect a lack of psychological resources

that could be needed for successful adaption to age-related changes (Schwartz 2010).

As for self-transcendence, results indicate that individuals who prioritize benevolence and universalism perceive their own ageing as associated with more psychological gains as well as less social losses at follow-up. This result recalls Lars Tornstam's gerotranscendence theory, in which he defines gerotranscendence as "a shift in meta-perspective, from a materialistic and pragmatic view of the world to a more cosmic and transcendent one" (Tornstam 1997, p. 143). This shift in focus away from an egocentric value orientation to a more universal view might be indicative of successful adaptation to the ageing process, integrating both age-related gains and losses in a positive way.

Taken together, this study supports and extends findings on the impact of personality traits on SPA by providing first evidence for the role of personal value priority. It thus seems of benefit to look at personality not only from a "Big Five-perspective", but to also include other personality aspects, such as values, in the discussion of SPA. A special emphasis lies on the role of self-transcendence values as a probable facilitating factor in successful adaption to age-related changes that may be reflected in more gain-related and less loss-related SPA in the domains of ongoing development and social losses. It seems to be beneficial for older individuals to shift their focus from pursuing self-centred goals to a more universal concern with the well-being of others—distant or close.

Limitations and strengths

The study has some limitations which need to be considered. First of all, data came from a large German national panel of community-dwelling adults that is affected by selective sample attrition: participants dropping out were less healthy, less educated and older than the participants who could be followed longitudinally and also differed in their SPA and values. These effects were, however, small in size. Though the use of Full Information Maximum Likelihood estimation does not solve the issue of selective attrition, it at least adds more information to the estimation than full-case analyses would, thereby reducing potential bias. Another limitation was that values and age stereotypes where only asked for in the 2008 wave of the German Ageing Survey. Thus, we were not able to model the change in value priorities and age stereotypes over time, which might have provided additional insights into the relationship between values, age stereotypes and SPA. Additionally, it would have been interesting to model the information added by values above personality traits, but

traits have not been assessed in the survey. This question should thus be addressed in future studies. Furthermore, the effects of value priorities are quite small. This is most likely due to the relative stability of SPA. SPA generally do not change much, unless there is a critical life event like, for example, a cardiovascular event (Wurm et al. 2019). Due to this stability, only minor effects on SPA can be expected. Furthermore, age stereotypes are well supported predictors of SPA and we were still able to find a comparable impact of personal values on SPA beyond these stereotypes. Further strengths of our study lie in the large sample and the longitudinal design as well as the fresh insights gained by investigating the role of personal values for SPA for the first time. Also, we investigated SPA not on a global but domain-specific level, as is increasingly called for in the literature (e.g. Kornadt et al. 2019b). This allows for a more detailed understanding of associations between the different value priorities and gain- and loss-related domains of SPA.

Implications and future research

The results of the study suggest that personal value priorities partly account for the multidimensional nature of self-perceptions of ageing: what people find most important shapes which aspects of the ageing process they focus their attention on. Future research should thus further investigate the role of values for other domains of SPA such as physical losses or the domains of family and work (e.g. Kornadt and Rothermund 2015). Also, research could investigate mechanisms to reduce anxiety and worries in individuals who prioritize the deficiency-related values conservation and self-enhancement, thus freeing resources needed to focus on age-related gains. It is also worth further exploring the pathways through which values might lead to actual negative experience with ageing and thus negative SPA. One way might be behaviour: for example, people for whom power is relatively important tend to engage in unhealthy behaviour such as smoking, unhealthy eating habits and irregular exercise (Honka et al. 2019). Future studies should thus consider different mechanisms through which personal values affect age-related experiences.

Conclusions

In this study, we were able to provide first evidence for the role of personal value priorities for two domains of SPA over a 3-year period: ageing as ongoing personal development and ageing as related to loss in social status. This finding expands on previous research on longitudinal associations of the Big Five personality traits and SPA by adding another aspect of personality to the debate. We found all four value priorities to be related to gain- and loss-related SPA in specific and meaningful ways: openness to change predicted more and conservation less gain-related SPA, whereas self-enhancement predicted more loss-related SPA over time. Self-transcendence predicted more gain- and less loss-related SPA, thus reflecting an important resource for overall positive SPA. Research in gerontology should more often consider personal values when investigating the attitudes of older persons, since what is most important to them determines which part of the ageing process attracts their attention and whether they perceive ageing as threat or chance.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

See Table 3.

