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Subjective Aging – Measurement Issues, Developmental Consequences,
and Malleability in Midlife and Early Old Age

Presented by
Martina Gabrian (née Miche), M.Sc.

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Dean: Prof. Dr. Birgit Spinath
Advisors: Prof. Dr. Hans-Werner Wahl
               Prof. Dr. Manfred Diehl

Ein Mann, der Herrn K. lange nicht gesehen hatte, begrüßte ihn mit den Worten:

„Sie haben sich gar nicht verändert." „Oh!" sagte Herr K. und erbleichte.

A man, who had not seen Mr. K. for a long time, greeted him and said:

"You have not changed at all." "Oh!" said Mr. K. and turned pale.

Berthold Brecht (1953, p. 132)

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Martina Gabrian, October 2015

Abstract

Subjective aging research has developed into a lively and much-noticed field of research in geropsychology throughout the past two decades. The renewed interest in subjective aging picks up on a longstanding measurement tradition, which assesses subjective aging by asking individuals how old they feel (Kastenbaum, Derbin, Sabatini, & Artt, 1972). More recently, the field of subjective aging research has seen new conceptual and theoretical development as well as an increasing amount of longitudinal and experimental studies (Diehl, Wahl, Brothers, & Miche, 2015; see also Chapter 1).

This body of research has established subjective aging as a predictor of a broad range of developmental outcomes, including physical and mental health, cognitive functioning, and longevity (Levy, Pilver, & Pietrzak, 2014; Stephan, Sutin, Caudroit, & Terracciano, 2015; Westerhof et al., 2014). This empirical evidence for the significance of subjective aging then calls for a closer look at the manifestations and operationalizations of subjective aging. For example, more sophisticated multidimensional approaches to subjective aging have been proposed as a means to gain a better understanding of the mechanisms and pathways that link subjective aging to developmental outcomes (e.g., Diehl & Wahl, 2010; Kornadt & Rothermund, 2011; Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001). Also, subjective aging researchers have insisted that the manifestations and developmental implications might change as individuals move through different life stages (Barrett & Montepare, 2015). Beyond that, given the detrimental long-term effects of a negative view on aging, subjective aging might become an important vehicle within gerontological interventions (Kotter-Grühn, 2015). Targeting negative views on aging and raising peoples' awareness for the heterogeneity, plasticity, and developmental opportunities of the aging process, might enable individuals to take active control of their aging process. However, before making an informed statement about promising intervention strategies, more research is warranted to examine the potential for short- and long-term intraindividual change in subjective aging and to determine potential risk groups that have a particularly negative view on aging.

This dissertation aims to address a selected range of open research questions in the field of subjective aging, which are summarized within three overarching thematic areas: measurement issues, developmental consequences, and malleability of subjective aging phenomena. Research questions related to measurement issues involve the advantages and disadvantages of a domain-specific over global measurement approaches; the mani-

festation of subjective aging phenomena in everyday life; and the potentially changing meaning of subjective aging across the second half of life. In terms of developmental consequences, two studies in this thesis focus on the role of subjective aging as a predictor of different health and well-being dimension. Finally, the malleability of subjective aging phenomena is investigated in terms of longitudinal change trajectories over 12 years as well as in terms of the potential short-term manipulation of subjective aging by means of experimentally induced cognitive aging experiences. To these ends, four individual studies are included in this cumulative dissertation in Chapters 2-5.

By investigating the domain-specific contents of subjective aging phenomena in the everyday lives of old-old adults, Chapter 2 constitutes the starting point of this dissertation. Based on the conceptual framework of Awareness of Age-Related Change (Diehl & Wahl, 2010) a qualitative content analysis on semi-structured daily diary reports was conducted, which provided support for the notion that subjective aging is best understood as a multidimensional construct and rooted in everyday experiences. Moreover, the findings of this study revealed that subjective aging represents a relatively frequent phenomenon in the daily lives of older adults, which is linked with a specific set of subjective well-being measures (i.e., positive affect, negative affect, and valuation of life, but not satisfaction with life). Domain-specific associations emerged when gain- and loss-oriented aging experiences were distinguished and considered separately by behavioral domain, thus providing further support for the advantages of multidimensional assessment tools.

With regard to measurement issues, Chapter 3 tested whether the items of the Attitude Toward Own Aging Scale, a well-established unidimensional measurement approach to subjective aging, are being interpreted similarly across midlife and young-old adulthood. Such measurement invariance issues are an important prerequisite for conducting age-group comparisons and for investigating long-term intraindividual change in Attitude Toward Own Aging. Support for the assumption of partial measurement invariance of Attitude Toward Own Aging was found in each age group, but not between age groups, implying that the meaning of the items changes as individuals move from midlife to young-old adulthood. Hence, long-term change trajectories were analyzed separately by age group. On average, Attitude Toward Own Aging declined both across middle adulthood as well as across early old age, albeit with significant intraindividual variation only in midlife. In addition, Attitude Toward Own Aging was shaped by a broader range of predictors in midlife as compared to early old age, where only health-

related variables were significant predictors of the baseline level of Attitude Toward Own Aging.

The focus of Chapter 4 then was to disentangle the direction of effects in the association between subjective aging and different health domains. This issue is of particular interest with regard to health, because more recently longitudinal research has accumulated that establishes subjective aging as an antecedent of health, physical functioning and longevity (Westerhof et al., 2014). At the same time, health impairments are a dominant topic in age stereotypes, thus potentially making health declines a prime predictor of subjective aging. To this end, cross-lagged panel analyses were employed to analyze data of a nationwide representative survey of community residing older adults aged 40 years and older. The results of this study revealed that subjective age has predictive validity for objective health indicators, whereas a bidirectional effect was found for subjective health, suggesting that subjective aging and self-ratings of health are mutually dependent. Also, for all cross-lagged effects the direction and size of effects was found to be stable between midlife and early old age, suggesting that a generally more negative outlook on one's aging is relevant for health outcomes across the entire second half of life.

Following up on previous experimental studies, an experimental manipulation strategy anchored in the fluid intelligence sphere was developed in Chapter 5 in order to test and compare the potential malleability of a multidimensional subjective age measure in response to gain- and loss-oriented aging cognitive experiences. Of the four subjective age domains that were assessed before and after the experimental manipulation, only 'do age' (but not felt age, look age, or interest age), was affected by cognitive loss experiences. Hence, the findings of this study underscore the intricacy of a comprehensive and cross-domain improvement of subjective age.

An integrating discussion of the four individual studies is provided in Chapter 6. Also, implications for research and practice are derived in the general discussion. Overall, the results of this thesis suggest that physical functioning is a dominant and highly self-relevant domain of subjective aging, which is likely reflected by unidimensional, global measures of subjective aging. Therefore, it is concluded that global subjective aging measures represent an appropriate and economic measurement approach, if the aim of a study is to examine general tendencies in the association of subjective aging with health-related predictors and outcomes. At the same time, domain-specific measurement approaches toward subjective aging are deemed necessary in order to disentangle poten-

tial domain-specific mechanisms underlying the predictive effects of subjective aging. In the future, short versions of multidimensional subjective aging questionnaires should be developed for inclusion in large-scale epidemiological studies.

Furthermore, this thesis provides support for the notion that the salience of subjective aging domains changes across the adult life span. Future research should therefore adopt a life-span perspective on subjective aging, which asks for the mechanisms that link subjective aging to developmental outcomes during specific life phases and life contexts. Such a life-span perspective is also considered necessary for the development of tailored subjective aging interventions that take into account life-span specific needs and requirements. Middle-adulthood emerged as a critical time period for interventions, given that the average downturn in Attitude Toward Own Aging across the middle-adult years varied largely between individuals, thus pointing to some extent of plasticity of subjective aging during midlife. However, the results of the experimental study indicate that intervention strategies aiming at creating a greater awareness for age-related gains need to be developed with caution. A promising strategy might be to draw attention to the domains in which older adults themselves indicate to have various gain experiences, such as interpersonal relationships and social-cognitive and social-emotional functioning.

List of Publications for the Cumulative Dissertation

I. Publication

*Miche, M., Wahl, H.-W., Diehl, M., Oswald, F., Kaspar, R., & Kolb, M. (2014). Natural occurrence of subjective aging experiences in community-dwelling older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 69*, 174-187. doi: 10.1093/geronb/gbs164

II. Publication

*Miche, M., Elsässer, V. C., & Wahl, H.-W. (2014). Attitude Toward Own Aging in midlife and early old age over a 12-year period: Examination of measurement equivalence and developmental trajectories. *Psychology and Aging, 29*, 588-600. doi: 10.1037/a0037259

III. Publication

Spuling, S. M., *Miche, M., Wurm, S., & Wahl, H.-W. (2013). Exploring the causal interplay of subjective age and health dimensions in the second half of life: A cross-lagged panel analysis. *Zeitschrift für Gesundheitspsychologie, 21*, 5-15. doi: 10.1026/0943-8149/a000084

IV. Publication

*Gabrian, M. & Wahl, H.-W. (submitted). Being slower, feeling older? Experimentally induced cognitive aging experiences have limited impact on subjective age. *European Journal of Ageing.*

Note. *Indicates the author of this dissertation.

1

General Introduction

Chapter Overview

Motivational Background:
The Role of Subjective Aging Research within an Aging Society

As demographic change continues to transform the faces of today's societies its effects will extend to the life of individuals. Over the course of the past century, Western Europe and other western industrialized countries have witnessed a historical gain in life expectancy. In these countries, an average life today is about 15 years longer than at the middle of the past century (World Health Organization, 2015). Part of this prolonged life expectancy results from a reduction in old-age mortality, especially since the 1950s and 1970s (Christensen, Doblhammer, Rau, & Vaupel, 2009). Particularly those individuals aged younger than 85 years spend the added life years in a relatively good functional health (Christensen et al., 2009; Doblhammer & Kytir, 2001). The prospect of a long and mostly healthy life will become true for an increasing number of individuals in the western industrialized countries (Vaupel, 2010). From modernity to post-modernity we have faced a transition that has turned a previously uncertain lifetime into a relatively certain lifetime (Imhof, 1984), which changes the individual life course and the way of living and experiencing life in old age.

First of all, the demographic change is reflected in changing family structures and social life (Settersten, 2007). With an increasing number of people surviving until old age and fertility rates declining, we are witnessing the emergence of so called 'beanpole families' with many living generations but fewer members within each generation (Bengtson, Lowenstein, Putney, & Gans, 2003): Unlike earlier times, many grandparents today have the chance to watch their grandchildren reach adulthood and it is not unlikely to also experience great-grandparenthood in later life. More decades of shared lives between generations have extended the availability of family support and enable a new configuration of role relationships which may alter the experience of old age for older adults, but may also increase intergenerational contact for younger age groups (Bengtson & Martin, 2001). Furthermore, the expectation of a longer life span allows individuals a more flexible timing of life projects and to delay life transitions throughout an extending period of adulthood (Harper, 2014). Together with a trend toward an improving functional health status in today's older generations, this has led to a historically new life stage coined as the 'third age' (P. B. Baltes & Smith, 1999; James & Wink, 2006; Laslett, 1987). The third age, a time when people have retired from their primary career but do not feel old at all, is now often a time for 'encore careers' or new life projects in areas such as partnership, intergenerational engagement, volunteering, housing, or leisure (James & Wink, 2006).

"As a consequence of restructured life courses, changing opportunity structures, and major advances in the medical sciences and technology, current generations of older adults might have developed a different understanding of the adult years and old age, including the recognition that old age is characterized not only by losses but also by its own potentials and opportunities." (Miche, Brothers, Diehl, & Wahl, 2015, p. 221).

Not only do we observe changed living conditions around the ages of 60 to 85 years. The oldest-old, those individuals aged 85 years and older who are most susceptible to disease and disability, represent a rapidly growing segment of the population (Christensen et al., 2009). As a consequence, demographers forecast a 'chronic disease burden' with an increasing proportion of the population suffering from complex chronic long-term ill health and disability (Harper, 2014). These warnings should be treated with some caution in light of first findings that younger cohorts reach old-old age in a better cognitive and functional status (Christensen et al., 2013). However, they may raise public awareness for the difficulties of the latest period of life and may induce concerns or even fears about one's own aging process, with people increasingly focusing on age-related losses and vigorously watching their health and vitality (Miche et al., 2015).

On the level of the society, demographic change has led to a growing number and proportion of older people, thus triggering intergenerational conflicts over limited resources and shaping societal images of aging (Silverstein, Parrott, Angelinni, & Cook, 2000). The 'aged dependency ratio', defined as the number of older retirees (i.e. those aged older than sixty-five years) per working person (i.e. those aged between twenty and sixty-four years), is expected to rise across the European Union from around 0.25 in 2000 to 0.4 by 2025 and around 0.55 by 2050 (Green, 2009). The changing age-composition of Western societies has sparked discussion about resource allocation between young and old framed as the "generational equity debate" with claims being made that older people are an economic burden for the young (Harper, 2014; Silverstein et al., 2000). The fervent public debate is reflected in provocative headlines, announcing a "tyranny of America's old" (Fortune, January 13, 1992; see Silverstein et al., 2000), a "wave of grey" steamrollering the health care system (Barer, Evans, & Hertzman, 1995), a "war of generations" (Siems, 2013, November 4) or a "pensioners' republic" in which "the old assume power" (Will Media GmbH, 2008, April 29). Such a negative portrayal of the older generation might at times affect the attitudes and respect displayed toward older people (Silverstein et al., 2000), and there is indeed empirical support that populations

with a greater proportion of older adults (age > 65 years) hold less favorable views of aging (Löckenhoff et al., 2009).

Certainly, the effects of demographic change on images and subjective experiences of aging should not be mistaken as a one-way process. The term "mind matters" nicely illustrates how subjective interpretations of reality may govern behavior to the point of becoming a self-fulfilling prophecy (Levy, 2003). A vast body of literature reveals that the way individuals think about aging in general and their own aging in particular affect their physical, cognitive, and mental health status in old age (e.g., Westerhof et al., 2014). The influence of subjective aging phenomena on health even extends to longevity: Individuals with a positive view on aging live on average 7.5 years longer than those with a more negative outlook on their own aging (Levy, Slade, Kunkel, & Kasl, 2002). A changing perception of the aging process may therefore reversely affect the life expectancy and functional status of future generations of older adults. Establishing a realistic view of aging, with a focus on aging-related gains and resources, holds the promise of increasing the number of healthy years and facilitating healthy and proactive lifestyle in old age. Thereby, research on subjective aging may help to address some of the health and care challenges brought about by demographic change. In particular, insights from subjective aging research provide tools to "maintain health among older populations for as long as possible, thus reducing the requirement to provide and finance long term health and social care" (Harper, 2014, p. 590).

The present dissertation aims to contribute to the growing body of subjective aging research with four individual studies presented in Chapters 2-5. Chapter 2 investigates which daily events and experiences old-old adults associate with their feeling of growing old(er) and may thus provide insights into the subjective aging experience of the current generation of old-old adults. The study follows a multidimensional approach, thereby also attending to the various functional and life domains that have witnessed recent transitions through demographic change, such as family life and interpersonal relationships as well as leisure behavior and lifestyle. In Chapter 3, within-person change patterns of subjective aging over a period of twelve years, including the predictors of such change, are being distinguished for two different age groups: the middle-aged and the young-old adults. The strong psychometric approach taken in this chapter reveals how the meaning and understanding of age-related experiences may change from mid-adulthood to early old-age, thus highlighting the importance of focusing different periods of the extending adult life span. The cross-lagged panel analyses presented in Chapter 4

represent an attempt to disentangle the causal effects in the potentially bidirectional relationship between subjective aging and various health domains. Understanding the time-ordered and causal relationship is important in order to utilize findings from subjective aging research for gerontological practice. Finally, the experimental study presented in Chapter 5 examines the malleability of subjective aging in the cognitive domain and may thus inform intervention research that aims at generating a more positive or balanced view of the personal aging process.

The four individual studies presented in Chapters 2-5 are framed with an overview of the theoretical foundations of subjective aging research in Chapter 1 and an integrating discussion of the study findings in Chapter 6. The present chapter, Chapter 1, starts out with a review of definitions and measurement approaches to subjective aging, based upon which psychological theories about the formation processes and developmental consequences of subjective aging phenomena will be presented. These fundamental theoretical assumptions of subjective aging research will then be contrasted with an overview of the current state of empirical findings. Research gaps and references to the specific research questions of the four individual studies will be made throughout this introduction and summarized at the end of this chapter.

Psychological Theories and Concepts Relevant to the Understanding of Subjective Aging Phenomena

Subjective Aging: Constructs and Definitions

At the most general level subjective aging can be conceptualized as 'images of aging'. Images of aging encompass ideas and beliefs of old age as a life phase, of the aging process, and of the group of older people (Rossow, 2012). This very broad conceptualization of subjective aging makes no distinction with regard to its proponent: images of aging may be held by *societies* and cultures as a whole or by *individuals* within a society, including older individuals themselves as well as those people not yet considered as old. Nor does this definition specify the object of evaluation: images of aging may address both *inside perspectives* about one's own age and aging as well as *outside perspectives* on aging and older people in general. Nor does it determine the degree of accuracy: beyond *descriptive elements*, images of aging may also contain *evaluative and normative aspects*.

This thesis follows a more narrow approach to subjective aging that focuses on selected aspects of the foregoing definition. Throughout this thesis, the term subjective

aging will be used to refer to the inside perspectives of older individuals, that is the ideas, beliefs, and experiences that older adults themselves associate with their own aging. Although subjective experiences are not completely unaffected by objective aging experiences, individuals undertake interpretative efforts in the construction of their subjective aging experiences. Thus, the focus of this thesis will lie on the evaluative aspects of subjective aging. Methodologically subjective aging will be approached with a selected range of the variety of theoretical and measurement concepts. (For a comprehensive overview of subjective aging constructs see Diehl et al., 2014). The description of the selected subjective aging constructs below includes a definition for each concept along with its respective measurement approaches, the research tradition in which the construct is rooted, and a summary of how the construct changes with chronological age. In conclusion a comparison and evaluation of subjective aging constructs will be made to determine the utility of the different constructs for the scope of the present dissertation.

Subjective age

In the early seventies, Kastenbaum and colleagues (Kastenbaum et al., 1972) introduced subjective age[1], which by now is presumably the most common and frequently used concept in subjective aging research. Subjective age draws upon the notion that an individual's felt age may deviate from his or her chronological age as a consequence of "anchoring and adjusting one's age in relation to distal [i.e., subjective age norms] and proximal reference points [i.e. physical age markers] of age" (Montepare, 2009, p. 43). Thus, subjective age ratings originate from psychological states or physical sensations and the construct can be regarded as a 'person-centered' (as opposed to 'socio-centered') approach to subjective aging (Diehl et al., 2014).

Already in middle childhood (around the age of 8 years), individuals develop a more flexible representation of their age, with their felt age typically being older than their chronological age (Benson & Elder, 2011; Galambos, Turner, & Tilton-Weaver, 2005; Montepare, 2009). This perception shifts in early adulthood, where a crossover from an older to a younger subjective age can be observed (Galambos et al., 2005; Rubin & Berntsen, 2006). Throughout adulthood individuals then feel increasingly younger than their actual age, although from midlife on the relative discrepancy remains rather stable with individuals feeling about 20% younger than their actual age (Rubin & Berntsen,

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[1] Note that although the wording of subjective age and subjective aging is almost identical, these two terms are semantically different and refer to distinct constructs. Whereas subjective aging is used as an umbrella term for the way individuals subjectively experience their own aging and comprises a broad range of different measurement approaches, subjective age is used to denote a specific measurement tradition (i.e., asking for individuals' felt ages).

2006). This 'youthfulness bias' has often been interpreted as a self-enhancement strategy to protect the self from the negative age stereotypes prevailing in Western societies (Teuscher, 2009).

Next to feel age, the original multidimensional approach introduced by Kastenbaum (1972) distinguished three other domains of subjective age: look age, do age, and interest age, thus acknowledging that aging perceptions may differ across behavioral domains (Kastenbaum et al., 1972). Other authors have proposed additional dimensions, such as perceived mental age, psychological age, physical age, and social age (Montepare, 1996a; Uotinen, Rantanen, & Suutama, 2005). Statistically, however, most subjective age dimensions load onto a single factor and thus seem to form a unidimensional construct (Barak, 1987; Hubley & Russell, 2009; Teuscher, 2009). Ideal age ratings (Kaufman & Elder, 2002; Keyes & Westerhof, 2012), that is the age an individual ideally would like to be, constitute the only exception. The markedly different associations of felt age and ideal age with other personal variables (e.g., mental health; Hubley & Russell, 2009; Keyes & Westerhof, 2012) suggest that ideal age and other subjective age ratings arise from distinct psychological processes (Barak, 2009). The multidimensional approach to subjective age, although broadly used in marketing psychology (Barak & Rahtz, 1999; Mathur & Moschis, 2005), has never really found its way into psychological aging research. The majority of studies in psychological aging research rather use a simple unidimensional approach and focuses only on people's felt ages. Diehl and colleagues (2014) conclude that "this application of the concept has increasingly limited the field of subjective aging research to a very simplistic and restrictive view, and has potentially hindered theoretical and empirical progress" (p. 98).

Conceptually, the construct of subjective age treats positive and negative perceptions of aging as two ends of the same spectrum: Feeling younger is regarded as an adaptive, positive perception of a person's own aging as it is commonly associated with positive outcomes. In contrast, feeling older is seen as indicating a maladaptive, negative perception of a person's own aging, which is associated with negative outcomes. Thus, apart from representing a rather reductionist operationalization of positive and negative perceptions of one's own aging, subjective age ratings do not allow for the simultaneous experience of age-related gains and losses, which seems to be an inherent condition of subjective aging experiences (Diehl & Wahl, 2010). Diehl and colleagues (2014) further criticized subjective age ratings for their lack of reference to individuals' aging expectations or personal aging experiences, thus capturing subjective aging at a rather general

level. The age norms or personal experiences underlying subjective age ratings could provide important information about the content of individuals' subjective aging. Despite these limitations, as will be demonstrated later in this chapter, the simple one-item measure of felt age shows impressive predictive power for a broad range of developmental outcomes.

Aging attitudes

Aging attitudes represent a specific subset of attitudes, which are commonly defined as a preference or evaluation of socially significant objects, groups, events or symbols (Banaji & Heiphetz, 2010). Attitudes operate mostly with little awareness, which makes them a particularly powerful influencing factor for behavior (Hess, 2006). The literature typically distinguishes three components of attitudes, namely affective, cognitive, and behavioral responses towards social stimuli (cf., Eagly & Chaiken, 1998; Fiske & Taylor, 1991). Thus, attitudes toward one's own aging can be described as individuals' feelings or emotions, beliefs, and reactions toward his or her own growing older. The following section is purposefully limited to attitudes toward *own* aging, because within the scope of this thesis subjective aging is defined as inside perspectives of older adults (a more detailed description of the related outside perspectives, as reflected in attitudes about aging in general or attitudes about older adults, can be found in Hess, 2006).

The study of aging attitudes is rooted in social psychological research on age stereotypes and has made important contributions to the field of subjective aging research. For example, one main research topic has evolved around the content and manifestation of age stereotypes as well as stereotype internalization processes, through which age stereotypes gain self-relevance and are being directed at the self (for more details see "Contamination Hypothesis" on page 20). Furthermore, research on age stereotypes has demonstrated that self-directed aging attitudes may result in stereotype-consistent behavior via stereotype threat. That is, if put in a situation of potentially confirming a self-relevant negative age stereotype, the activation of that stereotype triggers processes that lower older adults' performance (Hess, Auman, Colcombe, & Rahhal, 2003).

A frequently used operationalization of self-directed aging attitudes is by means of the Attitude Toward Own Aging (ATOA) scale; a subscale, which has been decoupled from the Philadelphia Geriatric Center Morale Scale and which asks for an individuals' general evaluation of his or her own aging process (Lawton, 1972, 1975). A look at the item wording (e.g., "Things keep getting worse as I get older" or "As you get older, you

are less useful") suggests that the ATOA scale captures affective and cognitive components of self-related aging attitudes. However, in the subjective aging literature the ATOA scale is not clearly understood as a measure of attitudes, as researchers have applied various labels to what has been measured with the ATOA scale, for example "aging satisfaction" (Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008), "aging self-perceptions" (Levy, 2008), and "personal views about aging" (Kim, Jang, & Chiriboga, 2012).

Several studies have examined how attitudes toward aging and age stereotypes change across adulthood. These studies reveal that although the relatively negative attitudes toward aging are shared by younger and older adults (Heckhausen, Dixon, & Baltes, 1989; Hummert, Garstka, Shaner, & Strahm, 1994), the configuration of attitudes changes as people grow older, suggesting that they incorporate own aging experiences into their aging attitudes. More precisely, middle-aged as compared to younger individuals have more differentiated and more complex aging attitudes and have more positive associations with old age (e.g., Brewer & Lui, 1984; Hummert et al., 1994; Linville, Fischer, & Salovey, 1989). These findings are in support of the externalization hypothesis which assumes that age stereotypes represent a projection of older individuals' self-views (Rothermund & Brandtstädter, 2003). Such an improvement of other-related attitudes toward aging, however, is not reflected in self-related attitudes. To date, two studies have analyzed the development of ATOA over chronological age in a sample of old-old adults and found a pattern of steady decline between the ages of 70 to 104 years (Kleinspehn-Ammerlahn et al., 2008; Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009).

To sum up, next to subjective age ATOA is a frequently used measure in the subjective aging literature. Like subjective age, ATOA is strongly associated with developmental outcomes, including health and well-being (Bryant et al., 2012; Levy, 2003; Moser, Spagnoli, & Santos-Eggimann, 2011). However, given the predominant use of the ATOA scale the study of aging attitudes is currently restricted to a unidimensional and global measurement approach, although it has been shown that contents and valences of (other-related) aging attitudes are context-dependent and may differ tremendously by behavioral domain (Kornadt & Rothermund, 2015). Thus, taking a domain-specific perspective in the study of aging attitudes seems warranted.

Subjective aging experiences

More recently, the focus on the denial of aging and the rejection of the label 'old' in most studies on subjective age and age identity has caused social and psychological scientists to ask for the everyday events and experiences that create the feeling of being young(er) or old(er) (Connidis, 1989; Giles, McIlrath, Mulac, & McCann, 2010; Sherman, 1994; Steverink et al., 2001). These phenomena have been studied using the labels 'subjective aging experiences' or 'self-perceptions of aging'. The underlying assumption is "that subjective age ratings are rooted in individuals' actual experiences and reflect how they subjectively experience and process the effects of advancing chronological age on their physical, psychological, and social functioning" (Diehl et al., 2014, p. 100). Diehl and colleagues (2014) assume that self-perceptions of aging are processed at a preconscious or implicit level and represent a form of tacit knowledge (Cianciolo, Matthew, Sternberg, & Wagner, 2006), which is "the foundation upon which retrievable knowledge about one's own aging process is based" (Diehl et al., 2014, p. 100).

This assumption establishes subjective aging experiences as a precursor of the more explicit construct of Awareness of Age-Related Change (AARC), which will be presented in the section following hereafter. Although the semi-structured answering format that was used to elicit the aging experiences of daily life (Chapter 2) bears mostly upon the AARC-model, the concept of subjective aging experiences is highly relevant for this measurement approach, because similar to qualitative studies on subjective aging experiences participants were asked for the specific events and experiences that they associated with their age(ing) each day. Therefore, a separate section on subjective aging experiences is deemed necessary for the scope of this dissertation.

Both qualitative and quantitative methods have been used to elaborate contents of self-perceptions of aging. These studies clearly advocate a multidimensional view of the construct, taking into account both the positive and negative aspects of aging. The emerging theme in most qualitative studies is that subjective age and age identities (i.e. the age group a person identifies with) are constructed in a dialectic way between declining health and mental capabilities on the one hand and satisfaction about being able to control one's life on the other hand (Lin, Hummert, & Harwood, 2004). For example, Keller and colleagues (1989) derived five categories of "meanings of aging" from in-depths interviews with adults aged 50-82 years. Respondents perceived aging as (1) a natural, mostly unnoticed process, (2) a period of life evaluation, philosophical reflection, or increased wisdom and maturity, (3) a period of increased freedom, new interests, and

fewer demands, (4) a period with physical health difficulties or concerns about health, and (5) a period of both interpersonal and job-related losses. Whereas 86% of all statements regarding the meaning of aging in this study were indicative of a positive view, the specific changes that respondents identified as signs of aging were primarily loss-oriented and comprised social, physical, emotional, and cognitive decrements. Using a factor-analytic approach to analyze data from a representative sample of 4,034 Germans aged 40 to 85 years, Steverink and colleagues (2001) identified two loss-oriented dimensions of aging experiences, namely physical decline and social loss, and one gain-oriented dimension, that is the experience of continued growth. Thereby, the authors of this study provided a multidimensional questionnaire that has been frequently used to measure self-perceptions of aging quantitatively in empirical studies (e.g., Wurm, Tesch-Römer, & Tomasik, 2007).

Qualitative studies focusing on different age groups point to the changing contents of self-perceptions of aging from midlife to late adulthood. First of all, there is a greater chance of reporting no positive but at least one or more negative aging experiences as people grow older (Connidis, 1989). Karp (1988) conducted a study on the changing age consciousness of professionals aged 50-60 years that highlights how the range of communications with the immediate environment gives rise to a subjective sense of aging in midlife. The categories of age reminders specific to this life phase were related to (1) the body, (2) being positioned between the children and the grandparent generation, (3) belonging to the oldest age group in a number of contexts (e.g., the working environment), and (4) mortality of age-peers. In later life, the focus of self-perceptions of aging lies on the various kinds of losses associated with the fourth age. Among interviewees aged 85-96 years, the experience of feeling old entailed (1) fear of helplessness and of being unable to manage one's life situation, (2) not recognizing one's former self, and (3) feeling different from others (Nilsson, Sarvimäki, & Ekman, 2000).

Taken together, such a comprehensive understanding of the specific events and experiences behind the feeling of being young(er) or old(er) is an important prerequisite for investigating the mechanisms that link subjective aging to developmental outcomes. Research on self-perceptions of aging has therefore enhanced the subjective aging literature by further shining a light on the psychological and behavioral consequences of subjective aging experiences. For example, in her analysis of how people construct subjective age identities, Furstenberg (2002) delineates the type of responses triggered by the imagined future of one's own aging. Typically interviewees talked about both affective responses,

for example feelings of sadness, fear, resentment, but also thankfulness and pride, and behavioral and cognitive responses, which covered the broad range of selection, optimization, and compensation processes. Similarly, Keller and colleagues (1989) distinguished five coping activities that people engage in in order to counter their negative aging experiences: compensation, stress management, maintenance, involvement with others, and alteration in meaning. Furthermore, Diehl and colleagues (2014) have pointed out the relevance of self-perceptions of aging as an antecedent of a conscious and explicit understanding of one's own aging process, which, in turn, is a necessary prerequisite for taking active control over one's aging process.

Awareness of Age-Related Change

The concept of AARC is a very recent addition to the subjective aging literature. The intention behind this new concept was to provide a theoretical framework for the investigation of psychological processes and mechanisms underlying the impressive effects of subjective age ratings on developmental outcomes (Diehl et al., 2014).

According to the definition provided by Diehl and Wahl (Diehl & Wahl, 2010), AARC is composed of "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). Two aspects in the definition of the construct are noteworthy. First, it is assumed that as individuals age AARC becomes part of individuals' self-knowledge incorporating both content-related and evaluative information about subjectively experienced age-related changes. Therefore, AARC relies on an advanced degree of self-reflection or conscious processing, which – in contrast to subjective age and age identity – requires individuals to be able to verbalize or evaluate their experiences of age-related change. Second, the perception that age (instead of other conditions, e.g. changes in health status or living conditions) is the underlying cause of the perceived changes constitutes a core feature of AARC. This is important because attributing experienced changes to age has implications for how individuals deal with that situation (Leventhal, 1984). As common-sense models of aging often claim that age-related losses are inevitable, uncontrollable, and irreversible (P. B. Baltes, Lindenberger, & Staudinger, 2006; Heckhausen et al., 1989; Lachman, Andreoletti, & Pearman, 2006; Masaro, 2006; Sarkisian, Hays, & Mangione, 2002), holding age responsible for experienced losses might lead to distress, anxiety, and inactivity (Lachman, 2006). Hence, Diehl and Wahl (2010) acknowledge that AARC may

function as a trigger for processes of personal meaning making and self-regulation and highlight that individuals take an active role in shaping and monitoring the way they grow older.

Although socio-cultural influences, such as culturally shared expectations and beliefs about age-related gains and losses (Heckhausen et al., 1989), are not entirely ruled out as sources of a person's AARC, it becomes evident from this definition that the emergence of AARC draws predominantly upon subjective, individual aging experiences. AARC is closely tied to the construct of the aging self and can be classified as rooted in a person-centered, psychological research tradition (Diehl et al., 2014). Further, the AARC construct was developed from the perspective of life-span developmental theory, explicitly taking into account the principles of multidimensionality and multidirectionality (P. B. Baltes, 1987). That is, besides a focus on negative and loss-related changes, the definition of AARC incorporates positive, gain-related aging experiences which might represent a resource and motivational force for continued development in old age (Diehl & Wahl, 2010). In terms of multidimensionality, five key behavioral domains that give rise to adults' subjective aging experiences have been posited. These are: (1) health and physical functioning; (2) cognitive functioning; (3) interpersonal relationships; (4) social-cognitive and social-emotional functioning; and (5) lifestyle and engagement. The development of these categories was based on the observation that subjective aging processes have been studied within multiple domains, however, without systematic attempts to link findings and concepts between domains. Diehl and Wahl (2010) argue that such a cross-domain investigation of subjective aging phenomena would advance the scientific understanding of the subjective experience of aging, because subjective aging can vary substantially across different behavioral domains.

AARC was initially introduced as a theoretical framework with the potential to integrate multidisciplinary findings about the antecedents and consequences of subjective aging and to stimulate empirical research. As corresponding measurement approaches are still in the process of development, there are yet only few empirical data available that provide insights on how AARC changes across the second half of life. Findings from an exploratory study with a preliminary questionnaire indicate that as people grow older they develop an increasing awareness for age-related losses, while at the same time also noticing an increasing amount of age-related gains (Wahl, Konieczny, & Diehl, 2013).

Overall, the construct AARC is deemed as a particularly promising approach for the study of subjective aging phenomena as it overcomes some of the drawbacks of tradi-

tional measurement approaches. In particular, AARC focusses on the specific events and experiences that give rise to feeling young(er) or old(er) and it takes into account both the co-occurrence of age-related gains and losses as well as the multidimensionality of subjective aging phenomena. One purpose of the present dissertation therefore was to examine the baseline rates of AARC in the daily lives of old-old adults and to explore the multifaceted contents of the five domains of the AARC model (cf. Chapter 2).

Comparison and evaluation of subjective aging constructs

The four subjective aging constructs presented above have in common that they capture individuals' beliefs and experiences related to their own aging and were thus eligible for the examination of subjective aging phenomena within the scope of this thesis. However, the differences with regard to how each construct is conceptualized and measured (see Table 1.1 for an overview) require further reflections about the suitability of each construct for specific research questions. Brothers and colleagues (Brothers, Miche, Diehl, & Wahl, 2015), who have examined the empirical associations among three subjective aging constructs (Feel Age, ATOA, and AARC), suggest that these constructs can be evaluated along two criteria: dimensionality/valence and rating specificity. With regard to *dimensionality and valence*, the traditional measures, subjective age and ATOA, rely on a unidimensional approach, which does not consider aging experiences across various life contexts. At the same time, these two measurement approaches treat positive and negative aging perceptions as two ends of the same continuum. Individuals with a relatively young subjective age or a high sum score on the ATOA scale are assumed to hold positive views of aging, whereas individuals with a relatively high subjective age or a low ATOA sum score are thought to perceive their own aging in a negative way. In contrast, newer constructs, such as self-perceptions of aging and AARC, take into account that an individual may experience his or her aging differently across various behavioral domains and assesses positive and negative experiences as being mostly independent of each other. Therefore, it can be assumed that multidimensional measures are particularly well-suited to disentangle domain- and valence-specific mechanisms that link subjective aging to specific developmental outcomes (e.g., physical health or cognitive functioning).

Table 1.1. Comparison of the Subjective Aging Constructs Used in this Dissertation (adapted from Diehl et al., 2014)

Construct	Definition	Measurement Approach(es)	Dimensionality/Valence	Rating Specificity	Development Across the Second Half of Life
Subjective Age	The age an individual feels like or views him or herself	Feel age, look age, do age, and interest age (Kastenbaum, 1972); mental age, psychological age, physical age, and social age (e.g., Montepare, 1996a); ideal age (e.g., Kaufman & Elder, 2002)	Feel age most commonly used as a stand-alone unidimensional measure	Global, no reference to specific aging experiences	Absolute discrepancy between feel age and chronological age increases, but relative deviation is stable (around 20%; cf. Rubin & Berntsen, 2006)
Attitude Toward Own Aging	An evaluation of one's own aging process consisting of an affective, cognitive, and behavioral component	Attitudes toward Aging Subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975)	Unidimensional	Mostly global, reference to age-related physical, emotional and social changes on a very general level	ATOA become more negative during the latest years of life (Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008)
Subjective Aging Experiences	Everyday perceptions and experiences that create the feeling of being young(er) or old(er)	Mostly qualitative studies; only quantitative approach: Personal Experience of Aging Scale (Steverink et al., 2001)	Multidimensional, yet with a variety of classification systems and with valence and behavioral domains intertwined	Behavior-specific	Changing contents and increasingly negative experiences in old age
Awareness of Age-Related Change	"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)" (Diehl & Wahl, p. 340)	AARC Questionnaire	Multidimensional, discrimination of gains and losses: - Health and physical functioning - Cognitive functioning - Interpersonal relationships - Social-cognitive & -emotional functioning - Lifestyle and engagement	Behavior-specific	Awareness of age-related gains and losses increase across the second half of life (Wahl, Konieczny, & Diehl, 2013)

The second distinguishing feature evident in the review of subjective aging constructs above is the rating specificity; that is whether or not participants are required to refer to specific behavioral experiences when responding to a measure's items. Traditional constructs (e.g., subjective age and ATOA) can be described as tapping into a mostly general understanding of a person's own aging, without considering the specific behavioral instances that lead to these judgments (Diehl et al., 2014). For example an affirmative answer to the ATOA item "Things keep getting worse as I get older" can refer to a multitude of specific experiences from increasing financial strain to poorer physical functioning to a narrowing network of social relations. In contrast, behavior-specific measures, such as AARC or qualitative surveys of subjective aging experiences, draw on individuals' actual behavioral experiences (Diehl & Wahl, 2010; Miche et al., 2014; Steverink et al., 2001) and require an explicit consideration of whether an age-related change in a particular behavioral domain has occurred. Diehl and colleagues (2014) thus arrive at the conclusion that different subjective aging constructs map onto an awareness continuum and consequently utilize different pathways to influence developmental outcomes. For example, Levy and colleagues (Levy, 1996; Levy, Pilver, Chung, & Slade, 2014) have shown that age-stereotypes seem to have a more powerful influence on cognitive and physical functioning, when utilizing an implicit, non-conscious pathway, whereas behavior-specific measures might rather motivate adaptation processes through volitional control and conscious self-regulation (Brothers et al., 2015).

