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The Changing Conceptualization of Self-Rated Health

Shifting Prediction Patterns for Self-Rated Health in the Second Half of Life

Dissertation

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ABSTRACT

Self-rated health (SRH), the self-evaluation of one's own health status, is a strong and independent predictor for various future health outcomes, including mortality. Previous studies have demonstrated that SRH is predicted by numerous factors: Health constructs (e.g., physical health, physical functioning, health behavior), psychological well-being components (e.g., depressive symptoms, positive affect, life satisfaction), and psychological resources (e.g., subjective age, optimism).

Still, SRH may not mean the same for all individuals: little is known about the changing pattern of predictors influencing SRH across the adult lifespan, across people with different resources and across people from different birth cohorts. The importance of different factors for the conceptualization of SRH can be seen by their predictor strength for SRH (i.e. the weight of a factor for predicting SRH in multivariate analyses).

Assessing age differences in factors predicting SRH has often been limited to a cross-sectional approach in previous studies. However, cross-sectional age group-differences can arise from a number of reasons unrelated to age-related changes such as cohort effects. In order to disentangle age and cohort effects, it is necessary to analyze age- and cohort-related changes in SRH predictor strength with longitudinal, cohort-sequential data. Furthermore, it is not known if age-related changes in SRH predictor strength apply similarly to all ageing individuals, for instance to individuals with different educational status, or if critical life events such as the experience of a serious health event have an impact on SRH predictor strength as well.

Thus, the present dissertation analyzes intra- and inter-individual differences in factors predicting SRH across the adult lifespan. Predictor strength of various factors for SRH is compared across age groups, cohorts, educational status, and before and after the experience of a serious health event. Four research questions are examined in the following chapters:

(1) Does predictor strength for SRH change with age?
(Chapters 2, 3, 4)

(2) Does predictor strength for SRH change with cohort?
(Chapter 3)

(3) Does predictor strength for SRH change with education? (Chapter 4)

(4) Does predictor strength for SRH change after the experience of a serious health event? (Chapter 5)

The data used to answer these questions come from the German Ageing Survey, an ongoing cohort-sequential nationwide representative study investigating the living situation of community-dwelling older adults aged 40 years and older. Recent state-of-the-art analysis methods were employed (e.g., multigroup latent multivariate regression design, accelerated longitudinal design, latent difference score model).

The findings of the present dissertation show that predictor strength for SRH is moderated by age, cohort, educational status, and the experience of a serious health event: The importance of several predictors for SRH changes not only with age (e.g., weaker association with physical functioning with advancing age, stronger association with positive affect and depressive symptoms with advancing age), but differ additionally between cohorts (stronger association with positive affect and depressive symptoms in later-born cohorts), education (e.g., stronger association with physical conditions and loneliness in lower educational groups), and the experience of a serious health event (stronger associations with depressive symptoms and optimism after the event). Thus, health means something different to individuals dependent on how old they are, in which decade they were born, which educational background they have, and if they have experienced a serious health event. Physical conditions on the other hand seem to be of similar importance for SRH up to old age. Consequently, well-known associations between SRH and other outcomes (e.g., mortality) must be examined and confirmed repeatedly within individuals over time, across different birth cohorts, and in different societal groups.

In conclusion, the present dissertation fills important gaps in the literature on SRH by examining intra- and inter-individual differences in how predictor strength for SRH changes within individuals over time, between individuals across cohorts, and across different societal groups. Using advanced statistical research methods, this dissertation advances previous knowledge by applying a longitudinal design throughout all empirical chapters which allows, for example, to disentangle

age and cohort effects. The findings of the present dissertation are therefore a substantial contribution to the literature on SRH and the change in meaning of health over the lifespan.

ZUSAMMENFASSUNG

Die subjektive Gesundheit, das heißt die individuelle Bewertung des eigenen Gesundheitszustandes, ist ein wesentlicher Prädiktor für verschiedenste andere zukünftige Gesundheitsoutcomes, inklusive der ferneren Lebenserwartung. Bisherige Studien haben gezeigt, dass die subjektive Gesundheit nicht allein auf der körperlichen Gesundheit einer Person beruht. Zahlreiche andere Faktoren fließen in die Bewertung der eigenen Gesundheit mit ein: funktionale Gesundheit und körperliche Aktivität, Wohlbefinden (z.B. depressive Symptome, positiver Affekt, Lebenszufriedenheit) sowie psychische Ressourcen (z.B. subjektives Alter, Optimismus).

Es ist jedoch weniger darüber bekannt, ob sich der Zusammenhang zwischen diesen verschiedenen Faktoren und der subjektiven Gesundheit über die Lebensspanne ändert und ob es Unterschiede zwischen Personen mit unterschiedlicher Ressourcenausstattung sowie zwischen Personen unterschiedlicher Geburtskohorten gibt. Bisherige Studien, die Alterseffekte in diesem Zusammenhang untersuchten, basierten oftmals auf Querschnittsuntersuchungen, bei denen verschiedene Altersgruppen miteinander verglichen wurden. Altersgruppenunterschiede im Querschnitt können jedoch auf Kohortenunterschiede zurückgehen. Deshalb ist es notwendig, zwischen Alters- und Kohorteneffekten mit geeigneten Datensätzen und Analysen zu differenzieren. Es ist bislang auch noch nicht untersucht worden, ob altersbedingte Unterschiede hinsichtlich des Zusammenhangs verschiedener Faktoren mit der subjektiven Gesundheit auf alle alternden Menschen gleichermaßen zutreffen, zum Beispiel unabhängig von ihrer Bildung. Schließlich ist bislang unbekannt, welche Rolle eine abrupte Gesundheitsverschlechterung mit Blick auf die Prädiktoren subjektiver Gesundheit spielt.

Das Ziel der vorliegenden Dissertation ist es daher, die Frage zu beantworten, ob es zu intra- und inter-individuellen Unterschieden hinsichtlich der Veränderung der Bedeutung der subjektiven Gesundheit kommt. Im Speziellen sollen folgende vier Forschungsfragen in den folgenden Kapiteln untersucht werden:

(1) Hängt der Zusammenhang verschiedener prädiktiver Faktoren mit der subjektiven Gesundheit vom Alter ab?
(Kapitel 2, 3, 4)

(2) Hängt der Zusammenhang verschiedener prädiktiver Faktoren mit der subjektiven Gesundheit von der Geburtskohorte ab?
(Kapitel 3)

(3) Hängt der Zusammenhang verschiedener prädiktiver Faktoren mit der subjektiven Gesundheit von der Bildung ab?
(Kapitel 4)

(4) Verändert sich der Zusammenhang verschiedener prädiktiver Faktoren mit der subjektiven Gesundheit durch das Erleben eines schwerwiegenden Krankheitsereignisses?
(Kapitel 5)

Die genannten Forschungsfragen wurden mit den Daten des Deutschen Alterssurveys untersucht, einer laufenden bundesweit repräsentativen Quer- und Längsschnittbefragung von Personen, die 40 Jahre oder älter sind und zum ersten Befragungszeitpunkt in einem Privathaushalt leben. Es wurden für die Fragestellung geeignete Analysemethoden angewendet (z.B. ein multivariates Multigruppen-Strukturgleichungsmodell, ein akzelleriertes Längsschnittdesign, ein latentes Differenzwertmodell).

Die Ergebnisse der vorliegenden Dissertation zeigen, dass die subjektive Gesundheit eine soziale Konstruktion ist, die nicht allein die körperliche Gesundheit einer Person widerspiegelt. Der Zusammenhang zwischen verschiedenen prädiktiven Faktoren mit der subjektiven Gesundheit verändert sich nicht nur mit dem Alter (z.B. nimmt der Zusammenhang mit funktionalen Einschränkungen mit steigendem Alter ab, der Zusammenhang mit positivem Affekt und depressiven Symptome nimmt dagegen mit steigendem Alter zu), sondern unterscheidet sich zusätzlich zwischen Personen verschiedener Geburtskohorten (der Zusammenhang mit positivem Affekt und depressiven Symptomen ist in nachfolgenden Geburtskohorten stärker) und in Abhängigkeit von der Bildung einer Person (z.B. ist der Zusammenhang mit körperlichen Erkrankungen und Einsamkeit bei Menschen mit niedrigerer Bildung stärker). Dies bedeutet, dass Gesundheit jeweils etwas anderes für Personen bedeutet, je nachdem wie alt sie sind, wann sie geboren wurden und welchen Bildungshintergrund sie haben.

Außerdem verändert das Erleben eines schwerwiegenden Krankheitsereignisses den Zusammenhang zwischen einigen Faktoren mit der subjektiven Gesundheit (nach Erleben eines schwerwiegenden Krankheitsereignisses hängen depressive Symptome und Optimismus stärker mit der subjektiven Gesundheit zusammen als zuvor). Körperliche Erkrankungen sind dagegen bis ins hohe Alter ein stabiler und wichtiger Faktor für die subjektive Gesundheit. Aufgrund dieser differentiellen Prädiktorstruktur müssen wohlbekannte Zusammenhänge zwischen der subjektiven Gesundheit und anderen Outcomes (z.B. der Sterblichkeit) auch in Zukunft mit Personen unterschiedlichen Alters, verschiedener Geburtskohorten und in verschiedenen sozialen Gruppen wiederholt untersucht und bestätigt werden.

Zusammenfassend lässt sich sagen, dass die vorliegende Dissertation wichtige Forschungslücken hinsichtlich der Bedeutung der subjektiven Gesundheit füllt, indem intra- und inter-individuelle Unterschiede hinsichtlich der Veränderung des Zusammenhangs verschiedener Faktoren mit der subjektiven Gesundheit innerhalb von Personen über die Zeit sowie zwischen Personen verschiedener Geburtskohorten und verschiedener Bildungsgruppen untersucht werden. Die Datenanalyse in dieser Dissertation zeichnet sich durch die Anwendung modernster statistischer Analysemethoden im Längsschnitt aus, die zum Beispiel eine Unterscheidung von Alters- und Kohorteneffekten ermöglichen. Die Ergebnisse der vorliegenden Dissertation tragen damit bedeutende und substanzielle Erkenntnisse zur Erforschung der subjektiven Gesundheit und zur Veränderung der Bedeutung der Gesundheit über die Lebensspanne bei.

CHAPTER 1

GENERAL INTRODUCTION

Background: Ageing and Health

Health is important over the whole lifespan but it is of particular importance in the second half of life. Good health is a precondition for older people to live independently, to spend time with family and friends, and to participate in the community. However, with advancing age many people experience chronic health conditions and losses in functional capacities. As life expectancy increases, more and more people grow older, hence, the health status of older people gains individual, societal and political relevance. Current life expectancy at birth in Germany is over 78 years for men and over 83 years for women – further life expectancy at age 65 is over 17 years for men and over 20 years for women (Statistisches Bundesamt, 2014). The increased life expectancy leads to concerns regarding the quality of life of older people: Does the increase in life expectancy add only years to life (in terms of reducing mortality) or does it also result in "life added to years" (in terms of decreasing morbidity and increasing quality of life)?

In order to address these questions, aging research relies on different indicators of health. Physical health refers to (chronic) health conditions, functional health refers to difficulties in activities of daily living such as problems with climbing stairs or carrying heavy bags, and self-rated health (SRH) refers to the individual evaluation of one's own health status. Although all of these facets are meant to assess the health status, they tend to disaggregate with advancing age. Chronic conditions quite often lead to functional impairments, but this might not be true for everyone. Moreover, chronic conditions do not necessarily affect SRH in old age. While physical health (and also functional health) deteriorate with advancing age, SRH remains relatively high across the adult lifespan. Hence, one might assume that SRH does not simply reflect the objective health status of a person, but is influenced by other factors as well.

Aging research has explored the pattern of factors predictive of SRH. Although there is a large body of evidence on the relevance of various predictors for SRH, it is still an open question if the pattern of SRH predictors is stable across the lifespan, across cohorts, and across social groups. Hence, the shifting prediction patterns for SRH in the second half of life is the topic of the present dissertation.

Self-Rated Health as an Important Health Dimension in the Second Half of Life

SRH is part of many large-scale surveys as a proxy for a more comprehensive measure of objective health status, since it is very easy to administer. Normally SRH consists of a single item. In the German Ageing Survey (*Deutscher Alterssurvey*, DEAS) people are asked: "How would you rate your present state of health?" and to answer that question on a 5-point scale ranging from "very good" to "very bad" (Engstler et al., 2013). This single item is the evaluation of the individual global health status in contrast to other SRH-items such as retrospective and prospective change in health as well as age-comparison. The focus of the present dissertation is on global SRH.