Table 3 Bivariate correlations of study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	–														
2. Gender	−0.09***	–													
3. Educ.	−0.16***	−0.20***	–												
4. PF	−0.36***	−0.07***	0.19***	–											
5. Panel	0.15***	0.004	0.03*	−0.03**	–										
6. Place	−0.01	0.02	0.10***	−0.07***	−0.01	–									
7. AS SL	−0.08***	0.02	−0.02	−0.10***	−0.02	−0.11***	–								
8. AS OD	−0.16***	−0.004	0.13***	0.26***	0.01	−0.01	0.41***	–							
9. SPA SL T1	0.05***	−0.02	−0.13***	−0.20***	−0.02	−0.004	−0.45***	−0.28***	–						
10. SPA OD T1	−0.26***	0.02	0.20***	0.34***	−0.003	−0.10***	−0.17***	0.53***	−0.41***	–					
11. O	−0.19***	−0.05***	0.12***	0.16***	0.02	−0.10***	0.01	0.20**	−0.08***	0.33***	–				
12. SE	−0.17***	−0.17***	0.10***	0.09***	−0.06***	−0.03*	0.03*	−0.02	0.06***	−0.003	−0.01	–			
13. C	0.33***	0.03*	−0.22***	−0.19***	0.005	0.13***	−0.07***	−0.16***	0.10***	−0.33***	−0.74***	−0.35***	–		
14. ST	−0.04**	0.21***	0.05**	−0.02	0.04**	−0.02	0.05**	−0.01	−0.11***	0.04**	−0.24***	−0.54***	−0.08***	–	
15. SPA SL T2	0.08***	−0.004	−0.12***	−0.15***	−0.03	−0.01	0.25***	−0.17***	0.54***	−0.31***	−0.05**	0.06**	0.09***	−0.14***	–
16. SPA OD T2	−0.28***	0.03	0.16***	0.26***	−0.04*	−0.10***	−0.03	0.31***	−0.26***	0.60***	0.24***	0.02	−0.28***	0.06**	−0.38***

$T1$ = baseline (2008); $T2$ = follow-up (2011), *Educ.* education, *PF* physical functioning, *Place* place of residence (former East/West Germany), *AS* age stereotype, *SL* social losses, *OD* ongoing development, *SPA* self-perceptions of ageing, *O* value priority of openness to change, *SE* value priority of self-enhancement, *C* value priority of conservation, *ST* value priority of self-transcendence

*$p < .05$; **$p < .01$; ***$p \leq .001$

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Paper 3

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BMC Geriatrics

Domain-specific self-perceptions of aging are associated with different gait patterns in older adults: a cross-sectional latent profile analysis

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Abstract

Background: Previous studies have pointed to the impact of self-perceptions of aging (SPA) on self-reported physical function in later life. However, less is known about associations of SPA with objectively measured physical function, especially gait. Research that examined other psychological variables and objectively measured gait has focused on single gait parameters such as gait speed, which seems to fall short for the complexity of this movement. Some approaches have proposed ways to identify gait patterns in specific patient groups, but not in community samples. Our goal was (a) to identify gait patterns based on a combination of important gait parameters in a community sample, and (b) to investigate differential associations of gain- and loss-related SPA with these gait patterns.

Methods: The study used an electronic walkway to assess gait parameters of 150 community dwelling adults aged 71–93 years (61.0% women) at their usual and maximum gait speed. SPA were assessed with a questionnaire. We used latent profile analysis (LPA) to identify groups exhibiting distinct gait patterns and binary logistic regression to investigate associations of SPA with these groups, controlling for personality traits, number of illnesses, age, gender, and education. To compare overall function between groups, a t-test for scores in the Short Physical Performance Battery was used.

Results: LPA revealed two distinct groups in both gait speed conditions. The fit group exhibited a stable, well-coordinated and faster gait pattern, while the functionally limited group's gait pattern was less stable, less coordinated and slower. The odds of belonging to the functionally limited group were increased by loss-related SPA at usual gait speed, while the odds of belonging to the fit group were increased by gain-related SPA at individual maximum speed.

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Conclusions: The findings (a) suggest LPA as a useful approach to investigate complex gait patterns considering several gait parameters simultaneously, and (b) provide first evidence for differential associations of gain- and loss-related SPA with gait patterns at usual and maximum gait speed. Intervention studies addressing gait in older adults should additionally address gain-related views on aging.

Keywords: Self-perceptions of aging, Gait profile, Gait pattern, Older adults, Views on aging

Background

Self-perceptions of aging and physical function

In recent years, a large number of studies have provided broad evidence for the impact of self-perceptions of aging (SPA) on physical and mental health and even mortality [1, 2]. SPA refer to an individual's overall expectation and attitude towards the aging process. Especially in old age, SPA also increasingly reflect a person's own actual aging experiences [3]. SPA are multidirectional, which means a person can hold both positive or gain-related and negative or loss-related SPA at the same time. SPA are also multidimensional: they refer to different life domains, e.g. to health, self-development or social relationships. Positive SPA can refer to gains such as personal growth and development, having time to make new plans and being able to pursue new ideas. Negative, loss-related SPA usually refer to physical or social losses, such as physical decline, illness or loss of social embeddedness.

By now, there is abundant evidence for the importance of SPA for the way people actually grow older [3, 4]. For example, people with more positive SPA report better physical and mental health [5] and even live up to 7.5 years longer [1], while people with more negative SPA are at increased risk of physical decline or frailty [6, 7]. However, most findings in this context rely on self-report data for physical function obtained by measures like the Short Form Health Survey [8, 9] or the Health Scale for the Aged [10]. These might be subject to bias through social desirability or simply because some people over- or underestimate their actual physical performance, e.g. their ability to walk several blocks without a break. It is therefore important to accumulate additional knowledge about associations of SPA with objectively measured physical function.

So far, only few studies have addressed this question. In addition, we see a very limited range of outcomes in these studies—they either looked at composite measures of physical performance like the Short Physical Performance Battery [11] or at single gait parameters like gait speed [12].