Although global, unidimensional measures have often been criticized for a reductionist treatment of subjective aging phenomena, they still represent a valuable measurement approach if the research aim is to study superordinate effects of subjective aging. In fact, studies using subjective age or ATOA have revealed impressive effects on a number of developmental outcomes. Furthermore, individuals might differ with regard to the subjective importance they attach to changes in a specific behavioral domain. For example, whereas one person might be particularly threatened by age-related bodily changes, another person might be more worried about perceived cognitive deficits. Multidimensional behavior-specific measures can be used to explicitly test such interindividual differences in domain importance. In contrast, unidimensional, global measures "force" participants to weigh and integrate aging experiences from multiple domains into one overall judgement. Global measures might thus be appropriate if the aim is to examine how an overall negative or positive view on aging is associated with third variables, including questions related to the directions of effects (cf. Chapter 4).

The four individual studies in this dissertation purposefully make use of different measurement approaches. The AARC model was used to theoretically structure the detailed subjective aging experiences in everyday life and to investigate domain-specific effects of subjective aging on different well-being indicators (Chapter 2). ATOA and subjective age were employed when the aim was to study subjective aging trajectories and questions related to directionality of effects at a more general level (Chapter 3 and 4). Finally, Chapter 5 evaluates what insights can be gained by using multidimensional subjective age questions instead of the commonly used single-item approach of felt age in an experimental study.

Theories about the Formation of Subjective Aging Phenomena

Several theories developed from very different theoretical perspectives are able to speak to the formation processes underlying subjective aging phenomena. The most important theories will be delineated in the following. *Social Identity Theory* elucidates how intergroup relations and social comparison processes may serve the preservation of a positive age identity; the *Contamination Hypothesis* describes the conditions under which age stereotypes are being internalized into self-views and become self-descriptive, and *Symbolic Interaction Theory* highlights the role of interpersonal interactions in the negotiation of age stereotypes and the construction of age identities.

These theories are deemed relevant within the scope of this thesis as they provide important insights about the sources from which subjective aging phenomena arise and the motivational processes underlying their formation. They represent the theoretical background for questions about the emergence of subjective aging phenomena in everyday life (Chapter 2), long-term determinants of subjective aging (Chapters 3 and 4), and about potential ways of changing individuals' subjective aging (Chapter 5).

Social Identity Theory and Social Comparison Processes

Social identity theory (Tajfel, 1978; J. Turner, 1984) has its roots in social psychology and aims at describing intergroup relations, group processes, and the social self. The fundamental assumptions of social identity theory are that individuals categorize people (including the self) into contextually relevant groups and that the defining characteristics of one's in-group are employed to construct a self-definition. Further, individuals have the desire to uphold a positive identity, which arises from a positive evaluation of one's in-group in comparison to out-groups.

Transferred to the field of subjective aging, social identity theory implies that individuals construct their social self (amongst others) based on their belonging to a certain age group, because age is among the most salient characteristic for categorizing people (Settersten & Mayer, 1997). In order to protect their self-concept from being tainted by the negative age stereotypes existing in Western societies, older adults therefore need to employ various self-protective strategies (Allport, 1954; Tajfel, 1978). One such strategy is to simply deny ones membership to a group if it is threating to the self-concept (Allport, 1954), as evidenced in the general tendency of older adults to foster a youthful subjective age or age identity. In a more outwardly oriented attempt to conceal one's belonging to an older age-group, older adults may also be inclined to cover the physical signs of aging by dyeing their hair, using anti-aging cosmetics, or undergoing cosmetic surgery (Harwood, Giles, & Ryan, 1995). In contrast, if positive characteristics of an age group are made salient, for example generation membership, which is positively connoted with socially shared experiences and common fate, experimental studies show that older adults are less inclined to deny belonging to a positively perceived group (Weiss & Lang, 2009). A very similar self-enhancing strategy is to purposefully select specific reference groups for a favorable reference group comparison. By comparing with a negatively distorted view of a generalized other, e.g. "other people my age", older adults arrive at a more favorable evaluation of their own abilities. Heckhausen and Brim (1997) provide evidence for this phenomenon of 'social downgrading', especially in older adults who experience problems related to the aging process. Furthermore, Pinquart (2002) as well as Weiss and Lang (2012) were able to show that the presentation of negative age stereotypes undermines general perceptions of other older adults whereas self-perceptions (i.e. self-efficacy, perceived social competence, and age identity) are being improved.

In sum, Social Identity Theory holds that older adults are motivated to dissociate from their own age group, to not consider themselves as being as old as "the other old people", and to maintain a positive outlook on their own aging. Chapter 2 provides multiple examples for such strategic selections of references groups in order to mitigate the effects of everyday encounters of with one's aging process. Furthermore, the identification with an age group might interact with membership in other social categories such as gender or socioeconomic status. Therefore, identifying with an old age group or feeling old(er) might have very different implication for men and women or for individuals with high and low socioeconomic status. The question how sociostructural factors shape subjective aging is being approached in Chapters 2 and 3. Finally, as individuals grow

older, the empirical literature reports an increasing absolute discrepancy between chronological and subjective ages, which could be interpreted as a result of dissociation processes. The question arises, whether other conceptual approaches to subjective aging, which are less closely related to social group membership, such as ATOA, show similar effects of 'aging denial' as people grow older. This question is addressed in Chapter 3.

Contamination Hypothesis

In contrast to the self-serving biases that result from social comparison processes the contamination hypothesis (Rothermund, 2005; Rothermund & Brandtstädter, 2003), also known as labeling theory (Kotter-Grühn & Hess, 2012), describes conditions under which negative age stereotypes have detrimental effects on self-views. The contamination hypothesis posits that age stereotypes are learned in early childhood, at a time when age stereotypes are a long way from being self-relevant. Children as young as age 4 years hold stereotypes about salient social groups, including the group of older adults (Bigler & Liben, 2007). When individuals grow older and self-define as being old, they integrate age stereotypes learned earlier in life into their self-concepts, as can be observed in a convergence of self-views with age stereotypes. However, a positive correlation between age stereotypes and self-views can also be explained by externalization processes. That is, the older person perceives his or her self-evaluations as being characteristic for older people at large and overgeneralizes own experiences. To rule out this alternative explanation, Rothermund and Brandstädter (2003) conducted a longitudinal study of profile changes in self-views. Across a large set of different attributes, initially held age stereotypes predicted changes in self-views. That is, supporting the contamination hypothesis, self-ratings became more similar to personally held age stereotypes over time (and not the other way round). A very recent longitudinal study pursued a cross-lagged panel approach to evaluate the rivaling assumptions of internalization and projection effects in a life-span sample (Kornadt, Voss, & Rothermund, 2015). This study found that internalization effects occur largely during young adulthood and midlife, at a time when the self-relevance of age stereotypes is increased through expectations of impeding age-related changes.

In addition to age, Rothermund (2005) other factors that influence whether negative age stereotypes contaminate self-views or serve as a self-enhancing reference standard. Assimilation effects seem to occur when age stereotypes are perceived as self-applicable and when they are processed automatically and without awareness of the participant.

The way stereotypes are presented, their content, and characteristics of the person communicating the age stereotype (e.g., status, credibility) were proposed as further moderating factors.

Overall, the contamination hypothesis holds that subjective aging phenomena are a reflection of personally held age stereotypes, meaning that older adults will likely experience their own aging in a way that is consistent with previously held age stereotypes. Given that the biological and functional changes of the aging process are a prominent theme of age stereotypes (Löckenhoff et al., 2009), these contents very likely represent a major topic and driving force of subjective aging. Thus, the contamination hypothesis represents an important framework for the contents of subjective aging experiences that are being investigated in Chapter 2 as well as for Chapters 3 and 4 which examine the role of a person's health status for subjective aging. Furthermore, the experimental manipulation strategies that are developed in Chapter 5 bear on the contamination hypothesis, assuming that experimentally induced experiences, which lay persons typically associate with cognitive aging, are being integrated into individuals' self-views.

Symbolic Interaction Theory

The term "symbolic interactionism" was coined by Herbert Blumer in the 1930s and refers to the sociological school of thought established by George Herbert Mead (Mead, 1959; J. H. Turner, 2013). Symbolic interactionism has inspired a whole family of symbolic interactionist theories of personal identity revolving around the dynamics of the self in social interaction. A fundamental assumption of this theoretical framework is that the social and personal identity of a person is negotiated within and through social interactions. From the perspective of symbolic interactionism, the self represents an important social object of which individuals make meaning based on the ways in which people react and interact to their presentation of identity. This negotiation process is motivated by a need for mutual verification. That is, individuals "seek to have their identities verified by others by assessing others' reactions to their behavioral output to see if these outputs are consistent with an identity and are acceptable to others" (J. H. Turner, 2013, p. 354). Thus, communication processes, and in particular language, socialization, and education, are considered as the centerpiece in the construction of identities and these micro interactions are linked with macro-social structures in which interactions occur (Lal, 1995; J. H. Turner, 2013).

Applying the perspective of symbolic interactionism to the subjective experience of aging, the discourse-analytical work by Justine and Nikolas Coupland moves beyond treating age identity as static, intraindividual construct and illustrates how social interactions in everyday life shape individuals' age identities (J. Coupland, Coupland, Giles, & Henwood, 1991; N. Coupland & Coupland, 1995). In many instances of everyday communication the authors observe practices that constrain individuals' age identities to a decremental model of aging. This constraint becomes evident in the almost ritualized practices of age disclosure with reference to health identities, where telling one's age is either used to account for health problems or to claim credit for a relatively good health status "despite" being old. Both ways of age disclosure implicitly endorse a decremental model of aging, thus challenging positive age identities despite ill health (N. Coupland & Coupland, 1995). Another prominent example can be found in "ideological matching", whereby in communication with age-peers older adults face some pressure to accommodate to the communicated age identities (J. Coupland et al., 1991). Thus, also from the perspective of symbolic interactionism, preserving an adaptive, resource-oriented view on aging may be particularly challenging in a society in which negative, loss-oriented age stereotypes prevail.

The perspective of symbolic interactionism is particularly relevant for the daily diary study in Chapter 2, because it holds that interpersonal interactions in daily might be an important source from which older adults derive and negotiate their subjective aging experiences.

Insights gained about the formation of subjective aging phenomena

Several conclusions about the formation processes of subjective aging phenomena can be drawn at this point. First, subjective aging seems to be strongly tied to age stereotypes and age norms. Social Identity Theory and the Contamination Hypothesis suggest two opposing directions of effects: On the one hand age stereotypes enhance subjective aging through dissociation processes (e.g., social downgrading) and on the other hand age stereotypes are being internalized and may taint people's self-concept. Second, Symbolic Interactionism holds that subjective aging is shaped and negotiated within everyday interactions and experiences. However, it also becomes evident from the above review that theories about the formation processes of subjective aging phenomena have mainly focused on the interplay between age stereotypes or age norms and an individual's subjective experience of aging. When contrasting the current state of theories to the body of

empirical literature about predictors and antecedents of subjective aging (see section "Predictors of Subjective Aging Phenomena" on page 28) it seems that there is a need to develop an overarching theoretical model that integrates a broad range of antecedents and determinants (e.g., socio-economic variables, personality) of subjective aging phenomena from a life-span perspective. In their overview of life-span developmental processes and outcomes related to subjective aging, Diehl and colleagues (2014) draw a similar conclusion and discus a variety of influencing factors (e.g., cultural influences, psychological resources, socio-economic resources) that should be considered in future theorizing.

Theories about the Influence of Subjective Aging on Developmental Outcomes

Although a vast body of empirical studies on the developmental consequences of subjective aging has accumulated over the last decades, there is still a lack of theoretical frameworks that explain the pathways and mechanisms through which subjective aging phenomena are linked with developmental outcomes, such as mental and physical health or cognitive functioning. In a similar vein, Diehl and colleagues (2014) noted the critical importance of subjective aging within theories of adult development and aging and have called for a better integration of subjective aging related processes within such theories. Two notable exceptions in which a theoretical connection between subjective aging and developmental outcomes has been made are the *Stereotype Embodiment Theory* and the *Stereotype Threat* framework.

These theories widen the understanding of the mechanisms and conditions under which subjective aging is linked to developmental outcomes and are relevant within this thesis when it comes to the investigation of domain-specific effects of subjective aging on subjective well-being (Chapter 2) and to the directionality of effects in the association between subjective aging and various health domains (Chapter 4).

Stereotype Embodiment Theory

Stereotype Embodiment Theory, which has been put forth by Becca Levy (2009) based on a series of longitudinal and experimental studies, is built on four guiding principles: (1) starting in childhood age stereotypes are being internalized and this processes continues across the life span; (2) age stereotypes become self-relevant when individuals self-identify as being old; (3) aging self-stereotypes utilize multiple pathways to influence psycho-physical functioning; and (4) the operation of age stereotypes can occur on an unconscious level. The following description of Stereotype Embodiment Theory will

focus primarily on the latter two principles, because the internalization of age stereo-types and the processes through which they gain self-relevance have been described in more detail in the previous section ("Theories about the Formation of Subjective Aging Phenomena").

The three pathways along which aging-self stereotypes exert their influence allude to psychological, behavioral, and physiological mechanisms (Levy, 2009). The psychological pathway suggests that age stereotypes generate aging-related expectations which then become a self-fulfilling prophecy. This mechanism is exemplified by stereotype-consistent behavior after subliminal presentation of either physical or cognitive age stereotypes (Levy & Leifheit-Limson, 2009). Other psychological processes that link subjective aging to developmental outcomes include control beliefs (Lachman, 2006; Levy, Slade, & Kasl, 2002) and self-regulation strategies (Diehl et al., 2014; Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). Research shows that older individuals who perceive to have little control over aging-related decline are less motivated to engage in adaptive behaviors, such as strategy use or physical exercise (Lachman, 2006). Furthermore, expectancy of control seems to be important for coping with age-related decline and maintaining posi-tive aging attitudes (Sargent-Cox, Anstey, & Luszcz, 2012a). With regard to self-regulation strategies, a longitudinal study by Wurm and colleagues (2013) revealed that individuals with more negative self-perceptions of aging are less likely to use selection, optimization, and compensation strategies in case of a serious health event, which, in turn, was associated with lower levels of self-rated health and life satisfaction over time.

The behavioral pathway alludes to the restricted range of adaptive behaviors in indi-viduals with negative self-perceptions of aging. For example, Levy and Myers (2004) found that a positive ATOA at baseline predicted engagement in a list of preventive health behaviors (e.g., taking a complete physical examination, eating a balanced diet, or taking prescribed medications) over the course of 20 years. Furthermore, the confronta-tion with negative age stereotypes, for example by means of patronizing talk (Ryan, Giles, Bartolucci, & Henwood, 1986) or reinforcement of dependent behavior (Margret M. Baltes & Wahl, 1992; Margaret M. Baltes & Wahl, 1996), significantly restricts the action range of older adults to stereotype consistent behavior (cf., Hess, 2006).

Finally, according to the physiological pathway, negative self-perceptions of aging put individuals at risk for heightened cardiovascular stress reactivity. For example, in a la-boratory setting it has been shown that individuals respond with a heightened cardio-vascular reactivity to environmental stressors when being exposed to negative as op-

posed to positive age stereotypes (Levy, Hausdorff, Hencke, & Wei, 2000). In the long run, an increased stress reactivity of individuals with negative self-perceptions of aging may translate into higher levels of systemic inflammation (Stephan, Sutin, & Terracciano, 2015b), thus putting these individuals at a higher risk to experience a cardiovascular event later in life (Levy, Zonderman, Slade, & Ferrucci, 2009).

The unconscious operation of age stereotypes has been tested by Levy in a series of experimental studies. These studies found that the subliminal priming of participants with both positive and negative age stereotypes affects functioning and behavior across multiple domains, such as handwriting (Levy, 2000) or will to live (Levy, Ashman, & Dror, 1999-2000). Given this lacking awareness of the adverse effects of negative age stereotypes, aging self-stereotypes can have particularly powerful and harmful consequences for adult development because older adults may see no reason to discard negative aging self-stereotypes or to take action against its negative consequences. Levy indeed has maintained that age stereotypes have a more powerful effect on subjective aging, when being processed subliminally. In support of this hypothesis, one of her recent experimental studies showed that the effects of an implicit age-stereotype intervention on self-perceptions of aging and on physical functioning were stronger than those of an explicit age-stereotype intervention (Levy, Pilver, Chung et al., 2014).

Although the pathways postulated by the Stereotype Embodiment Theory are not being explicitly tested in the present dissertation, the theory represents the theoretical background for the hypothesized effects of subjective aging on health and well-being (Chapters 2 and 4). That is, Levy's theory assumes that subjective aging has long-term consequences on a broad range of outcomes, including various health domains, cognitive functioning, and subjective well-being, as has been demonstrated in a host of individual studies. Chapter 4 investigates if the effect of subjective aging as well as the direction of the relationship is similar for different health domains. Furthermore, Chapter 2 discriminates between positive and negative domain-specific aging experiences and examines whether the effects of subjective aging on well-being are domain-specific.

Stereotype Threat

The notion of Stereotype Threat goes back to the work of Claude Steele (1997) who examined the influence of stereotypes on the behavior of students belonging to minority groups (i.e., students of African-American descent in the U.S.). This work has been extended to the field of age stereotype research by Thomas Hess and colleagues. One of

the fundamental assumptions of Stereotype Threat Theory is that when being in the situation to potentially confirm a negative, self-relevant stereotype (e.g., an older adult taking a memory test), the activation of the stereotype (e.g., old people have a bad memory) puts pressure on the individual which, in turn, leads to impaired performance. Several mediating variables have been proposed to explain stereotype threat effects; among them, increased anxiety, elevated arousal, evaluation apprehension, and decreased effort (Hess, 2006). Furthermore, it is assumed that stereotype threat effects depend on (a) strong identification with the stereotyped group, (b) high subjective importance of the stereotyped ability, (c) the test being perceived as diagnostic for the tested ability, and (d) low levels of awareness of the negative stereotype (Hess, 2006).

In a systematic attempt to test whether the stereotype threat framework is able to explain impaired functioning in older adults when being faced with negative age stereotypes, Hess and colleagues (2003) found that in older but not in younger adults memory test performance varied with the degree of activation of negative age stereotypes. Further, in line with stereotype threat theory, effects were largest for those older adults who placed the highest importance on their memory abilities. However, it seems that concerns about being negatively stereotyped are almost automatically triggered in older adults when taking a memory test and that these subjective beliefs have more powerful influence on memory performance than a positive or negative stereotype manipulation (Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005; Hess & Hinson, 2006). Although the Stereotype Threat hypothesis has been primarily tested with regard to cognitive functioning (Hess et al., 2003; Hess & Hinson, 2006; Hess, Hinson, & Hodges, 2009; Hess, Hinson, & Statham, 2004), other studies have also found that confrontation with negative age stereotypes also affects health indicators, such as blood pressure and skin conductance (Auman, Bosworth, & Hess, 2005).

In the same vein, some other studies show that "stereotype boost" effects can be achieved when instead of a negative age stereotype a positively stereotyped trait is made salient. For example, in an experimental setting with subliminal activation of positive age stereotypes participants improved in their cognitive performance (Levy, 1996; Swift, Abrams, & Marques, 2012).

In sum, although Stereotype Threat Theory focusses mainly on the effects of age stereotypes on performance, it is also a relevant framework for understanding the effects of subjective aging, because the self-relevance of an age stereotype is postulated as a prerequisite to achieve stereotype threat effects. Thus, Stereotype Threat Theory further

adds to our understanding of the pathways through which subjective aging is linked with physical and cognitive functioning.

Insights gained about the developmental consequences of subjective aging

Both theories presented above illustrate how self-directed age stereotypes influence adult development. Whereas Stereotype Threat has focused mainly on short-term effects of age stereotypes on cognitive functioning in experimental settings, Stereotype Embodiment Theory has taken a broader perspective. First, Stereotype Embodiment Theory does not only describe the developmental consequences of subjecting aging, but also postulates the processes through which age stereotypes gain self-relevance. Second, it extends effects of subjective aging from the laboratory to more naturalistic settings and describes the long-term processes that lead from a negative perception of aging to adverse developmental outcomes. Third, Stereotype Embodiment Theory proposes an extensive set of underlying mechanisms through which subjective aging may influence development.

Nevertheless, further theorizing with regard to the developmental outcomes of subjective aging is warranted. In particular, it seems that little is known about the contexts and conditions under which subjective aging is most influential. This pertains to questions such as the age periods of the adult life span at which subjective aging is most important for development, or how certain life contexts may function as a constraint or facilitator of the effects of subjective aging. Chapter 2 of the present dissertation therefore takes subjective well-being as an example and addresses the question whether the influence of subjective aging differs by behavioral domain, whereas Chapter 4 examines whether a negative subjective aging has detrimental effects for both middle-aged and young old adults.

Current State of Subjective Aging Research

After going through a period of disinterest in the 1980s, there has been a "revival" of subjective aging research since the late 1990s as can be seen in an increasing amount of conceptual as well as empirical literature in the field (Diehl et al., 2015). The following section will give an overview of empirical findings related to the formation processes of subjective aging phenomena, their developmental consequences, as well as their short- and potentially long-term malleability. Throughout this section, the description of empirical findings will be focused on those selected variables that are relevant for the individual studies of this thesis. In terms of predictors of subjective aging, these variables are

gender, socioeconomic status, and personality. With regard to developmental consequences of subjective aging, recent empirical research has widened the range of outcome variables from a predominant focus on health and well-being to other indicators of successful aging such as cognitive functioning (e.g., Stephan, Caudroit, Jaconelli, & Terracciano, 2014; Stephan, Sutin, Caudroit et al., 2015) and indicators of mental health (e.g., Keyes & Westerhof, 2012; Levy, Pilver, & Pietrzak, 2014). However, the below review of will focus on health and subjective well-being, given that these were the outcomes of interest within the individual studies of this thesis.

Predictors of Subjective Aging Phenomena

Sociostructural factors: Gender and socioeconomic status

Gender. Although many empirical studies in the field of subjective aging research use gender as a control variable, there have yet been few systematic attempts to investigate the role of gender as a driving force of subjective aging phenomena. Susan Sontag has coined the notion that there exists a "double standard of aging" according to which the aging process has more negative consequences for women than for men (Sontag, 1972). Sontag argued that women are primarily judged based on their physical attractiveness, which tends to diminish with increasing age, while men are evaluated based on intelligence, money, and power – characteristics that are likely to increase with chronological age. Consequently, women lose social status, while men gain social status through the aging process. Sontag argues that therefore, women should have a more negative outlook on their own aging compared to men.

Empirical findings on gender differences, however, are mixed. Although some individual studies find no gender differences regarding subjective age (e.g., Hubley & Russell, 2009; Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010; Schafer & Shippee, 2010a), the results of a meta-analysis including 19 studies on subjective age point to a more youthful subjective age in women compared to same-aged men (Pinquart & Sörensen, 2001). Out of a larger number of constructs related to well-being and the self-concept, the greatest gender difference in this meta-analysis was found for subjective age. Some authors have argued that the tendency of women to feel younger than men should not be misinterpreted as a more positive aging perception of women and as counterevidence for the double standard of aging hypothesis. Instead, these findings might be indicative of a self-enhancement strategy: Because of different standards applied to aging men and women, women experience greater pressure to distance from their chronological age and there-

fore tend to hold younger identities than men (Barrett, 2005; Pinquart & Sörensen, 2001). Going further, Barrett (2005) found that gendered aging experiences in the domains of health, work and, family concealed actually larger differences in age identities between men and women. For example, when controlling for women's worse levels of health relative to men, women reported significantly younger age identities than men. Other empirical findings, however, suggest that a greater devaluation of age in women, as proposed by the 'double standard of aging' hypothesis, does not set in until early old age. In a sample covering almost the complete adult life span from 17 to 85 years, Montepare (1996b) found that women's perceptions of their attractiveness initially increases throughout early adulthood until middle age and then becomes more negative again when women reach the age of 60. This inverted u-shaped pattern of attractiveness ratings across adulthood might reflect that since the 1970s, when Susan Sontag published her magazine article, societies have developed new beauty ideals specific to women in midlife. In a similar vein, a systematic comparison of gendered age stereotypes in different life domains revealed that older women were even rated as being more attractive than older men (Kornadt, Voss, & Rothermund, 2013). The results of this study further highlight the domain specificity of evaluative asymmetries in age stereotypes for men and women. Although older women received less favorable ratings than older men in the domains of finances and work (thus confirming the double standard of aging), they were at the same time evaluated more positively in other domains, namely religion, friends, and leisure (Kornadt et al., 2013). Therefore, given that gender differences in subjective aging have been examined primarily based on the unidimensional concept of subjective age, Chapter 2 extends these findings to a multidimensional measure of subjective aging and investigates whether men and women associate different events and experiences with their own aging process. Furthermore, Chapter 3 asks whether gender, in addition to explaining differences in the level of subjective aging, would also be predictive of longitudinal change trajectories in subjective aging.

Socioeconomic status. Similar to gender, socioeconomic status (SES) is a major factor that shapes the subjective experience of aging. A consistent finding emerging from the empirical literature is that individuals with lower SES have older subjective ages than more advantaged individuals (e.g., Baum & Boxley, 1983; Markides & Boldt, 1983). These findings can be explained through both proximal and distal effects of SES on subjective aging. A proximal cause of SES is that it shapes the way individuals think about aging and the life course. Individuals occupying lower socioeconomic strata indi-

cate younger chronological ages as the onset of old age, have earlier normative deadlines for family transitions, and expect to live shorter lives (Mirowsky & Ross, 2000; Rosow, 1967; Settersten & Hagestad, 1996). Such different conceptions of the life course depending on a person's social status might be partially owed to objective differences in life course patterns. This more distal influence of SES is exemplified by the timing of life transitions and health trajectories: Individuals with lower SES experience an earlier timing of life events, such as marriage, retirement, or health problems, which, in turn, is associated with an older subjective age (Neugarten & Moore, 1986). A systematic investigation of this mediation hypothesis by taking the example of health inequalities has been conducted by Barrett (Barrett, 2003). In her analysis of data from the national survey of Midlife Development in the U.S. (MIDUS) including individuals aged 25 to 74 years, she examined whether health disparities can account for a relatively older subjective age in individuals with lower SES and found that a less optimistic views of one's future health status accounted for the older subjective ages found in socioeconomically disadvantaged individuals. Furthermore, consistent with the cumulative advantage and disadvantage hypothesis, socioeconomic differences in subjective age were more pronounced with increasing age (Barrett, 2003).

Again, the empirical examination of socioeconomic status has been restricted by a predominant use of the subjective age construct. Therefore, Chapter 2 uses a multidimensional, behavior-specific measure of subjective aging to examine whether socioeconomically advantaged and disadvantaged individuals differ with regard to the everyday events and experiences that give rise to their feeling of being old(er). Furthermore, Chapter 3 asks whether socioeconomic status, in addition to explaining differences in the level of subjective aging, would also be predictive of longitudinal change trajectories.

Personality

Empirical research on personality as a predictor of subjective aging draws on the notion that the subjective perception of a person's own aging is rooted in the experiences that he or she associates with his or her own aging and how a person evaluates age-related changes in comparison with age peers or younger age groups. Consequently, personality is expected to shape the subjective experience of aging, because individuals might compare their own personality development with age-related expectations of personality development. Older adults are typically viewed as less open and extraverted, but also as more conscientious, agreeable, and emotionally stable compared to middle-aged

and younger adults (Haslam, Bastian, Fox, & Whelan, 2007; Igier & Mullet, 2003). Therefore, older adults with relatively extraverted and open behavior, thoughts, and feelings may be more likely to identify with younger age groups and feel younger. In addition, a certain personality structure may predispose individuals to focus on a selected range of age-related changes. For example, individuals high in neuroticism might pay closer attention to age-related functional decrements and may be less likely to notice positive aging experiences.

Associations between personality traits and subjective aging have been reported by several studies, although conflicting findings emerged for some personality traits. The most unequivocal case is that of extraversion, which has been found to be positively related with subjective aging phenomena. In a life-span sample covering the age-range of 18 to 91 years, extraversion was related to a more youthful subjective age particularly at older ages (Stephan, Demulier, & Terracciano, 2012). The same finding was also reported by Hubley and Hultsch (1994) in their analysis of data from community-dwelling adults aged 55 to 85 years. Furthermore, more extraverted individuals are less likely to report age-related loss experiences (Wahl et al., 2013). Similar to extraversion, individuals with high levels of internal stimulation (i.e. persons who find it easy to keep themselves engaged and interested) were shown to hold a larger youthfulness bias (Gana, Alaphilippe, & Bailly, 2004).

The cases of openness to experience, conscientiousness, and neuroticism are somewhat less clear. Stephan and colleagues (Stephan et al., 2012) found that older adults who are more open to experience feel younger and this association seems to be completely mediated through age group identification (Canada, Stephan, Caudroit, & Jaconelli, 2013), suggesting that open individuals perceive to have more commonalities with younger age groups and therefore arrive at a younger age identity. In another study, the association between openness and subjective age was, however, not confirmed (Hubley & Hultsch, 1994). Conscientiousness was found to be associated with older subjective ages, but only among young adults (Stephan et al., 2012). An expected negative correlation between conscientiousness and subjective age among older adults did not emerge in this study, but was found in a clinical sample of patients aged 38 to 92 years undergoing cataract surgery, with more conscientious individuals feeling younger at presurgery as well as 6 weeks postsurgery and also having an increasing youthfulness bias over time (Knoll, Rieckmann, Scholz, & Schwarzer, 2004). With regard to neuroticism, most studies revealed an association with subjective aging, with higher levels of

neuroticism being associated with more negative age stereotypes (Moor, Zimprich, Schmitt, & Kliegel, 2006), older subjective ages (Canada et al., 2013; Kotter-Grühn et al., 2009), and a negatively toned age awareness (Wahl et al., 2013), but others reports no effect (Hubley & Hultsch, 1994; Stephan et al., 2012).

Taking extraversion and neuroticism, the personality traits that emerged as the most important predictors of subjective aging in previous studies, Chapter 3 examines whether these two traits do not only serve as a predictor of interindividual differences in subjective aging (in this case ATOA) but would also be able to explain intraindividual change trajectories.

At the same time, it is important to acknowledge that the relationship between subjective aging and personality might very well be bidirectional. Some authors have proposed that personality could also be treated as a developmental outcome of subjective aging, reasoning that individuals who feel old relative to their age peers may adopt the characteristics typically associated with old age, which eventually also includes an 'old age personality' (Stephan, Sutin, & Terracciano, 2014). However, given that to date personality has mostly been discussed as a predictor of subjective aging in the literature, the same approach was pursued in the present dissertation, without explicitly testing the direction of effects between subjective aging and personality.

Developmental Consequences of Subjective Aging Phenomena

Health and longevity

Earlier studies on subjective aging phenomena have examined health primarily as a correlate or antecedent of subjective aging using cross-sectional data (nevertheless admitting a potentially bidirectional relationship between the two variables) (e.g., Barak & Stern, 1986). Beginning at the turn of the century the field has increasingly also considered the role of subjective aging phenomena as a driving force for older adults' health trajectories. By now, several longitudinal studies have established subjective aging as an influential antecedent of older adults' physical health and even survival and, as has been demonstrated in a meta-analysis of longitudinal data, the impact of subjective aging is comparable to the effect of well-being on health (Westerhof et al., 2014). In addition, the few studies that have conducted a simultaneous testing of the direction of effects between subjective aging and physical health speak for health being an outcome of subjective aging (Sargent-Cox, Anstey, & Luszcz, 2012b; Wurm et al., 2007). Given this overwhelming evidence for the health consequences of subjective aging, physical health is

here discussed as an outcome, which is not meant to deny its crucial role in the formation processes of subjective aging.

Generally speaking, poorer physical health is associated with more negative subjective aging. The relationship between subjective aging and physical health is apparent with regard to a broad range of specific health conditions. For example, both laboratory experiments and longitudinal studies have shown that negative aging perceptions are a risk factor for cardiovascular disease. When primed with negative age stereotypes in an experimental manipulation, older adults exhibited a more pronounced cardiovascular stress response, compared to individuals primed with positive age stereotypes (Levy et al., 2008). In a longitudinal study of a nationally representative sample, individuals who held negative age stereotypes earlier in life were significantly more likely to experience a cardiovascular event (e.g., stroke or heart attack) in the following three to four decades (Levy et al., 2009). Not only are negative age stereotypes associated with cardiovascular symptoms, but positive age stereotypes are also predictive of better functioning and recovery after a heart attack (Levy, Slade, May, & Caracciolo, 2006). An illustration of the physiological pathway (Levy, 2009) linking subjective aging to cardiovascular disease has been provided by Stephan and colleagues (Stephan, Sutin et al., 2015b). Their study of biomarkers showed that C-reactive protein (a marker of systemic inflammation that is associated with an increased risk of cardiovascular disease) is lower in individuals with younger subjective ages. Subjective aging may also influence conditions related to sensory functioning. Older adults who held more negative views of aging, and whose opinions of aging focused on external factors like appearance, showed significantly lower hearing test scores three years later, compared to individuals who held more positive views of aging (Levy, Slade, & Gill, 2006). These selected examples illustrate the persistent themes in the literature in which subjective age and physical health are interrelated across many different health conditions. Importantly, all of these studies have shown that subjective age predicts specific health conditions over and above other risk factors, such as participant's age, gender, education, body mass index, number of chronic conditions, or depressive symptoms. Furthermore, the impact of subjective aging on various physical illnesses seems to be higher than for the reverse direction of causality (Wurm et al., 2007). Also of importance, the effect of subjective aging goes beyond specific health conditions. Priming older individuals with negative age stereotypes undermines their will to live (Levy et al., 1999-2000) and a wealth of studies, all using different measurement approaches to subjective aging, provides consistent evidence that individuals with a more positive per-

ception of their own aging have a longer life expectancy (e.g., Kotter-Grühn et al., 2009; Levy, Slade, Kunkel et al., 2002; Markides & Pappas, 1982; Sargent-Cox, Anstey, & Luszcz, 2014; Uotinen et al., 2005).

Taking a more holistic approach to health, subjective aging also predicts other important health dimensions next to objective physical health status (e.g., number of diagnosed physical conditions). First, subjective aging predicts intraindividual change in physical functioning over time. Short-time effects emerged in an experimental setting, where participants were made to feel younger through a social comparison feedback which, in turn, was associated with increases in handgrip strength in the experimental group compared to the control condition (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). Over a longer time period of 18 years, Levy, Slade, and Kasl (2002) found that self-perceptions of aging at baseline were associated with physical functioning in a sample of community-residing adults aged 50 years and older. These autors' analyses compared individuals with the same physical functioning score at baseline and revealed a greater amount of physical functioning decline in individuals with a negative perception of aging. A positive perception of aging can thus be regarded as a protective factor for maintaining high levels of physical functioning until old age. In their attempt to further disentangle the direction of effects in the relationship between subjective aging and physical functioning by making use of Bivariate Dual Change Score Models and an objective physical performance measures, Sargent-Cox, Anstey, and Luszcz (2012b) provided further evidence for the predictive effect of subjective aging. Whereas subjective aging predicted changes in physical functioning (independent of age, gender, partner status, domicile, health, and psychological well-being), the path representing the opposite direction of effects was not significant. Second, subjective aging is cross-sectionally also associated with subjective health (Jang, Poon, & Martin, 2004; Moor et al., 2006), which is important because subjective health has been shown to be a better predictor of mortality in later life than numerous other health status indicators (Benyamini & Idler, 1999; Idler & Benyamini, 1997). Furthermore, in the case of a serious health event, a positive view on aging acts as a resource for preserving an optimistic view about a person's health status (Wurm, Tomasik, & Tesch-Römer, 2008). However, given the lack of longitudinal research on the association between subjective aging and subjective health, a definite answer concerning the direction of effects awaits future research.

As advocated in the Stereotype Embodiment Theory (Levy, 2009), evidence is accumulating that *health behaviors* are an important mediator linking subjective aging to

health and longevity. Individuals with a more positive perception of aging have been shown to be more likely to engage in task-oriented instead of avoidance-oriented coping strategies (Boehmer, 2007) or preventive health behaviors, such as eating a balanced diet, taking prescribed medication, or participating in some kind of exercise (Levy & Myers, 2004). Empirical findings on subjective aging and physical activity further exemplify the case of preventive health behaviors. Negative age stereotypes imply that health problems or functional decrements are inevitable in old age (Löckenhoff et al., 2009), which is often accompanied by the misconception that physical activity in old age is futile or even harmful (Chalabaev et al., 2013; Thogersen-Ntoumani, Ntoumanis, & Nikitaras, 2008). In addition, older adults often use their age as a pretext for an inactive lifestyle (Booth, Bauman, & Owen, 2002; Netz, Zeev, Arnon, & Tenenbaum, 2008). Therefore, a negative perception of aging may heighten risk perceptions, and could undermine outcome expectancies and self-efficacy beliefs, all of which are important determinants of physical activity (Schwarzer, 2001). Accordingly, empirical studies find that individuals holding a more youthful subjective age have a higher self-efficacy which, in turn, has a positive effect on intentions to exercise (Caudroit, Stephan, Chalabaev, & Le Scanff, 2012). Longitudinally, a predictive effect of subjective aging on behavior has been found with individuals who hold more positive self-perceptions of aging at baseline being more likely to engage in physical activity (i.e., athletic activities among middle-aged adults and walking among older adults) over a 6-year period (Wurm, Tomasik, & Tesch-Römer, 2010). A randomized controlled intervention study conducted by Wolff and colleagues indicates a causal relationship. Improvements in age stereotypes that were achieved in the intervention group led to an increase in physical activity over 11 weeks relative to the control group (Wolff, Warner, Ziegelmann, & Wurm, 2014).