SRH correlates with other health dimensions mentioned above but captures something different. Poor SRH often reflects the presence of one (or several) chronic health conditions, more or less functional impairment or the presence of depressive symptoms or other mental health disorders and good SRH is often a sign for good physical, functional and mental health. However, this association between objective and subjective health weakens with advancing age. It is possible that a person reports good SRH despite the presence of chronic conditions, functional impairments and mental health problems. Different health dimensions show different trajectories over the adult lifespan. Physical health starts to deteriorate in middle adulthood as individuals often tend to develop (chronic) conditions such as osteoporosis or cardiovascular diseases in this age span (Barnett et al., 2012). Functional health starts to worsen somewhat at the beginning of old age (Aarts et al., 2012). In contrast, SRH is rather stable over the whole lifespan – at least it does not decline to the same extent as physical and functional health (e.g., Jylhä, Guralnik, Balfour, & Fired, 2001; Leinonen, Heikkinen, & Jylhä, 2001; Liang et al., 2005).

SRH is an excellent predictor for various future health outcomes. SRH predicts for example future morbidity (Fayers & Sprangers, 2002), physical and cognitive functioning (Bond, Dickinson, Matthews, Jagger, & Brayne, 2006), and hospitalization (Kennedy, Kasl, & Vaccarino, 2001). Especially the association between SRH and mortality is well researched and documented: it could be shown repeatedly that SRH predicts mortality over and beyond objective health measures (e.g., Benyamini & Idler, 1999; DeSalvo, Bloser, Reynolds, He, & Muntner, 2005;

Idler & Benyamini, 1997). Idler and Benyamini (1997) propose four different explanations why SRH is a valid predictor of future health outcomes: SRH is a more inclusive measure than other health measures used in many studies; SRH is a dynamic evaluation reflecting not only the current health status but also health trajectories and expectations regarding future developments; SRH influences health behaviors such as smoking and physical activity which in turn affects the physical health status; and SRH reflects the availability of various resources such as social support, optimism, and control strategies which in turn affect ones ability to cope with deteriorations in health status (Benyamini, 2011).

Taken together, SRH has very good criterion-related validity. But what do we know about its content validity? As SRH itself is a predictor for various future health outcomes and is used in many surveys as a proxy for health, it is important to understand what exactly is measured by SRH.

Predictors of Self-Rated Health

SRH is, to some extent, based on the actual health status, but many other factors influence SRH as well.

Health dimensions are strong SRH predictors. SRH relies especially on the physical health status. This is why physical health is and will remain the main determinant of SRH up to old age (Galenkamp, Braam, Huisman, & Deeg, 2011; Manderbacka, Lundberg, & Martikainen, 1999). However, other health dimensions such as functional and mental health also influence the health self-perception (e.g., Schnittker, 2005). Individuals do not only consider their physical health status when evaluating their health but also their impairments in everyday life (functional health) and their mental well-being (mental health).

Besides various health dimensions other aspects as health also influence SRH. These other aspects are lifestyle factors, indicators of psychological well-being and various other psychological resources. Previous studies have shown that better SRH is associated with more physical activity (Darviri, Artemiadis, Tigani, & Alexopoulos, 2011), higher positive affect (Benyamini, Idler, Leventhal, & Leventhal, 2000), higher life satisfaction (Siahpush, Spittal, & Singh, 2008), and

less loneliness (Nummela, Seppänen, & Uutela, 2011). Subjective age (in contrast to chronological age) is also a powerful psychological resource – it itself is predictive for psychological health (Westerhof & Barrett, 2005), for physiological health (Westerhof et al., 2014) and even for longevity (Uotinen, Rantanen, & Suutama, 2005). However, less is known about its longitudinal influence on SRH. This is why the present dissertation investigates its influence on SRH longitudinally and additionally in different age groups.

The evidence presented so far shows convincingly that SRH relies on physical and functional health, but also on psychological factors. However, the main question of the present dissertation is not *which* predictors influence SRH, but if these predictors influence SRH *differentially*? According to the model of health evaluation developed by Marja Jylhä (2009) the importance of SRH predictors might change with age, cohort or education.

As can be seen in Figure 1.1, it is assumed that in a first step individuals identify various components that should be taken into account to evaluate their health status. These components are for example physical health conditions, functional impairments, symptoms, various health behaviors (e.g., smoking, physical activity). In a second step, one considers the way in which the components should be taken into account. This means each component is weighted according to different factors such as age, comparisons to age peers, past health experiences and future health expectations. For example, the presence of chronic conditions might influence SRH differentially dependent on the age of the individual (see below). In a last step, one has to decide which of the presented options of the scale best describes ones current health status.

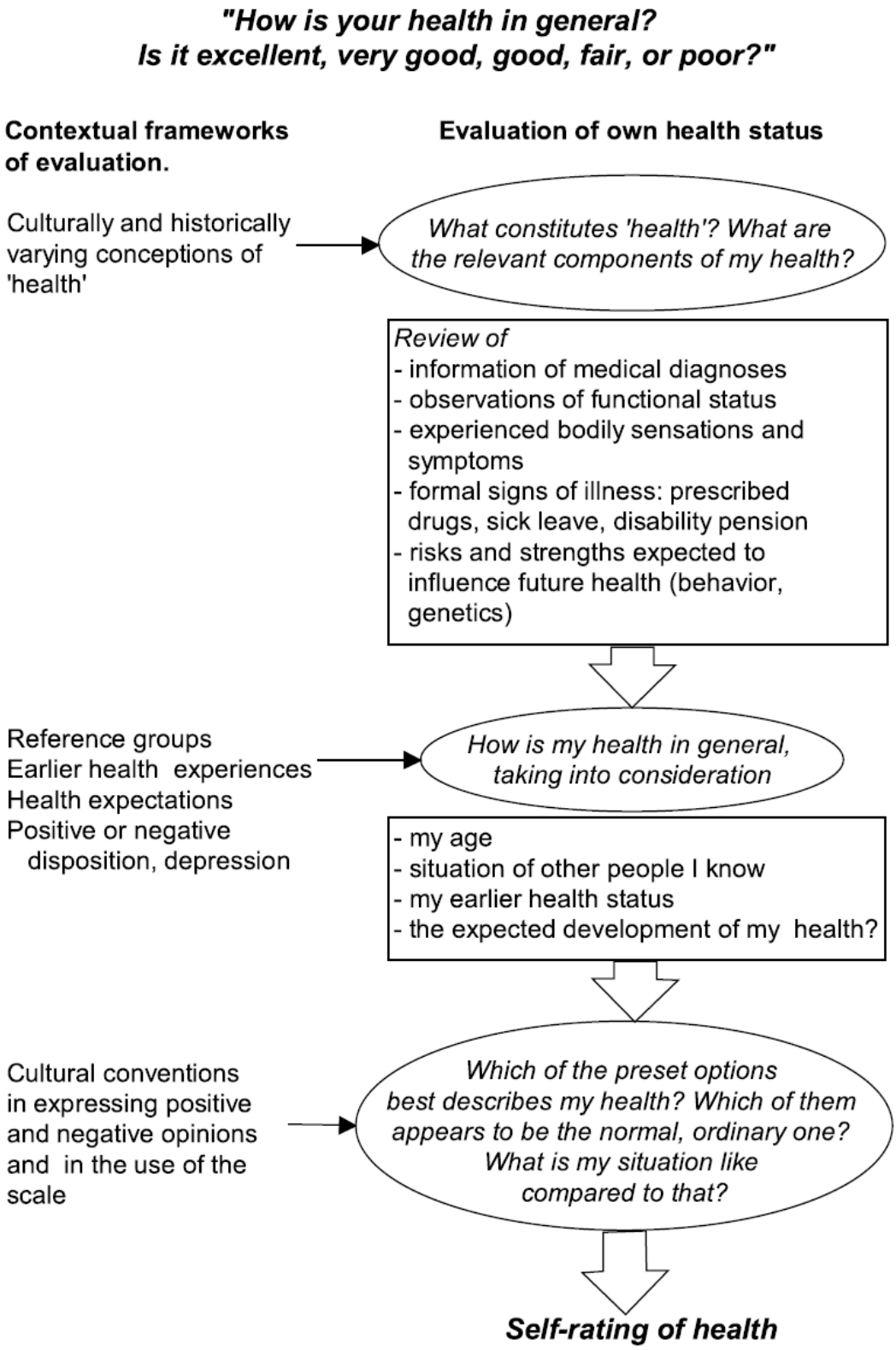

Figure 1.1 The process of individual health evaluation according to Jylhä (2009).

Differential Patterns of Self-Rated Health Predictor Strength

The present dissertation focuses on the second step of the health evaluation process. Therefore, the main aim is to examine, if and how various predictors change in importance for SRH with age, cohort, education, and after the experience of a serious health event (abrupt worsening of the health status).

Age Differences in Predictor Strength for Self-Rated Health

As pointed out above, SRH remains relatively stable with advancing age although physical health worsens and functional impairments increase. In other words, the association between SRH and objective health indicators lessens as individuals grow older (Pinquart, 2001). For example, Liang and colleagues (2005) showed that SRH becomes only slightly worse between the ages of 60 and 85 years, while there is a stronger decrease in physical health. The maintenance of good SRH across the ageing process despite worsening physical health and physical functioning suggests that factors constituting SRH change with age (e.g., Leinonen et al., 2001). Physical and functional losses are to some extent expected with advancing age and consequently are so-called on-time events in later life (Neugarten, 1996). This means they are expected to occur in older ages and, hence, have a smaller impact on SRH.

Furthermore, the ability to adjust personal goals and standards (accommodative coping; Brandtstädter, 1989; Brandtstädter & Rothermund, 2002) might facilitate the maintenance of high SRH. As goals and standards for the meaning of good health also change during the ageing process, indicators for SRH may change with age. To maintain good SRH despite worsening objective health status, the individual conceptualization of “good health” might change by reweighting different factors constituting the health self-perception. This process of reweighting factors is called reprioritization response shift (Rapkin & Schwartz, 2004; Sprangers & Schwartz, 1999; see also below).

Consequently, SRH might mean something different for different age groups. For older people, SRH might more strongly reflect psychological adaptation to worsening health than for younger adults (Idler & Benyamini, 1997) as a result of reweighting different factors constituting SRH. In line with this assumption, several studies showed that the association between various health factors and

SRH decreases with age, while psychological well-being factors such as positive affect and depressive symptoms gain in importance for SRH (e.g., Benyamini et al., 2000; French, Sargent-Cox, & Luszcz, 2012; Jylhä, Leskinen, Alanen, Leskinen, & Heikkinen, 1986; Schnittker, 2005; Shooshtari, Menec, & Tate, 2007). It seems that individuals incorporate more strongly those factors into their health self-perception that might help them to maintain high levels of SRH despite age-related physical and functional health losses. However, previous studies often used cross-sectional age-group differences to examine changing predictor strength for SRH with advancing age. Differences between age groups were interpreted as a result of individual reweighting processes associated with ageing. But it needs a longitudinal approach to demonstrate that the reweighting process occurs at the individual level. This is why all empirical chapters of the present dissertation examine their respective research questions longitudinally.

Taken together, there is evidence that the pattern of predictor strength for SRH changes with advancing age. As deteriorating health is part of the normal ageing process but SRH is rather stable with age, it is assumed that health predictors for SRH lose in importance, while psychological well-being factors gain in importance with advancing age. However, previous research in this field was normally based on cross-sectional analyses. A longitudinal approach is required to confirm that these reweighting processes occur on the individual level. Hence, the first research question (RQ) reads as follows:

Does predictor strength for SRH change with age? (RQ1)

Cohort Differences in Predictor Strength for Self-Rated Health

Chronological age is not the only relevant factor that influences predictor strength for SRH. The above-described age group-differences in associations between psychological constructs can arise for a number of reasons unrelated to age-related changes (Lindenberger, von Oertzen, Ghisletta, & Hertzog, 2011). Consequently, a closer look at age-related changes and alternative explanations is needed.

An alternative explanation of age-related changes regarding predictor strength for SRH might be cohort. There are several arguments leading to the assumption that predictors of SRH have changed over historical time, resulting in cohort effects. First, societies experience a change in values stemming from rising

prosperity and the associated lack of threats to basic physiological (e.g., food, water) and safety needs (e.g., security of body, family and health; cf. Maslow's [1954] hierarchy of needs). If these basic needs are satisfied, as for many people living in advanced industrial societies, individuals tend to long for postmodern values such as self-realization and self-esteem (Inglehart, 1977, 1997). The primary goal, thus, is no longer to ensure survival, but to enhance quality of life and subjective well-being. The general societal change in values can also be seen in the changing societal definition of health. While early medical approaches defined health primarily as the absence of diseases, the modern definition of health is broader and incorporates mental and social well-being (World Health Organization [WHO], 1948). Furthermore, the definition and detection of diseases has also changed substantially: Problems that had once been considered outside the purview of medicine became defined and treated as medical problems (Conrad & Waggoner, 2014). This medicalization in combination with advances in technology (e.g., screenings, increasingly sensitive tests) leads to an increase in prevalence rates for various diseases such as depression (Joyce, Oakley-Browne, Wells, Bushnell, & Hornblow, 1990; Wittchen, Knäuper, & Kessler, 1994) on the one hand, but also to overdiagnosis (Moynihan, Doust, & Henry, 2012) on the other hand. There is also empirical evidence that the mean level of reported depressive symptoms is higher in later-born cohorts on the population level (Brault, Meuleman, & Bracke, 2012; Yang, 2007). At the same time SRH has proven to be better in earlier-born cohorts (Chen, Cohen, & Kasen, 2007; Idler, 1993; Jagger et al., 2007) – a result that might reflect the changing definition of health in the direction of a broader understanding including various aspects besides the physical health status (Chen et al., 2007; Jagger et al., 2007; Jylhä, 2009). Consequently, later-born cohorts would be expected to place greater emphasis on their state of psychological well-being when evaluating their overall health status.