Gait as an indicator of physical function

Gait speed is a gait parameter that is relatively easy—albeit not trivial [13]—to measure and associated with a large range of health outcomes and has even been termed "the functional vital sign" [14]. Modern technological devices allow the detailed recording of a large range of gait parameters that give additional information on specific gait features over and beyond gait speed such as step-width-variability or walk ratio. As some gait parameters change with gait speed, recording walking at different gait speeds is recommended [15]. Participants complete the walk at their usual pace and at their individual maximum speed. This provides important indications of everyday functioning of older adults. Walking at a usual pace reflects everyday behavior, like the ability to go grocery shopping. Yet, when crossing a road at a traffic light, it is also important to be able to keep a stable gait while walking at increased speed. At maximum speed, limitations in walking capacity become more noticeable [15].

However, most studies have focused on the role of single gait parameters for e.g. incident disability [16] or compared single gait parameters between groups [17]. Since walking is a complex task that requires coordination of diverse motion sequences, looking at gait patterns as a combination of several different gait parameters might be of additional value. Some studies proposed methods to form gait patterns, e.g. through cluster analysis or latent profile analysis. However, these studies were interested in identifying gait patterns associated with specific illnesses [18, 19], and not among community samples of older adults. Furthermore, studies on psychological correlates of gait mostly focused on the role of proximal variables like attentional influences [20], fear of falling [21], and trait conscious movement processing [22, 23] that are directly relevant for gait. However, several studies also provided evidence for associations of personality traits as more distal psychological variables with objectively measured gait in older adults [24, 25]. In this study, we aimed at investigating associations with gait patterns of another distal variable that has been related to physical function, namely, self-perceptions of aging.

Aims and hypotheses

Taken together, as to our knowledge, this is the first study, which regards the complexity of gait while taking multidimensional and multidirectional aspects of SPA into account. We aimed at investigating associations of loss- and gain-related SPA, which refer to two different

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life domains, with gait patterns in a community sample of older adults.

To reach this goal, we first explored gait patterns in a community sample, and then—in a second step—investigated associations of SPA with these gait patterns. Based on previous research on SPA and physical function, we developed two specific hypotheses for associations of loss- and gain-related domains of SPA with gait patterns.

First, the loss-related domain of SPA physical losses refers to the notion of aging as associated with decline in health, fitness and vitality. This SPA domain is closely connected to the experience of actual physical losses in a reciprocal manner. On the one hand, many people who associated their own aging with physical losses report worse physical function [9] over time than those who do not have this view on aging, suggesting a longitudinal impact of this SPA domain on health. On the other hand, individuals often experience age-related physical decline and accumulating illnesses and then tend to attribute this to aging [26], resulting in the perception of aging as associated with physical losses. Since stronger physical limitations are already noticeable in everyday behavior and not only when investing effort, we hypothesized:

> H1: Higher SPA physical losses is associated with a higher likelihood to exhibit a functionally limited gait pattern when walking at usual gait speed.

Second, the gain-related domain of SPA ongoing development is a more motivational facet of SPA that refers to aging being associated with developing new plans, learning new things and following ideas. Thus, a person who associates their aging with ongoing development likely has certain resources available. For instance, gain-related SPA were related to tenacious goal pursuit in a previous study beyond a range of control variables [27]. Thus, a gain-related view on aging seems to be associated with a readiness to invest effort in reaching a goal. In addition, previous research found SPA ongoing development to buffer the negative effect of precariousness on health and well-being [28] and promote health behavior [29]. Positive SPA are also associated with a lower rate of overnight hospitalizations after 4 years [30], pointing to better health in older adults with positive SPA. Furthermore, the association of positive SPA and better self-reported physical function in late life is mediated by self-efficacy [8]: This means that positive SPA foster a person's ability to cope successfully with aging-related challenges, which is then later reflected in better self-reported, and, presumably, also objective physical function. However, it might also be the case that older adults who experience little physical limitations are more likely to perceive their aging as associated

with ongoing development, since they can focus on making new plans instead of being troubled by illnesses. Since our sample of older adults was very healthy and fit, we expected the domain of ongoing development to only be associated with a more favorable gait pattern at maximum gait speed. Walking at maximum speed requires effort and motivates participants to invest resources; thus, a distal psychological variable like SPA ongoing development might only become visible in this rather challenging condition.

> H2: Higher SPA ongoing development is associated with a higher likelihood of exhibiting a more favorable gait pattern when walking at individual maximum gait speed.

Methods
Participants and procedure
The study assessments took place in the city of Nuremberg in southeastern Germany. In total, 150 participants (61.0% women) were recruited via an existing address pool and distribution of additional flyers. Inclusion criteria were (1) an age of 70 years or older, (2) living independently, (3) ability to walk 10 m without a wheeled walker and (4) ability to understand and follow the test protocol. Participants were excluded if they reported serious orthopedical and/or neurological disorders that impeded walking. Participants needed to be able to come to the research institute were the assessment took place by themselves. At the study site, they completed several walks on an electronic walkway in a well-lit hallway and answered a structured personal interview that lasted approximately 120–240 min as part of a larger project. The participants also completed the Montreal Cognitive Assessment. The FAU Ethical Committee approved of the study (Reference number: 43_19B) and all participants gave their written informed consent.

Measures
Gait parameters
The GAITRite system is a 10-m-long walkway with embedded pressure sensors (Gold walkway, 972 cm long, active electronic surface area 792 × 61 cm, total 29,952 pressure sensors, scanning frequency 60 Hz, GAITRite, CIR Systems Inc., Franklin, USA). Previous studies have shown that the GAITRite system is a valid and reliable instrument to measure gait parameters [31, 32]. The active sensor area of the walkway is 8 m long. Two cones, placed 2.5 m before and behind the GAITRite system, indicated the start and finish area of the gait assessment, resulting in steady-state measurement over the walkway. Participants walked across the walkway once at their usual gait speed and once at their individual maximum

gait speed. The instruction for the walk at usual pace was: "Please walk in your usual gait speed until you reach the indicated cone." For maximum pace, the instruction was to "walk as quickly and safe as possible without running."

