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How do views on aging affect health outcomes in adulthood and late life? Explanations for an established connection

Susanne Wurm[a,*], **Manfred Diehl**[b], **Anna E. Kornadt**[c], **Gerben J. Westerhof**[d], **Hans-Werner Wahl**[e]

[a]Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany [b]Colorado State University, USA [c]Bielefeld University, Germany [d]University of Twente, The Netherlands [e]Heidelberg University, Germany

Abstract

Personal views on aging, such as age stereotypes and subjective aging, can affect various health outcomes in later life. For the past 20 years or so, a large body of experimental and longitudinal work has provided ample evidence for this connection. Thus, it seems timely to better understand the pathways of this linkage. The majority of existing studies has either focused on age stereotypes or subjective aging. This theoretical paper provides a systematic comparison of major theoretical approaches that offer explanations through which different views on aging may affect health. After a short review of findings on the short- and long-term effects of different views on aging, we describe theoretical approaches that provide explanations of underlying mechanisms for the effect of both uni- and multidimensional views on aging on health outcomes. We compare the specific characteristics of these approaches, provide a heuristic framework and outline recommendations for future research routes. A better understanding of the impact of different views on aging on health outcomes is not only relevant for basic research in life-span developmental psychology, geropsychology and health psychology, it has also implications for intervention research and public health practices.

Keywords

Age stereotype; Subjective age; Self-perceptions of aging; Views on aging; Health; Pathways

Introduction

Whenever individuals think about their own aging, about being old, or old people as a group, they are more likely to think of decline and losses than of gains and growth (Heckhausen, Dixon, & Baltes, 1989; Hummert, 2011). These losses can refer to physical or psychological changes (e.g., having wrinkles, having chronic diseases or disabilities, becoming forgetful), personality traits (e.g., being or becoming more rigid), social losses (e.g., death of a spouse or close friends), or behavioral tendencies (e.g., being or becoming dependent on others). In

*Corresponding author at: Institute of Psychogerontology, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Kobergerstrasse 62, 90408 Nürnberg, Germany. susanne.wurm@fau.de (S. Wurm).

comparison, gains and growth can, for example, refer to increase in freedom, patience, dignity, sense of maturity or wisdom associated with aging (Heckhausen et al., 1989). Do such gain- and loss-related views on aging and old age contribute to the understanding of the great interindividual differences in how individuals age? For the past 20 years or so, a large body of experimental and longitudinal work has shown that individuals' views on aging make a significant difference for how healthy and long they live (for meta-analyses see Lamont, Swift, & Abrams, 2015; Meisner, 2012; Westerhof et al., 2014).

In light of these well-replicated findings, researchers now face the task of understanding the pathways and mechanisms of how views on aging affect health and longevity. Existing meta-analyses and reviews have either focused on age stereotypes or subjective aging (i.e., self-perceptions of aging or subjective age). Now, as many studies have examined the connection between views on aging and health, it seems reasonable to undertake a joint reflection and systematic comparison of different conceptual approaches that refer to uni- or multidimensional measures of age stereotypes, self-perceptions of aging or subjective age. As the impact of views on aging on health is empirically well established, we now need to better understand the possible pathways and mechanisms by which different views on aging affect different health outcomes. The paper addresses and integrates what is currently known about possible pathways and what we still need to learn from future research.

Gaining a better understanding of the connection between views on aging and health outcomes is not only relevant for basic research in life-span developmental psychology, geropsychology and health psychology, but it also has implications for intervention research and public health practices. For example, promoting positive views on aging may facilitate the implementation of preventive health-promotion programs as recent studies suggest (e.g., Brothers & Diehl, 2017; Wolff, Schüz, Ziegelmann, Warner, & Wurm, 2015). Such approaches must be based on well-proven and robust conceptual frameworks regarding the mechanisms underlying the linkage between views on aging and health outcomes (Miche, Brothers, Diehl, & Wahl, 2015).

When we speak of health-related outcomes, we intentionally use a broad conceptualization of health, including physical, functional, cognitive, psychological as well as subjective health. Most studies investigating the connection between views on aging and health have only considered a single health outcome, but some studies have shown consistent findings for different health outcomes, such as physical and mental health (Wurm & Benyamini, 2014). Using a broad conceptualization of health might thus be beneficial in illuminating the processes and conditions under which views on aging exert their influence and to get a more comprehensive view on these processes.

For the sake of consistency and clarity, we will use the term *age stereotypes* when we speak of socially shared beliefs about the process of aging and about older people as a group. Whereas cultural age stereotypes refer to how older people are perceived and valued in a society, individuals also have personal age stereotypes; that is, they endorse certain but not all cultural stereotypes. If people apply these stereotypes to themselves they become self-stereotypes, and through this process of self-stereotyping cultural age stereotypes often exert their negative effects on individuals' behavior. In comparison, *subjective aging* refers to

individuals' experiences with their own aging process and the state of being old, including self-perceptions of aging, and feelings of subjective age. Thus, whereas age stereotypes that people apply to themselves are strongly influenced by societal views on aging, self-perceptions of aging are more based on own behavioral experiences as well as on a person's biography and personality. Subjective age may have an intermediate position: Older individuals may feel younger to protect themselves from environmental and social cues on aging, but subjective age also seems to be based on personal experiences with aging. Because age stereotypes and subjective aging are inseparably linked at the individual level, we treat them as a family of constructs for which we use the umbrella term *views on aging (VoA)*. The comparison of different VoA on health outcomes, however, can provide evidence about similarities and differences of their pathways to health-related outcomes.

In the following, we start our analysis with a brief overview of studies that have shown the impact of VoA on a variety of health outcomes. Second, we describe theoretical approaches that address the connection between different VoA and health outcomes, and systematically compare their strengths and limitations. Finally, we provide a heuristic framework and directions for further research routes.

Overview of research on views on aging and health-related outcomes

A considerable number of studies have examined the impact of age stereotypes or subjective aging on health-related outcomes. Experimental studies investigated the transient impact of a short-term activation of age stereotypes or subjective age on health-related outcomes, whereas longitudinal observational studies showed the long-term impact of VoA. In addition, a number of cross-sectional studies exist on the relation of VoA and health-related outcomes. However, the following sections focus on experimental and longitudinal observational studies, because they are better suited to speak to the causality and directionality of effects.

The impact of age stereotypes on health-related outcomes

Short-term activation of age stereotypes—Experimental studies, by definition and design, focus on the short-term activation of age stereotypes. Age stereotypes can be activated either implicitly by presenting primes with age stereotypic content (e.g., words, pictures, stories, quizzes) outside of participants' conscious awareness, or explicitly by presenting the primes openly and at the level of conscious awareness.

Starting in the late 1990s, Levy and colleagues found, for example, that priming older individuals with positive age stereotypes led to an increase in walking speed (Hausdorff, Levy, & Wei, 1999) and improved memory performance (Levy, 1996), whereas priming with negative stereotypes led to unsteadier handwriting (Levy, 2000), deterioration in postural stability and balance (Levy & Leifheit-Limson, 2009), as well as poorer memory performance (Levy, 1996). Most later experimental studies have been conducted in the cognitive domain, which is probably most strongly linked to stereotypes of age-related loss both in terms of memory (for a meta-analysis see Horton, Baker, Pearce, & Deakin, 2008) and cognitive performance in general (for a meta-analysis see Lamont et al., 2015). Both meta-analyses supported age-stereotype congruent effects.

In addition, psychological indicators of health are also susceptible to age-stereotype priming. Specifically, age stereotype congruency effects have been found for will to live (Levy, Ashman, & Dror, 1999; Marques, Lima, Abrams, & Swift, 2014) and dependency (Coudin & Alexopoulos, 2010), indicating that older people who were subliminally primed with negative stereotypes were more likely to turn down life-prolonging interventions in hypothetical medical situations and showed more frequent help-seeking behavior.

With regard to the overall effect of experimentally activated age stereotypes, the meta-analysis by Lamont et al. (2015) showed that more negative age stereotypes lead to less favorable behavior and performance (mean effect size $d = 0.28$). Positive age stereotypes seem to have a buffering function or even work in the opposite direction. Also, another meta-analysis showed a significant effect of age stereotypes on behavioral outcomes (partial $\eta^2 = 0.32$; Meisner, 2012). In addition, the study of Meisner (2012) pointed to an almost three times stronger impact of negative primes compared to positive primes, suggesting that negative stereotypes exert stronger effects on behavior, and possibly health, than positive ones. Thus, existing experimental research points to the role of age stereotypes for short-term health-related outcomes.

Long-term implications of age stereotypes—There is strong evidence for long-term effects of negative age stereotypes on different facets of health in later in life, even when controlling for other long-term predictors of health such as age, sex, education, physical status, self-rated health, and well-being. In a landmark study by Levy, Zonderman, Slade, and Ferrucci (2009), participants from the Baltimore Longitudinal Study of Aging (BLSA) who had more negative age stereotypes earlier in life were more likely to suffer from a cardiovascular event 38 years later compared to those with more positive age stereotypes. Furthermore, effects of age stereotypes on cognitive performance and respective biomarkers have repeatedly been supported. Levy's research group showed, among others, that individuals with more negative stereotypes developed worse memory performance over a 38-year time span than those with more positive age stereotypes (Levy & Leifheit-Limson, 2009; Levy, Zonderman, Slade, & Ferrucci, 2011). Another recent study based on BLSA showed that participants with more negative age stereotypes earlier in life had elevated counts of biomarkers related to Alzheimer's disease in a post-mortem brain autopsy (Levy et al., 2016).

Regarding other health-related outcomes, older individuals with more negative age stereotypes were more likely to experience a hospitalization (Levy, Slade, Chung, & Gill, 2014), had a lower likelihood to recover from disability (Levy, Slade, Murphy, & Gill, 2012), and showed a steeper hearing decline over a period of 36 months (Levy, Slade, & Gill, 2006). Besides physical health also psychological and subjective health are affected by age stereotypes. Emile and colleagues showed, for example, that negative age stereotypes at baseline were related to lower subjective perceptions of health over a 9-month period (Emile, d'Arripe-Longueville, Cheval, Amato, & Chalabaev, 2014). In addition, a study by Rothermund (2005) showed that participants with more negative age stereotypes at baseline had elevated depression scores four years later. Together, these studies indicate that age stereotypes also affect different facets of health in the long run.

The impact of subjective aging on health-related outcomes

Short-term activation of subjective aging—Compared to experimental research on age stereotypes, a smaller number of studies addressed subjective age, whereas self-perceptions of aging have not been considered. Several studies experimentally manipulated subjective age by experiences of visual disfluency (Eibach, Mock, & Courtney, 2010), experiences of generation gaps (Eibach et al., 2010), age stereotype priming (Kotter-Grühn & Hess, 2012; Weiss & Freund, 2012), memory tests (Hughes, Geraci, & De Forrest, 2013), or performance feedback (grip strength; Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). However, only one of these studies examined health-related effects of changes in subjective age: When older individuals were experimentally induced to feel younger, they showed a significant increase in grip strength (Stephan et al., 2013), which is a robust predictor of disability in old age (e.g., Rantanen et al., 1999).