Taken together, a broader definition of health, which includes not only physical diseases but additionally psychological well-being in combination with medical developments regarding the definition and detection of diseases, might lead to cohort effects regarding predictor strength of SRH. However, the question whether predictor strength for SRH differs between cohorts has not been examined to date in aging research. Because of broader definitions of health, it is assumed that factors of psychological well-being do not only gain in importance with

advancing age but are also especially important in later-born cohorts. Hence, the second research question of the present dissertation reads as follows:

Does predictor strength for SRH change with cohort? (RQ2)

Educational Differences in Predictor Strength for Self-Rated Health

As described above predictor strength for SRH certainly varies with age and may additionally vary with cohort. However, cohort is not the only additional factor to be considered in this field of research. An important subsequent question would be, whether age-related changes of predictor strength for SRH can be generalized to all ageing individuals.

It is well known that higher education is strongly associated with better health in general but also with better SRH in particular (Leopold & Engelhartdt, 2013). Education and health are associated for various reasons: according to Ross and Wu (1995) education influences health via economic and psychosocial resources as well as via health behaviors. Higher education implies more knowledge – including more knowledge about the beneficial effects of various health behaviors such as a healthy diet, not smoking or physical activity for the general health status. Furthermore, education is associated with individually experienced stress: according to the Family Stress Model (Conger, Rueter, & Conger, 1999), the probability to experience existential hardships and disrupted family relationships is higher in less educated groups as compared to higher educated groups since less education is associated with lower income, which in turn can lead to high economic pressure. Besides more knowledge and less stress in terms of the experience of existential hardships, higher educated individuals also have more psychosocial resources available (Reserve Capacity Model; Gallo & Matthews, 2003) which in turn have positive effects on health as well (Schöllgen, Huxhold, Schütz, & Tesch-Römer, 2011) as they facilitate to establish or maintain a healthy lifestyle for example achieved by regular physical activity. Additionally, psychosocial resources might attenuate the negative effect of poor health on SRH. As higher education is accompanied with more pronounced psychosocial resources (Schöllgen et al., 2011), health factors might be less important for SRH in higher educated individuals than in lower educated individuals. Furthermore, factors of psychological well-being may be less important for SRH in higher than in lower

educated individuals since higher education is accompanied by better health as described above. This means higher educated individuals have no “need” to compensate for poor health by emphasizing the importance of factors of psychological well-being for a stable and good SRH – in middle age at least.

Apart from having better health in general, the onset of age-related decline in health tends to start later in higher educated individuals than in lower educated individuals (Herd, Goesling, & House, 2007; Zajacova, Montez, & Herd, 2004). This is important for changing predictor strengths for SRH as social comparisons play a crucial role in the self-evaluation process of the own health status (Jylhä, 2009): people tend to rate their health in comparison to same-age peers and also in comparison to what they think is normal. As the social network tends to be homogenous in terms of social status (McPherson, Smith-Lovin, & Cook, 2001), it is probable that individuals rather compare themselves within the own educational group. However, as the onset of age-related decline in health begins on average earlier in lower educated individuals (Herd et al., 2007), the age-related changes regarding predictor strength for SRH might also differ between educational groups. Reweighting of SRH predictors, as characterized by a declining importance of health factors and an increasing importance of psychological well-being factors for SRH with advancing age, might start earlier for lower educated individuals as they are earlier in “need” to compensate for poor health.

Taken together, there are several reasons to believe that predictor strength for SRH might differ not only according to age and cohort but additionally according to education. Lower education is not only accompanied by worse health but also by less pronounced psychosocial resources and an earlier onset of age-related decline in health. However, education as a moderating factor regarding predictor strength for SRH has not been considered to date. Hence, the third research question of the present dissertation reads as follows:

Does predictor strength for SRH change with education? (RQ3)

Differences in Predictor Strength for Self-Rated Health After the Experience of a Serious Health Event

The first three research questions refer to changes regarding SRH predictors while experiencing normal age-related declines in physical and functional health. As described above, previous studies have repeatedly shown that many older adults still rate their health as good or even as very good although they experience those normative health declines (Jylhä et al., 2001; Leinonen et al., 2001; Liang et al., 2005). However, less is known about changes in SRH and associated adaptation mechanisms due to abrupt health declines such as a serious health event.

Only few longitudinal studies examined the general effects of various serious health events on SRH in the general (older) population (Diehr, Williamson, Patrick, Bild, & Burke, 2001; Wilcox, Kasl, & Idler, 1996; Wurm, Tomasik, & Tesch-Römer, 2008; Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). These studies have shown that the experience of a serious health event generally leads to decreases in SRH. However, these studies have also found that older-aged people sometimes report stable or even better SRH after the experience of a serious health event. One interpretation by Wilcox and colleagues (1996) is that changes in SRH after a serious health event might rather indicate individual adaptation to the serious health event than the actual impact of the serious health event on the physical health status. One very powerful adaptation mechanism in this context might be response shift. Response shift refers to various cognitive processes, which might help to maintain stable SRH despite declines in physical and functional health. According to Sprangers and Schwartz (1999) three types of response shift can be distinguished: recalibration, reprioritization, and reconceptualization response shift.

Recalibration response shift refers to a change in internal standards. This means that stable SRH despite the experience of a serious health event results because of lowered standards for good health. In line with this assumption, previous studies have shown that for people who experienced a serious health event there is often no change in SRH on an observable level (Bernhard, Lowy, Maibach, & Hürny, 2001; Hillen, Davies, Rudd, Kieselbach, & Wolfe, 2003; Yardley & Dibb, 2007). However, if people are directly asked about changes in SRH in the course of an experienced serious health event, individuals often report a decline in health. Several studies suggest, that in this case (stable SRH on an observable

level but a subjective decline in SRH when asked directly about a change in health) individuals tend to retrospectively overestimate their previous health assessment. For example, Galenkamp, Huisman, Braam, and Deeg (2012) showed that individuals who experienced an incident chronic disease were more likely to retrospectively overestimate their previous health assessment as compared to individuals who did not experience an incident disease in the same time period (mean follow-up: 3.6 years). This means that, although SRH is rather stable on an observable level, individuals might indeed experience a decline on a subjective level, but adapt to this experienced health decline by lowering their standards for good health and consequently tend to retrospectively overestimate their previous health assessments.

Reprioritization response shift refers to changes in values or priorities. This means that stable SRH despite the experience of a serious health event is the result of a change in the level of contribution of various predictors regarding their importance for SRH. As described above, reprioritization response shift is a powerful adaptation mechanism during the normal ageing process, where individuals are faced with physical and functional health declines. Empirical evidence supports this assumption by showing that health factors lose, while psychological well-being factors gain in importance for SRH with advancing age (e.g., Schnittker, 2005; Shooshtarie et al., 2007). This means, although SRH is rather stable on an observable level, individuals experience a decline in health on a subjective level, but adapt to this experienced health decline by changes in the individual weighting of factors that contribute to good SRH.

Reconceptualization response shift refers to a change in the definition of a concept. This means reconceptualization is an even stronger mechanism than reprioritization response shift. Concerning SRH this means, the very same predictor is not associated with SRH at one point in time but is significant at a later point in time (or the other way around). In this way, reconceptualization response shift is an extreme case of reprioritization response shift because predictors are not only reweighted (reprioritization) but deemed irrelevant (reconceptualization).

All three response shift types are powerful adaptation mechanisms not only for individuals, who are faced with a health threat such as a serious health event, but also for all ageing individuals in general who experience an age-related decline in physical and functional health. Consequently, all three response shift types can

be present during the normal ageing process. Previous studies have already shown that standards for good health decrease with age-related decreases in health (recalibration; e.g., Galenkamp et al., 2012; Idler, 1993) and health factors lose, while psychological well-being factors gain in importance for SRH with advancing age (reprioritization; e.g., Schnittker, 2005; Shooshtarie et al., 2007). However, as the experience of a serious health event is accompanied by an abrupt disruption of routines in which individuals need to cope with strong health declines, response shift should be even more pronounced as compared to individuals experiencing normal age-related health declines during the same time period. This comparison between an event group (=individuals experiencing a serious health event) and a no event group (=individuals without a serious health event) is a major strength of the present dissertation. Usually, response shift is studied in clinical samples, lacking not only a comparison group but also information regarding the concept of interest (in this case SRH) before the experience of a serious health event. Furthermore, the present dissertation considers various health events instead of only one specific health event and examines all three types of response shift simultaneously.

Taken together, the experience of a serious health event is accompanied by an abrupt disruption of routines in which individuals need to cope with strong health declines. As described above, predictor strength for SRH changes with age to maintain rather stable SRH despite experiencing age-related declines in physical and functional health. This adaptation mechanism is called reprioritization response shift and would be expected to be even more pronounced in individuals experiencing a serious health event as compared to individuals who only experience normal age-related health declines in the same time period. However, response shift is usually studied in the field of quality of life research and less is known about response shift in SRH in the general older population. Hence, the fourth research question of the present dissertation reads as follows:

Does predictor strength for SRH change after the experience of a serious health event? (RQ4)

Data Base: The German Ageing Survey

To answer the research questions presented in the previous section, data of the German Ageing Survey (DEAS) were used. The DEAS is an ongoing nationwide representative cross-sectional and longitudinal survey of the German population aged 40 years and older living in private households with a cohort-sequential design. The first DEAS wave was conducted in 1996. Since then every six years (2002, 2008, 2014) a new cross-sectional baseline sample is drawn by means of national probability sampling, stratified by age, gender, and place of residence. Additionally, former baseline samples are followed over time. Consequently since 2002 the DEAS consists of a baseline sample as well as a panel sample. Starting in 2008, the DEAS panel has been conducted every three years. The DEAS study design is displayed in Figure 1.2. As can be seen, cross-sectional analyses are possible as well as analyses of social change and analyses of intra-individual development. For the present dissertation data of the collection waves in 1996, 2002, 2008, and 2011 are used.

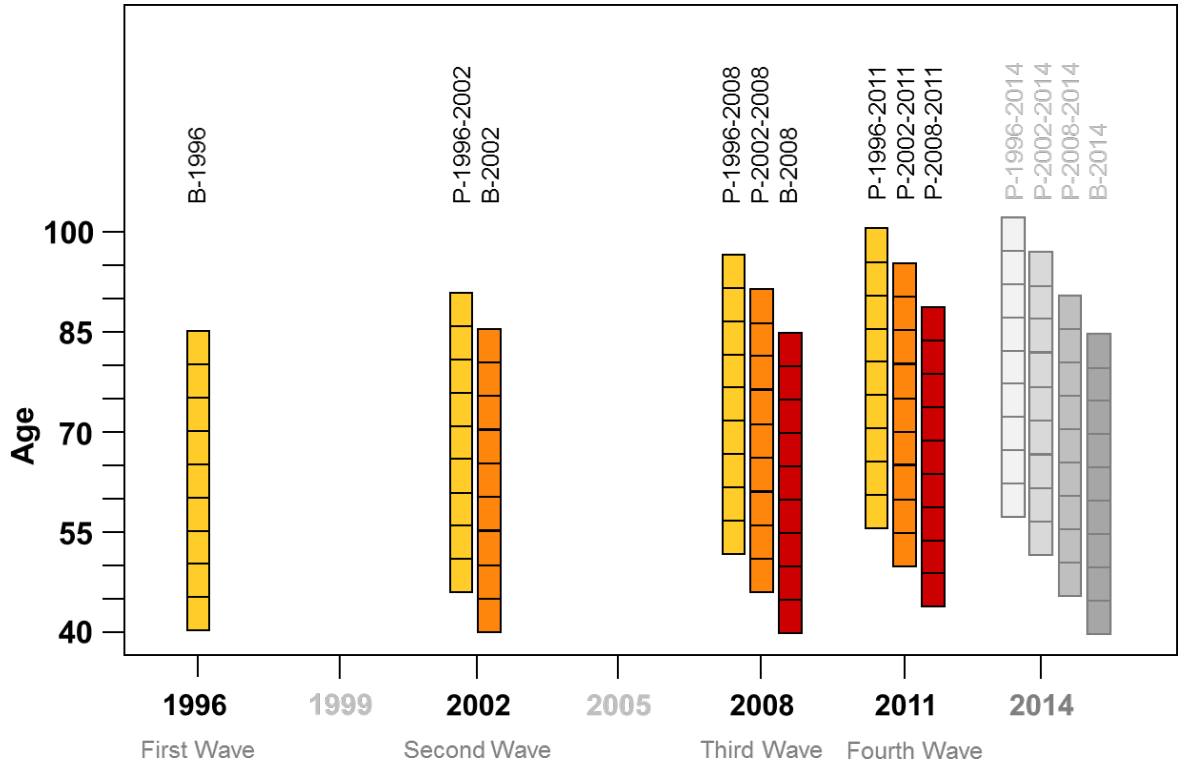

Figure 1.2 Design of the German Ageing Survey (DEAS)

The DEAS instrument consists of two parts: a face-to-face interview and a paper and pencil questionnaire (drop-off). The personal interviews were conducted by trained interviewers using a PAPI (paper assisted personal interview) approach in 1996 and 2002 and a CAPI (computer assisted personal interview) approach since 2008. The personal interview covers most of the health measures relevant for the present dissertation such as SRH, functional impairments, and depressive symptoms, while most psychological measures such as positive affect, life satisfaction, and loneliness are part of the self-administered questionnaire.