Self-perceptions of aging (SPA)

We used the two standard subscales "SPA physical losses" and "SPA ongoing development" of the AgeCog-Scales [5, 33] to measure SPA. The loss-related subscale "SPA physical losses" refers to the perception of aging as associated with physical decline and decreasing vitality and fitness. An example item is "Aging means to me that I am less healthy". The gain-related subscale "SPA ongoing development" refers to the notion that aging is associated with making new plans and following ideas. An example item is "Aging means to me that my capabilities are increasing". Each subscale contains four items on a four-point Likert-scale ranging from 1 "definitely true" to 4 "definitely false". We recoded the answers for the analysis so that a higher score signifies greater endorsement of the respective SPA domain. Scores were averaged across all four items of the respective subscale. Cronbach's α was 0.81 for SPA physical losses and Cronbach's α = 0.71 for SPA ongoing development.

Covariates

As covariates, we included the Big Five personality traits (openness, agreeableness, neuroticism, conscientiousness, and extraversion) as assessed with the 10-item short version of the Big Five Inventory [34], since personality traits have been associated with gait (e.g., gait speed [24] and walking limitations [25]) as well as objective physical function [35] in other studies. In addition, personality traits partly shape SPA [36] and both constructs are distal correlates of physical function. We thus controlled for personality to investigate unique associations of SPA with gait patterns. Respondents indicated the extent to which they agreed to the items on a 5-point Likert-scale ranging from 1 (do not agree) to 5 (totally agree). The score for each trait was averaged over the corresponding two items.

We also controlled for number of illnesses as assessed with the Functional Comorbidity Index [37], age, gender (0 = male, 1 = female), and years of education.

As the participants displayed overall good cognitive function with strong ceiling effects in the Montreal Cognitive Assessment, we chose not to include this variable in the analyses.

In addition, global physical function of the participants was assessed with the Short Physical Performance Battery [38] to help to characterize the groups identified by the LPA.

Analytical procedure

For descriptive analyses, we used IBM SPSS 25. Multivariate outliers were identified using Cook's distance. Three participants in the normal gait speed condition and one participant in the maximum speed condition had a distance > 1 and were therefore excluded from the analysis.

To identify gait patterns in the sample, we conducted a latent profile analysis (LPA) using Mplus7. The LPA identifies patterns in the data in an explorative manner: it identifies groups that are maximally homogenous within and maximally heterogenous between one another. The researcher must decide on the best fitting amount of patterns based on several indicators of model fit (e.g., AIC, BIC) and theoretical considerations. First, we decided on the gait parameters we used to form gait patterns. Based on the work of Lindemann [15], we chose four gait parameters that each represent an important gait feature: We used gait speed (m/s) to represent walking capacity and the variability of stride-length and step-width (coefficient of variation: CoV = SD/mean (in cm) × 100 [%]) to represent regularity and adaptability of gait. Additionally, we included the walk-ratio (cm/steps/min) to represent the spatiotemporal coordination of walking. The goal was to identify homogenous groups of individuals exhibiting similar gait patterns based on these four parameters. Individuals were assigned to a group based on the maximum posterior probability of group membership derived from the LPA. To further characterize groups in terms of physical function, we used normative values of Beauchet and colleagues [39] as well as a t-test to identify differences in SPPB-Scores.

In a second step, we used IBM SPSS 25 to apply binary logistic regression to the data to test the hypotheses about differential associations of SPA physical losses and SPA ongoing development with gait patterns. This regression tests whether the predictors increase the odds to exhibit a certain gait pattern. In both regression analyses, we added as predictors the two SPA domains of physical losses and ongoing development and as covariates the Big 5 personality traits, age, gender, education and the number of illnesses to predict whether a person exhibits a certain gait pattern.

We checked the predictors for multicollinearity using Pearson's r and the variance inflation factor (VIF). All correlations were below $r = 0.408$ and VIF was close to 1 which suggests no problems with co-/multicollinearity.

Results

Descriptive results

Table 1 shows the sample characteristics of the 150 study participants. Their mean age was 80.45 years ($SD = 4.46$) and 61% were women. They were highly educated with a mean education of 13.65 years ($SD = 3.27$). On

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Table 1 Means (M), standard deviations (SD) and range of the predictors of gait pattern

N = 150	M or %	SD	Range
Age	80.45	4.46	71–93
Female	61.00		
Years of education	13.65	3.27	8–28
Number of illnesses	3.59	2.23	0–9
SPA ongoing development	3.03	0.68	1.00–4.00
SPA physical losses	2.85	0.79	1.00–4.00
Extraversion	3.39	1.17	1.00–5.00
Neuroticism	2.64	1.12	1.00–5.00
Openness	4.03	1.02	1.00–5.00
Conscientiousness	4.04	0.95	1.50–5.00
Agreeableness	3.46	0.98	1.00–5.00

average, they associated their aging more strongly with ongoing development ($M = 3.03$, $SD = 0.68$) than physical losses ($M = 2.85$, $SD = 0.79$).