Long-term implications of subjective aging—Although the effect of subjective age on health-related outcomes has rarely been examined in experimental studies, there is more evidence on the long-term consequences of subjective aging on health and mortality. Three recent reviews of the literature examined the existing evidence regarding the influence of subjective aging variables on different health outcomes (Kotter-Grühn, Kornadt, & Stephan, 2016; Warmoth, Tarrant, Abraham, & Lang, 2016; Westerhof & Wurm, 2015). Integrating studies that investigated the longitudinal effects of self-perceptions of aging and subjective age on health and mortality of older adults, a recent meta-analysis found equally strong effects in the medium range of effect sizes for both kinds of measures (Westerhof et al., 2014). Individuals who perceived their own aging as more favorable or felt younger than they actually were, stayed in fact more healthy (e.g., Spuling, Miche, Wurm, & Wahl, 2013; Wurm, Tesch-Römer, & Tomasik, 2007; Wurm, Tomasik, & Tesch-Römer, 2008). Moreover, individuals with more positive self-perceptions of aging showed improved functional health and physical performance, such as walking speed (e.g., Robertson & Kenny, 2015; Sargent-Cox, Anstey, & Luszcz, 2012), and lived longer than those with more negative self-perceptions of aging or higher subjective age (e.g., Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Levy & Myers, 2005; Rippon & Steptoe, 2015; Sargent-Cox, Anstey, & Luszcz, 2014). To illustrate this, in a classic study by Levy, Slade, Kunkel, and Kasl (2002) adults who had more positive self-perceptions of aging lived, on average, 7.5 years longer than individuals with more negative self-perceptions of aging. This effect persisted after controlling for relevant covariates. Interestingly, this effect was also larger than the gain in years of life known from other studies for physiological measures (e.g., low cholesterol or systolic blood pressure), or health behavior (e.g., lower body mass index, no history of smoking, tendency to exercise). In addition, two recent longitudinal studies suggest that feeling older increases the risk for overnight hospitalization of older adults while positive self-perceptions of aging are associated with a lower risk for overnight hospitalization (Stephan, Sutin, & Terracciano, 2016; Sun, Kim, & Smith, 2017).

Finally, subjective age and self-perceptions of aging also have effects on cognitive abilities and psychological health. Focusing on episodic memory as well as executive abilities, Stephan, Caudroit, Jaconelli, and Terracciano (2014) showed that younger subjective age was linked to better cognitive performance 10 years later. In addition, a number of recent

studies up to twelve years have shown that negative self-perceptions of aging are associated with lower cognitive performance (Robertson, King-Kallimanis, & Kenny, 2016; Seidler & Wolff, 2017; Siebert, Wahl, & Schröder, 2016). Freeman et al. (2016) examined the impact of self-perceptions of aging on mental disorders over a period of about 2.5 years and confirmed the role of negative self-perceptions of aging for the development and persistence of depressive symptoms and anxiety.

Taken together, experimental studies have consistently provided evidence for short-term consequences of individuals' VoA, whereas a number of longitudinal studies were able to demonstrate that VoA can also have far-reaching effects on physical or psychological health, cognitive performance, and longevity. In order to identify the common and varying mechanisms by which age stereotypes and subjective aging lead to health effects, the next section compares different theoretical frameworks that provide explanations why, when and how age stereotypes and subjective aging may affect health-related outcomes.

Explaining effects and understanding underlying mechanisms

Since the 1990s, several theoretical approaches were developed to explain why and when VoA can exert deleterious or protective effects (Diehl, Wahl, Brothers, & Miche, 2015). In the following we will focus our discussion to theoretical approaches and empirical findings that provide explanations for the effect of age stereotypes or subjective aging on health-related outcomes. Some of these approaches explicitly address the role of multidimensional VoA by distinguishing between different gain- and loss-related, or domain-specific, VoA. As this differentiation might contribute to the understanding of how VoA affect health, we describe these approaches and findings in separate sections.

Concepts and findings on the pathways of age stereotypes to health-related outcomes

Stereotype threat theory—Stereotype Threat Theory (Steele & Aronson, 1995) was the first that provided explanations on how stereotype activation can affect health-related outcomes in the short term. The theory was developed in the context of experimental studies on racial stereotypes and refers to any group about whom stereotypes exist. According to this theory, people fear to confirm and thus being reduced to the negative stereotypes that exist in society about their group: this fear interferes with everyday tasks and thereby leads to a poorer functioning on these tasks (Steele, 1997). For example, the fear of being seen as old would interfere with a cognitive task by lowering performance expectations or by disrupting strategy use (Chasteen, Kang, & Remedios, 2012). The task is subsequently less well performed which in turn confirms the stereotype.

Age-related stereotype threat is usually induced by either fact-based manipulations (i.e., factual statements about age-group differences or age-related decline) or stereotype-based manipulations (i.e., statements reflecting what most people think about aging or old age; Lamont et al., 2015). Such experimental manipulations intend to explain when and how age stereotypes lead to lower performance in older adults. A meta-analysis on the effects of age-based stereotypes showed significant effects of stereotype threat on the physical and cognitive performance of older people (effect size of 0.28; Lamont et al., 2015), thus providing support for the effect of stereotype threat in this realm. Effects were small to

medium though, and according to Zebrowitz (2003), older people may be able to inoculate themselves against the negative effects of stereotype threat by having younger self-perceptions. Consequently and in line with research on other stereotypes (e.g., gender; Schmader, 2002; Schmader, Johns, & Forbes, 2008), stereotype threat has been shown to lead to stronger effects for people that identify more strongly with their age group (Kang & Chasteen, 2009; O'Brien & Hummert, 2006). For example, a recent study suggests that inducing stereotype threat about age-related hearing decline affects subjective hearing abilities of older individuals (i.e., those in their late 50s or 60s), but not that of younger individuals (Barber & Lee, 2016). Other studies also suggest that stereotype threat might be more salient and threatening for young-old people entering the life stage of "old age" because their association with the group of older persons is still ambiguous (Barber & Mather, 2014). For old-old individuals, however, stereotype threat could play a weaker role, possibly because they think they already match the stereotype (Eich, Murayama, Castel, & Knowlton, 2014; Hess & Hinson, 2006). Taken together, stereotype threat theory can explain when stereotypes exert short-term effects on health-related outcomes. People have to become aware of the stereotype and need to recognize that they belong to the stereotyped group in order to elicit fear.

Stereotype embodiment theory—Stereotype embodiment theory takes a lifespan perspective on the development and impact of both negative and positive age stereotypes on individual aging processes. That is, the theory recognizes that individuals internalize positive and negative stereotypical beliefs about aging and older persons from early childhood on (Levy, 2009). As these stereotypes first apply to another than the own age group, for a long time in life there is no psychological need to scrutinize their content or defend against them.

Rather, these age stereotypes are continuously reinforced over time because individuals are continuously exposed to the age stereotypes of their culture (North & Fiske, 2015). Yet, as individuals grow older, age stereotypes become increasingly self-relevant (Rothermund, 2005). Rothermund and Brandtstädter (2003), for example, showed that the content of age stereotypes was internalized into adults' current self-concepts over a period of eight years. That is, as participants got older, their self-representations turned more into the direction of the age stereotypes they held earlier in life. This finding that was corroborated by a study of Kornadt, Voss, and Rothermund (2017), providing further support that age stereotypes increase in self-relevance as individuals grow older.

Two meta-analyses on the effects of age-based stereotypes provided support for stereotype embodiment theory, showing that positive and negative stereotype priming affected memory performance and other behavioral outcomes (e.g., psychomotor skills such as gait speed, walking time or handwriting) of older people (effect sizes of 0.38 and 0.32, respectively; cf. Horton et al., 2008; Meisner, 2012). Besides experimentally induced short-term effects, internalization of age stereotypes can also have long-term effects on health-related outcomes (e.g., Levy et al., 2012).

Levy (2009) proposed three possible pathways by which age stereotypes exert their influence: physiological processes, behavioral pathways, and psychological mechanisms. The *physiological pathway* assumes that negative age stereotypes contribute to an increase in

psychological stress, which is reflected in a physiological stress response that can affect multiple organ systems; in turn, this might have negative effects on health. Experimental studies have shown impressive short-term effects of age stereotype manipulations on objective indicators of cardiovascular health: Priming people with negative age stereotypes induced cardiovascular stress responses, such as elevated blood pressure and heart rate (Auman, Bosworth, & Hess, 2005; Levy, Hausdorff, Hencke, & Wei, 2000; Levy et al., 2008; Weiss, 2016), whereas positive stereotypes ameliorated this effect (Levy et al., 2000). In addition, two longitudinal studies have examined long-term effects of age stereotypes on stress response. One study showed the long-term cortisol level of older people was lower if they held more-positive age stereotypes (Levy, Moffat, Resnick, Slade, & Ferrucci, 2016), whereas the other suggests that negative age stereotypes are associated with shorter telomere length, which is considered a marker of accelerated cellular aging (Pietrzak et al., 2016).

The *behavioral pathway* assumes that people with more positive age stereotypes are healthier, have higher life satisfaction, and live longer due to their engagement in preventive or health-promoting behaviors. An experimental study by Coudin and Alexopoulos (2010) indicated that older individuals who were subjected to negative stereotype activation more often asked for help with a puzzle task than those in a neutral or positive condition. According to the authors, the manipulation increased help-seeking behavior and might point to increased feelings of helplessness and dependency, but also to a higher deliberate use of secondary control strategies.

The third pathway relates to *psychological mechanisms*. In this context, Levy (2009) refers to the concept of “self-fulfilling prophecies” which traces back to Merton (1948). It assumes that a false definition of a prospective situation becomes an integral part of the situation and thus affects subsequent developments. Translated into the context of age stereotypes this could mean, for example, that negative age stereotypes may keep individuals from engaging in behaviors that would otherwise be good for them, because these stereotypes undermine psychological resources (Wurm & Schüz, 2015). By doing so, negative VoA may lead to outcomes that have been dreaded in the first place.

Several studies examined the role of psychological resources as potential mediator or moderator to understand how age stereotypes might turn into a self-fulfilling prophecy for health-related outcomes. With regard to mediators, experimental research has shown that negative age stereotypes decreased mathematical and memory self-efficacy as well as will to live and thereby cognitive function, health, and survival (Levy, 1996; Levy et al., 1999, 2000). Psychological resources have also been examined as moderator. A recent experimental study on negative age stereotypes showed that older people had lower memory performance and higher blood pressure if they believed in the inevitability rather than the modifiability of aging (Weiss, 2016). Similar results were reported by Plaks and Chasteen (2013), indicating that beliefs about the malleability of age-related changes influence the effects of stereotypes on outcomes.

Multidimensional approaches to age stereotypes: Stereotype matching—Many previous studies on age stereotypes were based on a unidimensional approach of VoA, placing adults’ perceptions on a good-bad or positive-negative continuum. As part of the

stereotype embodiment theory, the *stereotype matching effect* (Levy & Leifheit-Limson, 2009) goes beyond this approach and refers to the assumption that stereotypes in a certain life domain should have a stronger effect if their content matches the outcome domain. Levy and Leifheit-Limson (2009) subliminally primed older adults with stereotypes in the physical vs. cognitive domain, and found that priming effects on participants' performance (physical task vs. cognitive task) were substantially stronger when the stereotype content and behavioral domain matched. In two cross-sectional studies, Meisner and colleagues found that the association between general (i.e. not self-related) expectations regarding aging and old age and health-related outcomes was dependent on the type of aging expectations (Meisner & Baker, 2012; Meisner, Weir, & Baker, 2013). For example, only a subscale that referred to physical aging expectations was correlated with physical activity in older adults whereas this was not the case for subscales on mental and cognitive health (Meisner et al., 2013). These findings have implications for the conceptualization, measurement and pathways of views on aging, as they suggest that domain-specific VoA may help to understand which views may affect which kind of health-related outcomes.