Taken together, the DEAS is an excellent data pool to answer the research questions outlined above as it consists of a large nationwide representative sample of the German population covering a broad age range, includes a broad range of variables such as various health aspects as well as diverse factors of psychological well-being, and the design allows for analyses of intra-individual development over a long time period.

Structure and Aims of the Present Dissertation

Previous studies often focused on which predictors influence SRH. And even if age as a possible moderator was taken into account, the studies were often limited by a cross-sectional approach which confound age and cohort effects. Additionally, no study to date examined, whether age-related changes in predictor strength for SRH can be generalized to all ageing individuals (in the present case meaning all educational groups) or if predictor strength change after the experience of a serious health event. Therefore, the present dissertation aims at answering the open question *how* various predictors influence SRH *differentially*. To answer this overall question the preceding general introduction led to four research questions:

1) Does predictor strength for SRH change with age?
2) Does predictor strength for SRH change with cohort?
3) Does predictor strength for SRH change with education?
4) Does predictor strength for SRH change after the experience of a serious health event?

The following four chapters present empirical analyses to answer the four research questions listed above. *Chapter 2* examines the influence of a powerful psychological resource, namely subjective age, and considers possible age effects in the relevance of subjective age for SRH (RQ1). DEAS data from 2002 and 2008 are included in the analyses to regress SRH in 2008 on subjective age in 2002 for middle aged (40-64 years) and older adults (65 years and older).

Chapter 3 also focuses on RQ1 as it examines the influence of various predictors of health and psychological well-being differentially for various age groups over time. Other than in Chapter 2 various health predictors (physical conditions, functional impairments, and exercise) and indicators of psychological well-being (depressive symptoms, positive affect, and life satisfaction) are considered. Using data from the 2002 and 2008 DEAS waves as well, seven age groups with an age range of six years each are constructed, to match the longitudinal distance between the two measurement occasions. To disentangle age and possible cohort effects regarding the association between various predictors and SRH (RQ2), cross-sectional age-group differences are compared to changes within age groups over time.

Chapter 4 deals with the question, whether age-related changes of predictor strength for SRH can be generalized to all ageing individuals – in this case to different educational groups (RQ3). Some information regarding age effects on SRH predictors (RQ1) is already provided in the preceding two chapters but analyses are extended here by taking other indicators of subjective well-being (negative affect and loneliness) into account and by stratifying the analyses according to educational status (RQ3). Data is used from two baseline samples of the DEAS (1996, 2002) and their corresponding follow-up occasions (1996-2002-2008, 2002-2008).

Chapter 5 focuses on whether predictor strength of physical conditions and various indicators of psychological well-being (depressive symptoms, positive affect) as well as psychological resources (optimism, subjective age) for SRH changes after the occurrence of a serious health event such as the individual experience of an abrupt health decline (RQ4). Therefore, it is examined whether the association between various predictors and SRH changes before as compared to after the serious health event. This chapter focuses on older adults only (65

years and older) and includes data from two measurement occasions of the DEAS in 2008 and 2011.

Finally, *Chapter 6* provides a general discussion of the findings. The discussion integrates the findings into several academic disciplines and closes with an outlook to future research and practical implications.

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CHAPTER 2

Exploring the Interplay of Subjective Age and Health Dimensions in the Second Half of Life

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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.

Keywords: subjective age, health dimensions, longitudinal, causal interplay

Introduction

As part of the normal ageing process, physical health and functioning become increasingly fragile. At the same time, health restrictions are an integral part of stereotyped views of the ageing 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 self-stereotypes (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 (2010) 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, 2012) 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, 2015), 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 regard 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 Analyses

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 2.1) 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.

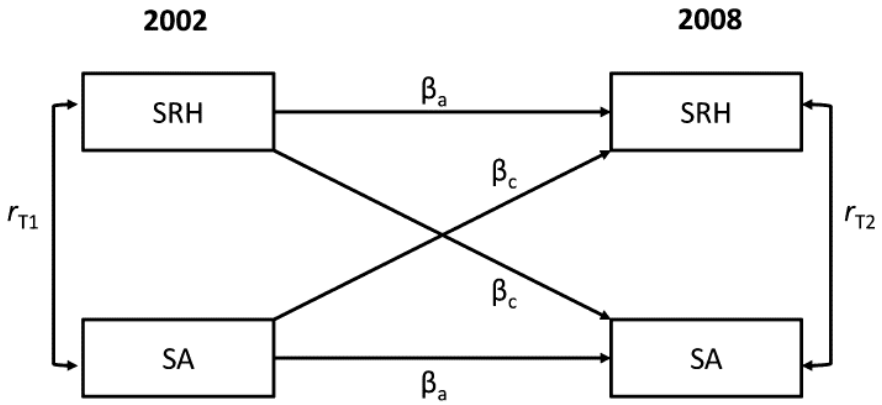

Figure 2.1 Illustration of the cross-lagged panel design to examine the causal relationship between subjective age (SA) and self-rated health (SRH). β_a = standardized autoregressive path coefficients; β_c = standardized cross-lagged path coefficients; r_{T1}, r_{T2} = correlations at baseline in 2002 (T_1) and reassessment in 2008 (T_2), respectively.

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).

Results

Descriptive Results

Means and standard deviations of subjective age and the four health dimensions are displayed in Table 2.1 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, $t(2518.615) = -4.896$, $p < .05$.

Table 2.1 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 Stratified

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)

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

Cross-Sectional Results

Table 2.2 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.

Causal Pathways

Standardized regression coefficients of cross-lagged panel models are shown in Table 2.3 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 ($\beta = .07$, $p < .05$; $\Delta X^2 = 2.893$, $\Delta df = 1$, $p > .05$); the coefficient reached significance in both age groups. There was also no significant age-group difference for the reverse relationship ($\beta = .05$, $p > .05$; $\Delta X^2 = 1.866$, $\Delta df = 1$, $p > .05$); in the constrained model, physical conditions did not predict subjective age in either age group.

Table 2.2 *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
	Total	-			
01 Subjective age	Middle	-			
	Old	-			
	Total	.10	-		
02 Physical conditions	Middle	.07	-		
	Old	.19	-		
	Total	-.16	-.47	-	
03 Functional health	Middle	-.13	-.37	-	
	Old	-.25	-.42	-	
	Total	-.25	-.45	.61	-
04 Self-rated health	Middle	-.24	-.39	.54	-
	Old	-.31	-.42	.62	-
	Total	.24	.27	-.40	-.49
05 Depressive symptoms	Middle	.24	.24	-.33	-.45
	Old	.25	.27	-.46	-.52

Note. All coefficients are adjusted using full information maximum likelihood (FIML) procedure and are considered 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)

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 ($\beta = -.08$, $p < .05$; $\Delta X^2 = 0.232$, $\Delta df = 1$, $p > .05$). 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 ($\beta_{middle\text{-}aged} = -.09$, $\beta_{old\text{-}aged} = -.11$, $p < .05$; $\Delta X^2 = 0.213$, $\Delta df = 1$, $p > .05$), just as self-rated health seems to be a predictor for subjective age in the middle-aged and the old-aged ($\beta = -.10$, $p < .05$; $\Delta X^2 = 0.694$, $\Delta df = 1$, $p > .05$).

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 ($\beta = .08$, $p < .05$; $\Delta X^2 = 0.001$, $\Delta df = 1$, $p > .05$). 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 ($\beta_{middle\text{-}aged} = .10$, $\beta_{old\text{-}aged} = .12$, $p < .05$; $\Delta X^2 = 0.019$, $\Delta df = 1$, $p > .05$); subjective age thus seems to be predictive of depressive symptoms in both age groups.

Table 2.3 *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) [a]	**.11 (.06)** [b]
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) [c]	**-.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) [a]	-.05 (.07) [a]
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) [a]	.11 (.07)

Note. 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, in 2002; old-aged: 65 years and over at T_1, in 2002), respectively. All correlations and autoregressive paths are considered 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 between age groups. [b] Coefficient was no longer significant after cross-lagged paths were set equal between age groups. [c] Coefficient reached significance after cross-lagged paths were set equal within the total sample.

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., 2012; 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 speculate 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 (2012) 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., in press). Furthermore, although a subjective age rating close to or greater than a person's chronological age may be interpreted as an indicator of an increased (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.

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CHAPTER 3

Changing Predictors of Self-Rated Health: Disentangling Age and Cohort Effects

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Abstract

Previous studies have shown that some predictors of self-rated health (SRH) become more important with age, while others become less important. Although based on cross-sectional data, these findings are often interpreted as age-related changes in evaluation criteria. However, results could be due to cohort effects as well. We attempted to disentangle age and cohort effects by combining and comparing cross-sectional and longitudinal data from a large-scale longitudinal survey. The sample consisted of 2,982 community- dwelling participants from 2 measurement occasions of the German Ageing Survey ages 40–81 years at baseline. Multigroup latent regression models were used to examine whether associations between various predictors and SRH differed between age groups and whether they changed over time. Comparisons of cross-sectional age differences in SRH-predictor associations and longitudinal age changes in the same associations allow the identification of cohort effects. Number of chronic conditions showed a constant negative association with SRH independently of age and cohort. In contrast, the association between SRH and all other predictors (physical functioning, exercise, life satisfaction, depressive symptoms, and positive affect) changed longitudinally, pointing to an age effect. Prediction of SRH by depressive symptoms and positive affect showed an additional cohort effect: The negative associations between depressive symptoms and SRH and the positive associations between positive affect and SRH were stronger among younger cohorts. The findings provide not only longitudinal support for previous cross-sectional studies, but also show the impact of historical change: Emotional facets of psychological well-being increase in relevance for SRH across cohorts.

Keywords: aging, self-rated health, cohort, comparison, longitudinal

Introduction

Self-rated health (SRH) – the self-perception and self-evaluation of one's health status – has been used as an efficient measure of health. While many large-scale surveys used SRH as a "proxy" for a more comprehensive measure of objective health, what is also interesting is that measures of SRH and objective health are often at odds, particularly in later life. Moreover, in many studies, SRH turned out to be a better predictor of mortality than objective health indicators (e.g., Benyamini & Idler, 1999; DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Idler & Benyamini, 1997). Additionally, numerous studies support an independent impact of SRH on physical functioning and cognitive health (Bond, Dickinson, Matthews, Jagger, & Brayne, 2006), future morbidity (Fayers & Sprangers, 2002), and hospitalization (Kennedy, Kasl, & Vaccarino, 2001). These findings raise the questions of which factors predict SRH, and if these factors change with age.

Jylhä (2009) introduced a model that describes SRH as resulting from a complex evaluation process. According to Jylhä's model, SRH first results from an interaction between various health factors (e.g., number of chronic conditions, physical functioning, health behaviors) and additional factors people take into consideration (e.g., chronological age, health expectations). Second, the model assumes that the importance of some of the evaluation criteria change with age. This suggests that SRH might mean something different at different age groups. In older people, SRH might more strongly reflect psychological adaptation to worsening health than in younger adults (Idler & Benyamini, 1997). Physical losses may be coped with by shifting from a temporal comparison of the current state of health with previous health states to a social comparison with people of the same age (response shift; Rapkin & Schwartz, 2004; Sprangers & Schwartz, 1999). In addition, the ability to adjust personal goals and standards (accommodative coping; Brandtstädter, 1989; Brandtstädter & Rothermund, 2002) might facilitate the maintenance of high SRH. As goals and standards for the meaning of good health also change during the aging process, indicators for SRH may change with age.

A novel aspect pointed out by Jylhä (2009) concerns the impact of social change. Conceptions of health might change over historical time. If, for example, the societal value of positive emotionality had increased during the last century, then it would follow that the level of positive emotions may have gained

importance as a factor in the subjective evaluation of health in later-born birth cohorts. Hence, the associative strength between predictors and SRH might not only depend on age but also on birth cohort. Thus far, the potentially changing importance of different predictors across cohorts (i.e., over historical time) has not been taken into account in empirical studies.