Gait patterns

LPA was able to distinguish gait patterns in the data. Based on AIC, BIC and the significant parametric bootstrapped likelihood ratio test (BLRT), we decided on a solution with two different gait patterns in both gait speed conditions. These two gait patterns were meaningful on theoretical grounds. The two patterns are represented by the straight and dotted lines in Fig. 1 (usual speed condition) and Fig. 2 (maximum speed condition). In the usual gait speed condition, a large ($n = 115$), relatively "fit" group emerged, represented by the straight line in Fig. 1. This group exhibited a gait pattern with a mean gait speed of 1.30 ($SD = 0.18$), a mean step-width-variability of 29.09 ($SD = 14.58$), a mean stride-length variability of 2.46 ($SD = 0.91$) and a mean walk ratio of 0.58 ($SD = 0.07$). The second, much smaller group ($n = 32$) can be termed "functionally limited". This group had a mean gait speed of 0.91 ($SD = 0.15$), a mean step-width-variability of 20.16 ($SD = 9.89$), a mean stride-length variability of 4.66 ($SD = 1.49$) and a mean walk ratio of 0.46 ($SD = 0.06$). The dotted line in Fig. 1 represents this functionally limited group. The average latent class probabilities for most likely latent class membership were 0.922 in the fit group and 0.974 in the functionally limited group.
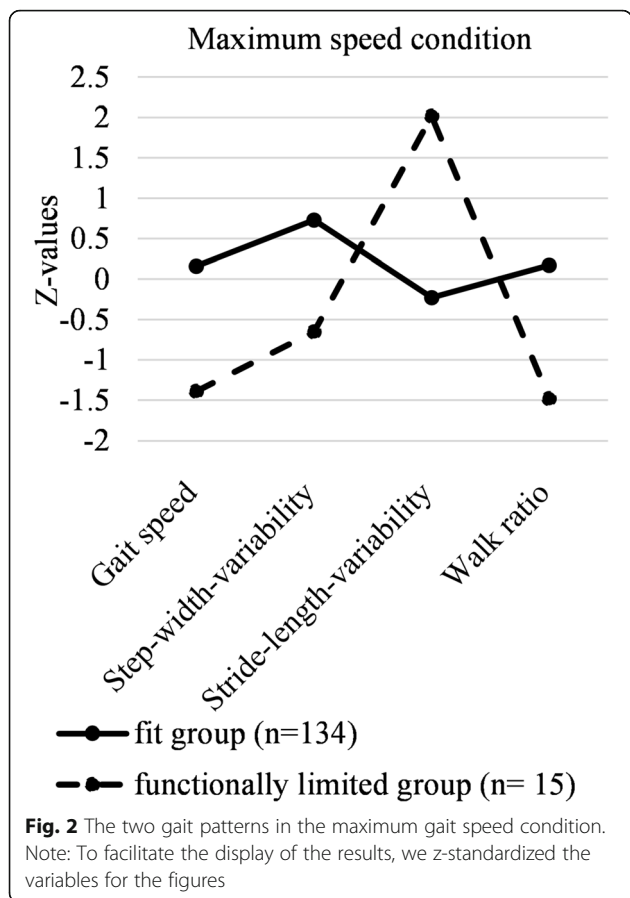
In the maximum speed condition, also two groups emerged: A large ($n = 134$) fit group had a mean gait speed of 1.58 ($SD = 0.29$), a mean step-width-variability of 28.06 ($SD = 13.94$), a mean stride-length variability of 2.80 ($SD = 1.32$) and a mean walk ratio of 0.55 ($SD = 0.08$). The straight line in Fig. 2 represents this fit group. The smaller ($n = 15$), functionally more limited group had a mean gait speed of 1.05 ($SD = 0.45$), a mean step-
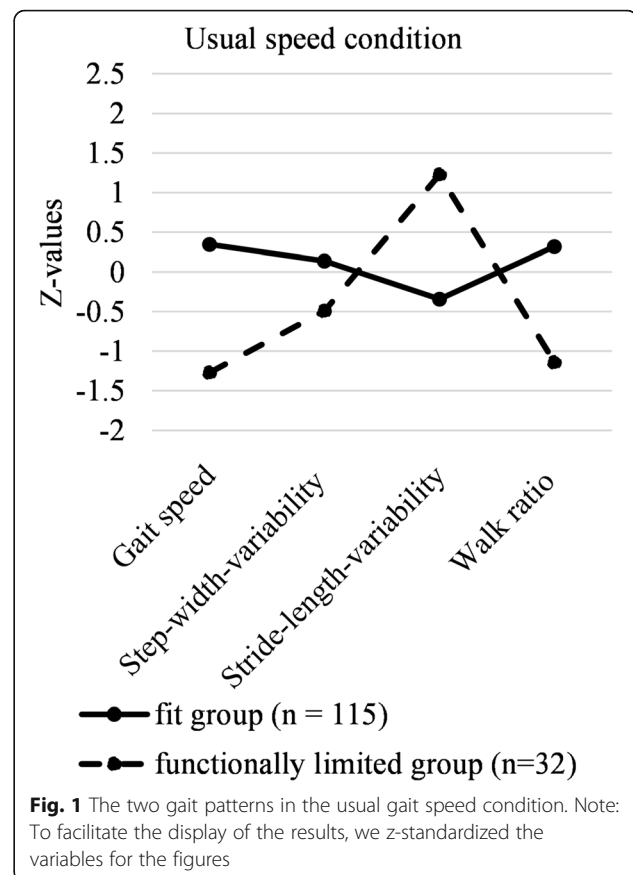
Fig. 1 The two gait patterns in the usual gait speed condition. Note: To facilitate the display of the results, we z-standardized the variables for the figures

width-variability of 17.81 ($SD = 12.37$), a mean stride-length variability of 7.18 ($SD = 2.31$) and a mean walk ratio of 0.40 ($SD = 0.07$). The dotted line in Fig. 2 represents this functionally limited group. The average latent class probabilities for most likely latent class membership were 0.989 in the fit group and 0.893 in the functionally limited group.