Concepts and findings on the pathways of self-perceptions of aging to health-related outcomes

When M. Powell Lawton developed a new scale to measure morale in old age during the 1970s, he aimed at complementing existing unidimensional morale scales by a new multidimensional scale, including attitudes toward own aging, agitation and lonely dissatisfaction (Lawton, 1975). The attitudes toward own aging subscale (ATOA) of Lawton's Philadelphia Geriatric Morale Scale (PGCMS) has provided the basis for a number of studies examining the impact of self-perceptions of aging on health and longevity (Westerhof et al., 2014). A conceptual framework of pathways of self-perceptions of aging on health and mortality has been described in the stereotype embodiment theory. According to this theory, age stereotypes are internalized and shape self-perceptions of aging. Thus, this theoretical framework allows also describing mechanisms and pathways by which self-perceptions of aging contribute to specific health outcomes. The following findings are based on the unidimensional ATOA scale reflecting adults' perceptions on a positive-negative continuum.

The *physiological pathway* was examined by a study that measured the effect of self-perceptions of aging on cortisol level of older adults on two consecutive days (Sindi et al., 2012). This study, however, could only find marginal effects which might have been due to the small sample size and short time interval of the study. More support for the validity of the physiological pathway comes from recent findings based on the Health and Retirement survey showing that C-reactive protein, a biomarker of inflammation, partially mediated the relationship between self-perceptions of aging and longevity over a six-year period (Levy & Bavishi, 2016). Another study based on the ATOA scale has provided support for the *behavioral pathway* of self-perceptions of aging to health. According to a study of Levy and Myers (2004), positive self-perceptions of aging predicted more preventive health behaviors over a period of two decades. Finally, also *psychological mechanisms* for the long-term impact of self-perceptions of aging on health could be identified. Levy showed that people with more positive self-perceptions of aging perceived higher control four years later which

was linked to better functional health within the next sixteen years (Levy, Slade, Kunkel et al., 2002). Another study pointed to the impact of positive self-perceptions of aging on higher longevity, whereas will to live mediated this relationship partially (Levy, Slade, & Kasl, 2002). In addition, self-perceptions of aging were examined as mediator between personality traits and depressive symptoms; especially, higher neuroticism was associated with more negative self-perceptions of aging, which, in turn, was associated with more depressive symptoms (O'Shea, Dotson, & Fieo, 2016). All three pathways are therefore empirically supported for the unidimensional concept of self-perceptions of aging.

Multidimensional approaches to self-perceptions of aging: Age-related gains and losses

Like age stereotypes, self-perceptions of aging can be both positive and negative, referring to aging-related losses, such as physical or social losses, as well as to gains, such as more liberties and time for new interests (Connidis, 1989; Keller, Leventhal, & Larson, 1989; Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001). For this reason, self-perceptions of aging have been increasingly conceptualized as *multidimensional constructs* (Diehl et al., 2014; Kornadt & Rothermund, 2015; Steverink et al., 2001; Wurm et al., 2007). In this way, self-perceptions of aging can better reflect the multidirectionality and multidimensionality that is inherent in adult development and the aging process (Baltes, 1987) as the specific impact of gain- and loss-related VoA on health can be considered.

Although some large-scale longitudinal studies have conceptualized self-perceptions of aging as multidimensional, only the concept of *Awareness of Age-Related Change* (AARC) provides a theoretical framework that explicitly focuses on multidimensionality. AARC was a priori conceptualized as a multidimensional and multidirectional construct that draws on middle-aged and older adults' actual behavioral experiences and perceptions in key behavioral domains (Diehl & Wahl, 2010; Diehl et al., 2014; Kornadt & Rothermund, 2011; Steverink et al., 2001). The concept of AARC is rooted in a phenomenological and action-theoretical tradition (Brandtstädter, 1999; Ryff, 1984). Diehl and Wahl (2010) defined AARC as "…all those experiences that make a person aware that his or her behavior, level of performance, or ways of experiencing his or her life have changed as a consequence of having grown older (i.e., increased chronological age)" (p. 340). AARC focuses specifically on five life domains: health and physical functioning; cognitive functioning; interpersonal relations, social-cognitive and social-emotional functioning; and lifestyle and engagement. Both positive and negative changes are considered for each domain, resulting in two overarching, cross-domain factors representing gain- and loss-related experiences. Regarding potential mechanisms, the concept of AARC assumes that awareness and processing of age-related change contributes to self-regulation of behavior and personal meaning making which for their part affect health-related outcomes. Whereas some multidimensional measures such as AARC and also the AgeCog scales (Steverink et al., 2001; Wurm et al., 2007) refer to the individual's present or past experiences, other studies have included future self-views, which comprise domain-specific expectations, hopes, and fears about how one will be and lead one's life in old age (Kornadt, Voss, & Rothermund, 2015; Sarkisian, Hays, Berry, & Mangione, 2002; Voss, Kornadt, & Rothermund, 2017).

The three pathways suggested in the Stereotype Embodiment Theory could also apply to multidimensional concepts of self-perceptions of aging. Whereas the *physiological pathway* has not been examined so far, the *behavioral pathway* was supported by two longitudinal studies, using the AgeCog subscale on the gain-related view of aging as ongoing development. One of these studies showed that a more gain-related view on aging led to more physical activity in a sample covering the age span from midlife to old age (Wurm, Tomasik, & Tesch-Römer, 2010), a finding which was complemented by another longitudinal study corroborating the mediating role of physical activity in the link between this self-perception of aging and health (Beyer, Wolff, Warner, Schüz, & Wurm, 2015).

Other studies provided support for the *psychological pathway of multidimensional self-perceptions of aging*. Dutt, Gabrian, and Wahl (2016) found in a longitudinal study over a period of 2.5 years that the association between perceived AARC gains and change in depressive symptoms was moderated by developmental regulatory strategies, i.e., assimilation and accommodation (Brandtstädter & Renner, 1990). When perceived gains were low, fewer increases in depressive symptoms were reported when accommodation was high, that is, when individuals showed a higher flexibility in "changing the self" strategies (Brandtstädter & Rothermund, 2002). Another longitudinal study pointed to the detrimental impact of a loss-related VoA (i.e. viewing aging as associated with physical losses) on physical and mental health. However, higher optimism buffered this detrimental effect (Wurm & Benyamini, 2014). Finally, a six-month longitudinal study on older adults found that a loss-related VoA moderated the effect of a serious health event on the use of SOC-strategies. That is, in case of a serious health event, the perception that aging is associated with physical losses led to lower use of SOC strategies promoting a healthy lifestyle (Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). So far, only few studies have examined the pathways of loss- and gain-related self-perceptions of aging on health which is why the question is still open whether it is similarly detrimental to health if individuals associate aging with losses and or if they do not associate aging with further gains. A cross-sectional study of Brothers, Miche, Wahl, and Diehl (2015) suggests that a loss-related view might be more detrimental to health. In this study, AARC mediated the association between global measures of subjective aging and functional health as assessed by the SF-36 (Ware et al., 2007). That is, holding more negative self-perceptions of aging was associated with greater AARC losses, which, in turn, was associated with poorer functional health. Remarkably, this association was considerably stronger compared to the association with AARC gains (Brothers et al., 2015).

Approaches to subjective age: Uni- and multidimensional concepts and age group dissociation

Drawing on the cultural maxim that "one is only as old as one feels," subjective age has mainly been studied using a single item on subjective age: "What age do you feel?" (Barak & Stern, 1986; Peters, 1971). Age identity is then operationalized as the difference between the person's subjective and chronological age (Westerhof, Barrett, & Steverink, 2003). This score is often additionally divided by chronological age to account for the fact that older people can feel much younger than younger people, i.e. an 80 year old person can feel 30 years younger than their actual age which is rather unlikely for a younger person aged 31

(Rubin & Berntsen, 2006). Besides this unidimensional concept of subjective age and age identity, other approaches have emphasized the multidimensional nature of subjective age by differentiating between felt age, look age, and act age (Kastenbaum, Derbin, Sabatini, & Artt, 1972), or physical, psychological, and social age (Montepare, 1996). Montepare (2009) has developed a subjective age framework in order to understand better when and why individuals feel younger or older than their actual age throughout the lifespan. She posits that age markers, triggered by historical, physical, normative or social events, may explain changes and variations in subjective age.

Several studies on subjective age have also addressed possible pathways through which feeling younger or older can exert effects on health-related outcomes. Based on data of the Health and Retirement Study (HRS), Stephan and colleagues addressed a possible *physiological pathway* by showing that younger subjective age was associated with lower C-reactive protein; however, this association was only shown based on cross-sectional data (Stephan, Sutin, & Terracciano, 2015c). Other studies have considered *behavioral pathways*, especially engagement in physical activity. Based on two longitudinal studies, the same research group (Stephan, Sutin, & Terracciano, 2015a) examined the impact of feeling younger on walking speed and observed that feeling younger was not only associated with faster walking speed but also with lower decline in walking speed over time. Using data from the Midlife in the United States Survey (MIDUS), Stephan and colleagues showed that a younger subjective age was associated with better cognitive functioning 10 years later, partially mediated by Body Mass Index and level of physical activity (Stephan et al., 2014). In an online survey with two measurement points four weeks apart, Wienert and colleagues used a domain-specific measure for subjective age ("How old do you feel physically?") and showed that feeling physically younger predicted higher physical activity (Wienert, Kuhlmann, & Lippke, 2015).

Finally, also *psychological mechanisms* were considered in studies on subjective age. Again based on longitudinal data of the HRS, younger subjective age predicted lower cognitive decline, mediated by fewer depressive symptoms (Stephan, Sutin, Caudroit, & Terracciano, 2015). In addition, Wienert, Gellert, and Lippke (2015) point to the mediating role of planning in the pathway between feeling physically younger and physical activity. In conclusion, as this review of studies shows, pathways that have been suggested in stereotype embodiment theory both for age stereotypes and for self-perceptions of aging (Levy, 2009) seem to also apply to measures of subjective age.

In addition, subjective age can protect individuals against age-related stereotype threat. The concept of *age group dissociation* provides an explanation how individuals protect themselves. When asked whether they feel they belong to the group of older persons many older individuals say they do not (Weiss & Lang, 2009, 2012a, 2012b). In addition, older persons tend to compare themselves favorably to others of their age; that is, they dissociate from the own age group through downward social comparison (Ferring & Hoffmann, 2007; Frieswijk, Buunk, Steverink, & Slaets, 2004; Pinquart, 2002). Several studies point towards the role of age group dissociation for maintaining good health. For example, a study of short-term priming effects of television commercials on cognitive functioning in older adults only found such effects for those who identified with older people as a social group

(Westerhof, Harink, Van Selm, Strick, & Van Baaren, 2010). Other empirical studies have indicated that age group dissociation can have health-protective effects regarding self-rated health and memory as well as psychological health (e.g., Cheng, Fung, & Chan, 2008; Robinson-Whelen & Kiecolt-Glaser, 1997; Spini, Clémence, & Ghisletta, 2007; Spuling et al., 2013).

Comparison: Similarities and specific characteristics of different approaches

A number of theoretical approaches exist that may explain the pathways by which VoA affect health-related outcomes. As we elaborated above, commonalities and specific characteristics of these approaches can be classified along six key questions:

1. Does the approach consider age stereotypes, experiences of subjective aging, or both kinds of VoA?
2. Does the approach consider both positive and negative VoA?
3. Does the pathway operate at the level of conscious or unconscious processes?
4. Does the approach refer to short-term effects and/or long-term effects of VoA on health-related outcomes?
5. Are VoA predominantly seen as unidimensional or multidimensional?
6. Does the approach include a lifespan perspective?