In summary, an increased risk for a range of health problems, including mortality, are among the most widely studied and well-documented outcomes of a negative perception of aging. Hence, subjective aging seems to be a key issue of life-long health prevention in aging societies, which calls for the development of gerontological interventions aimed at improving subjective aging both at the level of the individual as well as societies (Miche et al., 2015). However—as said before—given the host of age stereotypes that revolves around health decrements and physical impairments, health might likewise also be conceptualized as a predictor of subjective aging. Determining the direction of effects between health and subjective age requires the simultaneous testing of these two pathways, which has rarely been done in previous longitudinal studies. Therefore, based on the

assumption that different health dimensions might be differentially related to a global positive/negative subjective aging, Chapter 4 takes subjective age as a sample case to evaluate its role in the relationship with physical, functional, mental, and self-rated health.

Subjective well-being

A third well-established correlate of subjective aging is subjective well-being, which only recently has been extended by studies focusing on mental health. Cross-sectional data indicate that a younger subjective age or identification as being 'young' (versus middle-aged or old) is associated with a higher level of life satisfaction, happiness, and positive affect as well as lower levels of negative affect and distress (Barak & Stern, 1986; Gana et al., 2004; Keyes & Westerhof, 2012; Logan, Ward, & Spitze, 1992; Stephan, Caudroit, & Chalabaev, 2011; Westerhof & Barrett, 2005). The same association also holds for ATOA, as an alternative measurement approach to subjective aging (Bryant et al., 2012; Kavirajan et al., 2011; Steverink et al., 2001). Also on a daily level, within-person coupling effects between subjective age and subjective well-being have been observed in a sample of 43 adults aged 60 to 96 years (Kotter-Grühn, Neupert, & Stephan, 2015). That is, on days when participants experienced more negative affect (in comparison to their own average), they felt older than they normally did. The percentage of within-person variability in subjective age that was explained by negative affect amounted to 21%. Positive affect, however, was not associated with daily fluctuations in subjective age.

Overall however, surprisingly little longitudinal studies have been conducted to disentangle the direction of effects in the association between subjective well-being / mental health and subjective aging. Thus it remains an unresolved issue, whether subjective well-being and mental health are best treated as an outcome or a predictor of subjective aging or whether the nature of this relationship is best characterized as bidirectional. The study by Kotter-Grühn and colleagues (Kotter-Grühn, Neupert et al., 2015) represents a first attempt in this direction. Their analysis of time-ordered effects yielded insignificant results, suggesting that instead of a causal relationship a common-cause explanation might be plausible. That is, the same factors that make people feel younger (or older) on a daily basis also influence their subjective well-being.

Following up on these associations of daily subjective aging and subjective well-being, Chapter 2 employs a multidimensional, behavior-specific approach to subjective aging to

investigate which specific aging experiences are most closely associated with different subjective well-being indicators (positive affect, negative affect, life satisfaction, and valuation of life). Again, however, subjective well-being was assessed only once in this study, thus allowing no conclusions about the direction of effects. In addition, Chapter 4 represents a first attempt to disentangle the direction of effects between subjective age and depressive symptoms, which was treated as health dimension in that study but also has some overlap with the construct of subjective well-being.

Malleability of Subjective Aging Phenomena

The implications of a negative view of aging for health, cognitive functioning, and well-being in later life warrant a systematic investigation of the determinants of a positive view on aging and the routes through which negative self-perceptions of aging could be changed. Thus, within the scope of this thesis the term malleability is used to denote the potential for within-person variability (1) in terms of long-term change trajectories of subjective aging and their predictors and (2) in terms of possible ways of changing subjective aging through experimental manipulations. Predictors of subjective aging phenomena have already been discussed in the previous sections. Therefore, this section focuses on experimental research aimed at manipulating subjective aging phenomena.

Research aimed at changing subjective aging phenomena, however, is still in its infancy and little more than a handful of experimental studies have tried to alter the way individuals perceive their own aging. In addition, most of these studies have successfully shown that individuals can be made to feel older or more negative about their own aging, but there is yet little empirical evidence, if and how subjective aging can be changed to the positive (for a more detailed overview see Kotter-Grühn, 2015). As has been argued, subjective aging represents an integral part of the aging self (Diehl et al., 2014). Changing a person's subjective aging thus requires manipulation of psychological processes related to the self. Given the high degree of continuity and stability of the self-concept (Brandtstädter & Greve, 1994), particularly long lasting effects of experimental manipulations on a person's subjective aging might be difficult to achieve.

The manipulation strategies that have been employed in previous experimental studies can be classified into two groups based on the content of the experimental manipulation. Whereas in some studies participants were confronted with age stereotypes, others have induced 'senior moments' – personal experiences that are typically attributed to old age. A review of the literature shows that these two manipulation strategies yield differ-

ent results, which might be explained by two competing hypotheses about the integration of age-related information into the self-concept.

According to the comparison hypothesis (Rothermund & Brandtstädter, 2003), also referred to as resilience hypothesis (Kotter-Grühn & Hess, 2012), age stereotypes are used as a reference standard for social comparisons (e.g., "I don't have as many health problems as other old people usually have – for my age I am in pretty good shape."). Manipulating comparison processes by confronting individuals with negative age stereotypes should thus enhance self-evaluations of own competencies and lead to a more positive subjective aging. Similarly, positive age stereotypes represent a reference standard for upward comparisons and should result in a more negative subjective aging. Support for the comparison hypothesis comes from experimental studies that used age stereotype primes. Weiss and colleagues primed participants with an aging quiz that conveyed either positive or negative information about growing older (Weiss & Freund, 2012; Weiss & Lang, 2012). In these series of studies, negative age stereotype primesled to younger subjective ages (Study 2; Weiss & Lang, 2012) and a greater emphasis of similarities between oneself and a middle-aged person but dissimilarities with an older person (Study 2; Weiss & Freund, 2012). To activate either positive or negative age stereotypes, Kotter-Grühn and Hess (2012) used photographs of smiling or grumpy older women, respectively, accompanied by positive or negative age-stereotypical attributes. In this study, positive age stereotypes resulted in older subjective ages, particularly for middle-aged and older adults in good health (Kotter-Grühn & Hess, 2012). It is important to note, however, that in this case negative age stereotypes did not enhance self-views. In fact, older adults in good health felt even older after being confronted with negative age stereotypes.

The contamination hypothesis (Rothermund & Brandtstädter, 2003), also referred to as labeling hypothesis (Kotter-Grühn & Hess, 2012), has been suggested as an alternative pathway to understand the formation and possible experimental manipulation of subjective aging. It states that individuals internalize age stereotypes developed at younger ages into their self-concept when they self-identify as being old. Experimental studies found support for the contamination hypothesis if the experiences of age-attributed changes or age-stereotypical personal characteristics were made salient. That is, the experimental manipulation suggested that participants did or did not possess stereotypical characteristics of an older person. To induce experiences of age-related gains, Stephan and colleagues (Stephan et al., 2013) gave positive feedback on a handgrip task telling partici-

pants that their performance was better than that of 80% of the individuals in their age group. Similarly, Klusmann and colleagues (Klusmann, Evers, Schwarzer, & Heuser, 2012) used a physical activity intervention in which participants were able to make positive experiences about their physical capabilities. In both studies, the experience of positive age-related changes had positive effects on subjective aging. That is, participants felt younger (Stephan et al., 2013) and reported more positive views on aging (Klusmann et al., 2012). Conversely, the confrontation with negative aging experiences (e.g., through priming of losses in visual acuity and the experience of generation gaps; Eibach, Mock, & Courtney, 2010) led to an older subjective age in the experimental group. It seems that in addition to actual experiences, the possibility that one's own performance might conform with negative age stereotypes is sufficient to induce effects on subjective aging. Hughes and colleagues (Hughes, Geraci, & De Forrest, 2013) found that older adults felt older after taking, or when only expecting to take a standard memory test. The effect was specific to an age-related ability test, as no effect on subjective age emerged after participants took a vocabulary test.

As a conclusion that emerges from previous experimental studies, it seems that the confrontation with age stereotypes mostly triggers self-evaluation processes according to the comparison hypothesis, in which age stereotypes function as a reference for downward and upward comparison processes. In contrast, the experience of age-attributed behavioral and functional changes seems to affect subjective aging according to the contamination hypothesis. Age-related experiences have direct relevance to the self and (in contrast to age stereotypes) cannot be denied through comparison processes, which might explain the observed internalization effects. Consequently, a more positive subjective aging may be achieved either through the confrontation with negative age stereotypes or through the experience of age-attributed gains. Ethical concerns, however, remain when it comes to changing subjective perception of one's aging and need to be considered when developing subjective aging interventions. Specifically, wanting to make people feel more positive about their own age and aging entails the risks of perpetuating the negative age stereotypes that one wishes to challenge through an intervention (Kotter-Grühn, 2015). The experimental study presented in Chapter 5 therefore draws on increasing participants' awareness for age-related gains in the domain of cognitive functioning in order to improve subjective aging.

Open Research Questions and Contributions of the Present Dissertation

Table 1.2. Research Questions Addressed in the Present Dissertation

Thematic Area	Specific Research Question	Addressed in Chapter #
Measurement Issues		
Domain-specificity	- Which behavioral and functional domains are reflected in subjective aging experiences of daily life?	#2
	- What is the relevance and base rate of daily subjective aging experiences and how does this differ by domain?	#2
	- What are the advantages and disadvantages of a domain-specific over a global approach to measuring subjective aging phenomena?	#2 /#5
Validity of temporal and age-group comparisons	- Are subjective-aging items interpreted similarly across the adult life span as a prerequisite for conducting valid temporal and age-group comparisons?	#3
Developmental Consequences		
Directionality of effects in the association of health and subjective aging	- Is subjective age predictor or outcome of different health dimensions?	#4
	- Do associations between subjective age and health dimension remain stable from middle adulthood to early old age?	#4
Associations with subjective well-being	- Are daily subjective aging experiences associated differently with cognitive and affective components of subjective well-being?	#2
Intraindividual Change and Malleability		
Long-term change	- How does ATOA change over middle adulthood and over early old age and do individuals differ with regard to change trajectories?	#3
	- Can socio-structural variables, personality, and health account for interindividual differences in level and change of ATOA?	#3
Subjective aging in daily life	- What are the everyday events and experiences that give rise to the feeling of being old(er)?	#2
	- Do daily subjective aging experiences differ by age, gender, socio-economic status, and functional health?	#2
Malleability through experimental manipulation	- Can subjective age be changed through experimentally induced cognitive aging experiences?	#5
	- Do subjective age domains respond differently to experimentally induced cognitive aging experiences?	#5

The above review shows that the field of subjective aging research has moved significantly forward since the late 1990s both due to recent conceptual developments and as a result of an increasing amount of empirical work that has used more sophisticated measurement approaches and state-of-the-art data analytical techniques. Subjective aging research has also been enriched and stimulated by an increasing variety of research designs, including experimental studies and quasi-experimental studies with multiwave longitudinal data. Nevertheless, some conceptual gaps and unanswered research questions were identified throughout the literature review. The specific research questions addressed within the present dissertation will be summarized in the following along three thematic areas: measurement issues, developmental consequences, and malleability

of subjective aging phenomena. Table 1.2 gives an overview of these research questions and indicates in which chapter each of these questions will be addressed.

Measurement Issues Related to Subjective Aging Phenomena

Domain-specificity. An emerging theme in more recent conceptual approaches to subjective aging as well as in the conceptualization of age stereotypes has been the endorsement of a domain-specific perspective, acknowledging that subjective aging can differ fundamentally across functional and behavioral domains (e.g., Kornadt & Rothermund, 2015). Questions pertaining to the strengths and weaknesses of a domain-specific measurement approach will be posed in several ways. Employing the conceptual framework of AARC, Chapter 2 takes off to explore and systematize the contents of subjective aging experiences within five behavioral domains (physical functioning, cognitive functioning, interpersonal relations, social-cognitive and social-emotional functioning, and lifestyle and engagement). By doing so, this study presents a first attempt to validate the AARC model and a step toward the development of a quantitative AARC questionnaire.

Further it has been argued that subjective aging phenomena are rooted in everyday behavior and experiences (e.g., Diehl et al., 2014; Montepare, 2009) and experimental research has shown that it can change on a short-term basis (e.g., Stephan et al., 2013). Consequently, a detailed understanding of the nature of the formation processes and intraindividual fluctuations of subjective aging requires that measurement approaches capture subjective aging phenomena within the natural ecology and daily life of aging adults. So far, empirical research has paid limited attention to the assessment of *daily* subjective aging experiences. Therefore, another aim of Chapter 2 is to determine the relevance of subjective aging experiences in the daily lives of older adults and to examine whether different domains vary in frequency and importance. By using a qualitative, semi-structured diary format, this study also evaluates whether individuals can make accurate and comprehensive statements of the events and experiences that they associate with their growing older – a characteristic that was discussed to be inherent to individuals' AARC (Diehl & Wahl, 2010). In addition, the hierarchical structure of subjective aging experiences clustered into experienced gains and losses within in the five behavioral domains of the AARC model is being linked to subjective well-being to examine whether a domain-specific approach to subjective aging represents a better predictor of developmental outcomes than a global approach. Chapter 5 further addresses the ques-

tion which insights can be gained by employing a multidimensional subjective age measure instead of the common one-item approach that uses feel age as a stand-alone measure. The investigation of differential effects of experimentally induced cognitive aging experiences on four subjective age domains (feel age, look age, do age, interest age) in this chapter enables first conclusions about the specific aging experiences that are captured by different subjective age items.

Temporal and age-group comparisons. Empirical studies have investigated predictors and developmental consequences of subjective aging across almost the entire second half of life, from midlife to old-old age (e.g., Infurna et al., 2010; Wurm et al., 2007). Questions related to the changing predictive relevance of subjective aging across the adult life span, which is an important research gap in itself, require that subjective aging questionnaires yield comparable measures across time and between age groups. Barrett and Montepare (2015) note that the meaning and importance of subjective aging may change as individuals move through the life course, for example due to the different social meanings of age that become salient at different life stages. This topic has so far received only limited attention. Many empirical studies implicitly assume that the basic structure of subjective aging experiences remains stable across the adult life span when including participants from a broad age range without, however, explicitly testing the comparability of measures across age groups. Chapter 3 therefore takes the widely used measure of ATOA as a sample case in order to formally test age group and longitudinal differences with regard to meaning and interpretation of the ATOA items by means of measurement invariance analysis.

Developmental Consequences of Subjective Aging Phenomena

Directionality of effects in the association of health and subjective aging. With regard to the developmental consequences of subjective aging, an increasing amount of longitudinal research provides evidence for the predictive power of subjective aging with regard to health, health behavior, and longevity. At the same time, however, health might also be treated as a predictor of subjective aging. This argument builds on reasoning that health constraints are a persistent theme of stereotypical views of old age and may thus signal old age. Evaluating these rivaling assumptions or establishing a potential bidirectional relationship between subjective aging and health requires the simultaneous testing of these two pathways, which so far has remained a rare exception in the empirical literature. The question of directionality is of particular importance with regard to health,

because one might argue that subjective aging is simply a function of a person's health status (i.e., healthier individuals feel younger and perceive their own aging in a more positive way). If this argument was empirically supported, the idea of subjective aging interventions as a vehicle to foster healthy aging would become obsolete.

Going further, the causal interplay between subjective aging and health might differ depending on the specific health dimension under study. Whereas oftentimes health has been operationalized with a specific diagnosis or through functional health, fewer studies have investigated longitudinal associations between self-rated health and subjective aging. Therefore, using a cross-lagged panel analysis, Chapter 4 focuses on subjective age as a global indicator of subjective aging and investigates its predictive power as well as its dependency on physical health, functional health, self-rated health, and mental health. Again, as an important extension compared to existing empirical studies the question of directionality is approached by taking a life-span developmental perspective (Barrett & Montepare, 2015), which bears in mind that subjective aging might have different implications for development depending on a person's position in the life span. Cross-lagged paths between subjective age and different health dimensions were therefore compared between middle-aged and young-old adults.

Associations with subjective well-being. Another research question within the thematic area of developmental consequences revolved around the associations between daily subjective aging and subjective well-being. To date, empirical research has focused primarily on cross-sectional or long-term associations between these two variables with subjective well-being mostly operationalized through satisfaction with life. Only one study has yet investigated what implications short-term intraindividual variation of subjective aging may have for subjective well-being and found close linkages with negative affect but not positive affect (Kotter-Grühn, Neupert et al., 2015). Chapter 2 therefore considers a broad range of subjective well-being indicators as developmental outcomes of subjective aging, namely positive and negative affect, life satisfaction, and valuation of life, in order to investigate the differential implications that daily subjective aging may have for affective and cognitive components of subjective well-being. In addition, as discussed before, this daily diary study uses the multidimensional concept of AARC to investigate how perceived age-related gains and losses within different behavioral domains relate to subjective well-being.

Intraindividual Change and Malleability of Subjective Aging Phenomena

Long-term change. A well-established finding for the construct of subjective age is that starting in early adulthood people feel younger than they are and this youthfulness bias increases over the succeeding years and levels off in middle-adulthood (Rubin & Berntsen, 2006). It is also a well-known finding that with increasing age cognitive representations of old age become more complex (Hummert et al., 1994). However, less is known about the development of ATOA across the adult years. To date, only two studies have examined intraindividual change trajectories of ATOA (Kleinspehn-Ammerlahn et al., 2008; Kotter-Grühn et al., 2009). Both studies found a steady decline in ATOA over the latest years of life. Thus, contrary to the maintenance of a positive outlook on one's own aging that is implied in the youthfulness bias across the adult life span, attitudes toward aging seem to become more negative in old age. Further examination of the developmental trajectories of ATOA in younger age groups seems warranted and could also shine a light on the conceptual distinctions between different subjective aging constructs. An examination of the developmental trajectories of ATOA, including interindividual differences in change patterns, is therefore conducted in Chapter 3. As already said before, comparing scores on a subjective aging measure between age groups or over time requires that individuals of different ages interpret subjective aging items in a similar way. Chapter 3 represents an exception in this regard, because measurement invariance is explicitly tested as prerequisite for conducting longitudinal and age-group comparisons.

An imminent theme in studies about the predictors or malleability of subjective aging phenomena is the design and implementation of effective interventions to change negative views of aging and the selection of risk groups or adequate target groups to be included in such interventions. As delineated above, previous research has focused intensively on the variety of factors that are predictive of negative views of aging, among them, for example, low SES and certain personality traits. When it comes to predictors of subjective aging, the objective of inquiry has most often been to explain differences between individuals. Chapter 3 of the present dissertation extends empirical knowledge by focusing on the role of socio-structural variables (gender, education), personality (neuroticism and extraversion), and health (physical and mental health) as a driving force for intraindividual change of ATOA over a period of 12 years. Such knowledge about the variability of change trajectories of subjective aging during specific periods of the adult life span provides information about the potential of changing subjective aging at certain

ages. Such knowledge is important to determine the optimal age groups to be included in interventions.

Subjective aging in daily life. As described above, most empirical studies treat subjective aging as a rather stable trait-like variable and relate interindividual differences in subjective aging to other variables. However, subjective aging has been described as being rooted in everyday experiences and there is first empirical evidence that subjective age fluctuates from day to day and covaries with contextual influences (Kotter-Grühn, Neupert et al., 2015). Although not directly testing questions related to short-term, intra-individual change in subjective age, Chapter 2 augments scientific knowledge about the natural occurrence of subjective aging in daily life. The study delineates the everyday events and experiences that constitute the awareness of aging in everyday life, which is a first step toward a better understanding of the short-term dynamics of subjective aging. Furthermore, Chapter 2 addresses the question whether the common predictors of subjective aging (gender, SES, health) are also related to the way older adults experience their aging in everyday life, thus informing future quantitative research on the correlates of daily subjective aging.

Malleability through experimental manipulation. Recent experimental investigations have shown that individuals' subjective age ratings can be altered on a short-term basis through age stereotype primes as well as experimentally induced age-related loss experiences. A yet insufficiently answered question in the area of experimental subjective aging research is, whether subjective aging may also be changed to the positive and how broad this effect may be. That is, do different subjective age domains respond differently to induced aging experiences? As an important next step toward the development of subjective aging interventions, Chapter 5 takes the case of experimentally induced cognitive aging experiences and compares the effects of age-related loss experiences to that of age-related gain experiences.

2

Natural Occurrence of Subjective Aging Experiences in Community-Dwelling Older Adults

Martina Miche[1], Hans-Werner Wahl[1], Manfred Diehl[2], Frank Oswald[3], Roman Kaspar[3], and Maren Kolb[1]

[1]Institute of Psychology, Heidelberg University, Germany
[2]Department of Human Development and Family Studies, Colorado State University, Fort Collins, USA
[3]Interdisciplinary Aging Research, Goethe University Frankfurt, Germany

Abstract

Objectives. The subjective experience of aging is a relevant correlate of developmental outcomes. However, traditional approaches fall short of capturing the inherent multidimensionality of subjective aging experiences (SAEs). Based on the concept of Awareness of Age-Related Change (AARC; Diehl, M.K., & Wahl, H.-W. 2010. Awareness of age-related change: Examination of a (mostly) unexplored concept. *Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 65,* 340-350. doi: 10.1093/geronb/gbp110), this study provides a description of SAEs that is facet rich and based on their natural occurrence, analyzes interindividual differences, and associations with well-being.

Method. Data came from 225 participants (70-88 years) of the ongoing BEWOHNT study. Open-ended diary entries about age-related experiences were collected for more than 14 days and coded according to AARC domains and subdomains.

Results. Seventy percent of all participants had SAEs about physical functioning. About half of the sample reported experiences in the domains interpersonal relations, social-emotional and social-cognitive functioning (COGN-EMOT), and lifestyle. Thirty percent experienced aging in terms of changes in cognitive functioning. Contents of SAEs varied by gender, age group, and functional status. SAEs about COGN-EMOT were most consistently related to affective components of subjective well-being.

Discussion. Our results demonstrate the benefits of an open-ended approach to a multidimensional understanding of SAEs. Content-related, social-cognitive and social-emotional changes more than functional age-related changes were most important for well-being.

Key Words: Age identity, Life satisfaction, Positive and negative affect, Subjective experience of aging, Valuation of life, Well-being.

Introduction

The experience of passing (life)time is fundamental to the human condition. Individuals become consciously aware of the passing of personal lifetime through the age-related changes they notice. Despite certain regularities in age-related changes (e.g., graying of hair, social role changes), the personal experience of aging is highly subjective. First, there is a large degree of interindividual variability of developmental trajectories into old age (Baltes & Baltes, 1990). Second, individuals differ in terms of how much attention they pay to signs of aging (Montepare & Clements, 2001). Third, the tendency to causally attribute signs of aging to the aging process might differ among individuals (Levy, Ashman, & Slade, 2009). Behavioral and social scientists have reiterated the argument that chronological age is only a limited predictor of developmental changes and that more attention should be paid to the subjective experience of aging (Baars, 2007; Birren & Cunningham, 1985).

Since Neugarten, Moore, & Lowe (1965) presented their seminal work on how to "act one's age," the awareness of becoming older has developed into a growing field of gerontological research with several different empirical approaches. Frequently, the subjective experience of aging is studied in terms of subjective age (Kastenbaum, Derbin, Sabatini, & Artt, 1972). A second research tradition is the study of age stereotypes (Hummert, 2011), which affect functioning and health in old age through internalization as aging self-stereotypes (Levy, 2009). Further approaches address aging-related cognitions (e.g., Philadelphia Geriatric Center Morale Scale; Lawton, 1975; Personal Experience of Aging Questionnaire; Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001). Importantly, these different empirical approaches show similar associations with a number of developmental outcomes, such as physical health (Levy, Slade, Murphy, & Gill, 2012; Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2012; Wurm, Tesch-Römer, & Tomasik, 2007), cognitive functioning (Levy, Zonderman, Slade, & Ferrucci, 2012), and psychological well-being (Gana, Alaphilippe, & Bailly, 2004; Westerhof & Barrett, 2005).

Given these commonalities, researchers have begun to call for a more differentiated, domain-specific view of subjective aging experiences (SAEs; Diehl & Wahl, 2010; Hummert, 2011; Kornadt & Rothermund, 2011). Specifically, these authors argue that the self-evaluations of older people depend on contextual factors (e.g., life domains) and that implications of SAEs for behavior regulation and experience differ by behavioral domain. Thus, one advantage of distinguishing between domains of SAEs is that it allows

for a more detailed examination of their relationships with developmental outcomes, such as well-being. For example, seeing age-related losses in the domain of health and physical functioning as a normal and normative part of the aging process (Heckhausen, Dixon, & Baltes, 1989) could result in personal downgrading of their influence on subjective well-being. In contrast, age related losses in other domains, such as feelings of control, might be more closely related to well-being.

Diehl and Wahl (2010) proposed five domains of behavior and functioning in which SAEs might primarily manifest. These domains are health and physical functioning (PHYS), cognitive functioning (COGN), interpersonal relations (RELSHP), social-cognitive and social-emotional functioning (COGN-EMOT), and lifestyle and engagement (ENGAGE). In following the Diehl and Wahl (2010) model, we purposefully decided to not link the dimensions of the model to specific age-related life events, such as retirement, financial concerns, or housing relocation. The rationale behind this approach was to keep the model at this stage of theoretical and empirical development as general as possible and avoid any linkage with circumscribed age periods (e.g., transition to retirement only refers to those in their sixties or early seventies). As shown in Table 2.1, this proposed taxonomy covers the broad range of aging experiences reported in qualitative and mixed-methods studies that examine the semantic space of SAEs quite well (Furstenberg, 2002; Giles, McIlrath, Mulac, & McCann, 2010; Karp, 1988; Keller, Leventhal, & Larson 1989; Lin, Hummert, & Harwood, 2004; Nilsson, Sarvimäki, & Ekman, 2000; Sherman, 1994; Steverink et al., 2001). Although these studies do not represent a systematic attempt to delineate the content of the five domains comprehensively in old-old adults, as it is the aim of this study, they provide support for the need to distinguish domains of SAEs. For example, despite unequivocally negative perceptions of aging in terms of health and physical functioning, individuals display quite different social-emotional and social-cognitive reactions (Furstenberg, 2002). Furthermore, focusing on domains other than PHYS might yield a more varied picture of gains and losses as they co-exist in adulthood and old age (Karp, 1988).

In addition to their substantive content, aging experiences can be distinguished in terms of their reference points (Sherman, 1994). That is, it is also important to acknowledge that SAEs may derive from comparisons with other people and from comparisons with past or future states of the self.

Table 2.1. Dimensions of Subjective Aging Experiences (SAEs) in Previous Studies

Study characteristics — Author(s), Age range, Sample size	Dimensions of aging experiences according to the **Diehl & Wahl (2010) model**					
	Study focus	Health and physical functioning	Cognitive functioning	Interpersonal relations	Social-cognitive and social-emotional functioning	Lifestyle and engagement
Furstenberg (2002) 58-92 years, *n* = 26	Qualitative interview on the course of aging	• Physical deterioration and decline	• Mental deterioration and decline • Internal development		• Emotional and behavioral responses to the signs of aging	• Unexpected continuation of activities • Positive shifts in activities
Giles and colleagues (2010) Middle-aged (*M*=49) and older adults (*M*=74) n=380	Occurrences that induce feeling one's own age, younger or older	• Physical decrements	• Mental decrements	• Family developments • Contact to younger individuals		• Reduced leisure and sporting activities
Karp (1988) 50-60 years, *n* = 72	Signs of aging reported in an interview on occupational careers	• Changes in bodily experiences	• Wisdom	• Changes perceived in close others • Age-based expectations of others • Mortality reminders	• Changes of the meaning of time	• Enjoying the "empty nest"
Keller and colleagues (1989) 50-80 years, *n* = 32	In-depths interviews on the "things" associated with aging	• Physical declines	• Slowing of cognitive capacity	• Changed social roles	• Changes of prevalent emotions	• Changes in social activities
Lin and colleagues (2004) Age range unknown, *n* = 550	Age identities presented in an on-line forum for older adults	• Physical decline	• Maturity and wisdom	• Sense of loss	• Resistance of aging, mind-over-body attitude	• Continued active engagement • Freedom of age
Nilsson and colleagues (2000) 85-96 years, *n* = 8	Reported occasions of feeling old in narrative life stories	• Physical change • Changed looks	• Change in mental qualities	• Being perceived old by others • Loss of same-aged peers	• Fear of helplessness and dependency	
Sherman (1994) 41-96 years, *n* = 101	Interview on changes that led to feeling older	• Health	• Experience of a mature self	• Appraisals of others • Social role losses • Bereavement		
Steverink and colleagues (2001) 40-85 years, n = 4,034	Confirmatory factor analysis; items derived from qualitative interviews on aging experiences	• Physical decline		• Social loss		• Continuous growth

Besides these important conceptual distinctions, this study is motivated by the desire to focus on naturally occurring events that create a personal awareness of aging. Recalls of SAEs for longer periods of time, as in the qualitative studies cited earlier, might be biased by pre-existing schemata (Shiffman et al., 1997) or attitudes, such as age stereotypes, which have been shown to affect self-perceptions of aging (Kotter-Grühn & Hess, 2012). To overcome this problem, we employed a diary approach. The diary method (Bolger, Davis, & Rafaeli, 2003) captures SAEs close to the time of occurrence and thus minimizes that participants over-report stereotypical SAEs or under-report due to forgetting. Thus, the diary approach provides more accurate information regarding the frequency and relevance of SAEs in a person's everyday life. In addition, repeated sampling of SAEs over a longer interval, using an open-ended format, likely results in a more diverse and more accurate set of experiences for each individual. Furthermore, employing a daily diary approach allows investigating how naturally occurring SAEs relate to different components of subjective well-being. Previous research finds that affective compared with cognitive components of subjective well-being are more amenable to be influenced by situational factors. Of such situational factors, daily pleasures are more strongly linked with pleasant affect than with unpleasant affect, whereas daily troubles are more strongly linked with unpleasant affect than with pleasant affect (Diener, Suh, Lucas, & Smith, 1999). SAEs in everyday life, as an example of daily pleasures and stressors, might thus have consequences for affective well-being.

Finally, previous research has shown that there is considerable interindividual variation in SAEs (Giles et al., 2010). The most obvious factor that determines the experience of age-related events is age itself. With advancing age, health, independent living, and daily living routines become more fragile (Baltes, Maas, Wilms, Borchelt, & Little, 1999) and individuals tend to strive for emotion-regulation goals in social interaction (Carstensen, Isaacowitz, & Charles, 1999). Gender is another factor related to the experience of age-related change. Although men and women have similar subjective perceptions of their health, older women report higher levels of functional impairments than men (Arber & Cooper, 1999). This gender difference might carry over to SAEs in other domains such as social relationships, perceived control, and patterns of everyday activity. Further, low socioeconomic status is associated with poorer physical and functional health as well as lower levels of cognitive functioning (Wickrama, Mancini, Kwag, & Kwon, 2012), less support from non-kin ties (Broese van Groenou & van Tilburg, 2003), and engagement in fewer leisure and social activities (Jang, Choi, & Kim, 2009). Finally, functional

health affects the possible scope of activities and social relationships as well as perceived control. Besides these differences in actual experience of age-related change, gender, age, socioeconomic status, and functional status are linked to interindividual differences in SAEs through personal beliefs about age and aging (Ryff, 1991; Timmer, Bode, & Dittmann-Kohli, 2003).

Research Aims and Hypotheses

The main goal of this study was to examine domain specific contents of SAEs in a natural setting by using a daily diary approach and to provide a comprehensive description of the contents, frequencies, and interdependencies of older adults' SAEs. We expected that individuals' self-reported SAEs would fall into the domains of PHYS, COGN, RELSHP, COGN-EMOT, and lifestyle and ENGAGE.

Because most age-related change ostensibly occurs in the domain PHYS, SAEs in this domain should be most common across individuals. Changes of bodily conditions were also expected to be related to increased levels of SAEs in other domains (RELSHP, COGN-EMOT, and ENGAGE). Given that adults associate aging with decline and loss (Heckhausen et al., 1989), we expected that SAEs would be predominantly negative, particularly in the domains PHYS and COGN. But, in light of the contents of SAEs that were identified in previous qualitative research, we expected to find gain-related experiences to be present within the domains of RELSHP, COGN, and ENGAGE.

Our second aim was to contribute to the explanation of interindividual variation in SAEs. In particular, we expected older individuals, women, socioeconomically disadvantaged, and functionally impaired individuals to report more negative SAEs over the course of the diary study.

Our third aim was to examine the association between SAEs and subjective well-being. Using a more fine-grained approach to the assessment of SAEs, we examined if effects on subjective well-being differ across behavioral domains and affective valence. Building on the notion of two separate emotion systems (Diener et al., 1999), we expected that positive SAEs would be related to pleasant affect and negative SAEs would be related to unpleasant affect. Furthermore, as SAEs were assessed in daily life, there should be a stronger association with affective than with cognitive components of subjective well-being.

Method

Study Design and Sample

Data were collected as part of the ongoing project "Here is my Home—The role of aging in place for healthy aging" (German abbreviation: BEWOHNT; detailed information on the research project can be obtained from Dr. Oswald or Dr. Kaspar.) conducted in the metropolitan area of Frankfurt, Germany. An important part of this project was a daily diary capturing naturally occurring SAEs for up to 17 days. The target sample size is 600 participants, stratified by age group (70-79 and 80-89 years old), household composition (living alone vs. living with partner), and city district (three typical urban neighborhoods in Frankfurt, Germany). This study is based on the first 225 participants. This sample size was adequate to provide comprehensive theoretical saturation for the qualitative data analyses and sufficient power for the statistical analyses.

Procedure

According to public registration records, the three city districts from which study participants were sampled contain a total of 9,605 community-living older adults between 70 and 89 years. However, since only single and partner households were included, and no prior information on household composition was available from official registers, this figure overestimates the study population. Based on potential participants for whom this information could be obtained, we estimate a response rate of 9.4% for all eligible individuals. This can be regarded as a lower bound because we only included one person from partner households in the study. Visual inspection of the spread of participants' residential location indicates that the study covers a representative segment of the targeted district population. Participants gave their informed consent to take part in the study and underwent the Dementia-Detection (DemTect) screening assessment (Kessler, Calabrese, Kalbe, & Berger, 2000). Cut-off scores of 12 and 8 were employed to exclude participants with mild cognitive impairment or dementia (n = 6). During a first face-to-face interview in the participant's home, the diary was handed out and detailed instructions for its use were given. After 17 days a second face-to-face interview was conducted and completed diaries were collected. Ambiguous or incomplete diary entries were clarified in personal communication during the second interview. Both face-to-face interviews covered a wide range of psychological assessments, demographic characteristics, and personal evaluations of participants' living environment.

Measures

Subjective aging experiences

One page of each daily diary was reserved for open-ended reports of SAEs. At the end of each day, participants were asked to reflect whether they experienced any events related to the five domains of behavior and functioning suggested by Diehl and Wahl (2010). Written answers were provided in an open-ended fashion using short sentences, keywords, or bullet lists and sorted into the five domains by the participants themselves. An additional unspecified category was given for SAEs that did not match these five domains. In designing this assessment procedure, we had decided against a completely open format because we expected that this would produce only restricted material on SAEs in terms of semantics and meaning. Instead, we offered the five domains of the AARC-model as a guide for daily self-observation and provided a sixth fully open category to incorporate personal experiences that were not covered by the five domains.

Coding procedure

To capture the diverse contents of SAEs within the five domains of behavior and functioning, a coding scheme with several subcategories was developed through a multi-stage procedure following directed qualitative content analysis (Hsieh & Shannon, 2005). A preliminary coding scheme based on theoretical consideration was developed by the first author and applied to the data of 25 randomly selected participants. Further themes that emerged from these data were used to refine the coding scheme and to extract descriptions and example statements for each subcategory. After training in the use of the coding scheme, the same data were coded independently by a research assistant. Coding decisions of the two raters were compared, disagreements discussed, and definitions and coding guidelines further refined. Next, data of the remaining 200 participants were coded and previously coded segments were re-examined if new subcategories emerged. The resulting coding scheme is shown in Table 2.2.

For coding purposes each statement was segmented into meaningful idea units. Each idea unit was coded with regard to its domain of behavior or functioning, emotional valence, and reference point. The main categories representing the *behavioral and functional domains* (PHYS, COGN, RELSHP, COGN-EMOT, and ENGAGE), were divided into 23 subdomains (Table 2.2). A remainder category was created for each main domain to comprise statements that were clearly related to the respective domain but too vague to be coded within any of the subdomains. If none of the five main domains was

suitable, an idea unit was coded in a sixth category "other." The coding of behavioral and functional domains was performed irrespective of the category that had been assigned by the participant. The majority of SAEs was coded within the domain indicated by the participant (65%).

Table 2.2. Final Coding Scheme

Domain of behavior and functioning	Description
Health and physical functioning	
Physical sensations	Experienced states of the body; this includes sensations that might result from an illness (e.g. pain) if a causal condition was not mentioned
Muscle strength and physical endurance	Physical endurance, stamina , strength, including reports of activities that primarily require these qualities (e.g., carrying a bag of groceries)
Health and illnesses	Indications of specific illnesses or health conditions
Mobility	Physical agility, functionality of the mobility system, and balance, including reports of activities that primarily require these qualities (e.g., climbing a ladder)
Physical appearance	All outwardly visible body features (e.g., hair, skin, body posture, physical attractiveness)
Sensory functioning	Functioning of sensory organs (visual, auditory, somatosensory, gustatory, and olfactory systems); including accounts of activities that primarily require these qualities (e.g., driving in the dark)
Fine motor skills	Performance of small-scale motion sequences which require (manual) dexterity; including reports of activities that primarily require these qualities (e.g., opening the closure of a necklace)
Other	Statements that do not fit into any of the health and physical functioning categories
Cognitive functioning	
Memory	Short- and long-term retention of information
Information processing	Cognitive processing speed, cognitive capacity, ability to coordinate and concentrate on information, spatial perception
Knowledge	Insights that became available with age; gaps in current knowledge
Other	Statements that do not fit into any of the cognitive functioning categories
Interpersonal relations	
Social support	Receipt or provision of social support, such as emotional, instrumental, and informational help (or a lack thereof)
Number, frequency, and type of contacts	Extent and intensity of social contacts; contact/interactions with people of specific role relationships (e.g., friends, grandchildren, neighbor), if contact and socializing is the dominating aspect of information
Sense of belonging	Sense of connectedness, belonging, relatedness or community with social interaction partners (or a lack thereof)
Expectations in social interaction	Expectations, ascriptions and attributions, reactions and manners in social settings (both of others towards oneself and of oneself directed at others)
Other	Statements that do not fit into any of the interpersonal relations categories
Social-cognitive and social-emotional functioning	
Sense of control or dependency	Subjective perception of being capable to achieve personal goals by means of own efforts; being dependent on support of others
Self-esteem	Opinions, attitudes about, and valuation of one's own abilities and actions
Experience of time	A (changed) perception of past, current, or remaining lifetime; reflections on the passing of time; life review; thoughts about life and death
Motivational drive	(Lack of) motivation to do certain activities, desire/aversion to engage in particular activities, perceiving one's actions as meaningful, will to live
Joy or sadness	Inner feelings of happiness and enjoyment or sadness and depression in response to past, current, or expected events
Self-composure or anxiety	Inner state of calmness or disturbance and anxiety in response to past, current, or expected events
Other	Statements that do not fit into any of the social-cognitive and social-emotional functioning categories

Table 2.2. Continued

Domain of behavior and functioning	Description
Lifestyle and engagement	
Interests	Descriptions of the content of daily activities and daily routines or exceptional activities and hobbies
Time management	Accounts of temporal arrangements of daily schedule
Action scope	Geographic accessibility of certain locations, where daily activities are performed
Other	Statements that do not fit into any of the lifestyle and engagement categories

For *emotional valence* the main categories were negative, positive, ambivalent, and not assessable. If emotional valence was not explicitly indicated by the participant, classification was based on judgments of the coders. *Reference points* were coded for social comparison (with age-peers, younger, older, or unknown age groups) and/or temporal comparison (with past selves, future selves, or mere descriptions of current situation). Twenty nine diary entries from seven participants that had not been written by the participants (e.g., these entries were written in the third person), four diary entries from four participants in which they related SAEs to the research project, and three reports from three participants in which aging was explicitly excluded as a possible cause of the reported experience were dropped from further analyses, resulting in a total of 1,757 statements from which 2,897 idea units were derived. Interrater agreement was calculated from diary entries of 44 randomly selected participants (20%). Within the five domains of behavior and functioning interrater agreement ranged from $\kappa = 0.86$ for COGN-EMOT to $\kappa = 0.96$ for PHYS. Interrater agreement was also very satisfactory for emotional valence, $\kappa = 0.88$, social comparison, $\kappa = 0.82$, and temporal comparison, $\kappa = 0.89$.