Further analysis

To justify the labelling of the groups as "fit" and "functionally limited", we compared their SPPB scores in a t-test. In the usual speed condition, the mean SPPB scores were 11.44 ($SD = 0.91$) in the fit group and 9.41 ($SD = 2.06$) in the functionally limited group ($t(34.43) = -5.45$, $p < 0.001$). In the maximum speed condition, the mean SPPB scores were 11.22 ($SD = 1.12$) in the fit group compared to 8.13 ($SD = 3.02$) in the functionally limited group ($t(14.43) = -3.92$, $p \leq 0.001$).

SPA and gait patterns

To test the hypothesized associations of SPA physical losses and SPA ongoing development with gait patterns, we performed two binary logistic regressions in SPSS 25 (see Table 2). Hypothesis 1 about the association of SPA physical losses with a less favorable gait pattern in the

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Fig. 2 The two gait patterns in the maximum gait speed condition. Note: To facilitate the display of the results, we z-standardized the variables for the figures

usual speed condition is supported by the data. Higher SPA physical losses increased the odds of belonging to the functionally limited group in this condition (OR = 2.69, 95% CI 1.23–5.85). In addition, participants who were more extraverted (OR = 1.79, 95% CI 1.12–2.86)

and those that were older (OR = 1.85, 95% CI 1.15–2.89) had increased odds of belonging to the functionally limited group, whereas gender and education did not reach significance. Number of illnesses was close to significance with OR = 1.30, 95% CI 1.00–1.68.

Hypothesis 2 about the association of SPA ongoing development with a more favorable gait pattern in the maximum speed condition is also supported: SPA ongoing development decreased the odds of belonging to the functionally limited group (OR = 0.38, 95% CI 0.15–0.98). In addition, the number of illnesses increased the odds of belonging to the functionally limited group (OR = 1.45, 95% CI 1.04–2.04) in the maximum speed condition.

Taken together, binary logistic regression analyses provided support for both hypotheses on the differential effects of the two SPA domains for gait patterns under two gait speed conditions.

Discussion

In this study, we wanted to add to the scarce literature on associations of SPA with objectively measured gait parameters as an indicator of physical function in older adults. Extending previous studies, we investigated differential associations of two domains of SPA with gait patterns: SPA as associated with physical losses and SPA as associated with ongoing development. Furthermore, we did not use single gait parameters but instead accounted for the complex nature of gait by using gait patterns as our outcome. To our knowledge, this study is the first to explore gait patterns based on LPA with this selection of gait parameters in a community sample of older adults.

Table 2 Results of the binary logistic regression analyses of gait pattern group on SPA

Predictors	Usual gait speed condition	Maximum gait speed condition
	OR (95% CI)	OR (95% CI)
SPA physical losses	2.69 (1.23–5.85)**	1.40 (0.51–3.85)
SPA ongoing development	0.66 (0.29–1.15)	0.38 (0.15–0.98)*
Extraversion	1.85 (1.15–2.89)*	1.31 (0.73–2.35)
Neuroticism	0.88 (0.53–1.45)	0.60 (0.32–1.12)
Openness	1.48 (0.79–2.77)	1.46 (0.70–3.05)
Conscientiousness	0.73 (0.40–1.32)	0.88 (0.45–1.70)
Agreeableness	1.08 (0.61–1.93)	0.72 (0.35–1.47)
Age	1.29 (1.14–1.47)***	1.14 (0.99–1.31)
Gender	2.37 (0.63–8.93)	2.94 (0.55–14.69)
Education (years)	1.12 (0.93–1.35)	1.06 (0.86–1.32)
No. of illnesses	1.30 (1.00–1.68)	1.45 (1.04–2.04)*

Note: Reference group: fit group. Values above 1 imply an increased likelihood of belonging to the functionally limited group. Values below 1 imply an increased likelihood of belonging to the fit group
*$p < 0.05$; **$p < 0.01$; ***$p \leq 0.001$

LPA as an approach to identify gait patterns

Based on four objectively measured gait parameters that each represent a different gait feature [15], we found two distinct gait patterns—a fit one and one that reflected functional limitations—in the usual as well as the maximum speed condition. The means of all gait parameters in the fit group were above normative values based on usual gait speed [39], while means of all gait parameters in the functionally limited group were below these normative values. This finding supports our differentiation of the groups in fit vs. functionally limited, which is further supported by significantly differing SPPB-scores between the groups in both conditions. However, our approach goes beyond comparing single means of gait parameters between pre-defined groups; the explorative LPA looks for patterns in the data that differentiate homogenous subgroups based on *certain combinations* of gait parameters. This approach accounts for the complexity of gait.