Stereotype threat theory provides explanations for the impact of negative age stereotypes, but does not provide explanations regarding the impact of *positive* age stereotypes, even though there are some studies that have provided evidence for better performance of older adults when positive stereotypes were made salient (cf. Popham & Hess, 2015; Swift, Abrams, & Marques, 2013). Recent studies also point to the positive effects of negative stereotypes on performance in case of matching regulatory fit (e.g., Barber & Mather, 2013). However, the effects are still unclear and not as theoretically and empirically supported as those for negative effects. Stereotype threat is assumed to occur on a conscious level. This reasoning implies that individuals need to recognize that they belong to the stereotyped group and also recognize the applicability of the stereotype to their performance. Stereotype threat is assumed to operate mostly through motivational mechanisms, including emotional components, which differs from the more “cold” processes underlying stereotype priming effects that depend on the activation of the cognitive content of the stereotype (Lamont et al., 2015; Popham & Hess, 2017). Furthermore, this approach is limited to short-term effects of stereotypes and does not make any references to long-term effects, for example, on cognitive performance in the long run. There are indications, however, that there might be long-term consequences as well. Because threat effects have sometimes been found to be especially strong when people from the stereotyped group strongly identify with the domain that is threatened by the stereotype (Hess, Auman, Colcombe, & Rahhal, 2003), it is assumed that repeated exposure to stereotype threat might lead to long-term disengagement from the respective domain (Woodcock, Hernandez, Estrada, & Schultz, 2012). Furthermore, mechanisms underlying stereotype threat might change with age (Popham & Hess, 2015), highlighting the importance of a life-span approach for future research.

Stereotype Embodiment Theory refers, different from stereotype threat theory, both to age stereotypes and self-perceptions of aging. According to this theory, age stereotypes can operate consciously and unconsciously because age stereotypes are internalized from childhood on and lead to an increasing likelihood of self-stereotyping over the life course, which illustrates the lifespan concept of this approach. Stereotype embodiment can have both short-term and long-term consequences for health-related outcomes. Short-term priming effects differ from stereotype threat effects, mainly through the mechanisms that are in operation. The outcomes, however, might be similar, leading to compromised performance in older adults, for whom the stereotype is self-relevant (Barber & Mather, 2014). Finally, the stereotype matching effect complements the stereotype embodiment theory by explicitly addressing a multidimensional perspective.

Uni- and multidimensional approaches to self-perceptions of aging refer to personal (positive and negative) experiences of subjective aging and share the assumption that VoA operate on a conscious level. Approaches to self-perceptions of aging include a lifespan perspective and refer to long-term effects on health while no study so far has examined self-perceptions of aging in an experimental setting. Unidimensional approaches, mostly based on the ATOA scale have been used predominantly whereas more recent studies have also included gain- and loss-related VoA.

Finally, *subjective age and age group dissociation* refer to experiences of subjective aging – often against the background of age stereotypes. How old individuals feel can differ for different domains such as physical or social age and this can both have short- and long-term health consequences. The ability to consciously dissociate from the own age group may reflect an inoculation of the self against negative age-related perceptions and experiences and therefore against negative effects of age stereotypes (Zebrowitz, 2003). This approach might be limited to situations, where the resources to dissociate from one's own age group are given, and it might reach its limits when actual circumstances make an age group-dissociation impossible (Rothermund, 2005). Hence, stereotype threat can have an effect only if individuals identify with the own group, and age group dissociation serves to defend the individual against this identification (cf. Haslam et al., 2012; Kang & Chasteen, 2009).

Taken together, the different approaches have some commonalities but also specific characteristics, and depending on these characteristics, different pathways have been proposed. All approaches specifically contribute to a better understanding of the pathways through which VoA affect health outcomes in later life. Nevertheless, an overall evaluation of these approaches makes clear, that a number of questions are still open and further empirical insight is needed in order to better understand how VoA affect health-related outcomes.

Moving forward in the understanding of pathways for the views on aging-health connection: a heuristic framework and future research routes

The preceding discussion suggests that greater differentiation within approaches and also more specific considerations in terms of bridge-building elements between approaches are needed to advance this area of psychological aging research. In this section, we suggest

future research routes on two levels: First we introduce a model that aims at spelling out possible pathways among key constructs contributing to health-related outcomes. Second, we spell-out needed concrete research efforts that may help to strengthen the emerging evidence on pathways linking VoA and health-related outcomes.

A heuristic framework to establish most important pathways

With the framework shown in Fig. 1, we assume that not all constructs on VoA operate at the same level but that differentiation is needed and will facilitate the understanding of the nature of pathways among VoA and health outcomes. In this framework we suggest that age stereotypes and self-perceptions of aging should be seen as superordinate constructs that have direct impact on health outcomes. Existing studies have shown that age stereotypes affect self-perceptions of aging more than vice versa (e.g., Rothermund & Brandtstädter, 2003). Also, age stereotypes and self-perceptions of aging seem to have a direct impact on subjective age. That is, more negative age stereotypes and self-perceptions of aging go along with a smaller discrepancy between chronological and felt age (Bodner, Ayalon, Avidor, & Palgi, 2016; Kornadt, Hess, Voss, & Rothermund, 2016; Kotter-Grühn & Hess, 2012; Weiss & Freund, 2012). As has also been found in the meta-analysis of Westerhof et al. (2014), the impact of age stereotypes and self-perceptions of aging on health-related outcomes is of similar size as compared to the connection between subjective age and health.

In addition, we assume that VoA always operate in the context of efforts of the aging individual to be as much as possible a producer of his or her own development (Baltes, Lindenberger, & Staudinger, 2006; Brandtstädter & Renner, 1990; Heckhausen, Wrosch, & Schulz, 2010; Lerner & Busch-Rossnagel, 1981). Further, the previous literature also suggests that personality should play a role, when it comes to the interplay between VoA and health-related outcomes (Allen, Mejia, & Hooker, 2015; Kornadt, 2016; Stephan, Sutin, & Terracciano, 2015b). As has been shown by a number of studies, developmental regulation and personality are linked with health outcomes (e.g., Grande, Romppel, & Barth, 2012; Löckenhoff, Terracciano, Ferrucci, & Costa, 2012; Wrosch & Schulz, 2008). Finally, we assume that personality and developmental regulatory strategies bring a more individual and conscious element into the ‘chain of processing’ involving VoA thereby attenuating the influence of subconscious processes.

Future research needs on direct pathways between views on aging and health outcomes

In the following we outline six future research needs that could contribute to a better understanding of the pathways of VoA on health-related outcomes.

Linking different VoA in research on health-related outcomes

Existing research on the impact of VoA on health-related outcomes has usually examined either the role of age stereotypes or subjective aging on health. Only one study suggests that age stereotypes might partially affect health through self-perceptions of aging (cf. Levy, Pilver, Chung, & Slade, 2014). Future studies should aim at jointly considering the role of age stereotypes and subjective aging for different health outcomes in order to better understand the specific impact of age stereotypes, self-perceptions of aging and subjective age on health-related outcomes as well as the chain to health-related outcomes (see Fig. 1).

For example, does the impact of age stereotypes on health become less important with increasing age if self-perceptions of aging are also taken into account? This question seems reasonable because age stereotypes and self-views assimilate in later life and it is important to know if they have an effect over and beyond self-perceptions of aging. Also, which health outcomes are more affected by age stereotypes and which are more affected by self-perceptions of aging? Do age stereotypes and self-perceptions of aging vary regarding their pathways to health-related outcomes? A joint examination of different concepts can help to disentangle the impact of different types of VoA on health.

Linking pathways with subconsciously and consciously processed views on aging

Related to a better understanding of multiple pathways is the distinction between subconscious and conscious processes (see again Fig. 1). That is, processes that work below individuals' threshold of awareness (e.g., Levy, Pilver et al., 2014, induced by implicit priming) and processes individuals are aware of and can therefore defend against or reflect about. With a view to practical implications, future research should thus try to better understand under which circumstances interventions aiming at changing VoA should tackle subliminal processes (Levy, Pilver et al., 2014), and when it is equally or more effective to intervene on a more conscious level (Brothers & Diehl, 2017; Sarkisian, Prohaska, Davis, & Weiner, 2007; Wolff, Warner, Ziegelmann, & Wurm, 2014).

Future research could also examine the pathways of conscious and subconscious VoA. Do subconscious VoA, for example, more strongly affect physiological pathways, whereas conscious VoA more strongly affect psychological and behavioral processes? Physiological parameters have so far mostly shown to be influenced by age stereotype related constructs.

And, does subliminal priming have stronger effects on health than conscious awareness of age-related change because individuals cannot defend against subconscious influences? Conscious and subconscious processes go likely hand in hand in producing long-lasting effects on health, but their interdependency has not been investigated systematically yet.

Second, we argue that future research needs to consider both subconscious (i.e., implicit) *and* conscious (i.e., explicit) processes in a more unified approach. The concept of AARC (Diehl & Wahl, 2010; Diehl et al., 2014) argues that older adults are not only the passive victims of negative age stereotypes at the subconscious level, but are in a self-reflective way involved in developing their VoA over time based on their active perceptions and experiences (cf. Kornadt et al., 2017; Rothermund & Brandtstädter, 2003). This very likely also includes that VoA themselves change over time and are the function of a number of influences, including feedback from the social environment and the person's actual behaviors and experiences. Thus, we predict in our conceptual model that the impact of negative age stereotypes may vary depending on the utilization of self-regulatory strategies.

Adding differentiation to the understanding of pathways between VoA and health-related outcomes

Previous studies have provided support for the physiological, psychological and behavioral pathways suggested in stereotype embodiment theory. These pathways are not explicitly depicted in Fig. 1 as we aimed at keeping this heuristic framework as simple as possible. In

previous sections, however, we have described the pathways to health-related outcomes that were shown in empirical studies on age stereotypes, self-perceptions of aging and subjective age. Regarding physiological pathways, more clarification is needed in terms of which physiological processes are involved and which might be more important than others over longer time intervals. Most findings on physiological pathways have been based on experimental and cross-sectional studies, whereas only one longitudinal study so far has examined proinflammatory cytokine production (C-reactive protein) as mediator in the relationship between self-perceptions of aging and longevity (Levy & Bavishi, 2016). Additional longitudinal studies would help to better understand which (other) physiological mechanisms are able to explain long-term effects of age stereotypes and subjective aging on health, and longevity. Overall, we suggest stress-related pathways need more longitudinal research in the future because they are crucial for the explanation of health outcomes in the physical, psychological, and cognitive health domain. Future studies should develop clear models that hypothesize how stress-related pathways actually work in causal terms.

In addition, future research should also take a closer look at different behavioral pathways. One clarifying differentiation would be the one between healthy lifestyles, preventive health care, and traditional health-risk behaviors. Existing studies have mainly focused on preventive health care and health behavior. It would be desirable to broaden the understanding of healthy lifestyles to activities and interests that are also related to health, like volunteering (Warburton & Peel, 2008), work in retirement (Zhan, Wang, Liu, & Shultz, 2009), or engagement in other activities and goals, such as social media or later-life educational programs (for a first attempt with regard to preparation for age-related changes in different life domains, see Kornadt et al., 2015). Traditionally studied risk behaviors, such as tobacco smoking, poor nutrition, or sedentary behavior, also deserve more attention as they tend to be persistent lifestyle factors whose predictive relevance has been very much established in epidemiological research. For example, it could be that more gain-related views of one's aging and positive expectations for the future may facilitate the motivation to stop smoking or to give up unhealthy eating habits, whereas loss-related views might discourage from using primary health care. Overall, we argue that more evidence is needed to establish that gain- and loss-related VoA are differentially related to protective and risk-increasing pathways. Therefore, risk and resilience factors have to be examined simultaneously. Moreover, it should be examined whether all loss-related VoA keep adults from engaging in health-promoting behaviors: Arguably, views on aging are most important in undermining health-promoting behavior if they refer to aging as involving inevitable decline and loss, being outside a person's control, and being irreversible.