Age group

To compare SAEs by age group, two age groups were created at the cut-off point of 80 years. Contrasting the 70-79 year olds with those aged 80-89 years old permits the exploration of possible transitional dynamics associated with moving from the third age into the fourth age (Baltes & Smith, 1999).

Socioeconomic status

Ten categories were provided to classify monthly household income (1 = no income, 10 = more than 5,000€). Educational attainment was measured according to the years of formal schooling, including vocational training and attendance of college/university. Median splits were conducted to group participants into groups with low (≤ 2,000 €/month)

and high income (> 2000 €/month), and low (< 12 years) and high (≥ 12 years) educational attainment.

Functional health

The function component of the abbreviated Late Life Function and Disability Instrument (SF-LLFDI; Denkinger, Weyerhäuser, Nikolaus, & Coll-Planas, 2009) was used to assess functional health. The SF-LLFDI function component is a self-report questionnaire, in which participants rate the extent of difficulties experienced in activities of daily life on a 5-point Likert scale (e.g., getting into and off the car). Cronbach's alpha for this subscale was $\alpha = 0.90$. Individuals were grouped into a high or low functional status group based on a cut-off sum-score of 56, which corresponds to no or minor impairments on all 14 activities of daily life.

Subjective well-being related measures

Emotional well-being was assessed with the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS provides 10 adjectives each for positive affect (PA; Cronbach's $\alpha = 0.81$) and negative affect (NA; Cronbach's $\alpha = 0.79$) which were rated on a 5-point Likert scale with reference to the past year. Life-satisfaction (LS), cognitive component of subjective well-being was assessed with a single-item measure: "On the whole, how satisfied are you with your life?", which was rated on an 11-point scale (0 = absolutely dissatisfied; 10 = absolutely satisfied). The valuation of life (VOL) questionnaire (Lawton et al., 1999) was used to augment the range of outcome measures with a scale that captures more complex judgments of current life circumstances strongly related to a person's will to live (Cronbach's $\alpha = 0.81$). All measures were assessed before the diary was filled out, except for the PANAS, which was part of the second interview.

Data-Analytic Strategy

For each participant diary data were aggregated for the entire study period. Frequency distributions of these aggregated data were inspected for typical contents of SAEs. Next, we conducted chi square tests to analyze group differences of SAEs. Alpha level was set at 0.01 to control for the number of comparisons performed. In these analyses, SAEs were dichotomized as being reported or not reported within each domain and subdomain throughout the observation interval. Finally, multiple regression analyses were used to investigate associations between SAEs and subjective well-being related

measures. In these analyses, SAEs were again aggregated over time for each participant and adjusted for the number of days the diary was kept.

Results

Descriptive Findings

Participants were aged 70-88 years ($M = 77.1$, $SD = 5.0$) with a median monthly household income category of $2,400-3,000 (equal to 2,000-2,500€) and an average level of education of 12.8 years of schooling ($SD = 4.0$ years); 57.8% of the sample were women.

The majority of participants (80%) kept their diary for at least 12 days with an average duration of 14 days ($SD = 4.1$ days). These participants reported SAEs on an average of 48% of the days (6.4 days, $SD = 4.3$ days). Within-person variation in the total number of SAEs reported on a given day amounted to 45.2% of the total variance and between-person variation accounted for 54.8%. A multilevel model was estimated to model trends over the observation period showing a slight decrease in the total number of SAEs with each day of the observation period ($\beta = -0.04$, $SE = 0.01$, $p < .001$). For the majority of participants (68%) SAEs were multi-faceted, covering at least three out of the five domains ($M = 2.5$, $SD = 1.7$) of behavior and functioning throughout the study. The average number of domains per participant and day, however, was considerably lower ($M = 0.88$, $SD = 0.76$).

Relative frequencies of subjective aging experiences

Table 2.3 summarizes the absolute number of SAEs per domain and subdomain, percentages of participants reporting a SAE in each domain and subdomain at least once during the observation period, and distributions of valences and reference points. The majority of participants (71.6%) mentioned SAEs in the domains of PHYS. Approximately half of the sample had SAEs related to ENGAGE, COGN-EMOT, and RELSHP. SAEs in the cognitive domain (COGN) were mentioned by 32.4% of the sample. Table 2.3 further lists the subdomains of the five domains of behavior and functioning ordered by their frequency of being mentioned.

Table 2.3. Relative Frequencies of Subjective Aging Experiences within Subdomains of Behavior and Functioning

Domain of behavior and functioning	Number of idea units	Partici- pants (%)	Emotional valence (% of idea units)			Social comparison (% of idea units)			Temporal comparison (% of idea units)		
			Positive	Ambi- valent	Negative	Younger	Same age	Older	Past	Current	Future
Health and physical functioning	*1,285*	*71.6*	*10.0*	*0.5*	*82.6*	*1.4*	*1.2*	*0.2*	*14.9*	*79.1*	*0.2*
Physical sensations	403	50.9	5.2	0.2	94.0	–	–	–	4.0	96.0	–
Muscle strength and physical endurance	343	48.2	15.2	0.3	81.0	3.8	1.5	0.6	31.5	62.7	0.6
Health and illnesses	257	38.7	11.7	1.2	84.0	–	3.1	0.4	7.4	89.9	0.4
Mobility	130	25.2	8.5	–	88.5	2.3	0.8	–	14.6	82.3	–
Physical appearance	38	9.0	18.4	2.6	55.3	2.6	–	–	36.8	60.5	–
Sensory functioning	26	8.1	7.7	–	92.3	–	–	–	30.8	69.2	–
Fine motor skills	21	3.6	–	–	90.5	–	–	–	9.5	90.5	–
Other	67	18.5	7.5	–	14.9	1.5	3.0	–	7.5	23.9	–
Cognitive functioning	*221*	*32.4*	*13.6*	*0.5*	*79.2*	*2.7*	*0.5*	*0.5*	*14.0*	*80.5*	*–*
Memory	154	23.4	5.8	0.6	91.6	–	–	–	9.7	90.3	–
Information processing	23	9.0	21.7	–	73.9	–	–	–	17.4	82.6	–
Knowledge	19	7.2	57.9	–	21.1	26.3	–	–	47.4	31.6	–
Other	25	8.6	20.0	–	52.0	4.0	4.0	4.0	12.0	56.0	–
Interpersonal relations	*408*	*45.5*	*31.9*	*28.7*	*21.6*	*3.2*	*0.7*	*0.2*	*5.6*	*87.5*	*–*
Social support	174	28.8	29.3	60.3	6.9	–	–	0.6	2.3	97.1	–
Number, frequency, and type of contacts	95	21.2	30.5	4.2	26.3	3.2	–	–	12.6	83.2	–
Sense of belonging	76	17.1	53.9	6.6	31.6	3.9	3.9	–	6.6	82.9	–
Expectations in social interaction	48	12.6	12.5	6.3	56.3	14.6	–	–	4.2	83.3	–
Other	15	6.8	20.0	–	–	–	–	–	–	40.0	–

Table 2.3. Continued

Domain of behavior and functioning	Number of idea units	Partici- pants (%)	Emotional valence (% of idea units)			Social comparison (% of idea units)			Temporal comparison (% of idea units)		
			Positive	Ambi- valent	Negative	Younger	Same age	Older	Past	Current	Future
Social-cognitive and social-emotional functioning	*524*	*51.4*	*43.2*	*4.4*	*40.0*	*2.1*	*1.9*	*0.6*	*23.5*	*62.9*	*5.9*
Sense of control or dependency	135	26.1	26.7	2.2	68.9	–	3.7	2.2	19.3	71.1	4.4
Self-esteem	108	25.7	88.9	0.9	8.3	2.8	1.9	–	39.8	52.8	2.8
Experience of time	87	19.4	16.3	12.8	29.1	8.1	1.2	–	31.4	47.7	11.6
Motivational drive	60	13.1	28.3	3.3	66.7	–	–	–	8.3	85.0	5.0
Joy or sadness	59	14.4	69.5	1.7	28.8	–	1.7	–	18.6	79.7	–
Self-composure or anxiety	51	13.1	43.1	9.8	43.1	2.0	2.0	–	19.6	60.8	17.6
Other	24	8.1	–	–	12.5	–	–	–	4.2	25.0	–
Lifestyle and engagement	*448*	*52.3*	*19.4*	*2.0*	*65.2*	*1.3*	*2.0*	*0.2*	*29.2*	*63.2*	*1.6*
Interests	318	45.0	23.0	2.2	61.9	1.3	2.2	0.3	26.7	68.6	1.9
Time management	59	14.4	6.8	3.4	88.1	3.4	–	–	49.2	47.5	–
Action scope	38	11.7	15.8	–	84.2	–	2.6	–	39.5	60.5	–
Other	33	8.6	12.1	–	33.3	–	3.0	–	6.1	42.4	3.0

With regard to valences, SAEs were clearly distinguishable into positive experiences (21% of all idea units) and negative experiences (63%), whereas ambivalent or not assessable experiences were less frequent (5% and 11%, respectively). The majority of participants reported both positive and negative experiences (54%); 39% of the participants had only negative experiences. Four percent of all participants with SAEs had only positive SAEs. In the domains of PHYS, COGN, and ENGAGE, negative aging experiences were most frequent. Only the subdomain *knowledge* represented an exception. SAEs in the domain of RELSHP were balanced with regard to emotional valence. The domain of COGN-EMOT displayed the largest proportion of positive aging experiences, yet subdomains differed markedly in terms of emotional valence. Reports about self-esteem and emotional experiences (joy or sadness) were usually positive, whereas SAEs about sense of control or dependency and motivational drive were primarily negative.

Regarding reference points, SAEs were primarily derived from current behavior and functioning (77%). Comparisons with other people's functioning (4%) and past (18%) or future experience (1%) were fairly scarce.

Exploring interdependencies among subjective aging experiences

For SAEs domains with positive content correlations ranged from $r = 0.49$ to 0.88 and from $r = 0.32$ to 0.64 for SAEs domains with negative content, except for SAEs about COGN (Table 2.4). Correlations between positive and negative aging experiences, however, were less consistent: Negative SAEs in the domains COGN-EMOT and ENGAGE correlated weakly with positive SAEs in the domains RELSHP and COGN-EMOT. Overall, this pattern of correlations suggests that individuals, who report more negative SAEs, do not necessarily report fewer positive SAEs.

Table 2.4. Correlations Between Positive and Negative Subjective Aging Experiences(SAEs) Across Domains of Behavior and Functioning

Number of SAEs[a]	02	03	04	05	06	07	08	09	10
01 Health and physical functioning (–)	.10	**.32***	**.45***	**.64***	.09	.04	.20	.23	.14
02 Cognitive functioning (–)		-.02	.16	.08	.07	.01	-.04	.03	.11
03 Interpersonal relations (–)			**.53***	**.42***	.01	.11	**.24***	.16	.09
04 Social-cognitive and social-emotional functioning (–)				**.51***	.09	.03	**.38***	**.31***	.10
05 Lifestyle and engagement (–)					.19	.02	**.35***	**.31***	.22
06 Health and physical functioning (+)						.17	**.49***	**.70***	**.80***
07 Cognitive functioning (+)							.12	.20	.21
08 Interpersonal relations (+)								**.71***	**.59***
09 Social-cognitive and social-emotional functioning (+)									**.68***
10 Lifestyle and engagement (+)									

Notes. Correlations larger than .30 are printed in bold. [a]Each particpant's number SAEs was corrected for number of valid diary days. (–) = negative reports and (+) = positive reports. * p<.001

Differences in Subjective Aging Experiences by Gender, Age Group, Socioeconomic Status, and Functional Status

Findings from chi-square tests examining group differences in SAE with regard to several key variables are presented in Table 2.5. These findings indicate that women were more likely than men to have positive aging experience in the domains RELSHP and COGN-EMOT, but more negative aging experiences in the domains PHYS and ENGAGE. With regard to age group, participants in the older age group (80-89 years old) reported both more negative SAEs and more positive SAEs, compared with the younger age group. Group differences by socioeconomic status emerged only for participants with low levels of education, who had more negative aging experiences regarding physical appearance. Finally, participants with a low functional status reported more negative aging experiences across all five behavioral domains.

Associations of Subjective Aging Experiences and Well-Being Measures

Results from the regression of aggregated numbers of SAEs on positive and negative affect, life satisfaction, and VOL are presented in Table 2.6. Age, gender, education, income, and functional status were controlled in all analyses. SAEs were entered into the regression equation in blocks of positive, negative, and ambivalent experiences and tested for significant increase in model fit. We present only the findings for positive and negative SAEs, because no significant results were found for ambivalent SAEs. Each well-being measure was regressed both on the five domain-specific measures of positive and negative SAEs and on the aggregated positive and negative SAEs across domains, because we were interested in comparing the effect of domain-specific and cross-domain SAEs. Differences regarding predictive efficiency were tested for significance (Steiger, 1980).

Aggregated positive SAEs across domains were significantly associated with PA. Of the domain-specific aging experiences, positive experiences in the COGN-EMOT domain were the significant predictor of PA. However, prediction of PA from domain specific SAEs was as good as prediction from aggregated positive experiences across domains ($z = 0.98$, $p = .16$).

Table 2.5. Significant Group Differences for the Occurrence of Subjective Aging Experiences (SAEs)

Domain of behavior and functioning	Gender[a] (women report more than men)	Age[a] (80 to 89 year olds report more than 70 to 79 year olds)	Education[b] (ind. with low education report more than ind. with high education)	Functional status[c] (low functional status ind. report more than high functional status ind.)
Health and physical functioning	Negative SAEs about PHYS (χ^2=13.87, p=.0002, SP=0.96) Negative physical sensations (χ^2=11.91, p=.0006, SP=0.93)	Positive physical sensations (χ^2=7.02, p=.008, SP=0.32) Mobility constraints (χ^2=9.33, p=.002, SP=0.45)	Negative physical appearance (χ^2=8.46, p=.004, SP=0.83)	Negative mobility (χ^2=10.51, p=.004, SP=0.90) Health constraints (χ^2=8.30, p=.004, SP=0.82)
Cognitive functioning	–	–	–	Knowledge constraints (χ^2=6.76, p=.009, SP=0.74)
Interpersonal relations	Positive SAEs about RELSHP (χ^2=8.76, p=.003, SP=0.81) Positive sense of belonging (χ^2=8.01, p=.005, SP=0.81)	Negative SAEs about RELSHP (χ^2=10.45, p=.001, SP=0.48) Negative social support (χ^2=13.96, p=.0002, SP=0.50) Negative accounts of number, frequency, and type of contact (χ^2=9.06, p=.003, SP=0.40) Positive expectations in social interactions (χ^2=7.48, p=.006, SP=0.31)	–	Lacking sense of belonging (χ^2=10.69, p=.001, SP=0.90) Negative accounts of number, frequency, and type of contact (χ^2=11.86, p=.0006, SP=0.93)
Social-cognitive and social-emotional functioning	Positive SAEs about COGN-EMOT (χ^2=11.11, p=.0009, SP=0.92) Self-composure (χ^2=11.81, p=.0006, SP=0.93) Joy (χ^2=11.06, p=.0009, SP=0.91)	Negative SAEs about COGN-EMOT (χ^2=13.42, p=.0002, SP=0.60) Positive experiences of time (χ^2=7.06, p=.008, SP=0.31)	–	Negative SAEs about COGN-EMOT (χ^2=6.97, p=.008, SP=0.75) Lacking personal control (χ^2=9.42, p=.002, SP=0.87)
Lifestyle and engagement	Negative SAEs about ENGAGE (χ^2=10.20, p=.001, SP=0.89)	Restricted action scope (χ^2=7.10, p=.008, SP=0.34)	–	Negative SAEs about interests (χ^2=6.70, p=.009, SP=0.73) Negative time-management (χ^2=7.31, p=.007, SP=0.77)

Notes. SP = Statistical power; PHYS = health and physical functioning; RELSHP = international relationships; COGN-EMOT = social-cognitive and social-emotional functioning; ENGAGE = lifestyle and engagement. [a] χ^2(df=1,n=222). [b] χ^2(df=1,n=217). [c] χ^2(df=1,n=218).

Table 2.6. Standardized Regression Weights From the Regression of Domain-Specific and Aggregated Subjective Aging Experiences (SAEs) on Well-Being Measures

Predictors[b]	PA[a] β Model 2	PA[a] β Model 3	NA[a] β Model 2	NA[a] β Model 3	LS[a] β Model 2	LS[a] β Model 3	VOL[a] β Model 2	VOL[a] β Model 3
Domain-specific SAEs								
PHYS (−)	-0.13	-0.12	0.11	0.11	-0.17	-0.18	-0.22 †	-0.23 *
COGN (−)	0.02	0.04	-0.06	-0.05	0.02	0.03	-0.04	-0.03
RELSHP (−)	-0.17 †	-0.16	-0.25 *	-0.22 *	-0.01	-0.01	-0.04	-0.02
COGN-EMOT (−)	0.05	-0.05	0.28 **	0.24 *	-0.09	-0.13	-0.12	-0.18
ENGAGE (−)	0.22 †	0.15	0.08	0.04	0.16	0.14	0.19	0.17
PHYS (+)		-0.12		0.06		-0.16		-0.02
COGN (+)		-0.05		-0.03		0.02		0.05
RELSHP (+)		0.05		-0.08		-0.09		-0.07
COGN-EMOT (+)		0.33 *		0.13		0.32 *		0.27 †
ENGAGE (+)		-0.01		-0.04		0.03		-0.08
R²	0.08	0.14 †	0.17 ***	0.18 ***	0.09	0.12	0.09	0.12
ΔR²	0.03	0.06 †	0.09 **	0.01	0.02	0.03	0.05	0.03
SP²	0.39	0.74	0.93	0.16	0.28	0.46	0.63	0.43
Aggregated SAEs across domains								
Negative SAEs	0.01	-0.05	0.22 **	0.19 *	-0.05	-0.09	-0.17 *	-0.22 **
Positive SAEs		0.20 *		0.08		0.12		0.14 †
R²	0.05	0.09 *	0.12 **	0.13 **	0.07	0.08	0.06 †	0.08 †
ΔR²	0.00	0.04 *	0.04 **	0.01	0.00	0.01	0.03 *	0.02 †
SP	0.05	0.73	0.81	0.18	0.19	0.31	0.58	0.45

Notes. PHYS=Health and physical functioning, COGN=Cognitive Functioning, RELSHP=Interpersonal Relationships, COGN-EMOT= Social-Cognitive and Social-Emotional Functioning, EN-GAGE=Lifestyle and engagement; VOL=valuation of life; SP=Statistical Power. (−) denotes negative reports and (+) denotes positive reports. [a]All analyses were controlled for age, gender, education, income, and functional status in Model 1. [b]Each participant's number of SAEs was corrected for number of valid diary days. † p<.10, * p < .05, ** p < .01, *** p < .001

Aggregated negative SAEs across domains were significantly associated with NA. Of the domain specific aging experiences, negative experiences in the COGN-EMOT domain were associated with higher levels of NA and negative experiences in the RELSHP domain were associated with lower levels of NA. The prediction of NA from domain-specific SAEs was marginally better than prediction from aggregate measures of negative SAEs ($z = 1.61$, $p = .054$).

No significant effect of aggregated or domain-specific SAEs was found for life satisfaction. Finally, aggregated negative SAEs were associated with lower VOL and aggregated positive SAEs were (marginally) associated with higher VOL, whereas the overall model fit for domain-specific SAEs was not significant.

Discussion

Using a daily diary approach, this study examined the occurrence and content of SAEs in the everyday lives of older adults. The results from this study provided empirical support for the validity of the five behavioral domains for measuring the construct AARC (Diehl & Wahl, 2010). As expected, most accounts of aging experiences were about the domain PHYS, but RELSHP, COGN-EMOT, and ENGAGE were also common domains in which SAEs occurred. SAEs in the COGN domain were reported by comparatively few participants. Given the high prevalence rates of subjective memory complaints reported in the cognitive aging literature (Jonker, Geerlings, & Schmand, 2000; Ponds, Commissaris, & Jolles, 1997), this was a somewhat surprising and unexpected finding. Subjective memory complaints might be shaped by factors other than objective cognitive functioning (Kliegel & Zimprich, 2005). Thus, if memory complaints are noticed in everyday life, their diagnostic value for the sense of having grown older might either be downgraded or, alternatively, cognitive impairments might be repressed or overlooked because of their threat to the self-concept (Greve & Wentura, 2003) and other more tolerable age-related changes might attract older adults' attention instead.

SAEs about COGN were uncorrelated with other domains of age-related experiences at least in this group of cognitively unimpaired community-dwelling adults. In contrast, the domains PHYS, RELSHP, COGN-EMOT, and ENGAGE were closely linked for aging experiences of equal valence, whereas negative experiences were mostly uncorrelated with positive experiences. This latter finding suggests that the occurrence of negative SAEs does not necessarily imply that older adults have fewer (or more) positive SAEs but that negative and positive SAEs are statistically independent. Traditional sub-

jective age measures fall short in capturing this multidirectionality of SAEs and, hence, new measurement methods, such as the daily diary approach, are called for. Furthermore, the open-ended format generated a diverse and rich set of experiences, which is necessary to inform the development of new, domain-specific and more standardized measurement approaches. Indeed, we currently develop a new multidimensional questionnaire that incorporates this article's findings.

Consistent with previous studies, negative SAEs were predominant particularly in the domains of PHYS, COGN, and ENGAGE, thus pointing to the expected developmental losses that adults consider normative for later life (Heckhausen et al., 1989). In the behavioral domains of RELSHP and COGN-EMOT, however, positive and negative SAEs were reported with equal frequency and for some subdomains positive perceptions were even more characteristic (i.e., sense of belonging, self-esteem, joy or sadness). In addition, it is important to note that some positive SAEs were reported in domains where objective data suggest decline, such as physical appearance in the domain of PHYS. Here, participants usually reported that they realized that the common stereotype of deteriorating appearance did not apply to them. Drawing attention to positive contents of SAEs, as a means to counteract the effects of negative age stereotypes (Meisner, 2012), could provide important insights into how to preserve well-being into very old age.

Another aim of this study was to gain a better understanding of correlates of interindividual differences in SAEs. Except for an effect of education on negative SAEs about physical appearance, no group difference was found by socioeconomic status. Thus, similar to subjective age (Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010; Rubin & Berntsen, 2006), SAEs may remain relatively unaffected by sociodemographic indicators. Interestingly, functional status but not chronological age was consistently associated with more negative SAEs, which suggests that in this narrowly defined age group (i.e., old-old adults), the functional health of individuals affected their SAEs more than their age. In the subdomain of physical sensations the older age group (i.e., 80-89 year olds) reported even more positive SAEs compared with the younger age group (i.e., 70-79 year olds). This difference may be due to a selection effect that results in overall more healthy survivors (i.e., survivor effect). Apparently, physically impaired older adults are at risk to have negative aging experiences beyond the domain of PHYS, especially in terms of losses in personal control, which corroborates the finding that limited physical functioning and low mastery beliefs are important predictors of "feeling old" in old age (Infurna et al., 2010).

Furthermore, gender had an effect on participants' SAEs. In particular, women were more likely than men to experience their aging as positive in the domains of RELSHP and COGN-EMOT. This finding might explain the tendency of women to report younger subjective ages, which has often been explained in terms of a greater necessity for women to protect their self against negative aging stereotypes (Pinquart & Sörensen, 2001). Whether this finding extends to women of younger age groups warrants further investigation.

Results of the regression analyses of aggregated SAEs on subjective well-being displayed a modest though very consistent pattern of negative experiences affecting negative affect and positive experiences influencing positive affect without any cross-over effects (e.g., negative experiences affecting positive affect). Of the domain-specific SAEs, aging experiences about COGN-EMOT were a reliable predictor of both PA and NA. One could argue that this association was due to an overlap between the two constructs. The two COGN-EMOT subdomains joy or sadness and self-composure or anxiety were indeed conceptually related to PA and NA. However, COGN-EMOT did comprise other subdomains that were not related to emotions, which were even more common. Thus, distinguishing domain-specific SAEs reveals that not so much perceived age-related change in the behavioral domains PHYS, COGN, RELSHP, and ENGAGE, but the perceived ability to deal with these changes (COGN-EMOT) relates to subjective well-being. Life satisfaction, on the other hand, remained mostly unaffected by SAEs. As expected, positive and negative affect, as state measures, were more closely linked to SAEs in daily life than cognitive components of well-being. SAEs might be accepted as a natural part of growing older and their importance for being satisfied with one's life as a whole might be downgraded. These findings corroborate previous studies: Loss-oriented SAEs were more strongly related to negative affect than gain-oriented SAEs, and vice versa for positive affect, whereas the influence on life satisfaction was negligible (Steverink et al., 2001). With regard to VOL, both aggregated positive and negative experiences across domains displayed (marginally) significant associations. Given the focus of VOL on extending health-based quality-of-life measures to incorporate positive emotion and resilience when faced with age-related losses (Lawton et al., 1999), it is not surprising to find associations with both positive and negative SAEs. Thus, beyond the effect of SAEs on affective well-being, positive SAEs might play an important role in preserving attachment and purpose in life in old age.

Limitations

Several limitations of this study need to be acknowledged. First, social or temporal comparisons as reference points for SAEs were rare. We assume that temporal change was implied in participant's diary entries and not further explicated, as they reported about their aging process. In order to study the role of reference points of SAEs in more detail, it would be necessary to instruct participants to specify the origin of the aging experience.

Second, although we believe that a general model, such as the AARC model (Diehl & Wahl, 2010), is promising to better understand naturally occurring awareness of aging events, there are also proposals in the literature to adopt a more situation-specific approach (Kornadt & Rothermund, 2011; Schindler, Staudinger, & Nesselroade, 2006). We believe that such alternative approaches are informative in their own right and compatible with the AARC approach, because their prototypical situations can be mapped onto the five domains of the AARC model in a meaningful way. For example, situations such as financial strain or freedom to pursue new activities after entering retirement would in the AARC model be captured in the domain lifestyle and engagement. However, reports about retirement or relocation issues were not found in our data, suggesting that such events were not salient SAEs in the daily lives of our sample of old-old adults. As an alternative strategy, however, it would be interesting to apply other situation-oriented approaches to the assessment of naturally occurring age awareness experiences.

Third, it may be questionable that we provided our participants with AARC-related categories for their answers, as this could potentially have directed participants' attention toward noticing specific events. Leaving the format completely open and then delineating behavioral categories that entirely reflect the participants' perspective may be an alternative way to learn about SAEs. However, such an approach carries the risk of underreporting of SAEs and, thus, also has disadvantages. Moreover, in designing this study, we decided to use daily diaries instead of momentary reports to reduce the response burden for the study participants. Although differences between end-of-day and momentary reports have been found, we considered end-of-day assessments an adequate method for studying salient and relative discrete events such as SAEs (Stone & Shiffmann, 2002).

Furthermore, our data were constrained to the restricted age range of old-old adults and, therefore, may represent a sample of SAEs that was skewed toward certain behavioral domains, such as PHYS. Different distributions of SAEs might be found in younger

adults. Also, the cultural background of our sample of German-speaking adults living in the metropolitan area of Frankfurt restricts the generalizability of our findings. Previous studies indicated that SAEs are influenced by social and cultural factors (Westerhof, Whitbourne, & Freeman, 2012). Thus, different contents of SAEs might emerge when replicating this study in other countries.

Finally, we reported cross-sectional analyses based on aggregated measures of daily SAEs and its associations with recalled affect, which is only a limited indicator of momentary affect (Röcke, Hoppmann, & Klumb, 2011). Due to our cross-sectional research design, we cannot draw any conclusions about the dynamic, time-related interplay between different domains of SAEs or between SAEs and well-being related measures from this study. Investigating within-person fluctuations of SAEs over shorter and longer time periods, and their influence as a stressor on daily well-being, is an important next step in future research and can be addressed with this rich dataset and with follow-up data.

In conclusion, this study is—to the best of our knowledge—the first to present a complex, facet-rich conception of SAEs in old age based on a mixed-methods approach. Using the daily diary method, we were able to capture aging experiences in a natural, ecologically valid way. Differential effects of domain-specific aging experiences on subjective well-being point at the pivotal role of social-emotional and social-cognitive aging experiences and highlight the importance of considering multidimensionality and multidirectionality in exploring the mechanisms by which perceptions of a person's own aging affect developmental outcomes.

3

Attitude Toward Own Aging in Midlife and Early Old Age Over a 12-Year Period: Examination of Measurement Equivalence and Developmental Trajectories

Martina Miche, Valerie C. Elsässer, Oliver K. Schilling and Hans-Werner Wahl

Institute of Psychology, Heidelberg University, Germany

Abstract

The Attitude Toward Own Aging Subscale (ATOA) is a frequently used measure of subjective aging. Although ATOA in midlife might assume a preparatory role for psychosocial adjustment in old age, research has been dominated by a focus on older adults. To enable a comparison of developmental trajectories of ATOA between middle-aged and young-old adults, we tested measurement invariance between age groups and over a 12-year study period. In addition, personality variables, health dimensions, and socio-demographic variables were investigated as predictors of developmental trajectories of ATOA. Data came from the Interdisciplinary Longitudinal Study of Adult Development (ILSE) with two birth cohorts (1930-1932: n=500; 1950-1952: n=501) followed over 12 years. Data analyses were conducted with confirmatory factor analysis for ordered-categorical variables and latent growth models. Support for the assumption of partial measurement invariance of ATOA was found in each age group, but not between age groups. Latent growth models revealed a steady decline in ATOA for young-old individuals, whereas ATOA trajectories in midlife were characterized by interindividual variation. Health variables predicted level of ATOA in the young-old. In midlife ATOA were shaped by a variety of factors. Future studies should be conducted with an awareness of differential item functioning of the ATOA scale across age groups. Furthermore, our results point to a greater modifiability of aging attitudes in middle-aged compared to young-old individuals, thus highlighting the importance of the midlife years in shaping developmental trajectories into old age.

Key Words: Attitude Toward Own Aging, Philadelphia Geriatric Morale Scale, Subjective aging, Measurement invariance, Differential item functioning

Introduction

When introduced in the early seventies, the intention behind the Philadelphia Geriatric Center Morale Scale (PGCMS; Lawton, 1972) was to design a measure of older adults' subjective well-being suitable to serve as a marker of positive adjustment in old age. Several studies supported the multidimensional structure of the PGCMS that is made up of three factors (Lawton, 1975; Liang & Bollen, 1983; Morris & Sherwood, 1975): Agitation, Attitude Toward Own Aging, and Lonely Dissatisfaction. However, a total scale approach has mostly been followed, when the PGCMS was used as a well-being measure. The Attitude Toward Own Aging (ATOA) subscale asks for a personal evaluation of age-related changes. Therefore, in need of an internationally established measure, researchers in the field of subjective aging decoupled the ATOA scale from the original PGCMS and used it rather extensively as a stand-alone measure (e.g., Levy, Slade, & Kasl, 2002). The term subjective aging refers to the notion that individuals interpret and evaluate their own aging thus making the experience of aging a subjective matter. Besides the ATOA scale several related constructs (e.g., subjective age, internalized age stereotypes) have been used in the study of subjective aging. In this work, we exclusively focus on applying the ATOA scale to the research field of subjective aging. Note, however, that what has been assessed with the ATOA scale has received different labels such as "aging satisfaction" (Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008), "aging self-perceptions" (Levy, 2008), and "personal views about aging" (Kim, Jang, & Chiriboga, 2012).

Given the prominent role of the ATOA scale in the subjective aging literature, three issues still lack conclusive evidence. First, it is surprising that issues of measurement invariance across age groups and measurement invariance over time have found only limited attention (Meredith & Teresi, 2006). Yet, measurement invariance is a basic requirement when studying the longitudinal development of a given construct (Edwards & Wirth, 2009; Hertzog & Nesselroade, 2003; Khoo, West, Wu, & Kwok, 2006). That is, change in a variable over time should be attributable to "true" change and not to change caused by possibly differential item functioning at different ages. Similarly, the simultaneous investigation of ATOA in multiple age groups requires that group differences in ATOA reflect actual differences in the underlying variable instead of mere differences in psychometric properties of the observed measure (Millsap, 2010). More concrete, findings regarding longitudinal measurement invariance of the ATOA scale are yet inconclu-

sive. McCulloch (1991), applying ordinary linear confirmatory factor analysis, found variation in the full PGCMS factor structure over a 10-year period, whereas Ma, Green, and Cox (2010) were able to confirm longitudinal stability over a shorter study period of one year within the framework of item response theory. The latter study additionally tested whether the ATOA subscale had similar meaning in three different treatment groups undergoing interventions to improve care receiver self-efficacy. Differential item functioning was found between the intervention groups at post-treatment for three of the five items of the ATOA subscale. Taken together, a more detailed analysis of measurement invariance across age groups and measurement invariance over time of the ATOA scale seems generally needed.

Second, more evidence is also needed with regard to trajectories of ATOA over time in different age groups. In particular, research using the ATOA scale has been dominated by a focus on older adults (or has at least not differentiated between middle-aged and older adults; e.g. Levy et al., 2002) and has largely ignored processes of attitude formation and attitude change among middle-aged adults. For several reasons, midlife represents an interesting life phase to study, particularly when it comes to the personal evaluation of one's own aging experiences. As has been argued (Heckhausen, 2001), multiple challenges such as the existence of a complex constellation of gains and losses in midlife (e.g., emerging signs of physical problems may go hand in hand with grandparenthood), challenges in the workforce (e.g., re-balancing one's degree of job involvement), and the experience of a new framing of life time (remaining life time instead of time since birth) all happen with pronounced interindividual variability and might cause large variation in ATOA as well as in attitude change over the mid-adult years. In particular, large interindividual differences in the nature and timing of physical changes have been observed (Lachman, 2004). Physical changes of midlife, such as appearance and mobility, are also highly salient but quite differently experienced signs of aging in the mid years and might thus make health a strong influencing factor for ATOA (Whitbourne, 2001). In sum, midlife may be characterized as a life phase in which ATOA gain importance, but with pronounced interindividual variation. Going further, midlife can assume an important preparatory role for health and psychosocial adjustment in old age (Lachman, 2004). For example, recent studies report long-term effects of health behavior, psychosocial stress, personality and control beliefs, and social relationships in midlife on developmental outcomes in old age (Lachman & Agrigoroaei, 2010; Mroczek, Spiro, & Turiano, 2009; Wahrendorf et al., 2012). The extent to which ATOA in the mid-adult

years might shape developmental outcomes in later life is not well-understood yet. Therefore, we aim to extend and complement previous research with an exclusive focus on old age with research that focuses on developmental processes in midlife and early old age.

Third, given the implications of ATOA for health, physical functioning, and longevity (e.g., Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Sargent-Cox, Anstey, & Luszcz, 2012b), relatively limited attention has been paid to the factors that shape a person's ATOA, including potential predictors of attitude change over time. Gaining a better understanding of such predictors may be particularly important for the midlife years, because, as has been argued above, we expect pronounced interindividual differences in this phase of life. Existing longitudinal studies indicate that, on average, a person's ATOA becomes more negative with increasing age (Kleinspehn-Ammerlahn et al., 2008; Sargent-Cox et al., 2012b; Sargent-Cox, Anstey, & Luszcz, 2012a). However, some studies indicate that the level of ATOA depends on various factors, such as personality, health, and socio-demographic variables and it seems reasonable to assume that these factors may also affect the longitudinal development of attitudes towards one's own aging. Regarding *personality*, recent studies with related constructs suggest that traits, such as neuroticism and extraversion, play a role in shaping awareness of aging processes, with neuroticism being positively and extraversion being negatively related to negatively toned age awareness (Wahl, Konieczny, & Diehl, 2013). Individuals high in neuroticism, those having little optimism, and individuals low in tolerance of ambiguity tend to display more negative ATOA than others (Kotter-Grühn et al., 2009; Levy, 2008; Moor, Zimprich, Schmitt, & Kliegel, 2006). Beyond personality, psychological resources, such as control beliefs, might be important for preserving positive ATOA when physical functioning declines (Sargent-Cox et al., 2012a).

With regard to *health*, ATOA has often been studied as a precursor of health and physical functioning. These studies find a beneficial effect of positive ATOA on basic and instrumental activities of daily living (Moser, Spagnoli, & Santos-Eggimann, 2011), physical functioning (Sargent-Cox et al., 2012b), and longevity (Kotter-Grühn et al., 2009). At the same time, studies that treat health as an outcome of ATOA also discuss reverse effects (i.e., health as an antecedent of ATOA) reasoning that a person's health status functions as a reference point for self-evaluations of one's own aging process (Barrett, 2003; Demakakos, Gjonca, & Nazroo, 2007; Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010). Therefore, given these indications of potential bidirectional relationships between

health status and a person's perception of his or her own aging, this study examines the role of different health dimensions (i.e., physical health, subjective health, and mental health) as predictors of ATOA. In addition to physical health, mental health seems to correlate with a person's ATOA with attitudes being more negative in individuals who report depressive symptoms (Kavirajan et al., 2011; Kleinspehn-Ammerlahn et al., 2008). Furthermore, cognitive abilities and subjective memory complaints are interrelated with aging attitudes, indicating that subjective and objective measures of cognitive functioning might likewise be associated with ATOA (Kliegel & Zimprich, 2005).