Differential associations of SPA with gait patterns

In addition, the present study considered gain- and loss-related SPA in the domains of physical losses and ongoing development and thus used a multidimensional and multidirectional approach to SPA. Previous studies often used a global, unidimensional measure of SPA. Like examination of a single gait parameter, this yields valuable insights, yet needs further differentiation to fully understand associations and implications. For this reason, we tested specific hypotheses on associations of loss-related SPA in the domain of physical decline and gain-related SPA in the domain of ongoing personal development with gait patterns. In line with research on SPA and self-reported physical function [11], we found that SPA physical losses were associated with a higher likelihood of exhibiting an objectively measured, functionally limited gait pattern in the regular speed condition: those belonging to the functionally limited group perceived aging more strongly as associated with physical losses than those in the fitter group. In previous studies, this SPA domain was also associated with worse self-reported physical and mental health [40] and a higher number of self-reported physical illnesses [5]. This suggests that people with SPA physical losses indeed encounter physical limitations more often in their everyday lives, which is reflected in a functionally limited gait pattern. However, this study cannot determine causality; it might as well be the case that the experience of physical decline leads some people to think about their own age and aging as associated with physical losses.

We also investigated the role of SPA ongoing development for gait patterns. Previous studies found that positive SPA is associated with positive health outcomes [1, 5]. The present study's findings point into the same direction. For the gain-related SPA ongoing development, we found that this SPA domain increased the odds of belonging to the fit group in the maximum speed condition. This means, SPA ongoing development were associated with better gait performance in a condition that requires physical effort: Individuals with more SPA ongoing development showed a more stable, better coordinated and faster gait performance. This finding is remarkable since it provides further evidence that a positive view on one's own aging can be reflected in a more stable gait pattern and the ability to mobilize physical resources in old age. Yet, also here we cannot determine causality. The findings might as well show that a person who is able to walk stable at maximum speed possesses resources and energy that are reflected in gain-related SPA ongoing development.

Not only did our findings support previous findings showing associations of positive and, more specifically, gain-related SPA with a variety of positive health variables [4]; we were also able to show that there are domain-specific associations of SPA with gait performance under different walking conditions.

Strengths and limitations

This study has several limitations. One major limitation is the risk that some of our chosen gait parameters may not be reliable: We included the variabilities of step-length and step-width based on only a few gait cycles. However, according to Hollman, Childs et al. (2010), [41], a good reliability of variabilities requires more strides than we assessed in our study. This might have affected the accuracy of the LPA, and the regressions that follow from these. Furthermore, we had a relatively small sample that was selective in terms of health and education—the participants had relatively good physical function and reported an above average education. Accordingly, the number of individuals exhibiting the functionally limited gait pattern was rather small compared to the group with the fit gait pattern. In addition, our cross-sectional design does not allow for causal interpretation of effects. Furthermore, it has to be noted that conducting the LPA in Mplus and exporting the estimated class membership to SPSS has the potential for both rounding errors and non-equivalent estimation, which might have affected the results. However, our study also has several strengths. On a methodical level, we showed that LPA can be a useful approach to differentiate gait patterns. We also expanded past findings on associations of SPA and self-reported physical function by adopting an objective measure of physical function. Furthermore, we investigated differential effects of two domains of SPA—most other studies used a unidimensional positive/negative measure for SPA. On the one hand, our results strengthen previous findings on the role of SPA for (self-reported) physical function, thereby stressing the importance of SPA

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as a health-relevant concept. On the other hand, our approach also adds to the literature on gait, since we introduced SPA as a relevant construct for research on gait patterns, which could benefit from acknowledging the importance of distal psychological variables other than personality for gait performance.

Implications for future research

Our study showed that latent profile analysis is a promising approach to identify gait patterns not only for groups with specific illnesses [18], but also in community samples of older adults. Future research could use this method in larger, more diverse samples to identify a higher number of more differentiated gait patterns. This would allow for tailoring of interventions based on specific needs of the identified subgroups. In addition, future research is needed to confirm our findings. Especially, these studies should be based on longer walks to overcome issues of low reliability of the variability parameters [42]. Future studies should also include a larger sample size and could additionally select gait parameters based on other approaches, e.g. Hollman, McDade et al. [43]. Furthermore, our findings show that SPA are not only important in the context of self-views of physical function, as represented by self-report data, but also in the context of objectively measured gait performance as an indicator of physical function. Especially the finding that SPA ongoing development are associated with the mobilization of physical resources in the maximum speed condition points to the importance of a positive view on aging as a source of reserve capacity for physical function in later life; and it points to the importance of good physical function for gain-related SPA.

Longitudinal findings on SPA and self-reported health suggest that SPA work as a self-fulfilling prophecy. This means, those who view aging as associated with physical losses are more likely to actually experience physical losses; in contrast, those associating aging with personal development are more likely to have positive experiences [4]. Future studies should thus investigate longitudinal associations of domain-specific SPA with objectively measured gait to corroborate the cross-sectional findings of our study and to infer direction of causality. Furthermore, it might be interesting to investigate whether associations of SPA with gait are mediated by proximal factors (e.g., fear of falling) and to investigate the role of conscious movement processing inclination in the context of SPA and gait.

In a next step, interventions to improve physical function in older adults should more often address the SPA of the participants and promote a positive view on aging. There is first evidence that the combination of physical exercise and an intervention on SPA is a promising approach [34]. Interventions on physical activity might

additionally provide a good basis to sharpen older adults' eyes for gains and positive experiences in later life, which can be a source for happiness and comfort regardless of age. This view, in turn, might have a positive impact on their physical function.