The psychological pathway also needs further elaboration and differentiation. So far, studies on psychological pathways have mainly focused on motivational processes, such as control or self-efficacy beliefs. Motivational processes should be differentiated from defensive, self-protective reactions of the aging self, such as age group dissociation. The former might stimulate health-promoting activities, due to feelings of internal control and due to good role models, but could at the same time lead to feelings of resignation if the role model sets an impossibly high standard. In contrast, age group dissociation might better serve self-protection, in particular when uncontrollable and inevitable changes have to be accepted. In addition, recent studies have started to elucidate the link between VoA and personality

(Allen et al., 2015; Kornadt, 2016; Stephan et al., 2015b). The orchestration of the psychological pathway by the personality system (see also Baltes et al., 2006) needs more conceptual clarification. The psychological pathway of self-fulfilling prophecies (Levy, 2009) might also depend on an individual's personality. For example, a person scoring high in neuroticism is probably more likely to have negative expectations towards his or her future aging than a person low in neuroticism. Overall, it seems clear to us that we need more long-term evidence on the role of the personality system with regard to the linkage between VoA and health-related outcomes.

Differential pathways related to positive and negative age stereotypes/subjective aging

The simplified representation of age stereotypes and related constructs as done in our model (Fig. 1) needs closer examination, not only in its chain to health-related outcomes, but also in its valence. In particular, future studies should aim at better understanding when it is more important not to have loss-related views on aging and when it is more important to have gain-related VoA (e.g., positive age stereotypes). For example, studies on self-rated health suggest that older people often subjectively rate their health as good even when faced with various health problems (Pinquart, 2001). Due to the negative view that aging is associated with physical losses, individuals might be mentally prepared for losses that are associated with increasing age and thus might be better able to cope with them. However, findings on negative VoA clearly point to a harmful impact of these views on different health-related outcomes. We therefore need to better understand when it might be advantageous to have realistic, loss-related VoA and under which circumstances negative views become detrimental to health.

With regard to interventions it is an important question whether an intervention should focus on reducing negative VoA that are based on outdated notions of age and aging, or whether primarily positive VoA should be promoted. Meisner (2012) documented a three-time stronger effect of negative age stereotypes on behavior within experimental studies compared to positive primes; but only future studies in real-life contexts can reveal whether this applies in similar ways to long-term effects of age stereotypes and self-perceptions of aging on health. In addition, positive and negative age stereotypes as well as subjective aging might also attenuate or amplify other health-relevant factors. This has been shown, for example, in a study by Wurm et al. (2013), in which a greater loss-related view on aging led to a smaller increase in the use of health promoting strategies after a serious health event compared to those with a lower loss-related view.

Role of multi-dimensional VoA for the consideration of pathways

Another need for deepening the role of age stereotypes and related constructs as integrated in a more general way in our framework (see again Fig. 1) concerns the issues of multidimensionality and matching processes. A number of recent studies support the stereotype matching effect (Kornadt et al., 2017; Levy & Leifheit-Limson, 2009) showing that the impact of age stereotypes on health-related outcomes is stronger if the content of the stereotype corresponds to the outcome. For this reason domain-specific VoA, as for example proposed in the concept of AARC, are needed in order to understand why certain pathways are important in some domains yet irrelevant in others. For example, previous studies

suggest that people who expect further personal development in their life are more motivated to engage in health-promoting behaviors and adopt a healthy lifestyle (e.g., Wurm et al., 2010). In contrast, the view that aging is associated with physical losses, might operate more through psychological processes, such as self-regulatory strategies (Wurm et al., 2013), and maybe also through physiological stress response. Future experimental and longitudinal studies should include the comparison of different pathways for different facets of views on aging. In that regard, it might also be interesting to investigate whether views on aging in different domains might be related and influence each other. Chasteen, Pichora-Fuller, Dupuis, Smith, and Singh (2015) suggested, that self-perceptions of aging in lower-level domains such as sensory functioning might predict self-perceptions of aging (and thus performance) in higher order domains such as memory. This suggests that more positive/negative self-perceptions of aging in some domains might spill over to other domains, thereby affecting health and performance. This would be an interesting avenue for future research, illuminating some of the domain-specific pathways of influence. In a similar way, a person may receive stronger negative feedback in one behavioral domain than another and therefore this feedback may reinforce certain views on aging in this domain more than in others.

Future research needs on the pathways seen in different timeframes and the need for a lifespan view

This final consideration brings us to the need to consider different timeframes and lifespan view in future research on pathways linking VoA with health outcomes (see Fig. 1). Future studies should implement research designs that combine different timeframes of assessment into one study in order to gain a better understanding of how and to what extent short-term effects are linked and potentially causal to long-term changes and processes. What is defined as short- or long-term can vary depending on the study. The comparison of different timeframes can, for example, refer to immediate experimental effects compared to lasting effects after several hours or days, but also to the comparison of the impact of VoA on health-related outcomes after some months vs. years. A recent study examined the effect of subjective age on follow-up hospitalization based on three different surveys (Stephan et al., 2016). Although older subjective age predicted higher risk for hospitalization in all surveys, stronger effects were shown in the survey with the longest follow-up period of about 10 years compared to the period of about two years in one of the other surveys. However, as the three studies did not only differ in the follow-up length but also in the average age of their samples, the role of different time periods for the strength of the effect remains ambiguous. Another study showed that older people who experienced a serious health event and viewed aging as more strongly associated with physical losses reported less negative affect up to six months after the event. However, they had more functional limitations up to 2.5 years after the event compared to individuals who associated aging less with physical losses (Wolff et al., 2015). This study exemplifies that the beneficial or detrimental effects of VoA not only depend on the outcome but also on the timeframe assessed in a given study.

Furthermore, we need to know more about whether or not the pathways are similar or different for various timeframes: Immediate effects might be more driven by physiological effects that, in turn, trigger behavioral effects (e.g., psychological stress may lead to lower

memory performance), whereas long-term effects over months or years might be triggered more by psychological processes that again lead to physiological and behavioral effects over the long run (e.g., negative VoA may undermine self-efficacy beliefs and subsequently health-promoting behaviors). Future studies should therefore compare the strength of different pathways and examine how they are coupled, operate in succession, and potentially interact in the context of short- and long-term timeframes. Momentary ecological assessment designs and procedures may be used to enrich existing long-term data to better understand the impact of short- and long-term processes (Kotter-Grühn et al., 2016). It may also be good to more systematically examine at the empirical level whether the three postulated pathways operate similar with regard to different categories of health outcomes (e.g., physical vs. mental outcomes).

Considering time-dynamics of VoA in a more generalized way, a clear strength of stereotype embodiment theory, the stereotype matching approach as well as the AARC conceptualization is their lifespan developmental orientation. We assume that three processes interact across the lifespan with increasing importance later in life: First, with increasing age negative age stereotypes are more often activated in daily contexts. Second, negative age stereotypes are increasingly internalized throughout the lifespan, which is why aging individuals become more susceptible to subconscious self-stereotyping. Third, how much short-term stereotype threat affects long-term internalized age stereotypes may also depend on self-reflection. For example, individuals who critically scrutinize age stereotypes might be better able to avoid or downplay them through strategies of self-protection.

Discussion and outlook

Building on previous research on the role of age stereotypes and subjective aging for health in later life, we provided an analysis of different theoretical approaches that propose potential mechanisms how VoA might influence health-related outcomes across the life span.

We have argued that research on VoA and health has reached the point where different approaches should be critically compared and possibly integrated into an overarching framework. In order to better understand the underlying mechanisms for the impact of different VoA constructs on health-related outcomes, future research should aim at comparing the role of age stereotypes against other VoA. Also, VoA can differ in their beneficial or detrimental impact on health depending on whether short- or long-term effects are considered. Moreover, little is known about whether subconscious and more conscious pathways underlie different outcomes. Finally, we need to better understand which VoA become health-relevant in which stage of life (cf. Hehman & Bugental, 2012). Thus, future studies should more often consider a lifespan and domain-specific approach to VoA (e.g., Brothers et al., 2015; Eich et al., 2014; Kornadt et al., 2017; Wurm et al., 2007).

We acknowledge that we used a broad definition of the concept of health for our elaborations. Even though we explained in the introduction why we subsumed diverse health outcomes, such as cognitive performance, walking speed, health behaviors or longevity, under the umbrella term of health, it may be questioned whether similar pathways are at

work when it comes for example to physical versus psychological health. Similarly, cognitive functioning may be different from other health areas. In addition, it should be noted that our focus was on the micro-level of analysis, addressing mechanisms that predominantly operate in aging individuals and less through societal macro–micro interchange processes (e.g., how VoA in the media may impact health outcomes in aging individuals). However, which age stereotypes are experienced as threat and how individuals experience aging is shaped by societal norms and values. Both the individual and the society in which he or she is living are continuously changing—the latter, among others, due to changing demographic, epidemiological, and economical challenges (Settersten & Hagestad, 2015). Many countries are currently experiencing an increase in the proportion of people aged 65 or older (United Nations Department of Economic & Social Affairs/Population Division, 2015) and this demographic change seems to be associated with an increasing negativity of age stereotypes (Ng, Allore, Trentalange, Monin, & Levy, 2015; North & Fiske, 2015). This underscores that we need to better understand how age stereotypes and also subjective aging affect health.

During the past few years, several teams of researchers have started to develop interventions aiming at changing VoA (e.g., Brothers & Diehl, 2017; Levy, Pilver et al., 2014; Sarkisian et al., 2007; Wolff et al., 2014). These studies consistently indicate that not only can VoA be intentionally changed but also that such changes are associated with improved health behavior and functional health. Taking together, we believe that a better theoretical and empirical understanding of pathways between VoA and health-related outcomes will greatly add to conceptualization and theory building in developmental and health psychology at large. Such advancements will also have significant applied and societal implications for aging societies, providing more precise knowledge about how detrimental consequences of VoA on health can be prevented or ameliorated.

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References

Allen PM, Mejia ST, & Hooker K (2015). Personality, self-perceptions, and daily variability in perceived usefulness among older adults. Psychology and Aging, 30(3), 534–543. 10.1037/pag0000039. [PubMed: 26121284]

Auman C, Bosworth HB, & Hess TM (2005). Effect of health-related stereotypes on physiological responses of hypertensive middle-aged and older men. The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 60B(1), P3–P10. 10.1093/geronb/60.1.P3.

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

Baltes PB, Lindenberger U, & Staudinger UM (2006). Life span theory in developmental psychology. In Damon W & Lerner RM (Eds.). Theoretical models of human development (Vol. 1, pp. 569–664). New York: Wiley.

Barak B, & Stern B (1986). Subjective age correlates: A research note. The Gerontologist, 26(5), 571–578. 10.1093/geront/26.5.571. [PubMed: 3533727]

Barber SJ, & Lee SR (2016). Stereotype threat lowers older adults' self-reported hearing abilities. Gerontology, 62(1), 81–85.