In terms of *socio-demographic variables*, Kleinspehn-Ammerlahn et al. (2008) found interindividual variation in change trajectories over time, which were explained by gender, socioeconomic status, and age. Men, individuals with lower socioeconomic status, and older participants displayed lower ATOA-scores over the 6-year study period. Again, the studies cited above mostly included individuals above the age of 60 years and further evidence is needed regarding the predictors of ATOA in middle-aged individuals.

In summary, this study had three objectives. First, we focused on the construct of ATOA and its psychometric properties, with the purpose of testing measurement invariance across two different age groups (middle-aged and young-old adults) and over a period of 12 years in middle-aged and young-old adults. Establishing measurement invariance over time was the basic requirement for our second objective, that is, to examine developmental trajectories of ATOA in both age groups. Specifically, we expected that ATOA, in general, would become more negative over the period of early old age. In addition, the trajectory of ATOA in middle-aged adults was expected to show greater between-person variation as compared to old age. Third, looking at interindividual differences in level and change trajectories, we tested the predictive relevance of a selection of personality variables (i.e., extraversion and neuroticism), health dimensions (i.e., physical health, subjective health, and mental health), and socio-demographic variables (i.e., gender and education). Declining physical resources and health problems dominate in negative age stereotypes. Given this salience of physical losses in negative views of aging, we assumed that psychological and health variables would be able to explain significant portions of interindividual variation in ATOA in both age groups. In addition, we expected, in accordance with established predictor models in the area of well-being and self-views (Diener, Suh, Lucas, & Smith, 1999), that psychological and health variables would be stronger predictors of ATOA as compared to socio-demographic variables in both age groups.

Method

Participants and Procedure

Data for this study came from the "Interdisciplinary Longitudinal Study of Adult Development" (ILSE). To date ILSE has completed three measurement occasions that took place between the years 1992 and 2004 in two German urban regions (Leipzig in the former East Germany and Mannheim and Heidelberg in the Southwest of the former West Germany). ILSE is an ongoing population-based study with a strong interdisciplinary focus. At baseline in 1992/1993 (T1), 2,500 individuals were randomly selected from local registries and invited to participate in the study. Subsequent telephone interviews were conducted to obtain a sample that was stratified by birth cohort, gender, and region. The 500 young-old participants were born between 1930 and 1932 and the middle-aged group consisted of 501 individuals born between 1950 and 1952. Follow-up assessments were conducted in 1996/1997 (T2) and again in 2004/2005 (T3), thus having followed the middle-aged group from their early forties until their mid-fifties (T1: $M_{age} = 43.8$, $SD = 0.9$; T2: $M_{age} = 47.6$, $SD = 0.9$; T3: $M_{age} = 55.3$, $SD = 1.1$) and the young-old age group from their early sixties to their mid-seventies (T1: $M_{age} = 62.5$, $SD = 1.0$; T2: $M_{age} = 66.6$, $SD = 1.1$; T3: $M_{age} = 74.3$, $SD = 1.2$).

Of the middle-aged group, 10.8% of all participants did not take part in the study at T2 and another 8.7% dropped out between T2 and T3 reducing the sample sizes of the middle-aged participants to $N = 447$ and $N = 408$ at T2 and T3, respectively. Compared to the study drop-outs, participants who remained in the study until T3 had better subjective health and higher levels of education. Effect sizes of these mean differences between returnees and non-returnees were in the low to moderate range (d's ranged between .28 and .44). Of the young-old age group, 10.2% of all participants dropped out between T1 and T2 and another 21.6% did not participate at T3 reducing the sample sizes of the young-old participants to $N = 449$ and $N = 352$ at T2 and T3, respectively. Young-old participants who remained in the study until T3 had better objective and subjective physical health ratings, were better educated, and also revealed lower levels of depressive symptoms (d's = .22 - .51).

Measures

Attitude Toward Own Aging (ATOA)

ATOA was assessed with the respective subscale of the PCGMS (Lawton, 1975). This scale consists of the five items listed in Figure 3.1 (further explication of Figure 3.1 is given in the data analysis section), each one providing a statement referring to the personal evaluation of one's aging experience that can either be agreed with (scored as 0) or rejected (scored as 1). Items 2, 4, and 5 were recoded so that higher ATOA scores indicated a more positive attitude towards the individual aging process.

Predictor variables

As predictors of both baseline level and interindividual variation of change in ATOA, we included three sets of variables. First, neuroticism and extraversion, as personality variables, were assessed with the German version of the NEO-Five Factor Inventory (Borkenau & Ostendorf, 1993). Second, we included measures representing different health dimensions including an expert-based objective health rating. One to two trained geriatricians per measurement occasion conducted an in-depth medical check-up to assess objective physical health. Geriatricians aggregated the information obtained from a clinical in-depth examination[2] into a global physical health score that ranged from 1 (*very good*) to 6 (*very bad*). Participants were also asked for a personal evaluation of their health status. This subjective health rating relied on a scale from 1 (*very good*) to 6 (*very bad*). Furthermore, depressive symptoms assessed by the Self-Rating Depression Scale (Zung, 1965) served as an indicator for mental health. The Self-Rating Depression Scale consists of 20 items with a response format ranging from 1 = *never* to 4 = *always*. Third, socio-demographic factors included gender and education. Education was assessed with a categorical variable with four categories based on the number of years of school and university education (1 = *up to 10 years of education*, 2 = *between 11 and 12 years*, 3 = *between 13 and 15 years*, and 4 = *more than 15 years of school and university education*).

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[2] The overall objective health assessment used in this study represents a summary score of four sets of clinical in-depth examination: an anamnesis, a medical check-up, a laboratory test, and a geriatric assessment, with each clinical examination consisting of several subtests (e.g., medical history of the participant, hearing and vision test, blood pressure measurement, blood sugar measurement, assessment of functional status). Geriatricians aggregated the results of these four sets of clinical in-depth examination into an overall objective health score. This score relied on 6 levels that were all clearly described to allow objective assignment of the available clinical information from each participant (e.g., a poor health status, i.e. score 5, was assigned if a participant suffered from a very serious medical condition which is not immediately life-threatening or if assessment of functional status indicated that independent living was no longer possible). The descriptions of each level of the health rating were developed to ensure clinical significance of the assigned health score on the hand and to guarantee reliability on the other hand.
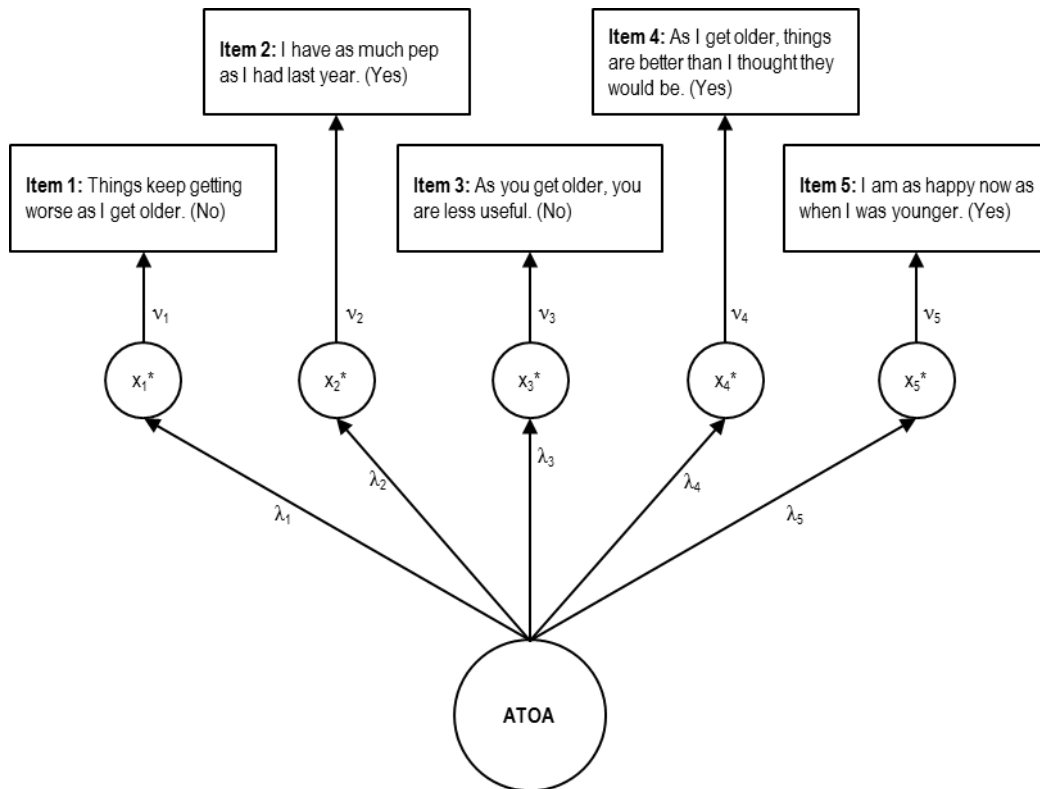
Data Analysis[3]

Figure 3.1.
Categorical confirmatory factor model for the five-item Attitudes Toward Own Aging Scale
Notes. Answers indicative of a positive attitude are given in parentheses for each item.

Measurement invariance testing was based on confirmatory factor analysis (CFA) for ordered-categorical variables, which is formally equivalent to item response theory (IRT) models (B. Muthén & Christoffersson, 1981). In the single-factor model of ATOA with five dichotomous indicators as depicted in Figure 3.1, a latent factor (f) is linearly related to underlying continuous latent response variables (x*) through factor loadings (λ's), and each latent response variable manifests as a discrete item score through its respective threshold (v). In terms of IRT, this model corresponds to the so-called two-parameter logistic model (e.g., Edwards & Wirth, 2009; Kim & Yoon, 2011), which implies that the probability of a particular item response is determined by the discrimination parameter (describing the sensitivity to differences on the latent variable) and the item difficulty (or

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[3] The comments of our reviewers on an earlier version of this paper made us well aware of the complexity of testing measurement invariance. As a result of this process and because of the fundamental importance of measurement invariance issues for developmental research, we use more space than usual for describing our data-analytic procedure. We would like to thank our reviewers for challenging us in how to address measurement invariance in this paper as well as for a set of other highly valuable comments.

severity) parameter (describing at which score on the latent variable the item has equal probabilities of being endorsed vs. not endorsed). These IRT parameters correspond with the CFA parameters depicted in Figure 3.1, in that the standardized λ's "translate" to the item discrimination, whereas the thresholds reflect difficulty parameters in a more complex way (for the exact formulae relating the IRT with CFA parameterizations see Muthén & Muthén, 2013).

A hierarchy of different types of measurement invariance has been introduced in the literature (Gregorich, 2006; Meredith, 1993; Vandenberg & Lance, 2000). *Configural invariance* requires that the factorial structure is identical in all groups and across time (i.e., the number of factors is invariant and each factor is associated with the same items). This implies that the five ATOA items load on one common factor in the two age groups and across all three measurement waves. *Metric invariance* refers to equal factor loadings for like items across groups and over time. Phrased in terms of the IRT model, rejection of metric invariance would indicate differential item functioning (DIF) with regard to the item's discrimination among high versus low degrees of ATOA. If metric invariance holds, the latent factor variances can be compared across groups or measurement waves. *Scalar invariance* implies that the factor loadings and the item thresholds of corresponding items are invariant across groups and/or over time. Phrased in terms of the IRT model, rejection of scalar invariance would indicate DIF with regard to the item difficulty parameter, that is, the level of the latent ATOA score which provides equal odds to agree or disagree with the item. Comparisons of ATOA factor means between age groups or across the three measurement waves is legitimate only if scalar invariance can be established.

Byrne, Shavelson & Muthén (1989), however, argued that complete measurement invariance is an ideal that is rarely achieved in empirical practice and therefore introduced partial measurement invariance. Partial invariance refers to a measurement model where DIF is found for some, but not all item parameters under study. There is some general consensus in the recent literature on DIF that such partial DIF may be suited for valid comparisons of latent factor variances and/or means across groups or measurement occasions (e.g., Edwards & Wirth, 2009; Gregorich, 2006; Khoo et al., 2006; Vandenberg & Lance, 2000). In particular, so-called common-item equating procedures use a set of invariant "anchor" items along with a set of non-common (or non-invariant) items to assign the latter to the same common scale of the construct across groups or time: "As long as some invariant item set exists between two time points (i.e., an anchor), the

mechanisms of equating can be used to provide valid scores despite other changes to the item set (e.g., adding/deleting items or noninvariance). In general, the larger the anchor, the more stable the equating procedure will be." (Edwards & Wirth, 2009, p. 94) Thus, the question is not whether partial measurement invariance itself is acceptable, but rather how many items of a scale may show DIF in order to be able to make valid comparisons of latent factor scores. With a view to the literature on the topic, this question appears not yet resolved conclusively. There is an ongoing discussion concerning the acceptable relative number of items with DIF for partial measurement invariance, but also concerning the direction and size of DIF effects (e.g., Flora, Curran, Hussong, & Edwards, 2008).

In the present paper, we followed the rationale to test for configural, metric, and scalar invariance. To test measurement invariance across age groups, we first estimated a separate multi-group model for each of the three measurement waves without any parameter constraints imposed between groups. A test of configural invariance across age-groups is implied in evaluating the model fit of this one-factor model for each group without any parameters constrained invariant across groups (Gregorich, 2006; Khoo et al., 2006; Vandenberg & Lance, 2000). Next, metric invariance was tested in that factor loadings of each of the five ATOA items were constrained to be equal across age groups in each of the three separate models (i.e., checking for DIF in item discrimination). If complete metric invariance was rejected, we tested for partial metric invariance. To detect the most parsimonious model with as few non-invariant loadings as possible, we tested all possible models with four anchors (i.e., the invariance restriction was relaxed for only 1 of the 5 loadings). If no four-anchor model was accepted, we tested all possible combinations with three anchors (i.e., the invariance restriction was relaxed for 2 loadings), and so on. Based on the metric invariance model accepted, we finally tested for scalar invariance by imposing additional equality constraints on item thresholds of each ATOA item (i.e. checking for DIF in item difficulty). Again, if complete invariance of the item thresholds was rejected, we checked for partial invariance with as few non-invariant thresholds as possible. Similarly to testing invariance across age groups, we tested configural, metric, and scalar invariance over time by first estimating a separate longitudinal model for each age group without any equality constraints imposed on the model parameters, next testing invariance of factor loadings, and finally testing invariance of item thresholds across the three time points in each of the two separate age-group models. Given the lack of clear-cut criteria for the acceptable magnitude of DIF in

case of partial measurement invariance, we applied the ad-hoc rule that at least half of the items should be invariant (i.e., in our case, at least three anchor items or – formulated the other way around – a maximum of two non-invariant items), and that DIF in the non-invariant items should be at most moderate in effect size.[4]

Categorical CFA was conducted with Mplus version 6.12 (L. Muthén & B. Muthén, 1998-2011), using a diagonally weighted least squares estimator with mean and variance adjustment (WLSMV). Model fit for models with increasing constraints imposed on the model parameters were evaluated by inspection of model fit indices as well as chi-square difference testing (for computational details see Asparouhov & B. Muthén, 2006).

Change trajectories of ATOA were modeled within the framework of multiple-indicator latent variable growth analysis. These models estimate a latent intercept and a latent slope to predict individual factor scores on the ATOA factors at each measurement occasion. One advantage of latent growth models is that they account for both similarities across individuals (i.e., fixed effects or means of the latent intercept and slope) and differences between individuals (i.e., random effects or variation in the latent intercept and slope) regarding level and change of ATOA. Latent growth models were also estimated in Mplus version 6.12 (L. Muthén & B. Muthén, 1998-2011) using the WLSMV. Results of the measurement invariance testing suggested that psychometric properties of the ATOA scale differed between age groups. We therefore fitted two separate latent growth models for the two age groups.

Results

Measurement Invariance Testing of the Attitude Toward Own Aging Scale

Measurement invariance across age groups

To evaluate measurement invariance across age groups, a model allowing parameters to be different between age groups was fitted separately for each measurement occasion and compared to models with increasing constraints imposed on model parameters. Fit

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[4] Steinberg & Thissen (2006) proposed to compare IRT item parameters to gain evidence of DIF effect sizes, but also pointed out that there are no general cutoff criteria to distinguish small, moderate, or large differences in these parameters. However, their reasoning basically grounds on the impact of DIF on differences in the proportions of item endorsement predicted by the standardized latent construct (i.e., corrected for differences in the latent construct between groups/times compared). The comparison of these proportions under different IRT parameter values provides an intuitive notion of how much DIF impacts on item endorsement. As both IRT parameters impact on this proportion, it could be used as a common basis to evaluate DIF effects in discrimination or difficulty. Therefore, at least for an ad hoc evaluation of the effects sizes we compared the proportions of item endorsement in models with DIF (for computation see, e.g., formula 6 provided by Steinberg & Thissen, 2006). As an intuitive rule of thumb, we viewed DIF as moderate if the proportions differed 5-10%.

indices of these one-factor models for each age group and measurement wave, which are shown in Table 3.1, indicate that the conditions for configural invariance of the ATOA scale are met. Testing for metric invariance in the T1 model, model fit did not significantly decrease when imposing equality constraints on the factor loadings, $\chi^2 = 2.25$, $df = 4$, $p = .69$. Additionally imposing equality constraints on item thresholds, however, resulted in significantly poorer model fit, $\chi^2 = 71.45$, $df = 4$, $p < .001$. Sequentially testing models with item thresholds of one and combinations of two items respectively set free across age groups did not reveal acceptance of a model with three invariant anchor items (we only yielded support for a model with thresholds of items 1, 2, and 3 being non-invariant between age groups, $\chi^2 = 1.94$, $df = 1$, $p = .16$).[5] At T2, model fit was worsened by imposing equality constraints on factor loadings across the two age groups, $\chi^2 = 24.40$, $df = 4$, $p < .001$. Sequentially testing models with factor loadings of one and combinations of two items respectively set free across age groups yielded support for a model with non-invariant factor loadings of items 3 and 5, $\chi^2 = 3.35$, $df = 2$, $p = .19$. With that model chosen, testing invariance of the thresholds yielded support for a model where, in addition to non-invariant factor loadings of items 3 and 5, thresholds of items 1 and 2 were non-invariant between groups, $\chi^2 = 1.99$, $df = 2$, $p = .37$. At T3 model fit significantly worsened when imposing equality constraints on the factor loadings, $\chi^2 = 12.07$, $df = 4$, $p < .05$. However, partial measurement invariance testing yielded acceptance of a model with a non-invariant item loading for item 2, but invariance across age groups for the other factor loadings, $\chi^2 = 6.05$, $df = 3$, $p = .11$. Based on that model, thresholds were found to be non-invariant for items 3, 4, and 5, $\chi^2 = 2.05$, $df = 1$, $p = .15$.

For these models with partial cross-groups invariance of loadings and/or thresholds that could be finally accepted, the DIF of the non-invariant items showed moderate to large effect sizes. In the T1 model with three thresholds varying between age groups, the predicted proportions of item endorsement (see Footnote 2) differed by 7% and 11% for items 2 and 3, respectively. In the T2 model, the proportions of endorsement differed by 7% and 9% for items 1 and 2, respectively. In the T3 model, DIF of items 2, 3, and 4,

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[5] Note that the DIF testing procedure comprises multiple statistical tests. In the literature on DIF testing, the Benjamini-Hochberg procedure to control for a false DIF discovery rate due to multiple testing has been advocated (Raykov, Marcoulides, Lee, & Chang, 2013; Thissen, Steinberg, & Kuang, 2002). This procedure implies a reduction of the single test significance levels, providing more liberal criteria for acceptance of invariance restrictions. In the present paper, we intend to draw conclusions of invariance with some caution only, hence we relied on the uncorrected conventional 5% significance level in DIF testing.

produced differences of 9%, 10%, and 6% respectively in the proportions of endorsement.

Table 3.1. Measurement Invariance of the Attitude Toward Own Aging Subscale across Age Groups: Model Fit Indices for the Categorical Confirmatory Factor Models by Measurement Occasion

Time	Model	RMSEA	CFI	TLI	χ^2 Difference Test	
					χ^2 (df)	*p*
T1	1. Unconstrained	.029	.995	.990		
	2. Invariance of factor loadings	.008	.999	.999	2.25 (4)	.69
	3. Invariance of factor loadings and thresholds	.084	.922	.913	71.45 (4)	<.001
	4. Invariance of factor loadings and partial invariance of thresholds (minus item 1,2,3)	.013	.999	.998	1.94 (1)	.16
T2	1. Unconstrained	.021	.998	.996		
	2. Invariance of factor loadings	.069	.966	.951	24.40 (4)	< .001
	3. Partial invariance of factor loadings (minus item 3+5)	.023	.997	.995	3.35 (2)	.19
	4. Partial invariance of factor loadings (minus item 3+5) and invariance of thresholds	.087	.938	.923	53.62 (4)	< .001
	5. Partial invariance of factor loadings (minus item 3+5) and partial invariance of thresholds (minus item 1+2)	.018	.998	.997	1.99 (2)	.37
T3	1. Unconstrained	.046	.992	.984		
	2. Invariance of factor loadings	.060	.981	.973	12.07 (4)	< .05
	3. Partial invariance of loadings (minus item 2)	.047	.989	0.984	6.05 (3)	.11
	4. Partial invariance of loadings (minus item 2) and invariance of thresholds	.112	.921	.906	71.20 (4)	<.001
	5. Partial invariance of loadings (minus item 2) and partial invariance of thresholds (minus item 3,4,5)	.045	.989	.985	2.05 (1)	.15

Taken together, there was only limited evidence for measurement equivalence across age groups when looking at all three waves of our longitudinal study. With regard to our criteria of "acceptable" partial invariance, a model with at least three invariant anchor items was not supported at all measurement waves. Given this considerable amount of non-invariance with no consistent pattern of partial invariance across the three measurement waves in terms of the respective items, we conclude that measurement invariance of the ATOA scale between young-old and middle-aged adults does not hold.

Longitudinal measurement invariance

Longitudinal measurement invariance of the ATOA subscale was assessed separately for each age group. Fit indices for the categorical confirmatory factor models with increasing constraints imposed on factor loadings and item thresholds are shown in Table 3.2. For the young-old age group, equality constraints imposed on the factor loadings

of the five ATOA items over the three measurement occasions did not decrease model fit, $\chi^2 = 14.02$, $df = 8$, $p = .08$ (note also that model fit in terms of the parsimony-based RMSEA even improved). Thus, invariance of the factor loadings over time was accepted. Constraining also the item thresholds to be equal across time resulted in a significantly poorer model fit, $\chi^2 = 34.78$, $df = 8$, $p < .001$. Sequentially testing models with item thresholds of one and combinations of two items respectively set free across time yielded acceptance of a model with non-invariant item thresholds for item 3 ("As you get older, you are less useful.") and item 5 ("I am as happy now as when I was younger."), but threshold invariance across time for the other three items, $\chi^2 = 8.24$, $df = 4$, $p = .08$. With respect to the effect size of the DIF effects, all differences between the proportions of item endorsement predicted for T1, T2, and T3 were only small (ranging from less than 1% up to 5%). The decreasing sizes of the thresholds across measurement occasions (Item 3: $v_{3.T1} = -0.53$, $v_{3.T2} = -0.86$, $v_{3.T3} = -0.85$; Item 5: $v_{5.T1} = -0.27$, $v_{5.T2} = -0.43$, $v_{5.T3} = -0.53$) imply that these items become less difficult over time for the young-old individuals. The interpretation is that young-old adults with a given latent ATOA factor score at T1 were more inclined to give an answer to these items that was indicative of a positive attitude toward own aging as were individuals with the same latent ATOA factor score at T2 and T3.

With regard to the middle-aged group, equality constraints imposed on the factor loadings of the five ATOA items across the study period did not decrease model fit compared to the baseline model without any constraints, $\chi^2 = 10.03$, $df = 8$, $p = .26$ (note also that model fit in terms of the parsimony-based RMSEA even improved). As in the young-old age group, invariance of the factor loadings over time was accepted. The assumption of complete invariance of item thresholds did not hold, $\chi^2 = 29.45$, $df = 8$, $p < .001$. However, partial measurement invariance testing yielded acceptance of a model with non-invariant item thresholds for item 2 ("I have as much pep as I had last year.") and item 4 ("As I get older, things are better than I thought they would be."), but threshold invariance across time for the other three items, $\chi^2 = 5.64$, $df = 4$, $p = .23$. The effect sizes of the DIF effects appeared mostly moderate (i.e., the differences between the proportions of item endorsement predicted for T1, T2, and T3 ranged from 2% to 10%). Item thresholds for both of these items increased over measurement occasions (Item 2: $v_{2.T1} = -0.58$, $v_{2.T2} = -0.38$, $v_{2.T3} = -0.23$; Item 4: $v_{4.T1} = -0.05$, $v_{4.T2} = 0.13$, $v_{4.T3} = 0.22$), suggesting that for the middle-aged individuals these items became more difficult over time. In other words, middle-aged individuals with a given latent ATOA factor score at

T1 were more inclined to give an answer to these items that was indicative of a negative attitude toward own aging as were individuals with the same latent ATOA factor score at T2 and T3.

Table 3.2. Longitudinal Measurement Invariance of the Attitude Toward Own Aging Subscale: Model Fit Indices for the Categorical Confirmatory Factor Models by Age Group

Age Group	Model	RMSEA	CFI	TLI	χ^2 Difference Test	
					χ^2 (df)	*p*
Young-Old Age Group (born 1930-1932)	1. Unconstrained	.050	.939	.927		
	2. Invariance of factor loadings	.047	.942	.936	14.02 (8)	.08
	3. Invariance of factor loadings and thresholds	.049	.932	.931	34.78 (8)	<.001
	4. Invariance of factor loadings and partial invariance of thresholds (minus item 3 + 5)	.047	.940	.937	8.24 (4)	.08
Middle-Aged Group (born 1950-1952)	1. Unconstrained	.044	.948	.937		
	2. Invariance of factor loadings	.041	.953	.948	10.03 (8)	.26
	3. Invariance of factor loadings and thresholds	.042	.944	.943	29.45 (8)	<.001
	4. Invariance of factor loadings and partial invariance of thresholds (minus item 2 + 4)	.040	.952	.949	5.64 (4)	.23

To conclude, these analyses suggest that within each age group there was a large degree of consistency in the psychometric properties of the ATOA scale over time. Partial measurement invariance with item thresholds of three anchor items in each age group being invariant over time was found, which allows for the testing of differences in factor mean scores over time (Byrne et al., 1989). As a consequence of our two-step testing of measurement invariance, which indicated partial measurement invariance over time within each age group but non-invariance between age-groups, we decided to examine change models regarding trajectories of ATOA separately for each age group in subsequent latent variable growth models.

Trajectories of Attitudes Toward Own Aging in the Two Age Groups

Interindividual differences in level and change trajectories of Attitudes Toward Own Aging

As the first step of multiple-indicator latent variable growth analyses, a baseline unconditional growth model was fitted for each age group to analyze overall developmental dynamics of ATOA over the 12-year study period. Parameter estimates of these models are displayed in Table 3.3. Significant mean estimates of the slope indicated that ATOA became, on average, more negative in both age groups. Interindividual variation

in the slope estimate was nonsignificant in the young-old age group as indicated by a nonsignificant chi-square difference test, $\Delta\chi^2 = 2.30$, $df = 2$, $p = .32$. Therefore, there was no substantial between-person variation in the decline of ATOA over time to be explained by the predictor variables in the young-old age group. In contrast, the middle-aged group did show interindividual differences in the slope estimate. Figure 3.2 depicts estimated mean ATOA factor scores for each age group and ATOA trajectories of 200 randomly selected individuals to illustrate age-group specific characteristics of interindividual variation of the latent slope estimate. As can be seen, the estimated ATOA trajectories displayed greater between-person variation in the middle-aged group as compared to the young-old age group. The average decline of latent ATOA factor scores was somewhat steeper in the young-old compared to the middle-aged group. Furthermore, significant variation in the intercept estimate indicated that the level of ATOA at T1 was significantly different across individuals in both age groups.

Table 3.3. Baseline Unconditional Linear Growth Models for Both Age Groups

Parameter	Young-Old Age Group[a]		Middle-Aged Group[b]	
	Estimate	SE	Estimate	SE
Fixed effects estimates				
Mean intercept	@0		@0	
Mean slope	-0.16 ***	0.02	-0.06 **	0.02
Random effects estimates				
Variance intercept	0.41 ***	0.06	0.47 ***	0.06
Variance slope	0.02	0.02	0.05 *	0.02
Covariance between intercept and slope	-0.03	0.02	-0.05 *	0.02
Model Fit				
RMSEA	.047		.042	
p (RMSEA<.05)	.715		.921	
CFI	.940		.946	
TLI	.937		.944	

Notes. Estimates and standard errors are unstandardized. @ parameters were fixed at the value indicated. [a]born 1930-1932. [b]born 1950-1952. * p < .05, ** p < .01, *** p < .001.
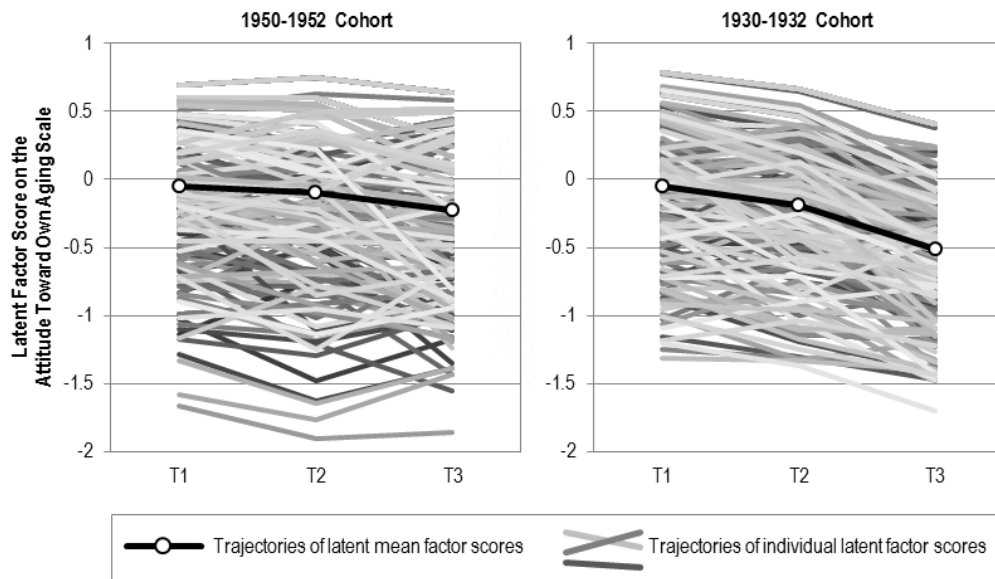
Figure 3.2. Trajectories of estimated mean Attitudes Toward Own Aging factor scores and for 200 randomly selected individuals of each age group based on the baseline unconditional linear growth model

Predicting interindividual differences in level and change trajectories of Attitudes Toward Own Aging

In our final step of latent variable growth modeling, we regressed the latent growth estimates on our set of predictor variables to test whether significant interindividual variation in the latent intercept and slope estimate was related to personality, health, and socio-demographic variables measured at T1. Effects of predictors on the slope estimate were only estimated for the middle-aged group, because of the nonsignificant variation of the slope in the young-old age group. Results of the two models are presented in Table 3.4.

In the young-old age group, variation in the level of ATOA at T1 was not predicted by personality or education, but all three health variables were significantly associated with the level of ATOA. A lower objective and subjective health status and having more depressive symptoms was associated with having a more negative ATOA at the starting point of the study. Furthermore, young-old men had more negative ATOA at T1. In the middle-aged group[6], neuroticism was associated with the level of ATOA. Of the three health variables, subjective physical health and depressive symptoms, but not objective

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[6] Including predictors to the latent variable growth model of the middle-aged group resulted in a negative variance of the latent ATOA factor at T3. A model constraint, forcing the variance of the latent ATOA factor at T3 to be greater than zero, was thus imposed on the latent variable growth model for the middle-aged group to avoid this source of misfit.

health, were significant predictors of variation in the level of ATOA at T1 in the middle-aged group. In addition, gender was significantly associated with level of ATOA. Higher levels of neuroticism, poorer subjective health, having more depressive symptoms, and being a man were associated with having a more negative ATOA at the starting point of the study.

Table 3.4. Linear Growth Models for Both Age Groups: Predictors of Level and 12-Year Change

Parameter	Young-Old Age Group[a]		Middle-Aged Group[b]	
	Estimate	*SE*	Estimate	*SE*
Fixed effects estimates				
Mean intercept	@0		@0	
Mean slope	-0.35	0.24	0.02	0.23
Predictors of intercept				
Neuroticism	-0.08	0.08	-0.23[*]	0.10
Extraversion	0.07	0.08	0.14	0.09
Physical health status	-0.17[***]	0.04	0.09	0.06
Subjective health	-0.14[**]	0.04	-0.11[†]	0.06
Depressive symptoms	-0.77[***]	0.14	-1.13[***]	0.17
Gender (1=male, 2=female)	0.17[*]	0.07	0.40[***]	0.09
Education	0.02	0.03	0.02	0.05
Predictors of slope				
Neuroticism	@0		-0.01	0.05
Extraversion	@0		0.02	0.05
Physical health status	@0		-0.11[***]	0.03
Subjective health	@0		0.00	0.03
Depressive symptoms	@0		0.26[**]	0.08
Gender (1=male, 2=female)	@0		-0.11[*]	0.05
Education	@0		0.03	0.03
Random effects estimates				
Residual variance intercept	0.28[***]	0.06	0.36[***]	0.07
(Residual) variance slope	0.04[†]	0.02	0.06[***]	0.01
Covariance bet. intercept and slope	-0.04	0.03	-0.05[*]	0.03
R²				
Intercept	0.44		0.48	
Slope			0.25	
Model Fit				
RMSEA	.042		.036	
p (RMSEA < .05)	.972		1.000	
CFI	.825		.891	
TLI	.814		.880	

Notes. Estimates and standard errors are unstandardized. @parameters were fixed at the value indicated. [a]born 1930-1932. [b]born 1950-1952. [†] p < .10, [*] p < .05, [**] p < .01, [***] p < .001.

Due to the nonsignificant variation of the slope factor in the young-old age group, we investigated effects of the predictor variables on interindividual variation in change trajectories in the middle-aged group only. Here, variation in change trajectories of ATOA was accounted for by objective physical health, depressive symptoms, and gender. Thus,

individuals in midlife with poorer ratings of physical health displayed a more negative slope in ATOA over the 12-year study period and, somewhat surprising, participants experiencing more depressive symptoms at T1 became more positive in their ATOA. Furthermore, the change toward more negative ATOA was greater in women as compared to men.

Comparing the variance of the intercept in the model with and without covariates, it became evident that the covariates accounted for a substantial proportion of the between-person variance of this latent growth estimate. Although the variation of the intercept remained significant in both age groups after including the covariates, its size decreased substantially. These results indicated that the chosen set of covariates accounted for substantial interindividual variance of the intercept estimates in both age groups.

Discussion

This study aimed to explicitly examine the measurement invariance of the ATOA subscale of the PGCMS (Lawton, 1972) across age groups and measurement occasions, which has been taken for granted in previous subjective aging related work. In particular, we intended to test measurement invariance over three measurement occasions spanning an observation period of 12 years and across two age groups as a prerequisite to conduct meaningful comparisons of ATOA between measurement occasions and between age groups. The results of these analyses indicated that factor loadings were stable over time within age groups, meaning that the sensitivity of each ATOA item to reflect differences in the latent ATOA factor was similar at each measurement occasion. Furthermore, in each age group the thresholds of three out of five items were invariant over time, thus fulfilling our criteria of a minimum of three invariant anchor items. From these results we inferred that partial longitudinal measurement invariance could be reasonably assumed and that the analysis of trajectories of ATOA is legitimate at least within age groups.

Testing for measurement invariance between age groups yielded a somewhat different picture. Here, we found substantial differences in factor loadings and item thresholds between age groups both at T2 and T3. Comparing age groups in their level and change trajectories thus involves the risk of ignoring age-group specific differences in the interpretation of the ATOA scale. As a consequence, we proceeded with separate model testing by age group in the analysis of predictors of ATOA.

Given invariance of factor loadings over time, the partial invariance of the item thresholds indicates DIF with respect to the level of ATOA where a positive and negative response to the respective item are equally probable. Partial invariance of item parameters implies that "the observed response frequencies are changing more (or less) than would be predicted by changes in the latent construct" (p. 88; Edwards & Wirth, 2009). Thus, if item thresholds decline over time, a greater proportion of the persons in the respective age-group endorsed the item than would have been expected due to the average change in latent ATOA. The decreasing thresholds of items 3 and 5 in the group of young-old adults might indicate that individuals from their early sixties to their mid-seventies shift their standards for social and emotional aspects of aging, which are captured by these two items. Extensive literature on socio-emotional aspects of aging suggests that as individuals age they make increasing use of secondary control strategies (e.g., Heckhausen & Schulz, 1995) and are oriented more toward positive emotional goals (e.g., Carstensen, Isaacowitz, & Charles, 1999). The non-invariance of socioemotional items in the young-old age group might reflect such adaptive developmental processes, thus resulting in a greater likelihood to endorse a positive answer to these items given a specific latent ATOA factor score. Items 2 and 4, which showed increasing item difficulties in the middle-aged group, might be interpreted as capturing physical aspects of aging. Based on our reasoning about the increasing salience of physical changes as a predominant sign of aging in midlife (Whitbourne, 2001), it seems plausible that middle-aged adults developed more rigorous standards of their physical aging across the midlife years. Given that theoretical reasoning about the presence of noninvariance can be seen as a means to assess construct validity (Edwards & Wirth, 2009), the observed non-invariance of socioemotional items in the young old age group and of physical items in the middle-aged group lend further support for the validity of the ATOA subscale.

Building on this measurement invariance work, this study is one of the first to contrast the development of ATOA in midlife with ATOA among young-old individuals. By following two birth cohorts, aged in their early forties and their early sixties, over a period of 12 years we were able to cover almost the entire span of the second half of life. Although one needs to be careful in drawing final conclusions about age-related differences because of the differential item functioning between age groups, overall, our findings point to important age-related differences regarding developmental trajectories of ATOA.