Based on the three assumptions mentioned earlier (i.e., there are multiple factors influencing SRH, these factors might change with age, and, additionally, these factors might be dependent on historical social change), it is possible to distinguish three types of SRH predictors. Some SRH predictors might change with age. For example, older people might feel healthy "for their age" because they expected to be worse off at their present age or because they have the impression that many other people of the same age have more serious health problems. Other SRH predictors might change because of societal changes that take place in historical time. Different birth cohorts grow old in different societal contexts, which might be associated with varying interpretation and understanding of health. For example, younger birth cohorts (i.e., those born later) might more strongly include their psychological well-being when rating their health, while older birth cohorts might tend to more strongly focus on their physical functioning. Finally, some SRH predictors might be relevant for predicting SRH regardless of age or cohort effects. Predictors of SRH can therefore be *invariant* (showing a constant influence on SRH across age groups and cohorts), *age contextual* (showing a changing influence with advancing age), or *cohort contextual* (showing a changing influence across different birth cohorts). The present study seeks to disentangle the invariant, age-contextual, or cohort-contextual association of predictors with SRH using a combination of cross-sectional and longitudinal data from a large representative survey.

The Role of Chronological Age for Predictors of Self-Rated Health

SRH is based on physical health status, but numerous other factors play an additional role (Quinn, Johnson, Poon, & Martin, 1999). Lifestyle factors such as physical activity (Darviri, Artemiadis, Tigani, & Alexopoulos, 2011) and indicators of psychological well-being such as depressive symptoms (Schnittker, 2005), positive affect (Benyamini, Idler, Leventhal, & Leventhal, 2000; Pressman &

Cohen, 2005), and life satisfaction (Siahpush, Spittal, & Singh, 2008) were shown to predict SRH, as well.

However, not all predictors exert a constant influence on SRH. The association between SRH and objective health indicators lessens as individuals grow older (Pinquart, 2001). For example, Liang and colleagues (2005) showed that SRH becomes only slightly worse between the ages of 60 and 85 years, while there is a stronger decrease in physical health. The maintenance of good SRH across the aging process despite worsening physical health and physical functioning suggests that factors constituting SRH change with age (e.g., Leinonen, Heikkinen, & Jylhä, 2001). To maintain good SRH despite worsening objective health, the individual conceptualization of what "good health" is might change by reweighting different factors constituting the self-perception. In line with this assumption, several studies showed that the association between various health factors and SRH decreases with age, while psychological well-being factors such as positive affect and depressive symptoms gain in importance for SRH (e.g., Benyamini et al., 2000; French, Sargent-Cox, & Luszcz, 2012; Jylhä, Leskinen, Alanen, Leskinen, & Heikkinen, 1986; Schnittker, 2005; Shooshtari, Menec, & Tate, 2007). As age-group differences in associations between psychological constructs can arise for a number of reasons unrelated to age-related changes (Lindenberger, von Oertzen, Ghisletta, & Hertzog, 2011), a closer look at age-related changes and alternative explanations such as cohort differences is needed.

The Role of Cohort Effects for Predictors of Self-Rated Health

To date, examinations of the age-related "change" of predictors for SRH as described above are commonly based on cross- sectional differences between age groups. Age-group differences, however, could not only arise because of age effects but also because of cohort effects (Costa & McCrae, 1982). Thus, it remains unclear whether predictors of SRH solely vary by age or whether they are additionally subject to cohort effects. Three possibly interrelated trends might have changed the predictors of SRH over historical time, resulting in cohort effects.

First, according to Inglehart (1977, 1997), advanced industrial societies experience a change in values stemming from rising prosperity and the associated lack of threats to basic physiological (e.g., food, water) and safety needs (e.g.,

security of body, family and health; cf. Maslow's [1954] hierarchy of needs). If these basic needs are satisfied, as for many people living in advanced industrial societies, individuals tend to long for postmodern values such as self-realization and self-esteem (Inglehart, 1977, 1997). The primary goal, thus, is no longer to ensure survival, but to enhance quality of life and well-being.

Second, there is a changing societal definition of health, possibly tied to the change of societal values described. While early medical approaches defined health primarily as the absence of disease, the modern definition of health is broader and incorporates mental and social well-being (World Health Organization [WHO], 1948). There is empirical evidence that SRH is better in earlier-born cohorts (Chen, Cohen, & Kasen, 2007; Idler, 1993; Jagger et al., 2007), perhaps because their conception of health is narrower. Later-born cohorts seem to have higher expectations about their health status or, at least, broader definitions of health (Chen et al., 2007; Jagger et al., 2007; Jylhä, 2009), both of which could explain why the relevance of different SRH predictors differs between birth cohorts.

Third, the definition and detection of diseases has also changed substantially: Problems that had once been considered outside the purview of medicine became defined and treated as medical problems (Conrad & Waggoner, 2014). This medicalization in combination with advances in technology (e.g., screenings, increasingly sensitive tests) leads to an increase in prevalence rates for various diseases such as depression (Joyce, Oakley-Browne, Wells, Bushnell, & Hornblow, 1990; Wittchen, Knäuper, & Kessler, 1994) on the one hand, but also to overdiagnosis (Moynihan, Doust, & Henry, 2012) on the other hand. In particular, in the domain of mental health, pharmaceutical companies have launched campaigns to ensure that new diagnoses of disease states are recognized in the population (Ebeling, 2011). There is also empirical evidence that the mean level of reported depressive symptoms is higher in later-born cohorts on the population level (Brault, Meuleman, & Bracke, 2012; Yang, 2007). With respect to SRH, these developments imply that later-born birth cohorts would be expected to place greater emphasis on their state of psychological well-being when evaluating their overall health status.

Study Goals and Hypotheses

Taken together, studies regarding different predictors of SRH across the lifespan have examined cross-sectional age group differences. Differences in predictor strength were interpreted as resulting from individual reweighting of criteria associated with aging. However, a longitudinal approach (i.e., contrast of predictor strengths for the same individuals at different points in time) is needed to demonstrate that the reweighting process occurs at the individual level. As previously described, chronological age is not the only relevant factor that influences SRH; rather, cohort differences can simultaneously play a role in this context. A recent study by Sutin and colleagues (2013) illustrates the need to disentangle age and cohort effects by showing that well-being decreases with age when ignoring birth cohort but actually is increasing with age when taking birth cohort additionally into account. A differentiation between age and cohort effects is only possible by combining cross-sectional and longitudinal data (Schaie & Baltes, 1975). This allows comparison of age-group differences in the cross section with individual change over time in the longitudinal section (see also Figure 3.1 for a visualization of age and cohort effects regarding predictors of SRH). By applying this approach, it is possible to broadly describe different predictors as invariant or as age contextual and/or cohort contextual.

The present study examines the importance of three health factors (number of chronic conditions, physical functioning, and exercise) and three psychological well-being indicators (life satisfaction, depressive symptoms, and positive affect) that were shown to predict SRH in previous studies (e.g., Benyamini et al., 2000; French et al., 2012; Shooshtari et al., 2007). As individuals often maintain good (or stable) SRH up to old age alongside worsening physical health status, it is assumed that health-related indicators may become less important SRH predictors with advancing age, while indicators of psychological well-being are expected to become more important (Benyamini et al., 2000; French et al. 2012; Jylhä et al., 1986; Schnittker, 2005; Shooshtari et al., 2007). Furthermore, because of historically changing conceptions of health, indicators of psychological well-being could be additionally subject to cohort effects.

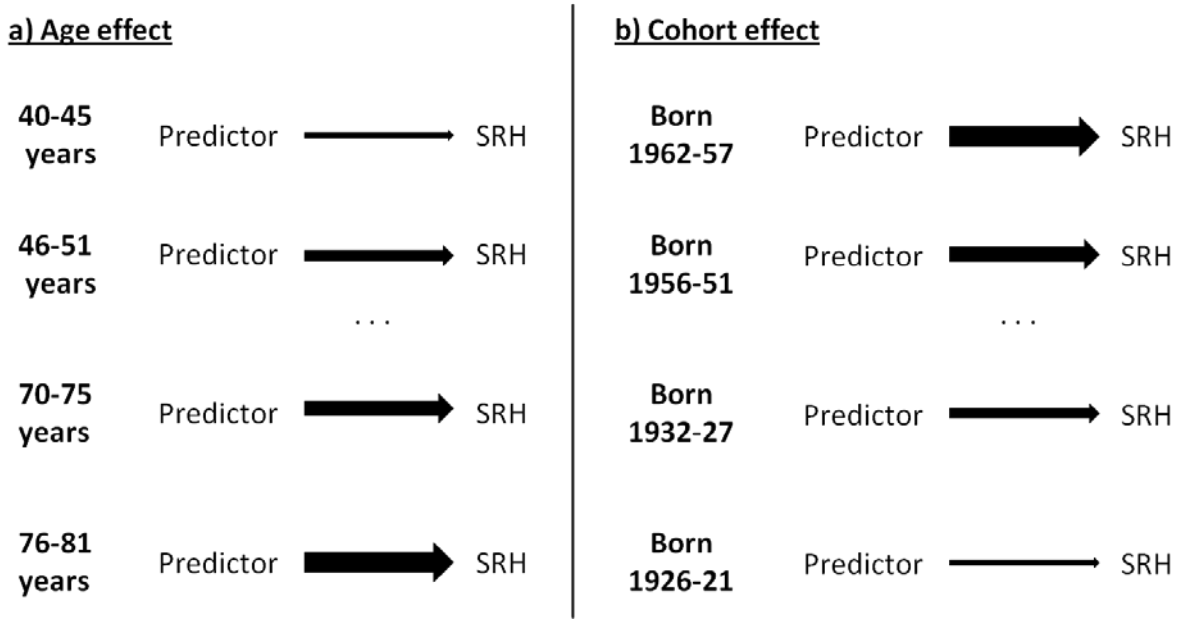

Figure 3.1 Exemplary visualization of possible age effects and cohort effects regarding predictors of self-rated health (SRH). Thinner arrows represent a smaller impact of this predictor on SRH. Thicker arrows represent a larger impact of this predictor on SRH. On the left, an age- contextual predictor with increasing impact on SRH with advancing age is shown. To exemplify that age-contextual and cohort-contextual effects can have opposing impacts, on the right, a cohort-contextual predictor with increasing influence on SRH in later-born cohorts is shown.

We therefore expect to observe age-related increases in importance for SRH as well as possible birth cohort effects for all three psychological well-being indicators. At least for positive affect and depressive symptoms previous studies have shown that associations with SRH are stronger in older age groups (Benyamini et al., 2000; Schnittker, 2005). This is why we treat life satisfaction, depressive symptoms, and positive affect in our hypotheses equally, as all three constructs represent a facet of psychological well-being. Simultaneously, we would be able to detect differential effects for positive and negative (life satisfaction/positive affect vs. depressive symptoms) or rather cognitive and emotional facets (life satisfaction vs. positive affect/depressive symptoms) of psychological well-being.

Taken together, our hypotheses are

Hypothesis 1: Health predictors have a decreasing association with SRH with advancing age (age-contextual predictors of decreasing strength).

Hypothesis 2: Psychological well-being predictors have an increasing association with SRH with advancing age (age-contextual predictors of increasing strength).

Hypothesis 3: Psychological well-being predictors are not only age-contextual predictors but are additionally subject to cohort effects (cohort-contextual predictors of increasing strength).

Method

Design and Sample

Data came from the German Ageing Survey (DEAS), an ongoing cohort-sequential nationwide representative survey of community-dwelling adults age 40 years and over. For this study, longitudinal data from the 2002 (baseline) and 2008 (follow-up) waves were used. In the present study, we only used the new baseline sample from the data collection wave in 2002 (N = 3,084), which was drawn by means of national probability sampling with stratified sampling by age, gender, and place of residence (Eastern or Western Germany). Of the original sample, 58.3% (1,087 individuals) could be interviewed again in 2008 (Engstler & Motel-Klingebiel, 2010). Follow-up participants were on average healthier and reported fewer depressive symptoms and a higher level of positive affect and life satisfaction; they were also younger and better educated. Nevertheless, dropout analysis (Lindenberger, Singer, & Baltes, 2002) showed that all selectivity effects never reached a medium effect size of 0.5 SD. We excluded participants with missing values on all variables used in the present study. All in all, data from 2,982 participants ages 40 to 81 years in 2002 (and 46 to 87 years in 2008, respectively) were analyzed in the present study.

Measures

Self-Rated Health

SRH was measured by a single item asking, "How do you assess your current state of health?" Response categories were *very good*, *good*, *average*, *bad*, and *very bad* on a 5-point scale (European version of SRH; WHO, 1996). Higher values indicate better SRH. We treated this variable as continuous as evidence suggests that SRH forms a continuum from poor to good health (Mackenbach, van den Bos, Joung, van de Mheen, & Stronks, 1994; Manderbacka, Lahelma, & Martikainen, 1998).