Barber SJ, & Mather M (2013). Stereotype threat can both enhance and impair older adults' memory. Psychological Science, 24(12), 2522–2529. 10.1177/0956797613497023. [PubMed: 24150969]

Barber SJ, & Mather M (2014). Stereotype threat in older adults: When and why does it occur and who is most affected? In Verhaeghen P & Hertzog C (Eds.), Emotion, social cognition, and problem solving during adulthood (pp. 302–319). New York, NY: Oxford University Press.

Beyer A-K, Wolff JK, Warner LM, Schüz B, & Wurm S (2015). The role of physical activity in the relationship between self-perceptions of ageing and self-rated health in older adults. Psychology & Health, 30(6), 671–685. 10.1080/08870446.2015.1014370. [PubMed: 25720739]

Bodner E, Ayalon L, Avidor S, & Palgi Y (2016). Accelerated increase and relative decrease in subjective age and changes in attitudes toward own aging over a 4-year period: Results from the Health and Retirement Study. European Journal of Ageing, 1(14), 17–27.

Brandtstädter J (1999). The self in action and development: Cultural, biosocial, and ontogenetic bases of intentional self-development. In Brandtstädter J & Lerner RM (Eds.), Action and self-development: Theory and research through the life span (pp. 37–65). Thousand Oaks, CA: Sage.

Brandtstädter J, & Renner G (1990). Tenacious goal pursuit and flexible goal adjustment: Explication and age-related analysis of assimilative and accommodative strategies of coping. Psychology and Aging, 5(1), 58–67. 10.1037/0882-7974.5.1.58. [PubMed: 2317302]

Brandtstädter J, & Rothermund K (2002). The life-course dynamics of goal pursuit and goal adjustment: A two-process framework. Developmental Review, 22, 117–150. 10.1006/drev.2001.0539.

Brothers AF, & Diehl M (2017). Feasibility and efficacy of the Aging^{PLUS} program: Changing views on aging to increase engagement in physical activity. Journal of Aging and Physical Activity, 25, 402–411. 10.1123/japa.2016-0039. [PubMed: 27918687]

Brothers AF, Miche M, Wahl H-W, & Diehl M (2015). Examination of associations among three distinct subjective aging constructs and their relevance for predicting developmental correlates. The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbv085.

Chasteen AL, Kang SK, & Remedios JD (2012). Aging and stereotype threat: Development, process, and interventions. In Inzlicht M, Schmader T, Inzlicht M, & Schmader T (Eds.), Stereotype threat: Theory, process, and application (pp. 202–216). New York, NY, US: Oxford University Press.

Chasteen AL, Pichora-Fuller MK, Dupuis K, Smith S, & Singh G (2015). Do negative views of aging influence memory and auditory performance through self-perceived abilities? Psychology and Aging, 30(4), 881–893. 10.1037/a0039723. [PubMed: 26479016]

Cheng S-T, Fung HH, & Chan ACM (2008). Living status and psychological well-being: Social comparison as a moderator in later life. Aging & Mental Health, 12(5), 654–661. 10.1080/13607860802343241. [PubMed: 18855182]

Connidis I (1989). The subjective experience of aging: Correlates of divergent views. Canadian Journal of Aging, 8(1), 7–18.

Coudin G, & Alexopoulos T (2010). 'Help me!: I'm old!' how negative aging stereotypes create dependency among older adults. Aging & Mental Health, 14 (5), 516–523. 10.1080/13607861003713182. [PubMed: 20480414]

Diehl MK, & Wahl HW (2010). Awareness of age-related change: Examination of a (mostly) unexplored concept. Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 65B(3), 340–350. 10.1093/geronb/gbp110.

Diehl M, Wahl H-W, Barrett AE, Brothers AF, Miche M, Montepare JM, & Wurm S (2014). Awareness of aging: Theoretical considerations on an emerging concept. Developmental Review, 34(2), 93–113. 10.1016/j.dr.2014.01.001. [PubMed: 24958998]

Diehl M, Wahl HW, Brothers A, & Miche M (2015). Subjective aging and awareness of aging: Toward a new understanding of the aging self. In Diehl M & Wahl H-W (Eds.). Annual Review of

Gerontology and Geriatrics (ARGG) (Vol. 35, pp. 145–165). New York: Springer Publishing Company.

Dutt AJ, Gabrian M, & Wahl H-W (2016). Awareness of age-related change and depressive symptoms in middle and late adulthood: Longitudinal associations and the role of self-regulation and calendar age Online first. Journal of Gerontology: Psychological Sciences. 10.1093/geronb/gbw095.

Eibach RP, Mock SE, & Courtney EA (2010). Having a 'senior moment': Induced aging phenomenology, subjective age, and susceptibility to ageist stereotypes. Journal of Experimental Social Psychology, 46(4), 643–649. 10.1016/j.jesp.2010.03.002.

Eich TS, Murayama K, Castel AD, & Knowlton BJ (2014). The dynamic effects of age-related stereotype threat on explicit and implicit memory performance in older adults. Social Cognition, 32(6), 559–570. 10.1521/soco.2014.32.6.559.

Emile M, d'Arripe-Longueville F, Cheval B, Amato M, & Chalabaev A (2014). An ego depletion account of aging stereotypes' effects on health-related variables. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbu168.

Ferring D, & Hoffmann M (2007). 'Still the same and better off than others?': Social and temporal comparisons in old age. European Journal of Ageing, 4(1), 23–34. 10.1007/s10433-007-0045-5. [PubMed: 28794769]

Freeman AT, Santini ZI, Tyrovolas S, Rummel-Kluge C, Haro JM, & Koyanagi A (2016). Negative perceptions of ageing predict the onset and persistence of depression and anxiety: Findings from a prospective analysis of the Irish Longitudinal Study on Ageing (TILDA). Journal of Affective Disorders, 199, 132–138. 10.1016/j.jad.2016.03.042. [PubMed: 27104801]

Frieswijk N, Buunk BP, Steverink N, & Slaets JPJ (2004). The effect of social comparison information on the life satisfaction of frail older persons. Psychology and Aging, 19(1), 183–190. 10.1037/0882-7974.19.1.183. [PubMed: 15065941]

Grande G, Romppel M, & Barth J (2012). Association between type D personality and prognosis in patients with cardiovascular diseases: A systematic review and meta-analysis. Annals of Behavioral Medicine, 43(3), 299–310. 10.1007/s12160-011-9339-0. [PubMed: 22237826]

Hausdorff JM, Levy BR, & Wei JY (1999). The power of ageism on physical function of older persons: Reversibility of age-related gait changes. Journal of the American Geriatrics Society, 47, 1346–1349. [PubMed: 10573445]

Heckhausen J, Dixon RA, & Baltes PB (1989). Gains and losses in development throughout adulthood as perceived by different adult age groups. Developmental Psychology, 25(1), 109–121.

Heckhausen J, Wrosch C, & Schulz R (2010). A motivational theory of life-span development. Psychological Review, 117(1), 32–60. [PubMed: 20063963]

Hehman JA, & Bugental DB (2012). "Life stage-specific" variations in performance in response to age stereotypes. Developmental Psychology. 10.1037/a0029559.

Hess TM, Auman C, Colcombe SJ, & Rahhal TA (2003). The impact of stereotype threat on age differences in memory performance. Journal of Gerontology: Psychological Sciences, 58, P3–P11.

Hess TM, & Hinson JT (2006). Age-related variation in the influences of aging stereotypes on memory in adulthood. Psychology and Aging, 21(3), 621–625. 10.1037/0882-7974.21.3.621. [PubMed: 16953723]

Horton S, Baker J, Pearce GW, & Deakin J (2008). On the malleability of performance: Implications for seniors. Journal of Applied Gerontology, 27(4), 446–465. 10.1177/0733464808315291.

Hughes ML, Geraci L, & De Forrest RL (2013). Aging 5 years in 5 minutes: The effect of taking a memory test on older adults' subjective age. Psychological Science, 24(12), 2481–2488. 10.1177/0956797613494853. [PubMed: 24100121]

Hummert ML (2011). Age stereotypes and aging. In Schaie KW & Willis SL (Eds.), Handbook of the psychology of aging (7 ed., pp. 249–262). San Diego, CA, US: Elsevier Academic Press.

Kang SK, & Chasteen AL (2009). The moderating role of age-group identification and perceived threat on stereotype threat among older adults. The International Journal of Aging and Human Development, 69(3), 201–220. 10.2190/AG.69.3.c. [PubMed: 20041566]

Kastenbaum R, Derbin V, Sabatini P, & Artt S (1972). "The ages of me": Toward personal and interpersonal definitions of functional aging. Aging and Human Development, 3(2), 197–211. 10.2190/TUJR-WTXK-866Q-8QU7.

Keller ML, Leventhal EA, & Larson B (1989). Aging: The lived experience. International Journal of Aging and Human Development, 29(1), 67–82. [PubMed: 2628349]

Kornadt AE (2016). Do age stereotypes as social role expectations for older adults influence personality development? Journal of Research in Personality, 60, 51–55. 10.1016/j.jrp.2015.11.005.

Kornadt AE, Hess TM, Voss P, & Rothermund K (2016). Subjective age across the life span: A differentiated, longitudinal approach. Journals of Gerontology Series B: Psychological Sciences and Social Sciences gbw072. doi:10.1093/geronb/gbw072.

Kornadt AE, & Rothermund K (2011). Contexts of aging: Assessing evaluative age stereotypes in different life domains. The Journals of Gerontology: Series B, 66B(5), 547–556. 10.1093/geronb/gbr036.

Kornadt AE, & Rothermund K (2015). Views on aging: Domain-specific approaches and implications for developmental regulation. Annual Review of Gerontology and Geriatrics, 35(1), 121–144. 10.1891/0198-8794.35.121.

Kornadt AE, Voss P, & Rothermund K (2015). Hope for the best, prepare for the worst? Future self-views and preparation for age-related changes. Psychology and Aging, 30, 967–976. 10.1037/pag0000048. [PubMed: 26302028]

Kornadt AE, Voss P, & Rothermund K (2017). Age stereotypes and self-views revisited: Patterns of internalization and projection processes across the life span. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 72, 582–592. 10.1093/geronb/gbv099.

Kotter-Grühn D, & Hess TM (2012). The impact of age stereotypes on self-perceptions of aging across the adult lifespan. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbr153.

Kotter-Grühn D, Kleinspehn-Ammerlahn A, Gerstorf D, & Smith J (2009). Self-perceptions of aging predict mortality and change with approaching death: 16-year longitudinal results from the Berlin Aging Study. Psychology and Aging, 24(3), 654–667. 10.1037/a0016510. [PubMed: 19739922]

Kotter-Grühn D, Kornadt AE, & Stephan Y (2016). Looking beyond chronological age: Current knowledge and future directions in the study of subjective age. Gerontology, 62, 86–93. 10.1159/000438671.

Lamont RA, Swift HJ, & Abrams D (2015). A review and meta-analysis of age-based stereotype threat: Negative Stereotypes, Not Facts, Do the Damage. Psychology and Aging. 10.1037/a0038586.

Lawton MP (1975). The Philadelphia geriatric morale scale: A revision. Journal of Gerontology, 30, 85–89. [PubMed: 1109399]

Lerner R, & Busch-Rossnagel NA (1981). Individuals as producers of their development: A life-span perspective. New York: Academic Press.

Levy BR (1996). Improving memory in old age through implicit self-stereotyping. Journal of Personality and Social Psychology, 71(6), 1092–1107. 10.1037/0022-3514.71.6.1092. [PubMed: 8979380]

Levy BR (2000). Handwriting as a reflection of aging self-stereotypes. Journal of Geriatric Psychiatry, 33, 81–94.