Whereas ATOA in the young-old age group followed a trajectory of steady decline with limited variation between individuals, the average downturn of ATOA observed in the middle-aged group revealed pronounced between-subject differences. These differences over a 12-year observation interval point to age-group specific effects regarding the influence of objective age-related changes on ATOA. With regards to their ATOA, individuals in their middle-aged years seem to be more sensitive to age-related changes as compared to young-old adults. That is, perceiving age-attributed changes (e.g., diagnosis of health conditions) as normative in young-old age versus non-normative in middle-age might explain differential trajectories of ATOA. The non-significant between-person variation in ATOA trajectories among the young-old individuals contradicts the findings of Kleinspehn-Ammerlahn et al. (2008) but is in concordance with Kotter-Grühn et al. (2009), who also failed to find between-person variation in the decline of ATOA. Both of these studies used data from the Berlin Aging Study. However, the former study used measurement occasion as the time-scaling variable, whereas the latter used calendar age in a multilevel model, which is similar to the operationalization of time in the present study because members of each age group had the same age when they were included in the study sample. Taken together, these studies suggest that there is no evidence for between-person variation in the decline of ATOA in young-old adults when investigating the development of ATOA over calendar age. Additional research, that disentangles the effects of calendar age and measurement occasion by using cohort sequential designs, is needed for further clarification of interindividual differences regarding the development of ATOA.

When comparing the two age-group models, differences were found in the expected direction regarding the association of covariates with the level of ATOA. In the young-old age group, only health-related variables and gender were associated with level of ATOA, whereas in the middle-aged group initial ATOA scores were related to personality, health-related variables, and gender. Although these differences between age-groups need to be interpreted with caution given the measurement non-invariance between groups that was detected in this study, applying less conservative criteria in testing measurement invariance would have resulted in a larger degree of similarity of anchor items. This pattern of results might therefore indicate that ATOA in the middle-aged group as compared to the young-old group are shaped by a broader range of factors, thus pointing to greater flexibility and malleability of ATOA in midlife as compared to early old age. First, the significant associations between health variables and level of

ATOA in both middle-aged and young-old adults emphasize that across the adult life span health factors are of great relevance for individuals' perceptions and evaluations of their aging process (Miche et al., 2013). Furthermore, corroborating previous research (Wahl et al., 2013) neuroticism as a risk factor for negative perceptions of aging seems to be more important in midlife. A possible explanation is that individuals high in neuroticism might be more prone to attend to ambiguous signs of age-related loss. The effect of personality on perceptions of aging might be stronger for middle-aged adults because age as a cause of midlife developmental changes is less obvious as compared to old age. Furthermore, throughout the life course certain personality traits (e.g., neuroticism) predispose individuals to experience crises when being confronted with transition points. Consequently, the losses and challenges of midlife, that mark such transition points might be particularly threatening for ATOA in individuals high in neuroticism (Lachman & Bertrand, 2001). Finally middle-aged and young-old women were found to have more positive ATOA at the beginning of the study. Researchers who have studied the role of gender for perceptions of aging reported similar findings (Barrett, 2005; Montepare, 2006) and argued that more positive perceptions of aging in middle-aged women might be due the use of a self-enhancing strategy when women are being confronted with double-standards of aging. The decline of ATOA in middle-aged women might be owed to specific midlife changes in physical appearance that endanger the female attributes of beauty for which women are valued more than men (Ferraro et al., 2008).

Other studies (Kleinspehn-Ammerlahn et al., 2008) indicated a dependency of ATOA on socio-economic status (i.e., composite score of income, occupational prestige and education). In contrast, in our study education was not significantly associated with level or change of ATOA, although these two variables were correlated on a bivariate level. This finding is in line with the assumption that health inequalities between different socio-economic status groups might account for differences regarding the experience of one's own aging (Barrett, 2003).

An unexpected finding of this study is the association between depression and change trajectories of ATOA in the middle-aged group. We found that middle-aged individuals who had more depressive symptoms at the starting point of this study showed more favorable change trajectories of ATOA (despite their lower intercept at T1). Several explanations are possible for this finding. First, an explanation for this result might be regression to the mean; because of their low baseline level in ATOA, individuals with a higher level of depressive symptoms may have had more possibilities to improve in

ATOA over time, particularly if "real life" only partially confirms negative age expectations hold earlier. It may also be the case that the negative effect of depressive symptoms on the level of ATOA represents developmental processes which unfolded prior to our observation period: Depressive symptoms that were present at or prior to the study baseline observation may have induced more negative ATOA at the study onset. Eventually, those who entered the study in a more depressed mood recovered from the depressive episode across the study period (Keller & Boland, 1998), which may have promoted a reactive increase of ATOA as well. Also, selective study drop-out of those who did not recover (or even worsen) may have further "pushed" the positive effect of depressive symptoms on the ATOA slope. Finally, this result might be interpreted in the framework of discounting (Cheng, Fung, & Chan, 2009). Participants with a higher level of depressive symptoms at the start of the study might have had a more pessimistic outlook with regards to their own aging. Subsequently, they may have experienced their own aging more positively than expected and therefore their ATOA did not decline as much.

Limitations and Future Research

First, although we focused on measurement equivalence issues related to ATOA, which has rarely been done in the subjective aging literature, such testing needs further extension. In particular, measurement equivalence of the ATOA subscale also needs to be examined in samples that include participants in the latest years of life.

Second, our selection of predictor variables was limited in the current study. For example, we did not include control beliefs and cognitive abilities or complaints as potential variables exerting an influence on ATOA. There is some evidence for the dependency of ATOA on such psychological factors (Kleinspehn-Ammerlahn et al., 2008; Sargent-Cox et al., 2012a) and future studies should analyze dynamics between ATOA and control beliefs and cognitive measures over the life span.

A third limitation of this study is that time-dependent dynamics between ATOA and its predictor variables, such as a coupling of change processes, were not examined. We used time-invariant predictors measured at the beginning of the study period only, as the primary aims of this study focused on issues of measurement invariance and a comparison of potential predictors of ATOA across the two age groups. Thus, the examination of time-varying predictors would have exceeded the scope of this study. Future studies should therefore extend research on change trajectories in midlife to analyze, for exam-

ple, associations between health status changes and the development of ATOA. Particularly in the group of young-old adults, deteriorating health instead of health status at the outset of the study might be responsible for the observed average downturn of ATOA.

Given the evidence in support of substantial measurement non-invariance across the two age groups (i.e. differential item functioning of the ATOA items for participants of the middle-aged and young-old age group), future studies should be conducted with an awareness of potentially different meanings of the ATOA scale across age groups. Nevertheless, this study's results indicated differences between levels, trajectories, and predictors of ATOA in midlife and early old age. The greater variation of ATOA as well as the broader range of influencing factors in midlife as compared to early old age provides first evidence for a greater plasticity of ATOA in mid-adulthood. Including primarily middle-aged adults in intervention studies targeting ATOA in order to affect associated developmental outcomes of subjective aging might thus be a promising next step for future research. Furthermore, more research on the implications of the development of ATOA in midlife for physical functioning and wellbeing in later life seems necessary.

To summarize, while the majority of studies using the ATOA scale focused on samples of older adults, our results include information on ATOA and its trajectories in midlife. Interestingly, in contrast to the young-old age group trajectories of the middle-aged individuals showed substantial interindividual differences. Furthermore, our results indicated a greater sensitivity of ATOA to the influence of other factors (personality, health, socio-demographic variables) in midlife and may illustrate a greater modifiability of aging attitudes in middle-aged as compared to young-old individuals. Taking a more general perspective, these results could underline the importance of the middle-aged years in shaping developmental trajectories and influencing developmental outcomes with regard to successful aging.

4

Exploring the Causal Interplay of Subjective Age and Health Dimensions in the Second Half of Life: A Cross-Lagged Panel Analysis

Svenja M. Spuling[1], Martina Miche[2], Susanne Wurm[1,3], and Hans-Werner Wahl[2]

[1]German Centre of Gerontology, Berlin, Germany
[2]Institute of Psychology, Heidelberg University, Germany
[3]Institute of Psychogerontology, University of Erlangen-Nuremberg, Germany

Abstract

Numerous studies have emphasized a stable relationship between subjective age and health. However, few longitudinal studies exist and these have normally tested only one causal pathway. The present study investigated the direction of effects between subjective age and different health dimensions in 3,038 participants of the German Ageing Survey, aged 40 years and older. Cross-sectionally, subjective age correlated with all health dimensions studied. Longitudinally, subjective age predicted physical, mental, and self-rated health, whereas the reverse effect was found only for self-rated health. Subjective age thus seems to be an important resource for preserving health in the second half of life.

Key words: Causal Interplay, Health Dimensions, Longitudinal, Subjective Age

Introduction

As part of the normal aging process, physical health and functioning become increasingly fragile. At the same time, health restrictions are an integral part of stereotyped views of the aging process. Given that these normative expectations of adult development serve as a reference for self-assessment (Heckhausen & Krueger, 1993), a person's health status is closely linked to subjective aging experiences across the adult life span.

Throughout recent decades, a variety of different theoretical and empirical approaches toward subjective aging experiences have emerged, which can be subsumed under the overarching framework of the emerging construct Awareness of Age-Related Change (AARC; Diehl & Wahl, 2010). A fruitful field of research on subjective age, for example, has evolved from the groundbreaking work of Kastenbaum, Derbin, Sabatini, and Artt (1972). Subjective age, the age a person feels irrespective of his or her chronological age, derives from a complex process of self-evaluation incorporating various age markers such as physical, normative, or historic events (Montepare, 2009). Other approaches focus on aging-related cognitions, such as the Attitudes Toward One's Own Aging subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975), the Personal Experience of Aging Questionnaire (Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001), or age stereotypes and their eventual relevance for the aging individual as aging selfstereotypes (Levy, 2009). An important common feature of these approaches and an empirically robust finding is their association with different health dimensions.

This paper focuses on subjective age as an indicator of AARC and its dynamic interplay with health. Of the constructs mentioned above, subjective age has been chosen because it represents the most global evaluation of a person's own situation in relation to age, taking various age-related changes, such as social roles or physical functioning, into account. In comparison with the other more attitudinal constructs, subjective age may derive from a less conscious process because people internalize age-related evaluations early in life (Levy, 2009).

Causal Pathways between Subjective Aging Experiences and Health

Despite the established link between subjective aging experiences and health, the direction of effects causing this linkage has remained equivocal. Conceptual arguments as well as existing empirical evidence so far support all three possibilities: that is, (1) health

as an antecedent of subjective aging experiences, (2) subjective aging experiences as an antecedent of health, and (3) an equally strong bidirectional relationship.

(1) Health as an Antecedent of Subjective Aging Experiences

Considerations that establish health as a predictor of subjective aging experiences assume that individuals are guided (among other things) by their health status when self-evaluating their age (Hubley & Russell, 2009). Health is one important category of domain-specific age stereotypes (Hummert, 2011; Kornadt & Rothermund, 2011), and most people regard health declines and physical symptoms as a normal part of aging (Furstenberg, 2002; Leventhal & Prohaska, 1986). Thus, older persons might compare their health with culturally shared models of age-related change in order to evaluate their age. Consistent with this assumption is the finding that health declines precede shifts from a younger to an older subjective age (e. g., Montepare, 2009). It is important to note that health factors gain salience already in midlife (Giles, McIlrath, Mulac, & McCann, 2010). Furthermore, Schafer and Shippee (2010b) argue that health problems might expose individuals to stress, which wears down psychological resources and thus impedes the maintenance of a youthful subjective age.

(2) Subjective Aging Experiences as an Antecedent of Health

Another line of reasoning holds that subjective aging experiences affect future health outcomes. Stereotype embodiment theory (Levy, 2009), for example, assumes that aging stereotypes are being internalized at young ages and directed toward the self in old age. These age-related cognitions affect developmental outcomes such as health and physical functioning, through three different pathways. The psychological pathway assumes that age-related cognitions generate expectations that serve as self-fulfilling prophecies (Levy & Leifheit-Limson, 2009). Positive age-related cognitions can thus be seen as a psychological resource, which supports preservation of life satisfaction and positive self-rated health (Wurm, Tomasik, &Tesch-Römer, 2008). The behavioral pathway suggests that negative age-related cognitions imply an inevitability of health problems as one grows older and thus undermine people's beliefs in the effectiveness of healthy practices (Levy & Myers, 2004), whereas positive age-related cognitions might motivate a person to engage in preventive health behavior even in old age (Levy & Myers, 2004; Wurm, Tomasik, & Tesch-Römer, 2010). Furthermore, positive age-related cognitions might bolster self-efficacy beliefs and perceptions of control (Levy, Hausdorff, Hencke, & Wei, 2000), which are important psychological resources for taking and keeping up adaptive health

behavior (Lachman, 2006). Through the physiological pathway, age-related cognitions might affect the central nervous system resulting in heightened cardiovascular responses to stress (Levy, 2009). Empirical support for stereotype embodiment theory comes from experimental research, where priming individuals with negative age stereotypes lowered their cognitive and physical performance (Levy & Leifheit-Limson, 2009), and from longitudinal studies, which found better survival for individuals with younger subjective ages (Uotinen, Rantanen, & Suutama, 2005) and more positive age-related cognitions (Levy, Slade, Kunkel, & Kasl, 2002).

(3) Subjective Aging Experiences and Health as Interdependent Constructs

Finally, as discussed in most studies which find cross-sectional associations between subjective aging experiences and health (e. g., Barrett, 2003; Demakakos, Gjonca, & Nazroo, 2007; Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010), the causal relationship could also be bidirectional. Such a reciprocal relationship implies both positive feedback loops as well as a vicious cycle, meaning that positive (or negative) subjective aging experiences may affect health which, in turn, may enhance (or deteriorate) subjective aging experiences.

Empirically, a persisting problem for sharpening our understanding of the causal pathways linking health to subjective aging experiences is the limited amount of longitudinal data and the preferred data-analytic strategy. In particular, normally only one specific causal pathway is tested in the existing longitudinal studies, meaning that the simultaneous testing of different causal pathways has remained the rare exception. To our knowledge, there are only two studies that allow for such simultaneous testing: Both studies found a clearly greater effect of subjective aging experiences on physical conditions (Wurm, Tesch-Römer, & Tomasik, 2007) and on change in functional health (Sargent-Cox, Anstey, & Luszcz, 2012b) as compared with the reverse direction of causality. The aim of this paper was to extend this evidence based on the simultaneous examination of possible causal pathways regarding subjective age and health, by employing cross-lagged panel models. In addition, previous studies testing causal pathways have focused on age-related cognitions but ignored other empirical approaches toward subjective aging experiences.

The Role of Chronological Age in the Interplay of Subjective Aging Experiences and Health

Despite age-group differences found in cross-sectional studies (Hubley & Russell, 2009; Wahl, Konieczny, & Diehl, 2013), cross-lagged panel studies include a broad range of individuals aged 40 and older, however, without conducting age-group comparisons. Thus, it remains unclear if effects in the causal interplay of subjective aging experiences and health vary by age. There are theoretical grounds to expect such age-differential effects. On the one hand, building on the notion of an internalized social clock (Neugarten, 1972), there is the view that health constraints, if incurring in midlife, represent an off-time event and could thus have greater effects on subjective aging experiences at earlier points in the adult life span. On the other hand, health becomes an increasingly relevant domain for self-evaluation throughout the late adult years (Furstenberg, 2002), suggesting greater effects of health on subjective aging experiences in the later years of the adult life span. Exploring such age differences in the interplay of subjective aging experiences and health is another focus of this paper. Going further, we aim to enrich the previous literature with a more differentiated – that is, multidimensional consideration of health.

The Need for a Multidimensional Consideration of Health in the Context of Subjective Aging Experiences

In some earlier studies, health has been equated with the absence of physical illnesses. Several researchers, however, have pointed to the issue that multiple dimensions need to be considered to evaluate a person's health status. These dimensions are physical health (e. g., different physical conditions), functional health (in terms of activity-of-daily-living impairments and disabilities), self-rated health (meaning the subjective evaluation of one's health status), and mental health (e. g., depressive symptoms). All four dimensions reflect different aspects of health, and it is important to distinguish between them to fully capture the phenomenon. While physical health and functional health emphasize somatic dimensions of health, self-rated health and depressive symptoms emphasize psychological dimensions. Differentiating these dimensions among older adults is even more important, because they reveal different trends over time: Although functional limitations and physical conditions increase in old age, there is no increase in depression (Menning & Hoffmann, 2009; Saß, Wurm, & Ziese, 2009), and most individuals still rate their health to be good (Jylhä, Guralnik, Balfour, & Fired, 2001). With re-

gard to subjective aging experiences, Hubley and Russell (2009) showed that health dimensions relate differently to subjective age and that health predictors differed somewhat for young-old and old-old groups. Considering these findings, it is important to distinguish different health dimensions when analyzing the interplay of subjective age and health.

Research Aims and Hypotheses

Building on previous research that has pointed to differential associations between subjective age and different health dimensions, we tested cross-sectional relationships between subjective age and four different health dimensions (physical conditions, functional health, self-rated health, and mental health) for significant differences. In line with the findings of Hubley and Russell (2009), we expected that, cross-sectionally, self-rated health and functional health would display stronger associations with subjective age than mental health, particularly in the old aged. The primary goal of this article, however, was to disentangle the causal direction of effects between subjective age and different health dimensions. There is theoretical ground for both directions. In light of the existing studies that have examined the causal interplay between age-related cognitions and health, which found stronger effects of age-related cognitions on health than for the reverse direction, we expected similar findings for the relation between subjective age and health. In addition, based on theoretical considerations suggesting differential associations across age groups, we explored the relationship between subjective age and health in middle-aged and old-aged individuals.

Methods

Sample

The German Aging Survey (DEAS) is an ongoing cohort-sequential nationwide representative survey investigating the living situation of community-dwelling older adults in the second half of life (40 years and older). Every 6 years a new baseline sample systematically stratified by age, sex and place of residence is drawn. Participants attend a computer-assisted personal interview and fill out an additional self-administered questionnaire.

The present study is based on 3,038 participants of the baseline sample of 2002 (T_1) born between 1917 and 1962 (M_{age} at $T_1 = 61.3$, $SD = 12.52$; 49.7% female; 32.8% living in Eastern Germany; 14.4% low educational level). From this sample, 58.3% were

reassessed in 2008 (T$_2$) (Engstler & Motel-Klingebiel, 2010). The follow-up participants were on average younger and better educated, reported better self-rated and functional health as well as fewer physical conditions and depressive symptoms compared with the baseline sample. However, dropout analysis as conducted by Lindenberger, Singer, and Baltes (2002) revealed that all selectivity effects were below 0.5 SD and thus small. To examine age differences, we split the sample into middle-aged (40-64 years; M_{age} at T$_1$ = 52.2, SD = 7.55; 50.1% female; 33% living in Eastern Germany; 7.5% low educational level) and old-aged (65 years and older; M_{age} at T$_1$ = 73.7, SD = 5.19; 49.4% female; 32.4% living in Eastern Germany; 23.8% low educational level). This cutoff at age 65 reflects the common legal transition age to retirement in Germany.

Measures

Subjective Age

Participants were asked, "Forget your actual age for a moment: How old do you feel, if you had to express it in years?" Subjective age was calculated as the difference between the answer to this item and chronological age, with negative (positive) values indicating a younger (older) subjective age compared with chronological age.

Health Dimensions

A checklist of 11 different health problems (e. g., cardiac and circulatory diseases, joint, bone spinal or back problems, and stomach and intestinal problems) was used as an indicator for physical health status. For each person, a sum score was computed, with higher values indicating more self-reported physical conditions and worse physical health respectively.

Functional health, in terms of functional limitations, was assessed by the Physical Functioning subscale of the SF-36 questionnaire (Bullinger & Kirchberger, 1998). Ten items covering impairments in everyday activities (e. g., walking, climbing stairs, lifting or carrying groceries) were rated on a 3-point scale (1 = "yes, limited a lot"; 2 = "yes, limited a little"; 3 = "no, not limited at all"). The scale was transformed to a range of 0-100, with higher values indicating less impairment and better functional health respectively.

We measured self-rated health by a single item, asking, "How would you rate your present state of health?" The answer scale ranged from 1 (very good) to 5 (very bad). This item was recoded, so that higher values indicate better self-rated health.

Depressive symptoms were used as an indicator for mental health and measured with the German 15-item version of the Center for Epidemiological Studies Depression Scale (CES-D scale; Hautzinger, 1988). Participants were asked to indicate the frequency with which they had experienced several depressive symptoms (e. g., feeling sad, feeling fearful, and having sleep problems) during the past week, on a 4-point scale (1 = "rarely or none of the time [less than 1 day]" to 4 = "most or all of the time [6 to 7 days]"). A sum score was computed and transformed to a range of 0-45. Higher values indicate more frequent depressive symptoms and consequently worse mental health.

Data Analysis

Mplus (Muthén & Muthén, 1998 – 2010) was applied for statistical analyses except for t-tests of age-group differences, which were analyzed using PASW Statistics (v. 18). The full information maximum likelihood (FIML) procedure was employed to make use of all data available and to avoid potential attrition effects. Correlations of subjective age and health dimensions were compared for significant differences in the total sample following the procedure proposed by Meng, Rosenthal, and Rubin (1992). To compare correlations between the middle- and old-aged participants, Fisher Z transformations were performed. Cross-lagged panel designs (Figure 4.1) were employed to examine the direction of causality between subjective age and the different health dimensions, with separate models for each health dimension. Subjective age and health dimensions at baseline (2002) and at follow-up (2008) were T-standardized ($M = 50$, $SD = 10$) using the mean and standard deviation at baseline to obtain a common metric across these variables.

First, every model was applied to the total sample. In a second step, the sample was divided into middle-aged (40–64 years at T_1) and old-aged (65 years and older at T_1) participants, and cross-lagged panel analyses were repeated to detect possible age-group differences regarding the direction of causality and the size of the effects. Alpha level was set at .05. As the baseline DEAS sample is disproportionally stratified according to age, sex, and region, all models were additionally estimated with these covariates. Furthermore, we used education as a three-category control variable (according to the International Standard Classification of Education, ISCED; UNESCO, 1997), because of its strong relationship with health (e. g., Lynch, 2003). The inclusion of the sample stratification factors as covariates in the models nullifies the need for sample weights (Winship & Radbill, 1994).
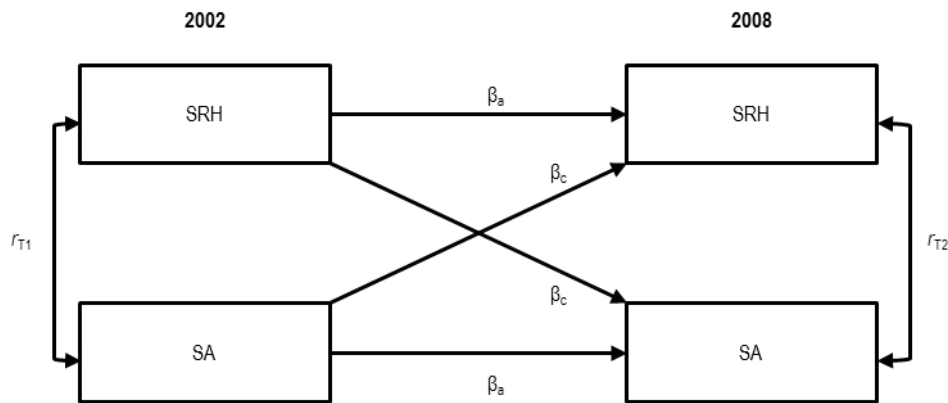
Figure 4.1. Illustration of the cross-lagged panel design to examine the causal relationship between subjective age (SA) and self-rated health (SRH). b_a = standardized autoregressive path coefficients; b_c = standardized cross-lagged path coefficients; r_{T1}, r_{T2} = correlations at baseline in 2002 (T_1) and reassessment in 2008 (T_2), respectively.

Results

Descriptive Results

Table 4.1. Subjective Age and Studied Health Dimensions at Baseline in 2002 (T_1) and Follow-Up in 2008 (T_2) in Total Sample and in Age Groups Studied

Variable	Total sample ($N = 3,038$)		Middle-aged ($n = 1,756$)		Old-aged ($n = 1,282$)	
	T_1	T_2	T_1	T_2	T_1	T_2
Subjective age	-7.03 (7.85)	-7.83 (7.59)	-6.58 (6.94)	-7.18 (7.25)	-7.62 (8.94)	-8.83 (8.13)
Physical conditions	2.30 (1.89)	2.64 (2.01)	1.76 (1.65)	1.93 (1.62)	3.04 (1.96)	3.64 (2.16)
Functional health	82.47 (24.6)	78.25 (26.2)	90.51 (17.6)	87.13 (20.1)	71.46 (28.3)	64.10 (30.5)
Self-rated health	3.49 (0.88)	3.38 (0.89)	3.68 (0.81)	3.55 (0.85)	3.23 (0.90)	3.11 (0.87)
Depressive symptoms	7.52 (6.56)	6.61 (5.75)	6.97 (6.39)	5.99 (5.56)	8.26 (6.74)	7.86 (6.03)

Notes. Values are means (standard deviations). All reported parameters have been adjusted using the full information maximum likelihood (FIML) procedure.

Means and standard deviations of subjective age and the four health dimensions are displayed in Table 4.1 for the total sample and the two age groups separately. At T_1, both age groups felt on average younger than their chronological age and, while individuals in both age groups rated their subjective health to be better than the scale midpoint, the old-aged reported on average more physical conditions, worse functional health, and more frequent depressive symptoms than the middle-aged participants did. These differences were significant: physical health, $t(2235.987) = -18.057$, $p < .05$; functional health, $t(1980.915) = 21.671$, $p < .05$; and depressive symptoms, $t(2518.615) = -4.896$, $p < .05$.

Cross-Sectional Results

Table 4.2 presents cross-sectional correlation coefficients between subjective age and the studied health dimensions at T_1. A more youthful subjective age is accompanied by better self-rated health, fewer physical conditions, better functional health as well as less frequent depressive symptoms, both in the total sample and in the two age groups.

Correlations with subjective age were strongest for self-rated health and depressive symptoms, with no significant difference between these two health dimensions. Correlations of subjective age with self-rated health, physical conditions as well as with functional health were stronger in old- than in middle-aged participants. However, there was no significant age-group difference for the relationship between subjective age and depressive symptoms.

Table 4.2. Bivariate Correlations Between Subjective Age and Health Dimensions for the Total Sample ($N = 3,038$) and the Age Groups Studied (Middle-Aged, $n = 1,756$; Old-Aged, $n = 1,282$) at Baseline in 2002 (T_1)

	Age Group	01	02	03	04
01 Subjective age	total	-			
	middle	-			
	old	-			
02 Physical conditions	total	.10	-		
	middle	.07	-		
	old	.19	-		
03 Functional health	total	-.16	-.47	-	
	middle	-.13	-.37	-	
	old	-.25	-.42	-	
04 Self-rated health	total	-.25	-.45	.61	-
	middle	-.24	-.38	.54	-
	old	-.31	-.41	.62	-
05 Depressive symptoms	total	.24	.27	-.40	-.49
	middle	.24	.24	-.33	-.45
	old	.25	.27	-.46	-.52

Notes. All coefficients are adjusted using full information maximum likelihood procedure (FIML) and significant at $p < .05$. Physical conditions and depressive symptoms: Lower values indicate a better health status. Functional health and self-rated health: Higher values indicate a better health status. total = total sample, middle = middle-aged (40-64 years at T_1), old = old-aged (65 years and over at T_1)

Causal Pathways

Standardized regression coefficients of cross-lagged panel models are shown in Table 4.3 separately for the total sample, the middle-aged and the old-aged.

Subjective Age and Physical Conditions

In the total sample, none of the cross-lagged path coefficients between subjective age and physical conditions was significant. However, age-group analyses revealed that subjective age was a significant predictor of physical conditions in the middle-aged but not in the old-aged, and physical conditions predicted subjective age in the old-aged but not in the middle-aged. Post hoc analyses were conducted to test these age-group differences. The cross-lagged paths were constrained to be equal across age groups, and model fit was compared with that of the unconstrained model via chi-square difference test. These post hoc analyses revealed no significant age-group difference regarding the cross-lagged path from subjective age to physical conditions ($\beta = .07$, $p < .05$; $\Delta\chi^2 = 2.893$, $\Delta df = 1$, $p > .05$); the coefficient reached significance in both age groups. There was also no significant age-group difference for the reverse relationship ($\beta = .05$, $p > .05$; $\Delta\chi^2 = 1.866$, $\Delta df = 1$, $p > .05$); in the constrained model, physical conditions did not predict subjective age in either age group.

Subjective Age and Functional Health

None of the cross-lagged path coefficients, either in the total sample or in any of the age groups, was significant. Neither did subjective age predict functional health nor was functional health a significant predictor for subjective age.

Subjective Age and Self-Rated Health

Self-rated health emerged as a significant predictor for subjective age in the total sample. However, post-hoc comparisons suggest that this predictive relationship is mutual ($\beta = -.08$, $p < .05$; $\Delta\chi^2 = 0.232$, $\Delta df = 1$, $p > .05$). Age-group analysis revealed that self-rated health predicted subjective age, and reversely, subjective age predicted self-rated health in the middle-aged but not in the old-aged. Post hoc analyses revealed that this age-group difference was not significant: Subjective age seems to be a predictor for self-rated health in both age groups ($\beta_{\text{middle-aged}} = -.09$, $\beta_{\text{old-aged}} = -.11$, $p < .05$; $\Delta\chi^2 = 0.213$, $\Delta df = 1$, $p > .05$), just as self-rated health seems to be a predictor for subjective age in the middle-aged and the old-aged ($\beta = -.10$, $p < .05$; $\Delta\chi^2 = 0.694$, $\Delta df = 1$, $p > .05$).

Subjective Age and Depressive Symptoms

In the total sample, depressive symptoms were a significant predictor for subjective age. This predictive relationship was mutual: Subjective age also predicted depressive

symptoms. Post hoc comparisons suggest that the coefficients of the cross-lagged paths do not differ ($\beta = .08$, $p < .05$; $\Delta\chi^2 = 0.001$, $\Delta df = 1$, $p > .05$). However, in age-group analysis, the path from depressive symptoms to subjective age was not significant. Only in the middle-aged did the path from subjective age to depressive symptoms remain significant. But this age-group difference did not hold in post hoc comparisons ($\beta_{middle\text{-}aged} = .10$, $\beta_{old\text{-}aged} = .12$, $p < .05$; $\Delta\chi^2 = 0.019$, $\Delta df = 1$, $p > .05$); subjective age thus seems to be predictive of depressive symptoms in both age groups.

Table 4.3. Results of Cross-Lagged Panel Analysis Examining the Interplay Between Subjective Age (SA) and Different Health Dimensions (HD) for the Total Sample ($N = 3,038$) and Stratified by Age Group (Middle-Aged, $n = 1,756$; Old-Aged, $n = 1,282$)

Health dimensions (HD)		Correlations r(SE) SA ↔ HD		Autoregressive paths β(SE)		Cross-lagged paths β(SE)	
		T_1	T_2	SA	HD	SA → HD	HD → SA
Physical conditions	Total	.10 (.02)	.16 (.04)	.45 (.03)	.61 (.03)	-.01 (.04)	.03 (.03)
	Middle	.07 (.03)	.18 (.04)	.45 (.03)	.52 (.03)	**.11 (.04)**	.02 (.02)
	Old	.18 (.03)	.17 (.06)	.38 (.06)	.58 (.04)	-.03 (.07) [b]	**.11 (.06)** [c]
Functional health	Total	-.16 (.02)	-.17 (.03)	.46 (.03)	.65 (.02)	.02 (.03)	-.00 (.04)
	Middle	-.13 (.03)	-.16 (.04)	.45 (.03)	.53 (.03)	-.06 (.04)	-.03 (.04)
	Old	-.25 (.03)	-.22 (.06)	.39 (.06)	.60 (.04)	.01 (.06)	-.02 (.07)
Self-rated health	Total	-.25 (.02)	-.25 (.03)	.44 (.03)	.52 (.03)	-.06 (.03) [a]	**-.09 (.03)**
	Middle	-.24 (.02)	-.28 (.04)	.43 (.04)	.48 (.03)	**-.10 (.04)**	**-.12 (.04)**
	Old	-.31 (.03)	-.21 (.06)	.38 (.06)	.51 (.07)	-.09 (.07) [b]	-.05 (.07) [b]
Depressive symptoms	Total	.24 (.02)	.15 (.03)	.44 (.03)	.37 (.03)	**.09 (.04)**	**.08 (.03)**
	Middle	.24 (.02)	.17 (.04)	.44 (.04)	.35 (.04)	**.09 (.04)**	.06 (.04)
	Old	.25 (.03)	.12 (.06)	.37 (.06)	.43 (.06)	.13 (.07) [b]	.11 (.07)

Notes. Correlations (r) and standardized regression coefficients (β) – both with standard errors (SE) in parentheses – arise from separate models for each health dimension for the total sample and for stratified analysis with two age groups (middle-aged: 40-64 years at T_1, 2002; old-aged: 65 years and over at T_1, 2002) respectively. All correlations and autoregressive paths are significant at $p < .05$. Significant cross-lagged paths at $p < .05$ are printed in bold.
SA = subjective age, HD = health dimension, total = total sample, middle = middle-aged, old = old-aged.
[a]Coefficient reached significance after cross-lagged paths were set equal within the total sample.
[b]Coefficient reached significance after cross-lagged paths were set equal between age groups.
[c]Coefficient was no longer significant after cross-lagged paths were set equal between age groups.

Control Variables

Results were robust when including region, sex, education, and age as controls. All final models (with cross-lagged paths set equal where tested and possible) were additionally estimated with these covariates included. Only within the physical conditions model differences did emerge: The cross-lagged path from physical conditions to subjective age in the total sample and both cross-lagged paths in the middle- and old-aged became significant.

Discussion

Our goal was to compare cross-sectional relationships between subjective age and different health dimensions in the second half of life and to disentangle the causal relationship between these variables. Cross-sectionally, a younger subjective age consistently correlates with fewer physical conditions, better functional and self-rated health, and less frequent depressive symptoms. The strongest associations were observed for self-rated health and depressive symptoms. As expected, associations between subjective age and health dimensions were stronger in old- compared with middle-aged individuals except for depressive symptoms. With regard to predictive relationships, our results in the final models (with cross-lagged paths set equal where possible) suggest that subjective age functions as an antecedent of physical conditions and mental health, whereas subjective health and subjective age seem to be interdependent constructs. Self-rated health, rather than physical conditions, thus seems to become incorporated into subjective age. No predictive relationship, however, emerged between subjective age and functional health. These results were consistent across age groups.

Interestingly, the two health dimensions that are conceptually closest to objective measures of health conditions were affected by subjective age: That is, the number of self-reported physical conditions, which correlates highly with diagnosed medical conditions (Katz, Chang, Sangha, Fossel, & Bates, 1996), as well as self-reported depressive symptoms on the CES-D scale, which is a good indicator of diagnosed depression (Radloff, 1977), was affected by subjective age. Corroborating previous studies that tested causal pathways (Sargent-Cox et al., 2012b; Wurm et al., 2007), our results demonstrate that positive subjective aging experiences have the potential to support – or at least prevent a decline in – health status across the entire middle and late adult life span. As mentioned before, the predictive effect for physical conditions can be explained through several mediating pathways. First, positive subjective aging experiences function as a psychological resource which supports positive development and preservation of life satisfaction even when faced with serious health events (Wurm et al., 2008). Second, whereas positive subjective aging experiences might motivate healthy practices, negative experiences might undermine beliefs in their effectiveness (Levy & Myers, 2004) and weaken self-efficacy and perceptions of control (Levy et al., 2000).

With regard to the causal interplay of subjective aging experiences and mental health, there have been only a few empirical studies (Chachamovich, Fleck, Laidlaw, & Power, 2008; Vahia et al., 2010) and even fewer efforts at theorizing. We can thus only specu-

late about the underlying causal mechanisms of the observed effects. It does not seem to be the case that a more negative view of life in general, as accompanied by depressive symptoms, extends to age-related cognitions (this direction of effect was significant in the total sample only, which may have been due to the larger sample size). In contrast, negative subjective aging experiences seem to be demoralizing for people's self-perceptions, to the point that they can represent a risk factor for depressive symptoms.

The reciprocal relationships between self-rated health and subjective age in this study might be due to an informative function that the two constructs serve for each other: Self-rating health involves aspects such as optimism, or general energetic feelings, which is conceptually close to subjective age, and reversely, when evaluating their subjective age, people might consider perceptions of their health as a reference point. This conceptual overlap is also reflected in the cross-sectional correlations where self-rated health was among the variables with the highest correlations ($r_{\text{total sample}} = -.25$). However, this overall small correlation also shows that subjective age and self-rated health measure two different constructs.

Unexpectedly, none of the cross-lagged paths between functional health and subjective age reached significance, suggesting that despite a strong cross-sectional relationship, these two variables are not predictive for each other. Possibly, the 6-year lag between measurement occasions in this study was too long to detect a relationship between these variables over time. The study by Sargent-Cox and colleagues (2012b) used 1-year intervals and found self-perceptions of aging to predict change in physical functioning. Thus, further research looking at the predictive relationship between subjective age and change in functional health over the observation period and not the status at T_1 would be necessary to substantiate our findings.

Our results suggest that there are no age-group differences in the predictive relationship between subjective age and different health dimensions. Consequently, there is justification neither for the social clock theory (Neugarten, 1972), which suggests that health constraints in midlife are experienced as off-time events and thus have decreasing influence on subjective age with increasing age, nor for Furstenberg's (2002) notion that health represents a more important domain of self-evaluation in later life and thus has increasing influence on subjective age with increasing age. Instead, it is important to note that beneficial effects of positive subjective aging experiences already exist in midlife, and these effects do not change toward the later years of adult life. Thus, subjective aging

experiences represent an important target of interventions across the entire second half of life.

Limitations and Future Research

There are of course some limitations to this study. First, only participants living in private households were eligible to participate at the time of their first interview. Consequently, participants were likely to have above average health and sufficient functional status, which might impede the generalization of our findings to adults living in institutions.

Second, our findings might rely on the use of self-reported health measures. Although different correlations of the health dimensions with subjective age point to the fact that different constructs are measured, and the validity of self-reported morbidity has been shown repeatedly (e. g., Katz et al., 1996), it is possible that self-reported health measures and subjective age are modified by similar evaluation processes (e. g., positive illusions, downward social comparisons). Objective health data would have strengthened the analyses and should be incorporated in future studies.