Health Predictors

Number of chronic conditions were assessed by a checklist of 11 health problems (e.g., cardiovascular diseases, gastrointestinal diseases). For each participant, a sum score was computed based on the absolute number of self-reported chronic conditions. We chose to use sum scores instead of single-reported chronic conditions, as sum scores yield the strongest correlations between medical and self-reports (Katz, Chang, Sangha, Fossel, & Bates, 1996). Higher values on the sum score indicate more self-reported chronic conditions. *Physical functioning* was measured by the Physical Functioning subscale of the SF-36 (Bullinger & Kirchberger, 1998). Impairments in everyday activities (e.g., walking, climbing stairs, carrying shopping bags) due to current health status were rated on a 3-point scale (1 = *yes, limited a lot* to 3 = *no, not limited at all*). The scale was transformed to a range of 0–100, with higher values indicating better physical functioning. *Exercise* was assessed by a single item asking, "How often do you do endurance sports, for example, swimming, long-distance running, jogging, cycling, or similar activities?" (*never* to *daily* on a 6-point scale). Higher values indicate more frequent sporting activities.

Psychological Well-Being Predictors

Life satisfaction was assessed with the Satisfaction With Life Scale (Pavot & Diener, 1993). All five items were rated on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). *Depressive symptoms* were assessed by the 15-item German version of the Center for Epidemiological Studies Depression Scale (Hautzinger, 1988). Participants were asked to indicate the frequency with which they experienced several depressive symptoms (e.g., being sad, trouble sleeping)

during the past week on a 4-point scale, with 1 = *rarely or none of the time—less than 1 day long* and 4 = *most or all of the time—5 to 7 days long*. A sum score was computed and transformed to a range of 0–45. Higher values indicate more frequent depressive symptoms. *Positive affect* was measured with the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). Participants were asked to indicate with 10 positive affect items how they felt (e.g., excited, inspired) during the past few months on a 5-point scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*).

Control Variables

Region (Eastern and Western Germany) and gender were used as controls, as the DEAS is a disproportionably stratified sample according to these variables.[1] Education (three categories according to the International Standard Classification of Education; United Nations Educational, Scientific, and Cultural Organization, 1997) was considered as a control variable because of the strong relationship between health and education (e.g., Lynch, 2003).

Statistical Analyses

Statistical analyses were conducted using Mplus 7 (Muthén & Muthén, 1998–2010). The large amount of missing data in 2008 was taken into account by applying the full information maximum likelihood procedure. By using all available data regardless of whether participants stayed in the study, we minimized potential differential sample attrition effects, as biases in parameter estimates are less severe if all information available is considered in contrast to using complete case information only (Graham, 2009; Newman, 2003). Furthermore, available-case analyses have substantially higher power than their complete-case counterparts (Graham, Cumsille, & Shevock, 2013). All variables at 2002 and at 2008 were converted to *T* scores (M = 50, SD = 10) using the mean and standard deviation at 2002 for standardization at 2008. When possible, predictors were operationalized as latent factors with two manifest indicators (i.e., two item parcels, each containing half of the items regarding the predictor at hand; Little, Cunningham, Shahar, & Widaman, 2002). Number of chronic conditions, physical

[1] The DEAS is also stratified by age, but we did not include age as a covariate because of the age groups with 6-year intervals we created (cf. statistical analyses).

functioning, life satisfaction, depressive symptoms, and positive affect showed measurement invariance between age groups and over time (differences of Comparative Fit Index for each indicator were less than or equal to 0.01 between the more restricted and the less restricted model; Cheung & Rensvold, 2002). SRH and exercise were operationalized as manifest variables as these measures consisted of single item questions. For latent variables, the loading of the first manifest indicator was fixed at one (as reference point to be able to estimate the model), and the loading of the second indicator was set equal over time (to ensure measurement equivalence). Intercepts of the manifest indicators were fixed at zero so that latent changes were conceptualized as changes in factor means.

We constructed seven age groups, each with an age range of 6 years. This distance matched the longitudinal distance between the two measurement occasions. To evaluate what constitutes SRH in different age groups and at different measurement occasions, we used multigroup latent multivariate regression models to test whether the regression weights of different predictors of SRH differed between age groups in the cross section and changed within age groups in the longitudinal section. This question is different from the "driver of change" question that could be addressed with a change score model (e.g., Schöllgen, Huxhold, & Schmiedek, 2012). Possible changes of regression coefficients were assumed to be linear, meaning that the regression weight changed for every 6-year interval by the same amount. For each predictor, a separate model was estimated to simplify the interpretation of the results as the extent of the unique effect of the predictor on SRH is dependent on the covariance between the predictor and a third variable unrelated to SRH (see Lindenberger & Pötter, 1998). Model fit was evaluated by the root-mean-square error of approximation (RMSEA; Steiger, 1990). Values of RMSEA close to .08 (or smaller) indicate acceptable fit (Marsh, Hau, & Wen, 2004). Only RMSEA for final models of each indicator are reported.

We illustrate our approach in Figure 3.2. In the analyses, we first compared the importance of a predictor for SRH between the different age groups shown for the year 2002 (vertical solid lines and change in cross section [Δ_{CS}] in Figure 3.2). If the strength of a predictor is weaker in younger age groups and stronger in older age groups, this could be due to age-related changes and/or cohort effects. To disentangle age and cohort effects, we used the following approach: In each of the seven age groups shown in Figure 3.2, SRH was regressed on the predictor, both

in 2002 and 2008. If the importance of this predictor for SRH changes over time (dashed lines and change in longitudinal section [Δ_{LS}] in Figure 3.2) in a way that corresponds to differences between age groups in the cross section in 2002 (that is, $\Delta_{LS} = \Delta_{CS}$), it suggests that cross-sectional age-group differences can (at least partially) be interpreted as age-related change. To test for birth cohort effects, we compared individuals who were the same age but were born at different points in time – for example, those who reached the age of 46 to 51 in 2002 and those who reached the same age in 2008. If the importance of the predictor for SRH does not differ between cohorts of the same age (that is, $\Delta_{LS} = \Delta_{CS}$ and, consequently, $b2_{02} = b1_{08}$), the finding suggests that cohort differences do not play an additional role. However, if the importance of the predictor at hand on SRH is stronger for later-born birth cohorts (i.e., for those who reached the same age only in 2008) this might point to an increasing importance of the predictor for later-born birth cohorts. To statistically test age-group differences in the cross section, changes within age groups in the longitudinal section as well as cohort differences, we used X^2-difference tests in three different models.

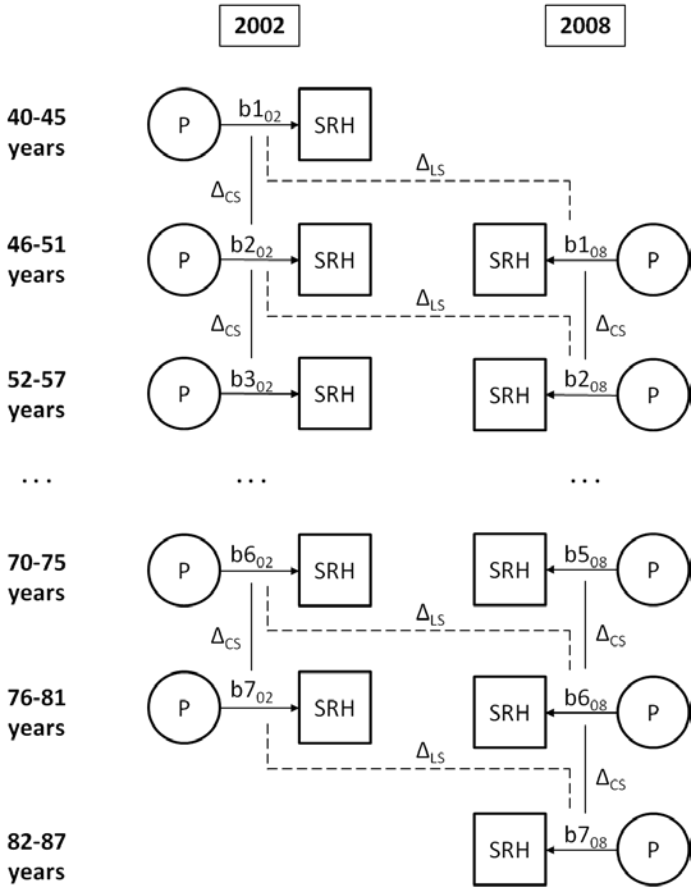

Figure 3.2 Regression model with multiple group design to examine the relationship between self-rated health (SRH) and a predictor (P). $b1_{02}$ to $b7_{02}$ represent the unstandardized regression coefficients in 2002 in each age group, $b1_{08}$ to $b7_{08}$ the unstandardized regression coefficients for 2008. Δ_{CS} (solid line) represents the linear change in regression coefficients between the age groups in the cross section (in 2002 and 2008). Δ_{LS} (dashed line) represents the linear change in regression coefficients within each age group between 2002 and 2008. SRH in 2002 and SRH in 2008 are allowed to correlate within each age group (not shown in figure). The same holds true for all predictors in 2002 and 2008. Individuals ages 40 to 45 in 2002 reached the age of 46 to 51 6 years later, which is why Figure 3.2 does not contain the age group 40 to 45 in 2008, and correspondingly, no individuals ages 82 to 87 years in 2002.

In Model 1, Δ_{CS} and Δ_{LS} were fixed at zero ($\Delta_{CS} = \Delta_{LS} = 0$). This means the regression coefficients are the same in every age group at both measurement occasions. In Model 2, Δ_{CS} and Δ_{LS} were allowed to vary as the same linear function ($\Delta_{CS} = \Delta_{LS} \neq 0$). This means the regression coefficients change linearly by the same amount between age groups in the cross section (Δ_{CS}) and within age groups in the longitudinal section (Δ_{LS}). In Model 3, Δ_{CS} and Δ_{LS} were allowed to vary as independent linear functions ($\Delta_{CS} \neq \Delta_{LS} \neq 0$). This means the linear change of regression coefficients differs between age groups in the cross section (Δ_{CS}) and

within age groups in the longitudinal section (Δ_{LS}).[2] Alpha was set at .05. A nonsignificant contrast between Model 1 and Model 2 indicates that the predictor is invariant across age and cohorts. A significant contrast between Model 1 and Model 2 suggests that the predictor is at least an age-contextual predictor. A significant contrast between Model 2 and Model 3 implies that the tested predictor is not only age contextual but also cohort contextual. With our approach, a "pure" cohort effect could only be detected if the differences between age groups in the cross section had been significant ($\Delta_{CS} \neq 0$) but not the longitudinal effect ($\Delta_{LS} = 0$). This was not the case for any predictor.

Finally, we tested whether the effects changed when region, gender and education are considered as controls. The inclusion of the sample stratification factors as covariates makes sample weights unnecessary (Winship & Radbill, 1994).

The Mplus code can be found in the appendix (A1).

Results

Descriptive statistics for the sample (49.6% female, 32.9% living in Eastern Germany, 14% with a low education) are displayed in Table 3.1. SRH and physical functioning were lower in older age groups and decreased over time, whereas number of chronic conditions was lower in younger age groups and increased over time. The amount of exercise decreased over age groups in the cross section starting with the age group of 58–63 years but increased in every age group over time. Depressive symptoms remained relatively stable in the first five age groups and then increased notably while there was a decrease in every age group over

[2] In a fourth step, we additionally tested for every predictor whether a difference could be found regarding the linear change of regression coefficients among the age groups between the two cross sections 2002 and 2008 (Δ_{CS} in 2002 ≠ Δ_{CS} in 2008 ≠ Δ_{LS} ≠ 0; Model 4). A significant contrast between Model 3 and Model 4 would suggest that there is not only a difference in linear change regarding the regression coefficients between and within age groups, but that the linear change differs between age groups for 2002 and 2008 – suggesting a possible period effect. However, this was not the case for any of the studied predictors. For an easier understanding, we only use "ΔCS" to indicate change between age groups in the cross section (both for 2002 and for 2008).

time (except for the age group of 76–81 years). Positive affect as well as life satisfaction remained relatively stable over age groups and over time.

All model parameters displayed in this section were taken from models without controls. Including the controls did not substantially change the model results. Therefore, we present results from models without controls for the sake of simplicity. All final models fitted the data well: number of chronic conditions RMSEA = .06, physical functioning RMSEA = .05, exercise RMSEA = .06, depressive symptoms RMSEA = .05, positive affect RMSEA = .04 and life satisfaction RMSEA = .04.