Levy BR (2009). Stereotype embodiment: A psychosocial approach to aging. Current Directions in Psychological Science, 18(6), 332–336. 10.1111/j.1467-8721.2009.01662.x. [PubMed: 20802838]

Levy BR, Ashman O, & Dror I (1999). To be or not to be: The effect of aging stereotypes on the will to live. Omega - Journal of Death and Dying, 40, 409–420. [PubMed: 12557880]

Levy BR, & Bavishi A (2016). Survival advantage mechanism: Inflammation as a mediator of positive self-perceptions of aging on longevity. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbw035.

Levy BR, Ferrucci L, Zonderman AB, Slade MD, Troncoso J, & Resnick SM (2016). A culture–brain link: Negative age stereotypes predict Alzheimer's disease biomarkers. Psychology and Aging. 10.1037/pag0000062.

Levy BR, Hausdorff JM, Hencke R, & Wei JY (2000). Reducing cardiovascular stress with positive self-stereotypes on aging. Journals of Gerontology. Series B: Psychological Sciences, 55B(4), P205–P213. 10.1093/geronb/55.4.P205.

Levy BR, & Leifheit-Limson E (2009). The stereotype-matching effect: Greater influence on functioning when age stereotypes correspond to outcomes. Psychology and Aging, 24(1), 230–233. 10.1037/a0014563. [PubMed: 19290757]

Levy BR, Moffat S, Resnick SM, Slade MD, & Ferrucci L (2016). Buffer against cumulative stress: Positive age self-stereotypes predict lower cortisol across 30 years. GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry, 29(3), 141–146. 10.1024/1662-9647/a000149.

Levy BR, & Myers LM (2004). Preventive health behaviors influenced by self-perceptions of aging. Preventive Medicine, 39, 625–629. 10.1016/j.ypmed.2004.02.029. [PubMed: 15313104]

Levy BR, & Myers LM (2005). Relationship between respiratory mortality and self-perceptions of aging. Psychology & Health, 20(5), 553–564. 10.1080/14768320500066381.

Levy BR, Pilver C, Chung PH, & Slade MD (2014). Subliminal strengthening: Improving older individuals' physical function over time with an implicitage-stereotype intervention. Psychological Science, 25(12), 2127–2135. 10.1177/0956797614551970. [PubMed: 25326508]

Levy B, Ryall A, Pilver C, Sheridan P, Wei J, & Hausdorff J (2008). Influence of African American elders' age stereotypes on their cardiovascular response to stress. Anxiety, Stress & Coping, 21(1), 85–93. 10.1080/10615800701727793.

Levy BR, Slade MD, Chung PH, & Gill TM (2014). Resiliency over time of elders' age stereotypes after encountering stressful events. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbu082.

Levy BR, Slade MD, & Gill TM (2006). Hearing decline predicted by elders' stereotypes. The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 61B(2), P82–P87. 10.1093/geronb/61.2.P82.

Levy BR, Slade MD, & Kasl SV (2002). Longitudinal benefit of positive self-perceptions of aging on functional health. Journal of Gerontology, 57B(5), 409–417.

Levy BR, Slade MD, Kunkel SR, & Kasl SV (2002). Longevity increased by positive self-perceptions of aging. Journal of Personality and Social Psychology, 83(2), 261–270. 10.1037/0022-3514.83.2.261. [PubMed: 12150226]

Levy BR, Slade MD, Murphy TE, & Gill TM (2012). Association between positive age stereotypes and recovery from disability in older persons. Journal of the American Medical Association, 308(19), 1972–1973. 10.1001/jama.2012.14541. [PubMed: 23168819]

Levy BR, Zonderman AB, Slade MD, & Ferrucci L (2009). Age stereotypes held earlier in life predict cardiovascular events in later life. Psychological Science, 20(3), 296–298. 10.1111/j.1467-9280.2009.02298.x. [PubMed: 19222809]

Levy BR, Zonderman AB, Slade MD, & Ferrucci L (2011). Memory shaped by age stereotypes over time. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbr120.

Löckenhoff CE, Terracciano A, Ferrucci L, & Costa PT Jr., (2012). Five-factor personality traits and age trajectories of self-rated health: The role of question framing. Journal of Personality, 80(2), 375–401. 10.1111/j.1467-6494.2011.00724.x. [PubMed: 21299558]

Marques S, Lima ML, Abrams D, & Swift H (2014). Will to live in older people's medical decisions: immediate and delayed effects of aging stereotypes. Journal of Applied Social Psychology. 10.1111/jasp.12231.

Meisner BA (2012). A meta-analysis of positive and negative age stereotype priming effects on behavior among older adults. The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 67B(1), 13–17. 10.1093/geronb/gbr062.

Meisner BA, & Baker J (2012). An exploratory analysis of aging expectations and health care behavior among aging adults. Psychology and Aging. 10.1037/a0029295.

Meisner BA, Weir PL, & Baker J (2013). The relationship between aging expectations and various modes of physical activity among aging adults. Psychology of Sport and Exercise, 14(4), 569–576. 10.1016/j.psychsport.2013.02.007.

Merton RK (1948). The self-fulfilling prophecy. The Antioch Review, 8(2), 193–210.

Miche M, Brothers A, Diehl M, & Wahl H-W (2015). The role of subjective aging within the changing ecologies of aging: Perspectives for research and practice. In Diehl M & Wahl H-W (Eds.). Research research on subjective aging: New developments and future directions (Vol. 35, pp. 211–245). New York: Springer Publ.

Montepare JM (1996). An assessment of adults' perceptions of their psychological, physical, and social ages. Journal of Clinical Geropsychology, 2(2), 117–128.

Montepare JM (2009). Subjective age: Toward a guiding lifespan framework. International Journal Of Behavioral Development, 33(1), 42–46. 10.1177/0165025408095551.

Ng R, Allore HG, Trentalange M, Monin JK, & Levy BR (2015). Increasing negativity of age stereotypes across 200 years: evidence from a database of 400 million words. PLoS ONE, 10(2), 1–6. 10.1371/journal.pone.0117086.

North MS, & Fiske ST (2015). Modern attitudes toward older adults in the aging world: A cross-cultural meta-analysis. Psychological Bulletin, 141(5), 993–1021. 10.1037/a0039469. [PubMed: 26191955]

O'Brien LT, & Hummert ML (2006). Memory performance of late middle-aged adults: Contrasting self-stereotyping, and stereotype threat accounts of assimilation to age stereotypes. Social Cognition, 24(3), 338–358.

O'Shea D, Dotson V, & Fieo R (2016). Aging perceptions and self-efficacy mediate the association between personality traits and depressive symptoms in older adults. International Journal of Geriatric Psychiatry. 10.1002/gps.4584.

Peters GR (1971). Self-conceptions of the aged, age identification, and aging. The Gerontologist, 11, 69–73. 10.1093/geront/11.4_Part_2.69.

Pietrzak RH, Zhu Y, Slade MD, Qi Q, Krystal JH, Southwick SM, & Levy BR (2016). Association between negative age stereotypes and accelerated cellular aging: Evidence from two cohorts of older adults. Journal of the American Geriatrics Society, 64(11), e228–e230. 10.1111/jgs.14452. [PubMed: 27641354]

Pinquart M (2001). Correlates of subjective health in older adults: A meta-analysis. Psychology and Aging, 16(3), 414–426. [PubMed: 11554520]

Pinquart M (2002). Good news about the effects of bad old-age stereotypes. Experimental Aging Research, 28(3), 317–336. 10.1080/03610730290080353. [PubMed: 12079581]

Plaks JE, & Chasteen AL (2013). Entity versus incremental theories predict older adults' memory performance. Psychology and Aging, 28(4), 948–957. 10.1037/a0034348. [PubMed: 24128076]

Popham LE, & Hess TM (2015). Theories of age stereotyping and views of aging. In Pachana NA (Ed.), Encyclopedia of geropsychology (pp. 1–10). Singapore: Springer Singapore.

Popham LE, & Hess TM (2017). Theories of age stereotyping and views of aging. In Pachana Nancy A. (Ed.), Encyclopedia of Geropsychology (pp. 105–112). Singapore: Springer. 10.1007/978-981-287-080-3_127-2.

Rantanen T, Guralnik JM, Foley D, Masaki K, Leveille S, Curb JD, & White L (1999). Midlife hand grip strength as a predictor of old age disability. Journal of the American Medical Association, 281(6), 558–560. 10.1001/jama.281.6.558. [PubMed: 10022113]

Rippon I, & Steptoe A (2015). Feeling old vs being old: Associations between self-perceived age and mortality. JAMA Internal Medicine, 175(2), 307–309.

Robertson DA, & Kenny RA (2015). Negative perceptions of aging modify the association between frailty and cognitive function in older adults. Personality and Individual Differences. 10.1016/j.paid.2015.12.010.

Robertson DA, King-Kallimanis BL, & Kenny RA (2016). Negative perceptions of aging predict longitudinal decline in cognitive function. Psychology and Aging, 31(1), 71–81. 10.1037/pag000006110.1037/pag0000061.supp. Supplemental. [PubMed: 26691302]

Robinson-Whelen S, & Kiecolt-Glaser J (1997). The importance of social versus temporal comparison appraisals among older adults. Journal of Applied Social Psychology, 27(11), 959–966. 10.1111/j.1559-1816.1997.tb00281.x.

Rothermund K (2005). Effects of age stereotypes on self-views and adaptation. In Greve W, Rothermund K, & Wentura D (Eds.), The adaptive self. Personal continuity and intentional self-development (pp. 223–242). Göttingen: Hogrefe.

Rothermund K, & Brandtstädter J (2003). Age stereotypes and self-views in later life: Evaluating rival assumptions. International Journal of Behavioral Development, 27(6), 549–554. 10.1080/01650250344000208.

Rubin DC, & Berntsen D (2006). People over forty feel 20% younger than their age: Subjective age across the lifespan. Psychonomic Bulletin & Review, 13(5), 776–780. 10.3758/BF03193996. [PubMed: 17328372]

Ryff CD (1984). Personality development from the inside: The subjective experience of change in adulthood and aging. Life-span Development and Behavior, 6, 243–279.

Sargent-Cox KA, Anstey KJ, & Luszcz MA (2012). The relationship between change in self-perceptions of aging and physical functioning in older adults. Psychology and Aging, 27(3), 750–760. 10.1037/a0027578. [PubMed: 22390161]

Sargent-Cox KA, Anstey KJ, & Luszcz MA (2014). Longitudinal change of self-perceptions of aging and mortality. The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 69B(2), 168–173.

Sarkisian CA, Hays RD, Berry S, & Mangione CM (2002). Development, reliability, and validity of the Expectations Regarding Aging (ERA-38) Survey. The Gerontologist, 42(4), 534–542. [PubMed: 12145381]

Sarkisian CA, Prohaska TR, Davis C, & Weiner B (2007). Pilot test of an attribution retraining intervention to raise walking levels in sedentary older adults. Journal of the American Geriatrics Society, 55(11), 1842–1846. [PubMed: 17979902]

Schmader T (2002). Gender identification moderates stereotype threat effects on women's math performance. Journal of Experimental Social Psychology, 38, 194–201. 10.1006/jesp.2001.1500.

Schmader T, Johns M, & Forbes C (2008). An integrated process model of stereotype threat effects on performance. Psychological Review, 115(2), 336–356. [PubMed: 18426293]

Seidler AL, & Wolff JK (2017). Bidirectional associations between self-perceptions of aging and processing speed across 3 years. GeroPsych, 30, 49–59. 10.1024/1662-9647/a000165.