Third, we used subjective age as a measure of subjective aging experiences. A major shortcoming of subjective age in relation to measurement issues is its inability to capture the concurrent experience of both age-related gains and losses (Wahl et al., 2013). Furthermore, although a subjective age rating close to or greater than a person's chronological age may be interpreted as an indicator of an inreased (negative) Awareness of Age-Related Change, it is unclear which age-related experiences in particular are incorporated in individual subjective age ratings. Therefore, to gain a better understanding of the dynamic relationship of perceived age-related gains and losses in certain behavioral and life domains, it would be necessary to develop more fine-grained approaches to measuring subjective aging experiences.

Finally, the aim of this study was to look at direct effects between subjective age and different health dimensions. Causal mechanisms of this relationship were therefore not taken into consideration. Including such mediating mechanisms (e. g., preventive health behavior, perceived control) in future longitudinal studies would be the obvious next step to take to extend the present findings.

Conclusion

The present study was designed to disentangle the direction of effects between subjective age and different health dimensions. Our cross-lagged panel designs show that the relationships between subjective age and health dimensions are actually more complex than cross-sectional correlations suggest. Subjective age seems to have stronger implications for physical conditions than the other way around. On the other hand, subjective evaluations of one's age are of course not made without regard to one's health status. But rather than medical conditions, it is subjective perceptions of one's health status that are being incorporated into subjective age. In addition, our results show that this dynamic relation between subjective age and health holds across the second half of life. More longitudinal studies are needed in this research area to support and extend our findings – for example, by considering different mediator variables through which subjective age might influence health longitudinally.

5

Being Slower, Feeling Older?
Experimentally Induced Cognitive Aging Experiences
Have Limited Impact on Subjective Age

Martina Gabrian and Hans-Werner Wahl

Institute of Psychology, Heidelberg University, Germany

Abstract

Initial experimental research has shown that subjective age may change in response to induced aging experiences, but replication and extension is needed. The present study investigates if age-related cognitive gain- or loss-experiences evoke decreases/increases in subjective age. A multidimensional subjective age measure was used to explore domain-specific internalization effects. 78 individuals aged 59-70 years were randomly assigned to two experimental conditions and a control group. Participants took a cognitive attention test and received gain-oriented feedback on their accuracy or loss-oriented feedback on their processing speed. A mixed factors analysis of covariance was used to examine changes in feel age, look age, do age, and interest age. After being primed with age-related losses, participants reported older do ages as compared to before the experimental priming. Priming age-related gains had only a marginally significant effect on do age. All other subjective age dimensions remained unaffected by the experimental priming. Findings underscore the intricacy of a comprehensive and cross-domain improvement of subjective age.

Key words: Age stereotypes, Contamination Hypothesis, Labeling Hypothesis, Subjective Age

Introduction

Subjective age is a central component of the aging self (Diehl et al., 2014) and it is associated with a range of successful aging indicators, such as health, cognitive functioning, and subjective well-being (Barrett, 2003; Stephan, Caudroit, Jaconelli, & Terracciano, 2014; Teuscher, 2009; Westerhof, Barrett, & Steverink, 2003). Longitudinal evidence points to the predictive role of feeling younger than one's chronological age for psychosocial and physical functioning in later life (Westerhof et al., 2014). The strong empirical evidence for the developmental consequences of subjective age warrants a systematic examination of the plasticity and within-person variability of subjective age (Kotter-Grühn, Kornadt, & Stephan, 2015; Kotter-Grühn, Neupert, & Stephan, 2015). The present study aims to replicate and extend previous experimental findings on the plasticity of subjective age by comparing the effects of a gain- and loss-manipulation of aging experiences in the domain of cognitive functioning and testing if subjective age domains other than feel age can be changed through induced aging experiences.

Theoretical Foundations for the Experimental Manipulation of Subjective Age

A limited number of experimental studies have shown that the age a person feels can be changed when aging experiences are induced. Manipulation strategies that yielded an older subjective age include the experience of visual disfluency or generation gaps (Eibach, Mock, & Courtney, 2010) and taking or simply expecting to take a memory test (Hughes, Geraci, & De Forrest, 2013). To our knowledge, only one study succeeded in making participants feel younger, namely by providing positive social comparison feedback after a handgrip task (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). The observed effects can be explained with the contamination hypothesis (Rothermund, 2005; Rothermund & Brandtstädter, 2003), sometimes also referred to as labeling hypothesis (Kotter-Grühn & Hess, 2012). According to the contamination hypothesis, older adults assimilate their self-view to negative age stereotypes, particularly when becoming aware of belonging to the group of older adults. Consequently, negative age stereotypes may induce older subjective ages when being presented in an individualized way, that is, when participants are made to believe that negative age stereotypes are self-descriptive.

Another experimental approach to change subjective age has been to confront older adults with generalized views of older people. Findings of these studies are somewhat mixed. Whereas in one study the presentation of negative age stereotypes (conveyed

through an aging quiz) resulted in younger subjective ages relative to the conditions with positive or neutral age stereotypes (Weiss & Lang, 2012), the findings of another study point into the opposite direction; that is, the priming with negative age stereotypes as portrayed in photographs and text of older women resulted in older subjective ages (Kotter-Grühn & Hess, 2012). Contrary to the expectations of the authors, participants in this study also had older subjective ages after being primed with positive age stereo-types.

The emerging picture is that it seems to be easier to make individuals feel older, rather than inducing younger subjective ages (Kotter-Grühn, 2015; Kotter-Grühn, Kornadt et al., 2015). The most promising strategy to induce younger subjective ages seems to be the presentation of positive performance feedback (Kotter-Grühn, Kornadt et al., 2015). The manipulation strategy in our study therefore involves the priming of positive or negative aging experiences through performance feedback in the domain of cognitive functioning. In addition, we argue that the consideration of subjective age as multidimensional construct is needed to advance our knowledge about the plasticity of subjective age.

Multidimensionality of the Subjective Age Construct

In the early seventies, Kastenbaum and colleagues (Kastenbaum, Derbin, Sabatini, & Artt, 1972) introduced personal age as a multidimensional construct, suggesting the four dimensions feel age, look age, do age, and interest age. These multiple aspects of subjective age reflected in the four item scale have not been mirrored by subjective aging research over the past decades. In particular most experimental studies aiming to manipulate subjective age have used feel age as the primary indicator of a person's subjective aging perception (Eibach et al., 2010; Hughes et al., 2013; Stephan et al., 2013) and, to our knowledge, only one study discriminated between different subjective age domains (i.e., feel age, look age, and desired age, but not do age and interest age; Kotter-Grühn & Hess, 2012). However, asking participants how old they feel is only a limited portrayal of subjective perceptions of aging. Like other authors have done before (Kotter-Grühn, Kornadt et al., 2015), we claim that more research on subjective age domains other than feel age is needed to better understand the distinctions between subjective age domains and to test how the effects of experimental manipulations may differ for different facets of subjective age. Studies on the plasticity of a wider range of subjective aging indicators are especially needed in order to inform intervention research that aims at a long-term

and comprehensive improvement of subjective aging. This goal, however, may be difficult to achieve without further evidence about the modifiability of different facets of subjective aging. For example, a physical activity intervention conducted by Wolff and colleagues (2014) changed only one facet of general attitudes toward older adults. In particular, the 'views-on-ageing'-component included in one of the intervention groups yielded positive effects on the integrity subscale, which reflects how older adults are perceived in terms of satisfaction and confidence. Further justification for the need of using multiple subjective age dimensions comes from correlational research, which has shown that different dimensions of subjective age are uniquely linked to different identity constructs, such as body esteem (Montepare, 1996b). Therefore, we strive to examine the susceptibility of subjective age by considering a more fine-grained subjective age differentiation. To this end, the decision was made to include all four subjective age dimensions proposed by Kastenbaum (1972).

Based on the finding that age stereotypes seem to have greater effects on behavior and functioning if the outcome domain corresponds to the stereotype content (Levy & Leifheit-Limson, 2009), we argue that a similar stereotype-matching effect might play a role in internalization processes. This argument is further supported by cross-sectional research. Kornadt and Rothermund (2012) found domain specificity of the internalization of age stereotypes into current self-views. Consequently, we expected domain-specific priming effects of cognitive aging experiences. That is, we expected effects on subjective age domains that relate to cognitive performance, namely 'do age' and 'interest age'. Although 'do age' and 'interest age' do not exclusively pertain to the cognitive domain, these items cover aspects of subjective aging that are related to cognitive functions, such as the ability to perform well on cognitive tests as well as intellectual interests.

Potential of Cognitive Aging Experiences for the Manipulation of Subjective Age

Also of importance for our study, only little experimental research has been conducted in the field of cognitive functioning (Hughes et al., 2013), although cognitive functioning is associated with subjective age (Stephan et al., 2014) and highly important for individuals self-views (Dark-Freudeman, West, & Viverito, 2006; Kessler, Bowen, Baer, Froelich, & Wahl, 2012; Lawton et al., 1999). Moreover, cognitive aging is characterized by the coexistence of gains and losses. For example, on speed/accuracy trade-off tasks older adults perform slower but also more accurately (Brebion, Smith, & Ehrlich, 1997); char-

acteristics that are reflected in common sense models of gains and losses in adult development (Heckhausen, Dixon, & Baltes, 1989). Manipulating age attributions in the cognitive domain thus provided the opportunity to construct two comparable experimental conditions that prime widely accepted age-related gains (accuracy) or losses (speed)—a crucial requirement to compare the effects of negative and positive age-related changes.

Evidence from a meta-analysis suggests that negative age-stereotypes have a three-times larger effect on behavioral outcomes (e.g., memory) as compared to positive age-stereotypes (Meisner, 2012). This evidence related to negative age-stereotypes suggests that providing adults with information that reinforces their negative expectations with regard to aging should result in stronger effects on subjective age as compared to information that reinforces positive aging experiences. However, given that previous experimental research has mostly used loss-oriented manipulation strategies and compared effects to a control group, it is yet unclear whether the relatively stronger influence of negative compared to positive aging experiences also pertains to the manipulation of subjective age.

Research Aims

As an extension of previous experimental research, the goal of the present study was threefold. First, we employed a more fine-grained, multidimensional subjective age measure in order to test for differential and domain-specific effects. Second, in contrast to previous studies, which mostly primed age-related physical changes, our manipulation strategy was anchored in the domain of cognitive functioning. Third, instead of using only a negative (respectively positive) prime, we developed two parallel conditions inducing either age-related gains or losses which allowed for a comparison of effects. Based on the contamination hypothesis, we expected that induced aging experiences would be internalized into age-related self-views. That is, age-related losses should translate into older subjective ages and age-related gains were expected to result in younger subjective ages. This effect was expected to be stronger for induced age-related losses than for gains (Meisner, 2012). Due to a lack of multidimensional subjective age measures in previous studies, our aim was to explore if previously observed effects on feel age would extend to other subjective age domains. Overall, we expected effects to be most pronounced for 'do age' and 'interest age', given that these subjective age items are most closely related to the domain of cognitive functioning.

Method

Participants

Participants were recruited from various sources, such as a University database and senior education institutions. Upon commencement of the study, participants were told that the aim of the research project was to investigate personal goals and cognitive fitness in middle and old age. 78 participants (59.0% women) aged 59-70 years ($M = 64.6$ years, $SD = 3.1$ years) were randomly assigned to the three experimental groups (age-related gains, age-related losses, and control) with $n = 26$ in each group. Given this sample size, the power to detect an effect comparable to other studies (cf., Stephan et al., 2013, obtained an effect size of $f = .37$) in a mixed factors analysis of variance was $1\text{-}\beta = .99$.

Participants had above average monthly household incomes ($M = 3,089$ €; $SD = 1,683$ €) and above average education (64.1% with a university or university of applied science degree). Self-ratings of health were 'good' on average ($M = 3.8$; $SD = 0.7$) on a scale from 1 (*very poor*) to 5 (*very good*).

Experimental Manipulation

Participants completed an adapted version of the d2 Test of Attention (Brickenkamp & Zillmer, 1998). The d2 Test is a visual cancellation test consisting of the letters d and p with one to four dashes arranged individually or in pairs of two above and/or below each letter. Participants are asked to cross out each d that is accompanied by two dashes as quickly and accurately as possible. As one of the experimental conditions relied on feedback about the amount of time taken for the test, we slightly adapted the test format and measured the total time taken to answer a set of 180 characters instead of stopping participants each 20 seconds.

In the *gains condition* feedback was given on participants' accuracy. They were presented a bar graph depicting the actual percentage of correct answers along with fictional mean scores for three age decades below that of the participant's age. The graphs were standardized so that the mean accuracy score for each age decade departed by 10% from the next oldest age decade yielding a picture of steady increase in accuracy with age. The feedback was presented along with a statement on the participant's performance: "In this kind of tasks accuracy increases with age. This was also true for you. As you can see in the graph, your percentage of correct answers was higher than the

average of younger age groups." Here the intention was to prime age-related gain experiences and to induce a younger subjective age. Participants in the *losses condition* received feedback on the time taken for the test. A bar graph with processing time increasing over the three age decades was presented to convey age-related losses in processing speed, along with the verbal feedback: "The amount of time taken for such tasks increases with age. This was also true for you. As you can see in the graph, you performed slower than the average of younger age groups". No feedback was given in the *control group*.

Measures

Subjective Age Domains

Subjective age was measured in four domains: *feel age* ("Most of the time I feel as if I am … years old."), *look age* ("Most of the time I look as if I am … years old."), *do age* ("Most of the time my activities are most like those of a … year-old."), and *interest age* ("Most of the time my interests are comparable to those of a … year-old.") (Kastenbaum et al., 1972). The order of the subjective age items was kept consistent across measurement occasions and across participants. A proportional discrepancy score (Rubin & Berntsen, 2006) was calculated for each facet of subjective age. A negative proportional discrepancy score represents the percentage of years that a person feels younger compared to his or her chronological age. A positive proportional discrepancy score indicates a relatively older subjective age. Subjective age domains were assessed before and after the experimental manipulation. In order to keep subjective age ratings free from situational influences at pre-test, we used a slightly different wording at the two measurement occasions (most of the time vs. at the moment). A similar procedure has been successfully used in another experimental study, which also employed a within-person approach (Stephan et al., 2013).

Covariates

Functional health (Bullinger & Kirchberger, 1998), time taken for the d2 Test, and number of errors made were entered as control variables in all analyses.

Procedure

Participants were mailed a questionnaire including demographic variables, our set of covariates, as well as a pre-test measure of subjective age, which they completed on average 2.9 days before their individual lab appointment. During the interview, partici-

pants took the d2 Test, received the respective feedback, and were asked to evaluate their test performance. Afterwards, subjective age domains and some additional questionnaires not relevant to this study as well as a second speed/accuracy trade-off task were administered. Finally, participants were asked for the presumed goal of the study, debriefed, and received a compensation of €10 (≈ $14).

Results

Preliminary Analyses

Means and standard deviations for the key constructs of this study are presented in Table 5.1. The three experimental groups did not differ with regard to age, income, education, marital status, functional health, number of physical conditions, self-rated health, life satisfaction, self-esteem, time taken for the d2 Test, number of errors made, and subjective ages before the experimental manipulation (all p's > .05).

Table 5.1. Descriptive Statistics of Key Constructs

| | Experimental Condition | | |
	Age-Related Losses *M (SD)* or %	Age-Related Gains *M (SD)* or %	Control Group *M (SD)* or %
Age (years)	64.0 (3.0)	65.1 (2.7)	64.7 (3.5)
Gender (% female)	57.7	57.7	61.5
d2 Test:			
Time taken (in seconds)	152 (60)	146 (33)	144 (41)
Number of Errors	2.5 (1.9)	4.1 (5.0)	4.0 (3.8)
Feel Age T1	-13.7 (12.5)	-15.8 (12.0)	-11.2 (8.8)
Feel Age T2	-11.6 (10.2)	-10.9 (8.7)	-9.1 (9.0)
Look Age T1	-8.4 (7.7)	-6.7 (7.8)	-5.9 (6.2)
Look Age T2	-7.3 (6.3)	-5.4 (7.2)	-6.2 (5.8)
Do Age T1	-13.4 (11.8)	-11.9 (11.4)	-14.6 (11.4)
Do Age T2	-9.2 (9.8)	-14.6 (13.1)	-13.2 (9.4)
Interest Age T1	-18.3 (13.4)	-18.4 (10.0)	-17.4 (12.0)
Interest Age T2	-14.9 (12.5)	-16.4 (10.8)	-15.9 (12.4)

Table 5.2 depicts the bivariate correlations among the four subjective age domains before and after the experimental manipulations. Correlations among subjective age domains were somewhat higher after as compared to before the experimental manipulation. Overall, however, the largest correlations were found for the repeated measures of each subjective age item (r = .58 - .80).

Table 5.2. Bivariate Correlations Among Subjective Age Domains

	02	03	04	05	06	07	08
01 Feel Age T1	.46***	.50***	.51***	.62***	.42***	.56***	.46***
02 Look Age T1		.24*	.35**	.55***	.80***	.27*	.36**
03 Do Age T1			.55***	.44***	.30**	.58***	.54***
04 Interest Age T1				.49***	.25*	.52***	.68***
05 Feel Age T2					.59***	.57***	.60***
06 Look Age T2						.32**	.37**
07 Do Age T2							.56***
08 Interest Age T2							

Notes. *p<.05, **p<.01, ***p<.001.

Manipulation Check

Participants were asked to compare their performance on the d2 Test to that of younger, same-aged, and older individuals on a 5-point scale (1 = *much worse*, 5 = much better). Differences in comparative ratings with younger individuals were found between experimental conditions, $F(2,74) = 7.27$, $p < .01$, $\eta^2_p = .16$. Scheffé post-hoc tests revealed that participants in the losses condition evaluated their performance as more negative ($M = 2.4$) than individuals in the control group ($M = 2.8$) and in the gains condition ($M = 3.0$). Differences in comparative ratings with older individuals were marginally significant, $F(2,75) = 2.78$, $p = .068$, $\eta^2_p = .69$. Individuals in the gains condition rated their own performance to be more similar to older age groups ($M = 4.0$) than did individuals in the losses condition ($M = 4.3$). Comparative ratings with same-aged peers were similar between groups, $F(2,75) = 0.14$, $p = .87$. Taken together, these comparative ratings indicate that cognitive aging experiences and aging expectations were successfully manipulated: Participants in the losses condition had the impression of a comparatively higher extent of cognitive decline over the past years, whereas the answers of participants in the gains condition indicate expectations of a lower extent of cognitive decline over the years ahead.

Effects of the Experimental Manipulation on Subjective Age Domains

A 3 (Group: gains vs. losses vs. control) × 2 (Occasion: pretest vs. posttest) mixed factors analysis of covariance was used to test effects of the experimental manipulation. Group × Occasion interactions were non-significant for feel age, $F(2,67) = 0.67$, look age, $F(2,66) = 1.09$, and interest age, $F(2,66) = 0.38$, all p's > .05. For do age the Group × Occasion interaction reached significance, $F(2,70) = 5.31$, $p < .05$, $\eta^2_p = .12$. T-tests for dependent groups (cf. Figure 5.1) revealed an average increase between pre- and post-

manipulation in do age by 4.2 percentage points in the losses condition, $t(25) = 1.95$, $p < .05$, $d = .38$, which corresponds to an average absolute increase of 2.7 years ($SD = 6.9$ years) in respondents do ages. A statistical trend toward a decrease of 3.3 percentage points emerged in the gains condition, $t(24) = 1.62$, $p = .06$, $d = .32$, which corresponds to an average absolute decrease of 2.2 years ($SD = 6.6$ years) in respondents do ages. According to Cohen (1988), the effect sizes for these changes in do age were in the medium or typical range. No pre- to post-manipulation differences were observed in the control group, $t(25) = 0.84$, $p = .21$.
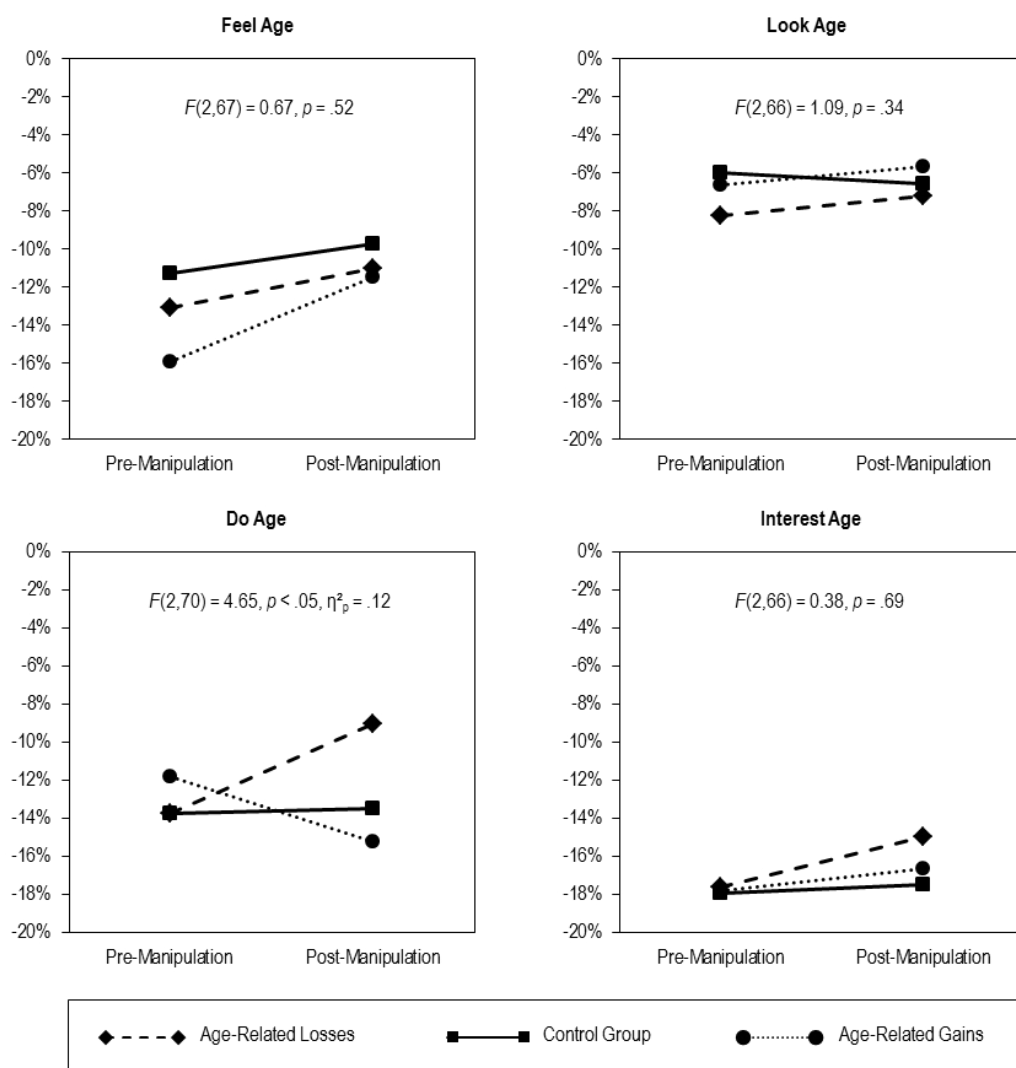
Figure 5.1. Change in the four subjective age domains before and after the experimental manipulation. *Note.* Plots depict estimated marginal means of percentage discrepancy scores between chronological age and subjective age domains. A negative discrepancy scores reflects a more youthful subjective age than chronological age. Estimated marginal means were controlled for physical functioning (SF-36), and cognitive functioning (d2 Test performance).

Taken together, inducing age-related cognitive losses resulted in older do ages and inducing age-related cognitive gains tended to increase the youthfulness bias for do age. This pattern of results suggests that negative feedback has a stronger impact on subjective age than positive feedback. To test this assumption, we combined the positive condition with the control group and contrasted it to the losses condition. Again, a significant Group × Occasion interaction effects emerged only for do age, $F(1,71) = 7.30$, $p < .01$, $\eta^2_p = .09$.

Finally, testing for gender differences in the effects of the experimental manipulation on all subjective age domains revealed no differences between men and women.

Discussion

This study provides one of the first simultaneous tests of the effects of experimentally induced positive and negative cognitive aging experiences on a multidimensional subjective age measure by using a repeated measures design. Experienced decrements in processing speed resulted in older do ages after as compared to before the experimental priming, whereas age-related gains in accuracy had only a marginally significant effect on do age.

We believe that important insights into the distinctions between subjective age domains can be gained from this study. Whereas previous research found that feel age can be experimentally manipulated (Eibach et al., 2010; Stephan et al., 2013), in the present study intraindividual variability was found only for do age. Asking participants to rate four subjective age items might emphasize subtle differences between these items and potentially prompts participants to use distinct reference points for each item. We argue that the experimental effect on do age can be explained with domain-specific priming effects (Kornadt & Rothermund, 2012; Levy & Leifheit-Limson, 2009). Whereas the global feel age rating has greater flexibility to capture a broad range of proximal and distal reference points (Montepare, 2009), do age might capture more momentary and performance-related aspects of subjective aging. Of the four subjective age domains, do age may be regarded as having the closest connection with cognitive performance, at least in terms of fluid intelligence. That is, do age comprises subjective perceptions of capabilities, vitality, and fitness, which (among other things) are important for the ability to perform well on an attention test. Therefore, cognitive aging experiences might have been internalized in a domain-specific way into do ages only. By contrast, the observed null-effects on look age, and interest age might suggest that cognitive performance, at

least in relation to fluid intelligence, is irrelevant for physical appearance (look age) and personal interests (interest age).

Furthermore, our findings corroborate existing research that compares the relative influence of positive and negative age stereotypes (Meisner, 2012). The relatively stronger influence of negative aging experiences can be explained by the high prevalence of negative age stereotypes in Western societies as well as their considerable persuasive power, which might be difficult to counteract through positive aging experiences. Hence, negative age stereotypes might reinforce individuals' negative expectations with regard to aging and are thus of greater personal salience. More generally, it seems that unfavorable stereotypes are acquired more easily and are more difficult to overcome than favorable stereotypes (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). However, alternative explanations might be possible. In particular, there are theoretical grounds for the assumption that positive age-related feedback can result in both younger and older subjective ages depending on the interpretation of the feedback. On the one hand, maintaining or even improving one's cognitive abilities may be regarded as a marker of youthfulness, thus resulting in younger subjective ages. On the other hand, feeling younger is often regarded as a denial of aging or a self-protective strategy (Kotter-Grühn, Kornadt et al., 2015). Thus, when age-related gains are made salient, there might be less need to deny one's own aging, as expressed in feeling older. The comparatively large variance of do ages at T2 in the gains condition point toward such an alternative explanation. Another potential explanation for the lack of effects of age-related gains might be the presence of floor effects: because most individuals already feel younger, there is only little potential to further increase this youthfulness bias (Kotter-Grühn, Kornadt et al., 2015).

In sum, our findings suggest that caution is warranted when it comes to the goal of "improving" subjective age. Given the high degree of continuity and stability of the self-concept (Brandtstädter & Greve, 1994), long lasting changes of a person's subjective aging perception might require personally relevant and repeated experiences of age-related gains or a greater extent of such age-related changes in order to have the potential to override the manifold aging experiences in everyday lives (Miche et al., 2014). Thus, when it comes to improving subjective aging perceptions and reducing the influence of negative age stereotypes by systematic intervention approaches, we conclude that a relatively modest feedback strategy anchored in the fluid intelligence sphere may not be a sufficient tool. Instead, it may be better to rely on domains that do not show age-related decline, such as positive emotional experiences, generativity related processes, and wis-

dom or life experience. At the same time, as discussed earlier, a younger subjective age may not be the only (and not even the best) indicator of a positive subjective aging perception. The intention to make older adults feel younger, although based on a vast body of research pointing to the negative developmental consequences of subjective aging, does indeed bear the risk of perpetuating negative age stereotypes (Kotter-Grühn, 2015). Therefore, we see a need to include an even broader range of conceptual approaches to the subjective experience of aging in future experimental research.

Limitations and Future Research

When interpreting the findings of this study, it is important to keep in mind that context-specific, potentially more dynamic subjective age ratings at post-test ("at the moment") were compared to average baseline and potentially more stable subjective age ratings at pre-test ("most of the time"). Although this procedure mirrors previous research (Stephan et al., 2013), there are important drawbacks to this change of wording. In particular, participants might have used different reference points to anchor their subjective age ratings at post-test compared to pre-test. Future research might therefore yield different results, if a consistent wording is used between measurement occasions. Additionally, a promising extension for future research would be to augment Kastenbaum's subjective age dimensions by developing a 'mental age' item. Such a mental age rating could then be used in a more unequivocal way of testing domain-specific internalization effects.

We selected the young-old age group for our study, because this is the age when cognitive loss experiences start to emerge and cognitive worries become stronger, while overall cognitive functioning is still maintained. Thus, cognitive functioning represents a highly valued and carefully monitored personal attribute during this life phase. Cognitive aging experiences might have less strong effects in middle-aged as well as in old-old adults. For middle-aged adults noticeable age-related cognitive decline is less realistic than for young-old adults, whereas for old-old adults it might be less threatening to the self-concept because of greater acceptance for cognitive decline they might have already faced (Heckhausen et al., 1989). It is therefore open to future research, if cognitive aging experiences have similar effects in other age groups.

Altogether, the results of our study in conjunction with previous experimental research indicate that, when age stereotypes are presented in a personalized manner, i.e. when older adults are made to believe that age stereotypes are descriptive of themselves,

particularly negative age stereotypes are being internalized into age-related self-views. We argue that the observed internalization effect is in line with the contamination hypothesis (Rothermund & Brandtstädter, 2003), because the personalized presentation of age stereotypes (as opposed to a more general confrontation with age stereotypes) provides little opportunity to distance oneself from the stereotypical trait, for example through social downward comparisons. However, it cannot be clearly determined if the effect in our study resulted from (a) the presentation of age stereotypes using fictional mean scores, (b) the personalized feedback, or (c) a combination of both.

Besides such consideration regarding the internalization of age stereotypes into self-views and the limited plasticity of subjective age, the domain-specific susceptibility of subjective age domains to induced cognitive aging experiences highlights subtle differences between subjective age domains. Future research on the plasticity of subjective aging phenomena should therefore employ a broader range of subjective aging measures and should prefer multidimensional over unidimensional constructs.

6

General Discussion

Chapter Overview

Summary and Synthesis of Findings

The aim of this dissertation was to contribute to the field of subjective aging research by addressing open research questions related to three thematic areas: measurement issues, developmental consequences, and malleability of subjective aging phenomena. In the following, for each of these three foci, findings of the present thesis will be summarized and synthesized. Subsequently, the theoretical and methodological approaches will be subjected to a critical evaluation of their strengths and limitations. And finally, it will be discussed which implications the findings of the present thesis may hold for future research and gerontological practice.

Findings Related to Measurement Issues of Subjective Aging

Domain-specific versus global assessment of subjective aging

Kornadt and Rothermund (2015) have discussed two reasons for the necessity of multidimensional approaches to subjective aging. First, according to life-span developmental theory, human development is characterized by the co-occurrence of gains, losses, and stability across multiple domains of functioning (P. B. Baltes, 1987). Second, life course sociology emphasizes the key role of contextual factors in shaping human development (Settersten, 2003). This call for multidimensional assessment strategies is reflected in the measurement approaches developed more recently (e.g., Diehl & Wahl, 2010; Kornadt & Rothermund, 2011; Sarkisian, Hays, Berry, & Mangione, 2002; Steverink et al., 2001). However, it remains yet unclear which classification schema (e.g. behavioral and functional domains versus life domains) is best suited to capture subjective aging experiences and under which conditions a multidimensional approach may be more appropriate than a global assessment strategy. To this end, the present thesis (Chapter 2) evaluated the utility of the AARC-model (Diehl & Wahl, 2010) as a sample case of a domain-specific approach to study subjective aging in the daily lives of older adults. The AARC-model has the advantage that its behavioral and functional domains are relevant across a broad range of situations and life domains and further considers age-related gains and losses as two distinct and superordinate categories.

Overall, the AARC-model proved as a valid classification schema, with subjective aging experiences being mentioned across all five domains and with only few exceptional responses being not classifiable. Further evidence for the notion of multidimensionality of subjective aging experiences was provided by the observation that over the course of

the 2-week diary study the majority of participants reported experiences within multiple domains and mentioned both positive and negative aspects of their own aging process. However, subjective aging experiences in the domain of health and physical functioning were by far the most frequent category, comprising almost 45% of all subjective aging experiences, whereas the next most frequent category (social-cognitive and social-emotional functioning) covered a little less than 20% percent of all SAEs. In addition, AARC-domains that were closely related to biological age-related changes, namely health and physical functioning as well as cognitive functioning, were characterized mainly by loss- and decline-oriented perceptions.

Domain-specificity of subjective aging was also evident in Chapter 5, which showed that by splitting-up the single-item subjective age measure into domain-specific subjective age ratings, a more comprehensive picture of a person's subjective aging experience can be obtained. Whereas feel age ("How old do you feel?") seems to be able to capture diverse aging experiences from a broad range of different domains when used as a stand-alone measure, participants referred to distinct events and experiences when multiple subjective-age items were presented. That is, in the experimental study presented in Chapter 5, do age changed in response to a cognitive aging experience, but neither feel age, look age, nor interest age did.

Altogether, the results of this thesis add to the growing evidence for the validity and advantages of multidimensional approaches to subjective aging. Several authors have advocated for a more detailed consideration of the diversity of subjective aging across different functional domains or life contexts (Diehl et al., 2014; Kornadt & Rothermund, 2015; Levy & Leifheit-Limson, 2009). These authors argue that multidimensional measurement approaches to subjective aging would enable a better prediction of specific developmental outcomes and represent a prerequisite for an in-depth understanding of the underlying domain-specific pathways. For example, subjective aging related to physical and cognitive functioning might be linked to developmental outcomes through the diverse set of pathways described in the Stereotype Embodiment Theory (Levy, 2009). In contrast, social-cognitive and social-emotional aging experiences, which are closely related to life review and self-evaluation, might affect developmental outcomes (e.g., well-being and mental health) through a more narrow set of pathways, such as deliberate selection of self-regulation strategies. Another advantage of domain-specific approaches to subjective aging is that these approaches are able to take into account the changing importance and self-relevance of subjective aging domains across the adult life span. As

different life contexts gain center stage at certain ages (Kornadt & Rothermund, 2015), the effect of a domain-specific aging experience might be life-stage dependent. For instance, unanticipated physical and cognitive losses might be more influential during mid-life, whereas in later life, when individuals have adjusted to a certain amount of age-related loss experiences, positive aging experiences in the domain of social-cognitive and social-emotional functioning might become more important. A life-span perspective on subjective aging therefore ultimately requires the use of domain-specific approaches.

Finally, with regard to the advantages of multidimensional measurement approaches this thesis has shown that age-related gain experiences and loss experiences should be treated as two distinct dimensions or facets of the aging experience. In line with the findings of other studies (Brothers et al., 2015; Meisner, 2012), age-related losses were more strongly associated with developmental outcomes than age-related gains (Chapters 2 and 5), which might be owed to the pervasiveness of negative age stereotypes in Western societies and their persuasive power in comparison to positive stereotypes (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Hummert, 2011). Given that the traditional subjective aging measures (e.g., subjective age, ATOA) treat positive and negative views on aging as two ends of one continuum, new measurement approaches are needed in order to study the potential interplay between perceived gains and losses and their unique predictive relevance for developmental outcomes. For example, given that age-related losses are considered normative in old age, the experience of age-related gains might be particularly important in late life. As demonstrated in Chapter 2, age-related gain experiences in later life very likely comprise mostly psychological processes related to emotional experiences, self-reflection, and life review. In contrast, physical and cognitive functioning is usually maintained to a large extend in midlife, which might render a premature experience of age-related losses a more critical predictor of developmental outcomes in mid-adulthood.

In general, however, unidimensional and global measurement approaches are still widely used (even within this thesis) and one might ask when such measures represent a legitimate way to assess subjective aging. Certainly, the length of the questionnaires is a major advantage of global measures, which are able to capture subjective aging with only five items or even only one item (e.g., ATOA and subjective age). Therefore, global measures of subjective aging often represent more economic assessment strategies and are thus more likely to be included in large-scale epidemiological studies for research-

pragmatic reasons. Additionally, these measures have proven to possess high predictive validity for developmental outcomes in various large-scale representative surveys.

The comparison of global and domain-specific measures thus leads to the question if subjective aging can be assessed in a de-contextualized, unidimensional way at all. Or put differently, one may ask what is being assessed by unidimensional, global measures of subjective aging compared to the multidimensional approaches. As has been shown in the classification of daily subjective aging experiences in Chapter 2, developmental losses in the domain of health and physical functioning were the most salient theme that came to mind when older people thought about their own aging. Thus, when being asked about their subjective aging experience in a very general way, individuals will most likely attend to the most salient and self-relevant domain, that is the physical and health related changes they associate with their own aging (Kornadt & Rothermund, 2015). Such as, when answering the ATOA item "Things keep getting worse as I get older", individuals might ponder about whether they have experienced any health problems as they grew older. The salience of the health domain might then also explain the general negativity effect that has been found in the host of studies using global, unidimensional subjective aging measures to predict health outcomes, physical functioning, longevity, or subjective well-being (Westerhof & Barrett, 2005; Westerhof et al., 2014). Similar effects were obtained for various health domains with the use of the single-item subjective age approach in Chapter 4 and also in Chapter 2, when cross-domain subjective aging experiences were aggregated into a sum score of gain- and loss-experiences to predict a range of subjective well-being measures. Here, the overall amount of experienced losses was significantly related to negative affect and valuation of life, whereas experienced gains played a minor role and were associated only with positive affect.

Because health-related evaluations of the aging process are the most salient reference point for global subjective aging measures, global measurement approaches seem appropriate, if, as done in Chapter 4, one wants to study the effects of subjective aging on health, physical functioning, and longevity. Furthermore, global measures might be considered an appropriate operationalization if the aim is to examine general issues related to the directionality of effects or overall changes in the negativity of subjective views on aging across the life span. Yet, as discussed above, when other outcomes, for example, cognitive functioning, mental health, or social relationships, are of central interest, measurement approaches that tap into subjective aging experiences in these specific domains

may prove as more effective predictors and may yield more in-depths insights into domain-specific pathways and the life-span dependency of effects.