Health and psychological well-being were significantly associated with SRH. The average prediction strength in terms of the average unstandardized regression coefficient (standard errors in parentheses) was b = -0.70 (.03) for number of chronic conditions, b = 0.63 (.02) for physical functioning, b = 0.16 (.02) for exercise, b = -0.52 (.02) for depressive symptoms, b = 0.40 (.02) for positive affect, and b = 0.43 (.02) for life satisfaction (according to Model 1, where no change at all regarding regression coefficients was assumed between and within age groups). The left side of Table 3.2 shows regressions of SRH on health and psychological well-being. The middle of Table 3.2 shows linear change of regression coefficients between age groups in the cross section (Δ_{CS}) and within age groups in the longitudinal section (Δ_{LS}), according to final models. For each predictor, unstandardized regression coefficients in the youngest age group in 2002 and 2008 are displayed. With this information, one is able to generate every regression coefficient of the regression model shown in Figure 3.2 by adding up the linear change in the cross section, Δ_{CS}, or in the longitudinal section, Δ_{LS}. For example, the unstandardized regression coefficient for depressive symptoms in the youngest age group (40–45 years) is b = -0.42 in 2002 (cf. Table 3.2). By adding -0.02 (=Δ_{CS}, cf. Table 3.2) this results in the unstandardized regression coefficient for the second youngest age group (46–51 years; b = -0.45[3]) in 2002. In a similar vein, adding -0.14 (=Δ_{LS}, cf. Table 3.2) to the unstandardized regression coefficient for depressive symptoms in the youngest age group (40–45 years) in 2002 results in the unstandardized regression coefficient for the youngest age group (46–51 years) in 2008 (b = 0.56).

[3] Rounding differences exist due to rounding to two digits after the decimal. The same applies to Table 3.2 and Figure 3.3.

Table 3.1 Sample Characteristics for the Total Sample (N = 2,982) in 2002 and 2008 According to Age Group

	Age group (2002)						
Variables	40-45 years (born 1957-1962) *n* = 441	46-51 years (born 1951-1956) *n* = 429	52-57 years (born 1945-1950) *n* = 344	58-63 years (born 1939-1944) *n* = 472	64-69 years (born 1933-1938) *n* = 394	70-75 years (born 1927-1932) *n* = 504	76-81 years (born 1921-1926) *n* = 398
Self-rated health[a]							
2002	3.83 (0.76)	3.76 (0.76)	3.63 (0.88)	3.53 (0.83)	3.43 (0.83)	3.29 (0.87)	3.06 (0.94)
2008	3.58 (0.82)	3.57 (0.84)	3.50 (0.95)	3.60 (0.82)	3.36 (0.76)	3.10 (0.85)	2.92 (0.92)
No. of chronic conditions[b]							
2002	1.19 (1.33)	1.50 (1.45)	1.95 (1.76)	2.22 (1.82)	2.59 (1.76)	2.89 (1.89)	3.36 (1.90)
2008	1.58 (1.36)	1.74 (1.47)	2.02 (1.64)	2.18 (1.76)	3.09 (2.04)	3.69 (2.13)	3.55 (2.03)
Physical functioning[c]							
2002	94.32 (14.36)	93.94 (13.76)	89.82 (17.91)	85.28 (21.24)	82.19 (22.04)	75.25 (26.02)	63.07 (29.94)
2008	90.41 (16.84)	89.24 (18.73)	85.61 (23.58)	84.40 (20.00)	78.48 (23.62)	67.53 (27.80)	54.50 (31.75)
Exercise[d]							
2002	2.83 (1.71)	2.89 (1.64)	2.64 (1.64)	2.83 (1.76)	2.46 (1.78)	2.08 (1.67)	1.75 (1.47)
2008	3.23 (1.76)	3.14 (1.67)	3.16 (1.83)	3.05 (1.83)	2.85 (1.82)	2.56 (2.00)	2.28 (1.86)
Life satisfaction[e]							
2002	3.66 (0.79)	3.76 (0.85)	3.74 (0.78)	3.93 (0.73)	3.93 (0.75)	3.88 (0.76)	3.72 (0.88)
2008	3.68 (0.78)	3.66 (0.77)	3.77 (0.70)	3.86 (0.73)	3.72 (0.77)	3.80 (0.73)	3.89 (0.73)
Depressive symptoms[f]							
2002	7.25 (6.40)	6.73 (6.60)	7.06 (6.54)	7.04 (6.03)	6.66 (5.90)	7.94 (6.39)	9.37 (7.22)
2008	6.42 (5.44)	6.00 (5.60)	6.08 (5.66)	5.42 (5.74)	5.94 (4.98)	7.24 (5.42)	9.38 (6.31)
Positive affect[g]							
2002	3.56 (0.55)	3.57 (0.58)	3.52 (0.58)	3.54 (0.53)	3.46 (0.57)	3.34 (0.62)	3.18 (0.70)
2008	3.49 (0.56)	3.54 (0.53)	3.51 (0.54)	3.50 (0.46)	3.47 (0.52)	3.27 (0.63)	3.26 (0.60)

Note. Sample characteristics are shown in means (*M*) with standard deviation (*SD*) in parentheses. To control for potential differential sample attrition effects, all reported parameters are adjusted using full information maximum likelihood procedure (see Statistical Analysis section).

[a] Single item rated on 5-point Likert scale. [b] Based on a checklist of 11 health problems. [c] Physical Functioning subscale of the SF-36 (Bullinger & Kirchberger, 1998), 10 items rated on a 3-point Likert scale. [d] Single item rated on a 6-point Likert scale. [e] Satisfaction With Life Scale (Pavot & Diener, 1993), five items rated on a 5-point Likert scale. [f] Center for Epidemiological Studies Depression Scale (Hautzinger, 1988), 15 items rated on a 4-point Likert scale. [g] Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), 10 items rated on a 5-point Likert scale.

Predictors of SRH could show the same strength for all age groups (invariant predictor), an increasing or decreasing association with SRH with advancing age (age-contextual predictor), differences between birth cohorts (cohort-contextual predictor), or a combination of age- and cohort-contextual effects. The present study revealed that in fact three different patterns exist for SRH predictors: invariant, age-contextual, and a combination of age- and cohort-contextual predictors; they are described in the following.

Table 3.2 Regression Coefficients, Linear Change of Regression Coefficients, and Kind of Finding from Age-Group-Stratified Regressions of Self-Rated Health on Different Health and Psychological Well-Being Predictors in 2002 and 2008

	Regression coefficients *b*(*SE*)		Linear change Δ(*SE*)		
Predictor	b_{02}(*SE*)	b_{08}(*SE*)	Δ_{CS}(*SE*)	Δ_{LS}(*SE*)	Kind of finding
No. of chronic conditions	-0.70 (0.03)		-		Age-invariant
Physical functioning	0.78 (0.04)	0.74 (0.03)	-0.04 (0.01)		Age-contextual
Exercise	0.11 (0.03)	0.13 (0.02)	0.02 (0.01)		Age-contextual
Life satisfaction	0.36 (0.03)	0.38 (0.03)	0.02 (0.01)		Age-contextual
Depressive symptoms	-0.42 (0.03)	-0.56 (0.04)	-0.02[a] (0.01)	-0.14 (0.04)	Age- and cohort-contextual
Positive affect	0.36 (0.04)	0.47 (0.05)	0.01[a] (0.01)	0.11 (0.04)	Age- and cohort-contextual

Note. Unstandardized regression coefficients (*b*) and standard errors (*SE*) are from models regressing self-rated health on health and psychological well-being predictors separately. Displayed is only the regression coefficient of the youngest age group, as well as the linear change of regression coefficients between (cross-sectional linear change, Δ_{CS}) and within age groups over time (longitudinal linear change; Δ_{LS}). If only one coefficient is shown, it means that regression coefficients do not differ between 2002 and 2008 ($b_{02} = b_{08}$) or linear change does not differ between and within age groups ($\Delta_{CS} = \Delta_{LS}$). Unless otherwise indicated, coefficients differ significantly from zero ($p < .05$).

[a] Not significant at the $p < .05$ level.

Invariant Predictors of Self-Rated Health

The contrast between Models 1 and 2 was not significant for number of chronic conditions only, $\Delta X^2 = 2.98$, $\Delta df = 1$, $p > .05$. Regression coefficients were equally high in every age group in both measurement occasions: Δ_{CS} (solid line) = Δ_{LS} (dashed line) = 0 (see left side of Figure 3.3). This means, as one can see in Figure 3.4 (top), the number of chronic conditions shows a constant association with SRH between age groups in the cross section and within age groups in the

longitudinal section. This means that, contrary to our hypothesis, number of chronic conditions was an invariant predictor for SRH.

Age-Contextual Predictors of Self-Rated Health

For physical functioning, the contrast between Models 1 and 2 was significant, $\Delta X^2 = 17.89$, $\Delta df = 1$, $p < .05$. In Figure 3.3 (middle), the result pattern for physical functioning is illustrated showing that age group differences in the importance of physical functioning for SRH are comparable to the age-related decrease in the importance of physical functioning over time: Δ_{CS} (solid line) = Δ_{LS} (dashed line) = -.04 (see Table 3.2). This is illustrated in Figure 3.4 (middle). In line with our hypothesis, physical functioning was an age-contextual predictor of SRH.

The same results pattern also holds true for exercise and life satisfaction (see Table 3.2). The contrast between Models 1 and 2 was significant for both predictors, exercise: $\Delta X^2 = 4.03$, $\Delta df = 1$, $p < .05$; life satisfaction: $\Delta X^2 = 6.82$, $\Delta df = 1$, $p < .05$. However, the contrast between Models 2 and 3 was for both predictors not significant. As we predicted, exercise and life satisfaction were age-contextual predictors of SRH both with an increasing association but without an additional cohort effect.

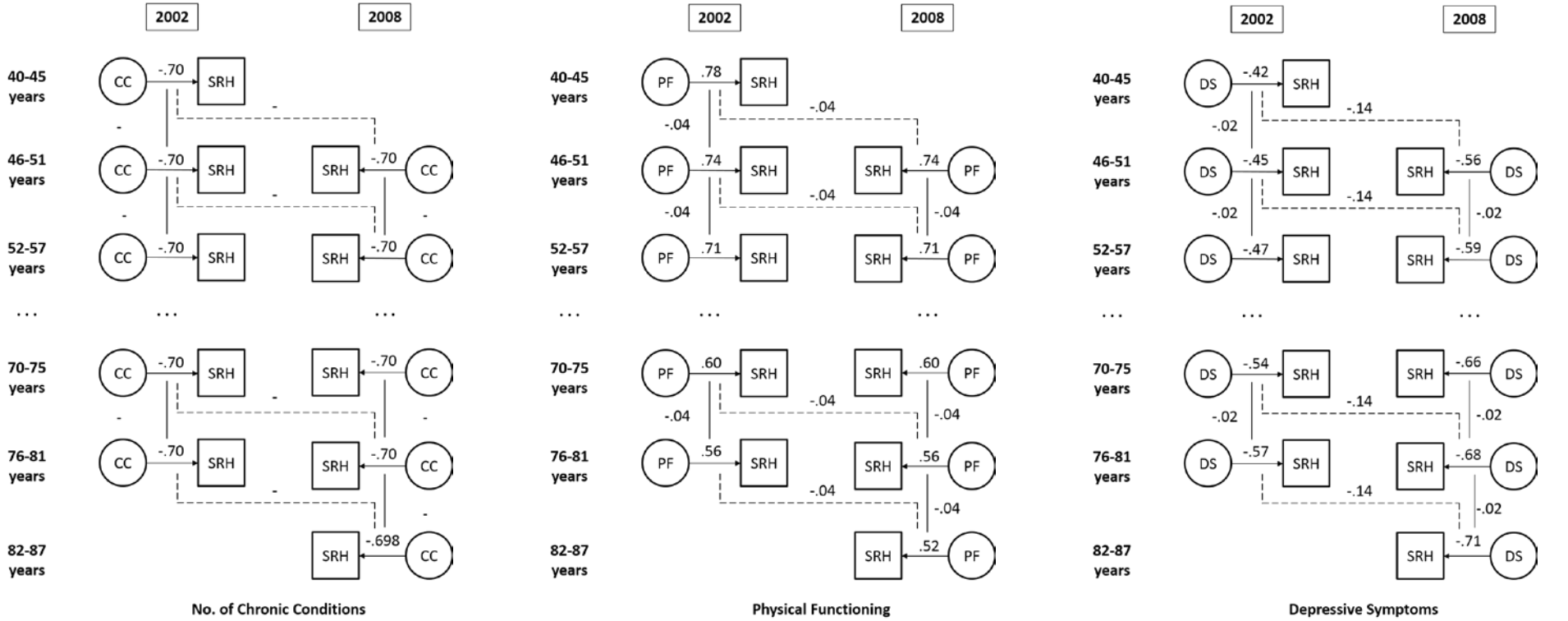

Figure 3.3 Results of regression models with multiple group design to examine the relationship between self-rated health (SRH) and number of chronic conditions (CC) on the left, physical functioning (PF) in the middle, and depressive symptoms (DS) on the right. Solid lines represent linear change in regression coefficients between age groups in the cross section (Δ_{CS}, cf. Figure 3.2). Dashed lines represent linear change in regression coefficients within age groups in the longitudinal section (Δ_{LS}, cf. Figure 3.2).