Settersten RA, & Hagestad GO (2015). Subjective aging and awareness of aging: Toward a new understanding of the aging self. Annual Review of Gerontology and Geriatrics, 35(1), 29–53. 10.1891/0198-8794.35.29.

Siebert JS, Wahl H-W, & Schröder J (2016). The role of attitudes toward own aging for fluid and crystallized functioning: 12-year evidence from the ILSE Study. Journal of Gerontology: Psychological Sciences. 10.1093/geronb/gbw050.

Sindi S, Juster RP, Wan N, Nair NPV, Kin NY, & Lupien SJ (2012). Depressive symptoms, cortisol, and cognition during human aging: The role of negative aging perceptions. Stress: The International Journal on the Biology of Stress, 15(2), 130–137. 10.3109/10253890.2011.599047.

Spini D, Clémence A, & Ghisletta P (2007). How are temporal and social comparisons related to appraisals of self-rated health during very old age? Swiss Journal of Psychology, 66(2), 79–89. 10.1024/1421-0185.66.2.79.

Spuling SM, Miche M, Wurm S, & Wahl H-W (2013). Exploring the causal interplay of subjective age and health dimensions in the second half of life. Zeitschrift für Gesundheitspsychologie, 21(1), 5–15. 10.1026/0943-8149/a000084.

Steele CM (1997). A threat in the air: How stereotypes shape intellectual identity and performance. American Psychologist, 52(6), 613–629.

Steele CM, & Aronson J (1995). Stereotype threat and the intellectual test performance of African Americans. Journal of Personality and Social Psychology, 69(5), 797–811. 10.1037/0022-3514.69.5.797. [PubMed: 7473032]

Stephan Y, Caudroit J, Jaconelli A, & Terracciano A (2014). Subjective age and cognitive functioning: A 10-year prospective study. American Journal of Geriatric Psychiatry, 22(11), 1180–1187. 10.1016/j.jagp.2013.03.007.

Stephan Y, Chalabaev A, Kotter-Grühn D, & Jaconelli A (2013). "Feeling younger, being stronger": An experimental study of subjective age and physical functioning among older adults. The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 68(1), 1–7. 10.1093/geronb/gbs037.

Stephan Y, Sutin AR, Caudroit J, & Terracciano A (2015). Subjective age and changes in memory in older adults. Journals of Gerontology. Series B, Psychological Sciences and Social Sciences. 10.1093/geronb/gbv010.

Stephan Y, Sutin AR, & Terracciano A (2015a). "Feeling younger, walking faster": Subjective age and walking speed in older adults. Age, 37(5), 86. [PubMed: 26296609]

Stephan Y, Sutin AR, & Terracciano A (2015b). Subjective age and personality development: A 10-year study. Journal of Personality, 83(2). 10.1111/jopy.12090.

Stephan Y, Sutin AR, & Terracciano A (2015c). Younger subjective age is associated with lower C-reactive protein among older adults. Brain, Behavior, and Immunity, 43, 33–36. 10.1016/j.bbi.2014.07.019.

Stephan Y, Sutin AR, & Terracciano A (2016). Feeling older and risk of hospitalization: Evidence from three longitudinal cohorts. Health Psychology, 35(6), 634. [PubMed: 26867044]

Steverink N, Westerhof GJ, Bode C, & Dittmann-Kohli F (2001). The personal experience of aging, individual resources, and subjective well-being. Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 6, 364–373.

Sun JK, Kim ES, & Smith J (2017). Positive self-perceptions of aging and lower rate of overnight hospitalization in the US population over age 50. Psychosomatic Medicine, 79(1), 81–90. 10.1097/PSY.0000000000000364. [PubMed: 27359184]

Swift HJ, Abrams D, & Marques S (2013). Threat or boost? Social comparison affects older people's performance differently depending on task domain. The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 68(1), 23–30. 10.1093/geronb/gbs044.

United Nations Department of Economic and Social Affairs/Population Division (2015). World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. New York: United Nations.

Voss P, Kornadt AE, & Rothermund K (2017). Getting what you expect? Future self-views predict the valence of life events. Developmental Psychology, 53(3), 567–580. 10.1037/dev0000285. [PubMed: 28230405]

Warburton J, & Peel NM (2008). Volunteering as a productive ageing activity: The association with fall-related hip fracture in later life. European Journal of Ageing, 5(2), 129–136. 10.1007/s10433-008-0081-9. [PubMed: 28798567]

Ware JE, Kosinski M, Bjorner JB, Turner-Bowker DM, Gandek B, & Maruish ME (2007). User's manual for the SF-35v2 Health Survey (2nd ed.). Lincoln, RI: QualityMetric Inc.

Warmoth K, Tarrant M, Abraham C, & Lang IA (2016). Older adults' perceptions of ageing and their health and functioning: A systematic review of observational studies. Psychology, Health & Medicine, 21(5), 531–550. 10.1080/13548506.2015.1096946.

Weiss D (2016). On the inevitability of aging: Essentialist beliefs moderate the impact of negative age stereotypes on older adults' memory performance and physiological reactivity. Journals of Gerontology: Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbw087.

Weiss D, & Freund AM (2012). Still young at heart: Negative age-related information motivates distancing from same-aged people. Psychology and Aging, 27(1), 173–180. 10.1037/a0024819. [PubMed: 21823797]

Weiss D, & Lang FR (2009). Thinking about my generation: Adaptive effects of a dual age identity in later adulthood. Psychology and Aging, 24(3), 729–734. 10.1037/a0016339. [PubMed: 19739929]

Weiss D, & Lang FR (2012a). 'They' are old but 'I' feel younger: Age-group dissociation as a self-protective strategy in old age. Psychology and Aging, 27(1), 153–163. 10.1037/a0024887. [PubMed: 21988154]

Weiss D, & Lang FR (2012b). The two faces of age identity. GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry, 25(1), 5–14. 10.1024/1662-9647/a000050.

Westerhof GJ, Barrett AE, & Steverink N (2003). Forever young? A comparison of age identities in the United States and Germany. Research on Aging, 25, 366–383. 10.1177/0164027503025004002.

Westerhof GJ, Harink K, Van Selm M, Strick M, & Van Baaren R (2010). Filling a missing link: The influence of portrayals of older characters in television commercials on the memory performance of older adults. Ageing & Society, 30(5), 897–912. 10.1017/S0144686X10000152.

Westerhof G, Miche M, Brothers A, Barrett A, Diehl M, Montepare JM, & Wurm S (2014). The influence of subjective aging on health and longevity: A meta-analysis of longitudinal data. Psychology and Aging, 29(4), 793–802. 10.1037/a0038016. [PubMed: 25365689]

Westerhof GJ, & Wurm S (2015). Longitudinal research on subjective aging, health, and longevity: Current evidence and new directions for research. Annual Review of Gerontology and Geriatrics, 35(1), 145–165. 10.1891/0198-8794.35.145.

Wienert J, Gellert P, & Lippke S (2015). Physical activity across the life-span: Does feeling physically younger help you to plan physical activities? Journal of Health Psychology. 10.1177/1359105315603469.

Wienert J, Kuhlmann T, & Lippke S (2015). Direct effects of a domain-specific subjective age measure on self-reported physical activity – Is it more important how old you are or how old you feel? Health Psychology Report, 2, 131–139. 10.5114/hpr.2015.51450.

Wolff JK, Schüz B, Ziegelmann JP, Warner LM, & Wurm S (2015). Short-term buffers, but long-term suffers? Differential effects of negative self-perceptions of aging following serious health events. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 10.1093/geronb/gbv058.

Wolff JK, Warner LM, Ziegelmann JP, & Wurm S (2014). What do targeting positive views on ageing add to a physical activity intervention in older adults? Results from a randomised controlled trial. Psychology & Health, 29(8), 915–932. [PubMed: 24559210]

Woodcock A, Hernandez PR, Estrada M, & Schultz PW (2012). The consequences of chronic stereotype threat: Domain disidentification and abandonment. Journal of Personality and Social Psychology, 103(4), 635–646. 10.1037/a0029120. [PubMed: 22746674]

Wrosch C, & Schulz R (2008). Health-engagement control strategies and 2-year changes in older adults' physical health. Psychological Science, 19(6), 537–541. 10.1111/j.1467-9280.2008.02120.x. [PubMed: 18578842]

Wurm S, & Benyamini Y (2014). Optimism buffers the detrimental effect of negative self-perceptions of ageing on physical and mental health. Psychology & Health, 29(7), 832–848. [PubMed: 24527737]

Wurm S, Tesch-Römer C, & Tomasik MJ (2007). Longitudinal findings on aging related cognitions, control beliefs, and health in later life. Journals of Gerontology. Series B: Psychological Sciences 62B(3), P156–P164.

Wurm S, & Schüz B (2015). Psychological theories on health and aging. In Pachana NA (Ed.), Encyclopedia of geropsychology (pp. 1–10). Singapore: Springer Singapore.

Wurm S, Tomasik MJ, & Tesch-Römer C (2008). Serious health events and their impact on changes in subjective health and life satisfaction: The role of age and a positive view on aging. European Journal of Ageing, 5(2), 117–127. 10.1007/s10433-008-0077-5. [PubMed: 28798566]

Wurm S, Tomasik M, & Tesch-Römer C (2010). On the importance of a positive view on ageing for physical exercise among middle-aged and older adults: Cross-sectional and longitudinal findings. Psychology and Health, 25(1), 25–42. 10.1080/08870440802311314. [PubMed: 20391205]

Wurm S, Warner LM, Ziegelmann JP, Wolff JK, & Schüz B (2013). How do negative self-perceptions of aging become a self-fulfilling prophecy? Psychology and Aging, 28(4), 1088–1097. 10.1037/a0032845. [PubMed: 24128074]

Zebrowitz LA (2003). Aging stereotypes – Internalization or inoculation? A commentary. Journal of Gerontology: Psychological Sciences, 58B(4), P214–P215.

Zhan Y, Wang M, Liu S, & Shultz KS (2009). Bridge employment and retirees' health: A longitudinal investigation. Journal of Occupational Health Psychology, 14(4), 374–389. 10.1037/a001528. [PubMed: 19839658]

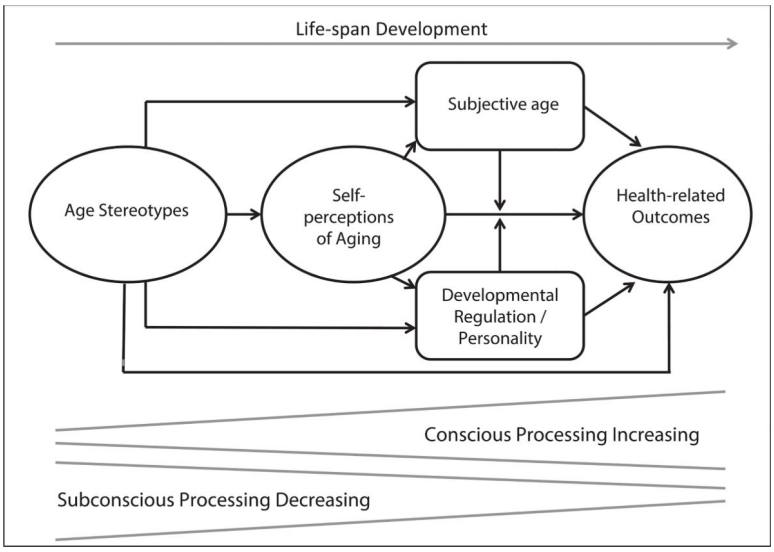

Fig. 1.
Heuristic framework on pathways from views on aging to health outcomes.