Conclusions

As a conclusion, studies that explore the gait of older adults should more often include SPA, as these views are not only related to subjective measures of physical function, but also to objective physical function as assessed with gait patterns. Furthermore, we were able to show domain-specific associations of SPA on physical function: those who viewed their aging as associated with physical losses were more likely to exhibit physical limitations at regular speed. However, those who perceived their aging as associated with ongoing psychological development were more likely to keep up a stable, fast gait at maximum speed. Our findings add to the literature on SPA and physical function and should be further explored in longitudinal studies.

Declarations

Ethics approval and consent to participate
The study was performed in accordance with the ethical standards of the ethical committee of the Friedrich-Alexander-University Erlangen-Nürnberg and with the 1964 Helsinki Declaration and its later amendments. This article does not contain any studies with animals performed by any of the authors. This study was approved by the FAU Ethical committee (43_19B). All participants of this project gave written informed consent to participate and for data analysis and publication.

Consent for publication
N/A

Competing interests
The authors declare that they have no competing interests.

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The Author's Contribution to the Scientific Papers

	Pub. 1 agentic and communal traits and SPA	Pub. 2 personal values and SPA	Pub. 3 SPA, Big Five and gait patterns
Manuscript conception	Yes	Yes	Yes
Data acquisition	Yes	No	No
Data management and cleansing	Yes	Yes	Yes
Data analysis	No	Yes	Yes
Data interpretation	Yes	Yes	Yes
Writing draft and revision	Yes	Yes	Yes
Corresponding author	Yes	Yes	Yes

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Eidesstattliche Erklärung

Hiermit erkläre ich, dass ich die vorliegende Dissertation selbständig verfasst und keine anderen als die angegebenen Hilfsmittel benutzt habe.

Die Dissertation ist bisher keiner anderen Fakultät, keiner anderen wissenschaftlichen Einrichtung vorgelegt worden.

Ich erkläre, dass ich bisher kein Promotionsverfahren erfolglos beendet habe und dass eine Aberkennung eines bereits erworbenen Doktorgrades nicht vorliegt.

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List of Publications

Publications in Peer-Reviewed Journals

Blawert, A., & Wurm, S. (2021). Shifting self-perceptions of ageing: differential effects of value priorities on self-perceptions of ageing beyond age stereotypes. *European Journal of Ageing*, *18*(2), 257-267. https://doi.org/10.1007/s10433-020-00578-3

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Seemer, J., Kiesswetter, E., **Blawert, A.,** Fleckenstein, D., Gloning, M., Bader-Mittermaier, S., Sieber, C. C., Wurm, S., & Volkert, D. (2021). An Individualised Nutritional Intervention Concept for Nursing Home Residents with or at Risk of Malnutrition: An enable Study. *Geriatrics*, *6*(1), 2. https://doi.org/10.3390/geriatrics6010002

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Blawert, A., Freiberger, E., Wurm, S. (2020). The Role of Self-Perceptions of Aging for Recovery of Older Adults After Hospital Stay. *Innovation in Aging*, 4, 588. https://doi.org/10.1093/geroni/igaa057.1970

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Conference Papers

Blawert, A., Schäfer, S. K., & Wurm, S. (2021, September). *Associations of Personality and Self-Perceptions of Aging in Old-Old Adults in Poor Health.* Poster presented at the Annual Congress of the German Society of Gerontology and Geriatrics, virtual conference.

Blawert, A., Freiberger, E. & Wurm, S. (2020, November). The Role of Self-perceptions of Aging for Recovery of Older Adults after Hospital Stay. In S. Wurm & Allison Brothers (Chairs), *Exploring Longitudinal Links and Mechanism Connecting Views on Aging with Health in Later Life.* Symposium conducted at the Annual Scientific Meeting of the Gerontological Society of America (GSA), virtual conference.

Blawert, A., Wirth., J. & Wurm, S. (2019, May). *Values Shape Experiences. The Longitudinal Impact of Personal Values on Self-Perceptions of Aging.* Poster presented at the Conference of the International Association of Gerontology and Geriatrics European Region (IAGG-ER), Gothenburg, Sweden.

Blawert, A., Wirth., J. & Wurm, S. (2019, September). The Role of Personal Values for Self-Perceptions of Aging. In A.-K. Beyer (Chair), *Views on Aging – New Perspectives for Research and Practice.* Symposium conducted at the Annual Congress of the German Society of Gerontology and Geriatrics (DGGG), Berlin, Germany.

Klusmann, V., Beyer, A., **Blawert, A,** Gabrian, M., Notthoff, N. (2018). *The Assessment of Views on Aging: A Systematization and Analysis of Available Methods.* Conference Paper presented at the Congress of the German Psychological Society in Frankfurt, Germany.

Klusmann, V., **<u>Blawert, A</u>**., Notthoff, N., Beyer, A.-K. & Gabrian, M. (2018, September). The Assessment of Views on Aging: Much thinking, less feeling?. In E.-M. Kessler & M. Wiest (Chairs), *Subjective Views on Aging – New Findings from Psychological Aging Research.* Symposium conducted at the Annual Congress of the German Society of Gerontology and Geriatrics (DGGG), Cologne, Germany.

Wirth, J., **Blawert, A**., Wurm, S., Sieber, C., & Freiberger, E. (2019, May). *Is it still worth it? The role of future time perspective for physical activity in old age.* Poster presented at the Conference of the International Association of Gerontology and Geriatrics European Region, Gothenburg, Sweden.