Measurement invariance issues

Given the above questions related to the changing importance of subjective aging across the life course, it seems that the current state of empirical research is constrained by a lack of comprehensive theories that are able to capture the manifestation and influence of subjective aging across the life span. Indeed, a host of studies examined the effects of subjective aging in age-heterogeneous samples, including participants from almost the entire range of adulthood, however without explicitly testing age effects. Moreover, only a few studies have addressed patterns of change (or stability) of subjective aging across time and across the (very last part of) life span (Kleinspehn-Ammerlahn et al., 2008; Kotter-Grühn et al., 2009).

But it is not only a lacking consideration of life-span issues in theoretical models, which hampers the implementation of a life-span perspective. More fundamentally, investigating how the manifestation and influence of subjective aging changes across the life span requires that measurement approaches to subjective aging capture the same latent construct at different ages of the adult life span. That is, comparing mean scores on a subjective aging scale across age groups or over time requires that mean differences reflect actual changes in subjective aging and not possible changes in how individuals interpret and respond to the scale's items (Hertzog & Nesselroade, 2003). In Chapter 3 this issue of longitudinal and cross age-group measurement invariance has been tested in an exemplary way for the widely used ATOA subscale of the PGCMS by using an IRT approach to measurement invariance testing.

The results of Chapter 3 attested partial measurement invariance to the ATOA scale with regard to its equivalence of meaning over time within two age groups (middle-aged and young-old adults). However, measurement invariance could not be established between the two age groups of middle-aged and young-old adults. Thus, whereas valid longitudinal comparisons of latent ATOA scale scores can be made (Steinmetz, 2013), the investigation of age-group differences seems to be complicated by a differing meaning of the ATOA items within different age groups. This finding might be due to properties of the ATOA scale, which has been described as assessing subjective aging at a more general level. For instance, the item "Things keep getting worse as I grow older" could be interpreted as alluding to a variety of age-related changes: physical functioning, finan-

cial issues, lifestyle factors, or social relationships, to name only a few. Which specific domain a respondent refers to might be influenced decisively by his or her belonging to a certain age group, as different domains of subjective aging gain salience at different stages of the adult life span (Barrett & Montepare, 2015). Further support for the changing salience of subjective aging domains across the adult life span is obtained from the finding, that within age groups specific item thresholds were non-invariant over time (i.e., socio-emotional items among the young-old and physical-aging related items among the middle-aged). Thus overall, the finding of measurement non-invariance within and across age groups once again calls for the use of multidimensional subjective aging measures in order to ensure that similar reference points are used when individuals make judgements of their subjective aging (Diehl et al., 2014).

Findings Related to the Developmental Consequences of Subjective Aging

Directionality of effects in the association of health and subjective aging

In its relationship with health, theoretical reasoning positions subjective aging both as an antecedent as well as a developmental outcome (Furstenberg, 2002; Levy, 2009; Schafer & Shippee, 2010b). There is indeed increasing longitudinal evidence which attests a predictive role to subjective aging (Westerhof et al., 2014). However, most of these studies have tested only the longitudinal pathway from subjective aging to health without controlling for the reverse association (i.e., health as a predictor of subjective aging). Therefore, in Chapter 4 cross-lagged panel analyses were conducted to test for the directionality of effects between health and subjective aging. This issue is of particular interest with regard to health, because health declines are a dominant topic in age stereotypes, thus potentially making health declines a prime predictor of subjective aging. Importantly, the direction of effects may differ depending on the specific health domain under study. Among others Johnson and Wolinsky (1993) argued for a multidimensional assessment of health, as ill health may manifest at different levels from body (disease, disability) to social limitations (functional impairment) to mind (self-rated health). Besides, mental health is considered important when evaluating a person's overall health status (World Health Organization, 2001).

As the primary focus of this chapter was a general interest in the potential bi-directionality of long-term effects between subjective aging and different health dimensions, this study made use of the large-scale representative data of the German Aging Survey. The single-item approach of subjective age that was used for economic reasons

in this survey was deemed appropriate to investigate such general tendencies. Cross-lagged panel analyses revealed that subjective age predicted objective health indicators (number of diagnosed medical conditions and depressive symptoms), whereas bidirectional effects were found between self-rated health and subjective age. Hence, subjective aging seems to play a predictive role for health when it comes to the bodily and psychic manifestations of health. On the other hand, subjective evaluations of one's health status seem to influence the way individuals perceive their own aging and vice versa.

Surprisingly, the strength and direction of effects was similar between middle-aged and older adults, which suggests that subjective aging in general plays a crucial role for both physical and mental health across the second half of life. However, when critically reflecting the use of subjective age ratings from a measurement-development perspective, this lack of age-group differences might be owed to the incapacity of global subjective age ratings to discriminate between gain- and loss-oriented as well as domain-specific aging experiences. It therefore remains open to future research, if specific domains of subjective aging show age-differential effects on developmental outcomes, which, in turn, would hold significant implications for life-phase specific subjective aging interventions.

Associations of daily subjective aging experiences with subjective well-being

A strong argument for the study of behavior and experiences as they unfold in everyday life is that this approach yields a "detailed, accurate, and multifaceted portrait of social behavior embedded in its natural context." (Reis, Gable, & Maniaci, 2014, p. 373). Thus, besides answering questions related to the prevalence of subjective aging, the daily diary study presented in Chapter 2 was also designed to examine the impact of "real-world" subjective aging experiences on subjective well-being. Subjective well-being was chosen as an outcome variable in this study, because it is a well-established developmental consequence of subjective aging and closely linked to everyday events and experiences (Diener, 1984). As a preliminary step in the examination of intraindividual dynamics, which would be required in future studies, Chapter 2 focused on the basic questions of how domain-specific subjective aging experiences in daily life are associated with different subjective well-being indicators, namely affective components of subjective well-being (positive and negative affect), cognitive components (life satisfaction), as well as valuation of life. Valuation of life was chosen as an additional well-being indicator, because, in contrast to life satisfaction, it captures a future oriented evaluation of current life circumstances denoting "the conviction that one's life is meaningful and worth living" (Lawton

et al., 2001, p. 24). Although the amount of variance explained by subjective aging experiences was very small in this study – which is not surprising given the plethora of factors influencing subjective well-being (Diener, 1984) – it revealed interesting differential associations for gain- and loss-oriented perceptions of aging with the different subjective well-being indicators. In line with the notion of two separate emotion systems (Diener, Suh, Lucas, & Smith, 1999), positive subjective aging experiences were associated with positive affect and negative subjective aging experiences were associated with negative affect. Chapter 2 therefore corroborates and extends another diary study, in which subjective age was associated with negative but not positive affect (Kotter-Grühn, Neupert et al., 2015), accordingly once again pointing to the utility of discriminating between perceived age-related gains and losses. Beyond that, loss-oriented perceptions of aging were also associated with valuation of life but not with life satisfaction. This differential pattern of associations might be explained by the fact that life satisfaction is a more stable personal characteristic than affective aspects of well-being, which tend to be more situation dependent (Diener, 1984). Consequently, aging-related experiences made in current daily life have little effect on the judgements about the life already lived, but they seem to be crucial when it comes to a person's attachment and valuation of the life yet to be lived. A similar interrelation of subjective time dimensions has been put forth by Brandstäder and Rothermund (2003), who argued that future plans and decisions are inseparably tied to the gains and losses experienced in the past.

Findings Related to Intraindividual Change and Malleability of Subjective Aging Phenomena

Long-term change of subjective aging across middle-adulthood and early old age

Considering the fundamental role of subjective aging for developmental outcomes across the second half of life, the improvement of subjective aging through gerontological interventions might become an important vehicle to encourage individuals to take active control and responsibility of their own aging process (Miche et al., 2015). However, it seems that yet some open questions need to be solved in order to develop targeted and effective intervention programs. One such pressing question relates to the developmental trajectories of subjective aging across the second half of life. Knowledge about the specific life phases at which individuals are most likely to develop a negative view on aging could help to identify the appropriate timing for interventions. Furthermore, knowledge about interindividual variability of change trajectories and its predictors

would be insightful, because it could help to identify vulnerable groups who are at risk of developing a negative view of aging during a specific life stage. To these ends, Chapter 3 examined trajectories of ATOA (including potential predictors) during two life phases, namely middle-adulthood and early old age.

The results of Chapter 3 indicate an overall downward trend of ATOA across the two life phases that were examined, thus replicating and complementing similar findings in older samples (Kleinspehn-Ammerlahn et al., 2008; Sargent-Cox et al., 2012a, 2012b). This finding implies that already in midlife individuals start to develop an increasingly negative ATOA. Other subjective aging measures, however, show a different trajectory across adulthood. Subjective age proportional discrepancy scores, for example, have been shown to remain stable after the age of 40, with individuals older than 40 years feeling, on average, about 20% younger than their actual chronological age (Rubin & Berntsen, 2006). Such stable proportional subjective age discrepancies might be interpreted as indicating a stable positive self-perception of aging across the second half of life (Gana et al., 2004), which at first sight seems to conflict the finding that ATOA becomes increasingly negative at older ages. At the same time, such distinct developmental trends of different subjective aging measures might illuminate conceptual differences between the constructs. The feeling of being younger than one's actual age serves to maintain continuity and coherence of the self-image in light of the negative age-related physical changes (Gana et al., 2004). This self-enhancement function of subjective age seems to be important across the second half of life. ATOA, which can be interpreted as a cognitive-affective evaluation of one's own aging process, might be less susceptible to such self-enhancing processes, therefore displaying negative age-related trends across the second half of life.

The worsening of ATOA was a uniform trend across individuals in early old age, whereas in middle-age ATOA trajectories were characterized by significant between-person variation, indicating that not all middle-aged individuals develop a more negative ATOA. One may conclude that ATOA trajectories are more malleable during middle-adulthood. Thus, midlife may represent a critical phase to prevent individuals from developing negative views on aging and interventions targeting this life phase might be particularly important.

With regard to the predictors of subjective aging, which are helpful for identifying groups of people that are at risk of holding a particularly negative view of aging, personality, different health indicators (physical, self-rated, and mental health), gender, and SES

were tested as potential predictors of subjective aging (Chapters 2-4). In order to not reiterate the results of these analyses, only a couple important findings will be highlighted in the following. First, across the second half of life (physical) health emerged as a central influencing factor for individuals' subjective aging perceptions and particularly in old age it seems to be the most important reference point on which subjective aging perceptions are based. This was, for example, apparent in daily subjective aging experiences of functionally impaired older adults, who had an overall more negative conception of their own aging across a broad range of domains (Chapter 2). Furthermore, health indicators were the only significant predictors of interindividual differences in the level of ATOA among the young-old adults (Chapter 3). And it seems to be the case that subjective evaluations of health play a more important role for shaping subjective perceptions of aging than objective health indicators (Chapter 4). Second, and in line with other studies (Wahl et al., 2013), of the two personality traits that were examined, neuroticism was associated with interindividual differences in the level of ATOA among the middle-aged adults (Chapter 3). This relatively higher importance of neuroticism in midlife compared to young-old adulthood may be due to individuals high in neuroticism being more alert for the ambiguous signs of age-related losses during midlife. Third, individuals with different socioeconomic backgrounds did not differ with regard to the subjective aging experiences they encountered in their daily lives (Chapter 2) nor did they have different levels or change trajectories of ATOA (Chapter 3). This null finding might be due to SES being a more distal influencing factor that shapes subjective aging through third variables, such as socioeconomic differences in health. Accordingly, when the effects of these more proximate predictors are taken into account, SES is no longer associated with subjective aging (Barrett, 2003). Taken together, the findings regarding the predictors of subjective aging suggest that when it comes to the development of effective subjective aging interventions, it would be important to particularly target individuals with poor self-perception of health and those with high levels of neuroticism. Focusing already on individuals in middle-adulthood may be a promising strategy to prevent these individuals from developing even more negative views on aging as they grow older. In addition, there is probably a greater likelihood that middle-aged adults can adopt new behaviors or self-correct bad habits with potential long-term effects until old age (Lachman, 2004).

Subjective aging in daily life

In light of the widespread assumption that subjective aging is rooted in the daily life of an aging person and that everyday encounters of one's own aging, such as age discrimination (Stephan, Sutin, & Terracciano, 2015a), or turbulences within the family and health events (Schafer & Shippee, 2010b), give rise to the sense of growing older, surprisingly little research has focused on the emergence and the contents of subjective aging in daily life. One main goal of the daily diary study presented in Chapter 2 was to determine whether subjective aging is a relevant phenomenon in the daily lives of old-old adults and, taking the AARC model (Diehl & Wahl, 2010) as a starting point, to synthesize the events and experiences that create the feeling of being old(er). First of all, the semi-structured response format used in this study revealed that older adults are able to relate to questions about perceived age-related changes and that they can make accurate statements about their subjective experience of aging. Moreover, age-attributed experiences were a relatively frequent phenomenon, which in the investigated sample of old-old adults occurred on average on every second day. As already discussed previously, experiences in the domain of health and physical functioning constitute a considerable part of subjective aging experiences in the daily lives of older adults. However, there was also substantial variation between participants with regard to the total number of subjective aging experiences that was reported over the two week period of the diary study. All in all, this study has contributed to the subjective aging literature by demonstrating that subjective aging experiences are rooted in everyday life and may be triggered by everyday experiences. As will be discussed in more detail later on, future research should focus on the determinants, correlates, and developmental consequences of short-term intraindividual variation in subjective aging.

Malleability of subjective aging through experimental manipulation

Recent experimental studies suggest that individuals vary in their subjective perception of aging over relatively short time-intervals (Eibach et al., 2010; Kotter-Grühn & Hess, 2012; Stephan et al., 2013), in addition to the macro-longitudinal within-person change of subjective aging observed in longitudinal studies. At the same time, the results of Chapter 5 indicate that changing subjective aging, and particularly creating positive aging experiences, by means of experimental manipulation strategies is less trivial than suggested by previous research. The experimental study presented in Chapter 5 represents one of the first attempts to changing multiple subjective age items by inducing a

cognitive gain or loss experience respectively. Participants in this study were more sensitive to induced loss experiences, which were incorporated into subjective age ratings in a domain-specific way (Levy & Leifheit-Limson, 2009). That is, individuals who were confronted with age-related losses in processing speed had older do ages after as compared to before the experimental manipulation, while no effects emerged for feel age, look age, or interest age or under the condition of age-related gain experiences. Hence, Chapter 5 underscores the intricacy of a comprehensive and cross-domain improvement of subjective age even over short time periods. Repeated experience of personally relevant age-related gains may be necessary to achieve long-term improvements of subjective aging and more research is needed in order to develop successful strategies to foster positive views on aging and alleviate negative views (Kotter-Grühn, 2015).

Previous experimental studies have achieved the goal of improving a person's subjective aging through the presentation of negative age stereotypes (Weiss & Lang, 2012) or downward social comparisons with age peers (Stephan et al., 2013). Despite the beneficial effects of social downward comparisons on subjective well-being (Bauer & Wrosch, 2011), improving individuals' perceptions of their own aging through the social downgrading of age peers implies an idealization of youthfulness that might hamper a positive acceptance of old age and is potentially counterproductive for an active, self-determined aging process. It might be more promising to target subjective aging by creating opportunities for the experience of age-related gains, because such experiences have the potential to change prevalent mindsets of inevitable age-related losses (Heckhausen et al., 1989), they signal personal control over one's own aging process (Diehl et al., 2014), and might eventually even improve individually held age stereotypes (Rothermund & Brandtstädter, 2003). The daily diary study in Chapter 2 revealed prime examples for domains in which individuals experience many positive aging experiences, namely the domains of interpersonal relationships and social-cognitive and social-emotional functioning; the domain of cognitive functioning might be less adequate for creating positive aging experiences because of the prevalent negative aging stereotypes that propagate physical and cognitive deterioration in old age.

Limitations and Strengths

The limitations and strengths that are specific to each publication of this dissertation were addressed in the respective discussion sections of Chapters 2-5 and shall not be

reiterated here. Instead, the goal of the general discussion is to address the overarching strengths and weaknesses which the four studies have in common.

A major strength of this dissertation is the variety of methods and study designs employed to meet the specific requirements of the research questions addressed in each chapter. A qualitative-quantitative daily diary approach was used to provide a detailed examination of the frequency and composition of the phenomenon under study. As an essential advantage of qualitative approaches, asking for participants' subjective aging experiences in a semi-structured way provided the opportunity to capture topics and domains of experiences that were initially not considered. Thus, Chapter 2 set the stage for the further quantitative analyses of long-term predictors and outcomes of subjective aging in Chapters 3 and 4. The large representative longitudinal data sets in these chapters were analyzed with state-of-the-art statistical techniques, such as cross-lagged path models, which allow to determine the direction of effects between two variables, and latent growth models, which account for both interindividual similarities and differences in change trajectories and allow to model measurement error as well. Finally, the formation process and potential manipulation of subjective aging phenomena was studied in an experimental study under laboratory conditions in Chapter 5. Altogether, the application of diverse methodological designs in combination with the broad range of measurement approaches to subjective aging used in this thesis (i.e., subjective age, ATOA, and AARC) enabled to address a diverse set of questions within the field of subjective aging. As evident in the summary and synthesis of findings above, these inquiries were related to each other within three thematic areas: measurement issues, developmental consequences, and malleability of subjective aging in midlife and early old age.

Another strength of this dissertation is that altogether the samples included in the four studies covered a broad age range from middle adulthood (early forties) to advanced old age (late eighties). The use of large longitudinal datasets in Chapters 3 and 4, including participants from almost the entire second half of life, allowed taking a much needed life-span developmental perspective on subjective aging research that asks for the importance of subjective aging during different life phases, for critical time periods during which subjective aging is most susceptible to change, and for the time-relatedness of the developmental consequences of subjective aging (Barrett & Montepare, 2015).

The validity and significance of the results of this thesis are further strengthened by the use of large, representative data sets. The data analyzed in Chapter 2-4 came from three different representative population-based samples, each of them randomly selected

from public registration records, which therefore permits the generalization of the study findings to a larger population.

Nevertheless, there are also some limitations and shortcomings of this thesis that need to be mentioned. First, given the variety of subjective aging constructs used in this thesis, similarities and differences between constructs were a recurring theme throughout and some first conclusions about the advantages and disadvantages of different measurement approaches were implied by the results of the four studies. However, the goal of this dissertation was not an empirical evaluation of the distinctiveness and usefulness of different subjective aging constructs. In order to draw final conclusions about the overlap and the differential predictive relevance of different subjective aging constructs, it would be necessary to assess these measures altogether in one data set as has been done elsewhere (Brothers et al., 2015). The findings reported by Brothers and colleagues provide first evidence for the assumption that subjective age, ATOA and AARC map onto an awareness continuum, with the more explicit, behavior-based measures, such as AARC, mediating the effects of the more general, implicit measures, such as ATOA and subjective age. Furthermore, it was shown in this study that AARC as a unidimensional subjective aging construct accounted for a significant amount of variance in functional health and life satisfaction over and above the unidimensional subjective aging constructs. So, similar to the conclusions already drawn in the previous section, it seems that domain-specific measures and the discrimination between perceived age-related gains and losses are necessary in order to expand scientific knowledge about the conditions and pathways that link subjective aging to developmental outcomes.

Still, the unidimensional, global measures of subjective age and ATOA were used across large parts of this thesis. One very practical reason for relying on these well-established, widely-used scales is their brevity, which allows their inclusion in large-scale longitudinal surveys. Therefore, an important implication of this thesis is the necessity of developing short, economic questionnaires for the assessment of subjective aging in terms of gains and losses across behavioral domains. The daily diary study (Chapter 2) represents a first step into this direction as it was part of the process of generating items for a questionnaire to assess AARC and the classification scheme based on the AARC model satisfied the criteria of content and face validity. Further evaluation of the psychometric properties of the coding scheme, however, would be necessary in order to ensure that the behavioral domains represent a valid representation of subjective aging experiences in everyday life. This implies, for instance, confirmatory factor analyses in

order to test whether the assumed hierarchical factor structure with two overarching factors of perceived age-related gains and losses and five subordinate behavioral and functional domains fits the empirical data.

Another shortcoming is that the results of this thesis offer only a limited amount of information about the conditions and pathways that link subjective aging to its predictors and developmental outcomes. Within this thesis predictors and outcomes of subjective aging were investigated mainly with a focus on determining whether effects are equal for different outcome domains (e.g., health domains, subjective well-being domains) or with a focus on the direction of effects. More recently, other researchers have extended this focus to the examination of moderators and mediators. These studies provide evidence for the assumed underlying mechanisms (Levy, 2009), namely psychological variables (e.g., will to live, control beliefs, or optimism; Lachman, 2006; Levy et al., 1999-2000; Wurm & Benyamini, 2014), behavioral patterns (e.g., health behavior, physical activity; Levy & Myers, 2004; Wolff et al., 2014), and physiological responses (e.g., cardiovascular stress response, inflammation markers; Levy et al., 2000; Stephan, Sutin et al., 2015b). Further research in this area is still needed, in order to answer questions related to a potentially sequential ordering, the domain-specific operation, or time-related and interindividual differences in the operation of these pathways.

Finally, all of the reported findings in this thesis relied on datasets with German participants, thus restricting the cross-cultural generalizability of the findings. The dominating focus on interindividual differences in subjective aging phenomena between members of the same culture (primarily Western developed countries) has only recently been augmented by some newer studies that investigate cultural determinants of subjective aging. Subjective age has been found to operate as a universal construct (Barak, 2009). Similarly, Löckenhoff and colleagues (2009) found broad consensus across cultures with regard to age stereotypes about biological changes (i.e. physical and cognitive aging), whereas age stereotypes related to more malleable aspects of aging (i.e. socioemotional functioning) displayed greater cross-cultural variation. Based on this pattern of cross-cultural similarities and differences one may conclude that the more global, unidimensional measures (e.g. ATOA, subjective age), which very likely reflect subjective aging in the salient domain of health and physical functioning (Kornadt & Rothermund, 2015), operate similarly across cultures, whereas subjective aging in other domains (e.g., interpersonal relationships, social-cognitive and social-emotional functioning) requires culture-specific approaches.

Future Directions in Research

The studies presented in this thesis contributed to the advancement of subjective aging research in several ways, nevertheless giving rise to new research questions. In the following, these open questions for future research will be discussed.

Since the late 1990s subjective aging research has increasingly focused on the long-term consequences of a negative image of aging. These more recent empirical studies have shown that subjective aging affects developmental outcomes, such as health and physical functioning, over the course of several years. Similarly, the focus of two chapters of this thesis (Chapters 3 and 4) was on long-term trajectories and the direction of effects. Only more recently, researchers have begun to study short-term day-to-day or moment-to-moment variation in subjective aging, similar to the daily diary and the experimental approaches in this thesis (Chapters 2 and 5). These studies indicate that there is indeed short-term intraindividual variation in subjective aging that is coupled to significant covariates such as stressors, pain, physical symptoms, negative affect (Kotter-Grühn, Neupert et al., 2015) or physical strength (Stephan et al., 2013). The short-term dynamics of subjective aging at the level of days, weeks, or months represent a promising route for future research. For instance, measurement burst designs, which capture variability and change over different time dimensions, enable linkages between micro-longitudinal developmental processes and long-term change (Nesselroade, 1991; Sliwinski, 2011). The use of such methodological approaches could shine a light on the mechanisms how subjective aging in daily life unfolds its long-term effects. For this purpose, given the importance of considering domain-specific subjective aging experiences that was discussed throughout this thesis, one important next step is the development of quantitative measures that are able to assess daily subjective aging in a domain-specific way.

Moreover, as already pointed out in the limitation section, future research needs to pay closer attention to underlying mechanisms and pathways. That is, how and under which conditions are subjective evaluations of experienced age-related changes linked to prospective development? One yet neglected pathway is the interaction between different subjective time dimensions. Subjective aging, as operationalized in this thesis, referred mainly to backward-looking or past-present evaluations of experienced changes in relation to aging. Perceived age-related gains and losses might then build the foundation on which expectations for future developmental aspirations are formed (Brandtstädter & Rothermund, 2003). Illustrating this pathway, Kornadt and Rothermund (2012), for example, showed that age stereotypes affect current self-views by means of how a person

perceives him- or herself at older ages in the future. Other studies show that negative aging perceptions can indeed be beneficial if they are paralleled by adaptive future-oriented cognitions. For example, individuals with a negative experience of their aging process, but who are nevertheless optimistic about their future, turn out to have better physical functioning and mental health in the long term (Wurm & Benyamini, 2014). Similarly, foreseeing a worse future, although accompanied by lower levels of concurrent well-being, leads to higher levels of well-being if the expected losses actually occur (Cheng, Fung, & Chan, 2009). Hence, future-oriented cognitions might be an important link inducing or conditioning the long-term developmental consequences of concurrent subjective aging experiences. Other future-oriented cognitions, such as aging-related expectations (Sarkisian, Steers, Hays, & Mangione, 2005), future time perspective (Carstensen & Lang, 1996), or preparations for age related change (Kornadt & Rothermund, 2014), represent promising mediators or moderators for future research. These thoughts further relate to the potential role that subjective aging plays within prominent life-span theories of self-regulation (e.g., Brandtstädter & Rothermund, 2002; Carstensen, Isaacowitz, & Charles, 1999; Heckhausen & Schulz, 1995), which posit that human development is driven by the future-oriented behaviors of goal pursuit and goal adjustment. As subjective aging informs and motivates future plans and decision making, these concepts need to find better integration within these theoretical frameworks—both theoretically and empirically (Diehl et al., 2014).

Another important avenue for future research that emerged repeatedly in this thesis is the adoption of a life-span perspective on subjective aging, which specifies the factors that shape subjective aging, the manifestations of subjective aging, and the mechanisms that link subjective aging to developmental outcomes during specific life phases and life contexts. Such a life-span framework could then be used as the basis for future research, for instance, to empirically test age as a moderator of the relationships between subjective aging and different determinants or developmental outcomes. Furthermore, a life-span perspective is considered a necessary prerequisite for the development of tailored subjective aging interventions that take into account life-span specific needs and requirements (Miche et al., 2015). In this regard, some life phases or groups of people that have been widely neglected in subjective aging research so far need to be given increased attention in the future. This includes in particular vulnerable groups such as older adults in institutionalized care settings or people in the fourth age. Initial findings, also from qualitative studies, suggest that in the fourth age mastery beliefs and being able to man-

age one's life situation independently are the most important factors for preserving a positive outlook on one's aging (Infurna et al., 2010; Nilsson et al., 2000). But many questions remain unanswered for this life phase. To give a few examples: Is a positive subjective aging in the fourth age equally important for adaptation or even more strongly associated with specific developmental outcomes (e.g., depression, social loneliness)? Does subjective aging show trajectories of terminal decline? Other yet understudied vulnerable groups include patients with chronic or terminal illnesses. For example, research on cancer patients indicates that subjective aging might represent an important psychological resource for coping with the disease (Boehmer, 2007). An interesting question for future research would be how subjective aging and future expectations interact in this group of people to predict health behavior (e.g. physical activity, adherence to treatment).

Related to the previous issue of developing a life-span perspective within subjective aging research, it is important to bear in mind that subjective aging, including its associations with predictors and outcomes, may not only change over chronological age but also over historical time. Several advances in todays' Western industrialized societies, such as longer life expectancies, changing opportunity structures, or medical and technological change (Diehl et al., 2015), suggest the assumption that subjective aging may have become more positive or at least more differentiated in more recent cohorts. Data sets that enable an empirical test of this assumption have become available only recently. For example, cohort comparisons between three subsequent measurement waves suggest that between the years of 1996 and 2002 individuals of all ages were more likely to conceive aging as a process of ongoing development and less as a process of physical decline (Wurm & Huxhold, 2010). An integration of different longitudinal datasets can bring subjective aging research closer to the goal of investigating change in subjective aging over historical time, which includes disentangling age and cohort effects and the examination of the potentially changing importance of subjective aging for developmental outcomes across different cohorts.

Furthermore, the context in which human development takes place was largely left unconsidered within the studies of this thesis. Future research should take into account how contextual factors may condition or moderate the associations of subjective aging with predictors and outcomes. Important exemplary contextual factors can be found at various levels, for example at the level of the individual (e.g., socioeconomic status), at the meso-level (e.g., walkability of the neighborhood, structure of the family network,

interpersonal relationships at work), within cities (e.g., opportunities for cultural engagement), regions (e.g., transportation accessibility, health care supply), or even countries (e.g., ratio of older to younger people), and first evidence indicates that these factors play an important role. For example, Marques and colleagues (2015) showed that subjective age is more closely linked with self-rated health in countries where older adults are being ascribed a lower social status. Besides, Wurm and colleagues (2014) found that the effect of disease burden on subjective aging can be buffered by primary care supply. Overall, further research on contextual factors would enhance our understanding of the conditions under which subjective aging unfolds its effects, which again would be important information to identify at-risk groups for intervention programs.

Future Directions in Practice

Although this thesis mainly addressed issues related to basic subjective aging research, it also holds some implications for the development of gerontological interventions, which will be delineated in the following.

A negative view on aging involves the perception that losses (e.g., physical impairments, cognitive decrements, social losses) are a common and inevitable concomitant of the aging process. Not only does this view contradict decades of gerontological research which have provided evidence in support of the plasticity, heterogeneity, and malleability of the aging process (Lowsky, Olshansky, Bhattacharya, & Goldman, 2014; Nelson & Dannefer, 1992); it also bears the danger of becoming a self-fulfilling prophecy, which has been shown in this thesis and elsewhere (Levy, 2009). Interventions that succeed at changing a negative view on aging might then be a promising vehicle to encourage individuals to take active control and responsibility of their aging, thus eventually representing part of the solution for the health and social care challenge entailed in demographic change.

Several conclusions may be drawn from this thesis for the development of subjective aging interventions. First of all, these are conclusions about the feasibility of changing a negative view on aging. The daily diary study in Chapter 2 revealed that subjective aging experiences are not solely negative; indeed, age-related gain experiences are existent in the natural daily ecology of older adults and may thus be potential targets for interventions. However, the experimental manipulation of subjective age through cognitive gain and loss experiences in Chapter 5 yielded no effect in the gains condition, indicating that intervention strategies that aim at creating a greater awareness for age-related gains need

to be developed with caution. At least, feedback strategies anchored in the fluid intelligence sphere seem to be not a successful strategy. Instead it might be more promising to draw attention to the domains in which older adults themselves indicate to have various gain experiences, which at the same time would also enhance the credibility of subjective aging interventions. Such domains were disclosed in Chapter 2 and include interpersonal relations, social-cognitive and social-emotional functioning, and crystalized intelligence within the domain of cognitive functioning.

This leads to a second set of conclusions regarding the facets of subjective aging that should be targeted in interventions. Several questions come to mind in terms of subjective aging facets: (1) Is it more advisable to increase older individuals' awareness for age-related gains or should interventions rather aim at lowering older individuals' preoccupation with age-related losses? The distinction between perceived age-related gains and losses that was made in Chapter 2 revealed that losses are more closely associated with subjective well-being than gains – a finding that corroborates previous studies (Brothers et al., 2015; Meisner, 2012). Given this comparably larger effect of a negative view on aging, one might conclude that it is a more urgent matter to reduce older individuals' preoccupation with age-related losses. However, more research with subjective aging constructs that discriminate between gains and losses seems necessary in order to better understand the potential interplay between age-related gains and losses. For example, a well-established finding in the health psychology literature is that positive, gain-oriented messages are more effective for inducing health behavior changes in older adults as compared to negative, fear-inducing messages (Notthoff & Carstensen, 2014). Similar effects might be expected when it comes to the effectiveness of subjective aging interventions in which participants consciously reflect their subjective view of aging. Also, age-related gains might unfold their beneficial effects as a buffer in the association between (perceived or actual) losses and outcomes (e.g., Wurm et al., 2008). If such a more complex interplay between perceived gains and losses is confirmed, the final conclusion would be to foster a balanced view on aging that encourages the strength and opportunities of growing older while acknowledging the realistic decrements of the aging process. (2) Is it more promising to target more general views on aging or should interventions rather focus on subjective aging within certain domains? As discussed earlier, "global" measures that capture subjective aging in a decontextualized way very likely elicit responses related to individuals' physical aging process and are based on concrete age-related experiences in daily life. Thus, it is essential that interventions focus on spe-

cific subjective aging experiences that older individuals encounter in different behavioral and life domains. (3) Which subjective aging constructs are the best outcomes to be targeted in subjective aging interventions? Or phrased differently, at the end of an intervention, should individuals feel younger, have a more positive ATOA, or perceive more age-related gains and fewer age-related losses? As discussed earlier, subjective age, in contrast to ATOA, fulfils a self-enhancement function in light of the low status ascribed to old age (Gana et al., 2004). Consequently, feeling younger is associated with developmental outcomes particularly when individuals hold a negative attitude toward aging (Mock & Eibach, 2011). Therefore, rather than inducing younger subjective ages, it is more advisable for gerontological interventions to target the underlying negative attitudes toward aging.

Third and finally, this thesis has implications with regard to the life-phases best suited for subjective aging interventions. The decline of ATOA across almost the entire second half of life that was found in Chapter 3, together with the greater interindividual variability in midlife, suggests that midlife represents a critical life phase for subjective aging interventions. In particular it was shown that individuals who score high on neuroticism are at risk of developing a more negative ATOA across the middle-adulthood. This finding might then indicate that neurotic individuals are more inclined to attribute ambiguous loss experiences in midlife to aging instead of other, situational factors and thus may arrive at a more negative evaluation of their own aging. Subjective aging interventions in midlife should therefore aim at increasing individuals' awareness for the coexistence of gains and losses across the adult life span, as well as for the plasticity and homogeneity of the aging process. Additionally, middle-adulthood can be regarded as an important time period for interventions, as it assumes a preparatory role for health and well-being in old age (Lachman, 2004). Hence, provided that negative views on aging in midlife set the tone for further downward trajectories until old age, negative perceptions of aging should be offset as early as possible.

Conclusion

Subjective aging research has developed into a lively and much-noticed field of research throughout the past two decades. This thesis contributed to the advancement of subjective aging research in several ways. First of all, it directed attention to the day-to-day experiences (both positive and negative) that make individuals aware of their own aging and through which they develop a subjective sense of growing older. Thus, it

seems that subjective aging phenomena are not only shaped by cultural and societal images of aging or age stereotypes, but certainly are also rooted in daily experiences and encounters that individuals make as they grow older. Second, this thesis further established the predictive role of subjective aging for objective health measures while pointing out that the association with self-rated health may be bidirectional. Third, it was highlighted that although subjective aging is an important predictor for health across the second half of life, the meaning and manifestation of subjective aging may differ fundamentally across different phases of the adult life span, which may present a challenge for measuring subjective aging in people of different ages. Finally, downward trajectories of subjective aging were found for both middle-aged and young-old adults, which make the improvement of subjective aging in midlife a pressing issue. However, attempts to change multiple facets of subjective aging within an experimental setting yielded sobering results, indicating that the long-term improvement of subjective aging may not be as easy as suggested by previous experimental studies.

Nevertheless, the results of this thesis encourage future attempts to develop lifelong prevention measures that target a negative view of aging. Based on the findings of this thesis, such interventions are regarded as a promising strategy to empower older adults to take responsibility and active control of their own aging process. Thereby, subjective aging research can contribute to turning the challenges of demographic change into an opportunity.

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List of Abbreviations

AARC	Awareness of Age-Related Change
ATOA	Attitude Toward Own Aging; Subscale of the Philadelphia Geriatric Center Morale Scale
BEWOHNT	Abbreviation of a research project; full title: „Hier will ich wohnen bleiben - Zur Bedeutung des Wohnens in der Nachbarschaft für gesundes Alter"
CES-D	Center for Epidemiological Studies Depression Scale
CFA	Confirmatory factor analysis
COGN	Cognitive functioning (subdomain within the AARC-model)
COGN-EMOT	Social-cognitive and social-emotional functioning (subdomain within the AARC-model)
DEAS	German Aging Survey
DemTect	Demential Detection Screening assessment
DIF	Differential item functioning
ENGAGE	Lifestyle and engagement (subdomain within the AARC-model)
FIML	Full information maximum likelihood
ILSE	Interdisciplinary Longitudinal Study of Adult Development
IRT	Item response theory
ISCED	International Standard Classification of Education
LS	Life satisfaction
MIDUS	National Survey of Midlife Development in the U.S.
NA	Negative affect
PA	Positive affect
PANAS	Positive and Negative Affect Schedule
PASW	Predictive Analytics Software
PGCMS	Philadelphia Geriatric Center Morale Scale
PHYS	Health and physical functioning (subdomain within the AARC-model)
RELSHP	Interpersonal relations (subdomain within the AARC-model)
SA	Subjective age

SAE	Subjective aging experience
SES	Socioeconomic status
SF-36	SF-36 Health Survey
SF-LLFDI	Short-Form Late Life Function and Disability Instrument
SP	Statistical power
SRH	Self-rated health
T1 – T3	Time 1 – Time 3
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOL	Valuation of Life
WLSMV	Diagonally weighted least squares estimator with mean and variance adjustment

Description of Personal Contribution for the Publications of this Thesis

I. Publication
Natural occurrence of subjective aging experiences in community-dwelling older adults.

M. Gabrian developed the coding scheme, coded parts of the data, trained research assistants in coding

the data, supervised the coding procedure, conducted the quantitative analyses, and wrote the article.

II. Publication
Attitude Toward Own Aging in midlife and early old age over a 12-year period: Examination of measurement equivalence and developmental trajectories.

M. Gabrian conducted the latent variable modelling and, together with V. C. Elsässer, wrote the article.

III. Publication
Exploring the causal interplay of subjective age and health dimensions in the second half of life: A cross-lagged panel analysis.

M. Gabrian advised on the data analysis and, together with S. Spuling, wrote the article.

IV. Publication
Being slower, feeling older? Experimentally induced cognitive aging experiences have limited impact on subjective age.

M. Gabrian designed the experiment, collected parts of the data and trained a research assistant to ad-

minister the experiment, analyzed the data, and wrote the article.

Declaration in accordance to § 8 (1) b) and § 8 (1) c)
of the doctoral degree regulation of Heidelberg University,
Faculty of Behavioral and Cultural Studies

Promotionsausschuss der Fakultät für Verhaltens- und Empirische Kulturwissenschaften der Ruprecht-Karls-Universität Heidelberg
Doctoral Committee of the Faculty of Behavioral and Cultural Studies, of Heidelberg University

Erklärung gemäß § 8 Abs. 1 Buchst. b) der Promotionsordnung der Universität Heidelberg für die Fakultät für Verhaltens- und Empirische Kulturwissenschaften
Declaration in accordance to § 8 (1) b) of the doctoral degree regulation of Heidelberg University, Faculty of Behavioral and Cultural Studies

Ich erkläre, dass ich die vorgelegte Dissertation selbstständig angefertigt, nur die angegebenen Hilfsmittel benutzt und die Zitate gekennzeichnet habe.
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