Age- and Cohort-Contextual Predictors of Self-Rated Health

For depressive symptoms, the contrast between Models 1 and 2 was significant, $\Delta X^2 = 12.43$, $\Delta df = 1$, $p < .05$, as was the contrast between Models 2 and 3, $\Delta X^2 = 8.44$, $\Delta df = 1$, $p < .05$. The right side of Figure 3.3 contains the regression coefficients, age-group differences ($\Delta_{CS} = -.02$, see Table 3.2), and changes within age groups ($\Delta_{LS} = -.14$, see Table 3.2). The regression coefficients change linearly but not by the same amount between age groups and within age groups. As illustrated in Figure 3.4 (bottom), depressive symptoms show overall an increasing association with SRH between age groups and within age groups. The increase within age groups was, however, stronger than the increase over age groups which points to an increasing importance of depressive symptoms for later-born birth cohorts.

The same pattern of results also holds true for positive affect. The contrast between Models 2 and 3 was significant, $\Delta X^2 = 6.28$, $\Delta df = 1$, $p < .05$. This means that, as expected, positive affect was not only an age- but also a cohort-contextual predictor of SRH.

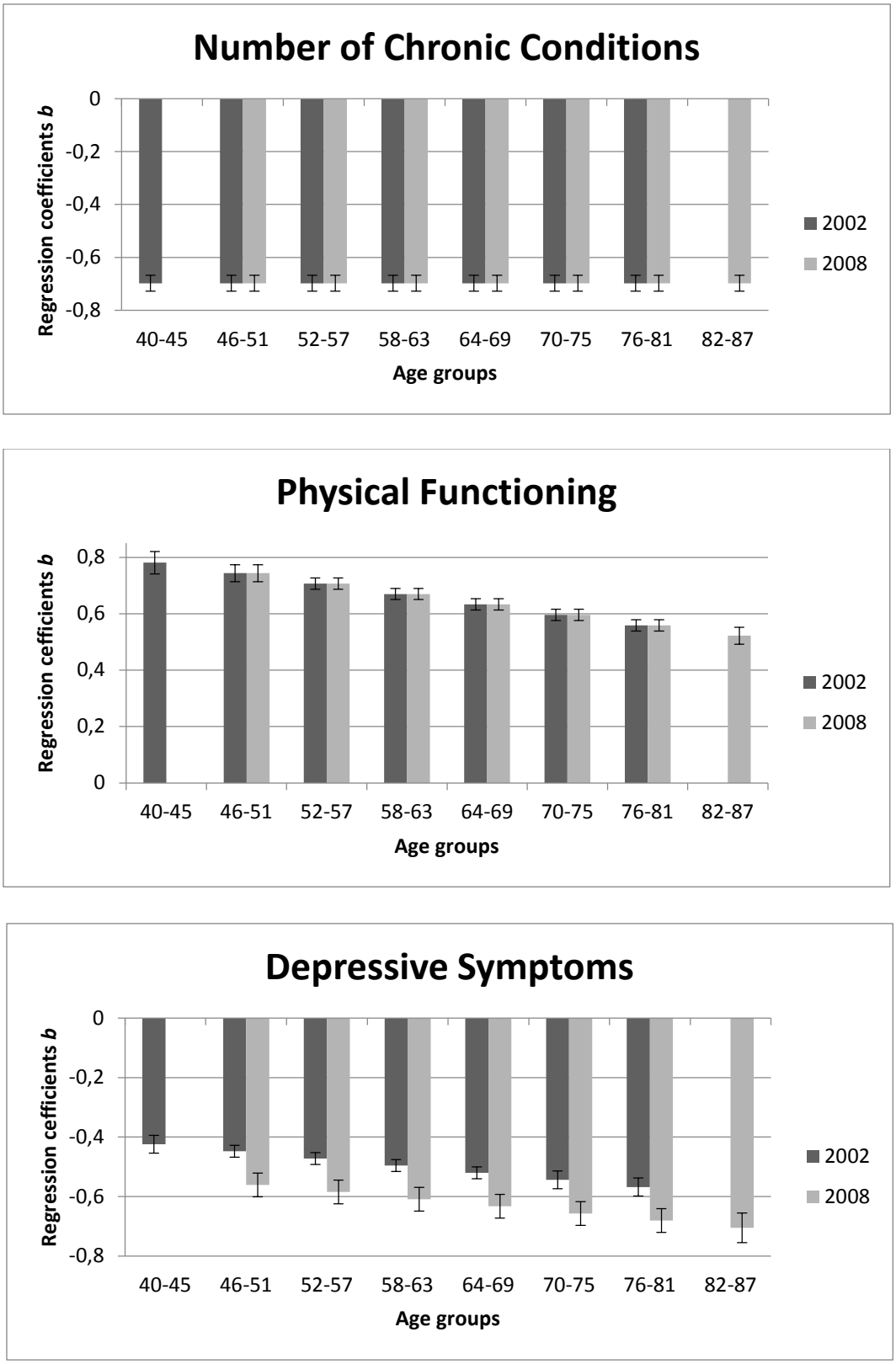

Figure 3.4 Unstandardized regression coefficients with standard errors for number of chronic conditions (top), physical functioning (middle) and depressive symptoms (bottom) for all age groups in 2002 and 2008, respectively (cf. Figure 3.2 for the regression model).

Discussion

The present study examined predictors of SRH using data from the 2002 and 2008 waves of the DEAS. Previous studies have shown that the importance of health indicators for SRH decrease in older age groups, while indicators of psychological well-being become increasingly important correlates of SRH with age (e.g., Benyamini et al., 2000; French et al., 2012; Heller, Ahern, Pringle, & Brown, 2009). In our study, we considered the possibility that cohort effects might also lead to changes in the importance of SRH predictors. Our findings suggest a differential pattern of age and cohort effects for SRH predictors: The association between SRH and all predictors but chronic conditions (i.e., physical functioning, exercise, life satisfaction, depressive symptoms, and positive affect) changed longitudinally, pointing to an age effect. Moreover, and as expected, the prediction of SRH by two indicators of psychological well-being showed an additional cohort effect: The negative associations between depressive symptoms and SRH and the positive associations between positive affect and SRH were stronger among later-born birth cohorts. However, neither age nor cohort effects were shown for the number of chronic conditions.

Invariant Predictors of Self-Rated Health

Our findings suggest that the number of chronic conditions is an invariant predictor of SRH. The importance or meaning of chronic conditions for SRH is stable across the examined age range (40–81 years at baseline; 46–87 years at follow-up). In contrast, we expected the number of chronic conditions to be an age-contextual predictor of SRH (Hypothesis 1). Previous studies concluded that physical health has a decreasing association with SRH with advancing age (e.g., French et al., 2012; Heller et al., 2009). Via post hoc analyses and extreme-group contrasts, we found small differences between the youngest and the oldest age groups on the changing association between number of chronic conditions and SRH. However, the trend over all seven age groups was nonsignificant. Our finding is in line with a study by Galenkamp, Braam, Huisman, and Deeg (2011), which also found no evidence for an age-related decreasing impact of diseases on SRH. Moreover, other studies suggest that physical health remains the major determinant of SRH in old age (Manderbacka, Lundberg, & Martikainen, 1999; Quinn et al., 1999).

Age-Contextual Predictors of Self-Rated Health

Our longitudinal findings support earlier reported cross-sectional age-group differences in predictors of SRH (e.g., French et al., 2012; Krause & Jay, 1994; Shooshtari et al., 2007) and emphasize the important role of chronological age for SRH predictors. The pattern of our results suggests that physical functioning and exercise are age-contextual predictors with a decreasing association between physical functioning and SRH and an increasing association between exercise and SRH (Hypothesis 1). The importance of social comparisons and expectations may explain this finding, as people tend to rate their health in comparison to same-age peers and also in comparison to what they think is normal (e.g., Jylhä, 2009). As impairments and functional limitations increase with age (Kriegsman, Deeg, & Stalman, 2004), functional impairments are so-called on-time events in later life (Neugarten, 1996). This means they are expected to occur in older ages and, hence, have a smaller impact on SRH. Similarly, the number of people who exercise (or are physically active) decreases with age (Shaw, Liang, Krause, Gallant, & McGeever, 2010). Thus, older adults who exercise stand out from their peers. Consequently, their level of activity is subjectively a strong indicator for high SRH ratings.

All of the psychological well-being indicators were also revealed to be age-contextual SRH predictors with an increasing importance with age, as expected (Hypothesis 2). This finding is in line with previous studies that showed that the association between positive affect and depressive symptoms gain in importance for SRH with age (e.g., Benyamini et al., 2000; Schnittker, 2005). The main factor in this context is probably the change in expectations with advancing age about what is good health (cf. also Moser et al., 2013).

Cohort-Contextual Predictors of Self-Rated Health

A novel finding of our analyses is the empirical support of cohort effects in SRH predictors. Depressive symptoms and positive affect were not only age-contextual predictors of SRH (Hypothesis 2), but were also found to be cohort-contextual predictors of SRH (Hypothesis 3). Not only do depressive symptoms and positive affect become more important for SRH with advancing age, but they have also

become increasingly important for later-born birth cohorts. This pattern is in line with different theoretical approaches concerning social change.

A shift in societal values has been described for advanced industrial societies (e.g., Inglehart, 1997). Values such as self-realization and self-esteem have gained societal relevance as compared to basic physiological and safety needs. If different values gain in importance on the societal level, this might also hold true for the individual level, for example, regarding SRH. This cohort related change in values is also reflected in an altered definition of health in the health sciences, from a biomedical comprehension of health to a biopsychosocial one in which psychological well-being plays a crucial role.

Furthermore, definitions of diseases have widened tremendously during the last century, a process which often is called "medicalization." Medicalization means the reinterpretation of certain physical and mental conditions as medical problems. This medicalization process has not only led to an increase in prevalence rates but could have potentially increased overdiagnosis and overtreatment (Moynihan et al., 2012). Some critics of this process claimed, for example, that, in the domain of mental health in particular, the interests of the pharmaceutical industry to increase the public awareness of their products have led to higher recognition of different diagnoses of mental illnesses in the general population (e.g., Ebeling, 2011). Other critics stated that campaigning focused on promoting new medical products heightens the danger that normal responses to stressors may increasingly be perceived as symptoms of mental disorders (Raven & Parry, 2012). As a consequence, medicalization could have increased the tendency of later-born cohorts to incorporate psychological well-being more strongly in their SRH in contrast to earlier-born cohorts. In general, recent cohorts might have broader expectations regarding their health status than earlier-born cohorts (Jylhä, 2009).

However, not all psychological indicators we analyzed showed the hypothesized cohort effect. We found no evidence that life satisfaction is more important for SRH in later-born cohorts than in earlier-born cohorts (Hypothesis 3). Life satisfaction was an age-contextual predictor of SRH only (showing an increasing association with SRH with advancing age; Hypothesis 2). Compared to positive affect, which reflects an emotional component of psychological well-being, life satisfaction refers to a cognitive global judgment of life (Diener, Suh, Lucas, & Smith, 1999). Depressive symptoms, in contrast,

contain both emotional and cognitive components. One potential reason why the association of life satisfaction with SRH did not show a cohort effect may lie in the emotional components of positive affect and depressive symptoms. It seems that emotional factors are of particular importance for health in later-born birth cohorts. Cognitive factors of psychological well-being gain in importance for SRH with age but apparently in the same way for different birth cohorts.

Taken together, our results suggest that there are both age and cohort effects in predicting SRH. Some SRH predictors gain importance with age: Especially, indicators of psychological well-being become more important for SRH. However, our results also reveal that cohort effects have to be considered, as well. What people include when they self-rate their health changes across different birth cohorts. In particular, later-born birth cohorts may be more inclined to articulate and accept emotions or emotional well-being as an important feature of their health. Our study therefore points to an important finding: Predictors of SRH are conditional on contextual considerations that include not only individual change (age effects), but social change (cohort effects), as well.

Limitations

Several limitations to the present study need to be acknowledged. First, although the DEAS is a nationwide representative survey of the German population over 40 years old living in private households, our findings are not representative of older adults who do not dwell in the community, such as those who live in institutions. Second, because of the necessary use of a cross-sectional design for the regressions, we could not determine the causal direction of the associations between the studied predictors and SRH. A third limitation concerns the analysis strategy. The complex analysis design restricted us to examining one variable at a time. Consequently, we were not able to evaluate the associative strength of every predictor after controlling for every other predictor. Moreover, the methodological approach taken was ill-suited to include time varying covariates. This capacity would have been particularly important for examining changes in SRH in the 58 – 63-year-old group. This age group showed in our analysis the most positive developments in all indicators considered (see Table 3.1). The positive development could be caused by a retirement effect relieving the participants from unfavorable working conditions. This effect, however, needs to

be examined more closely in more refined analyses centering at the point of retirement. A further limitation concerns the analyzed predictors. All health predictors were self-reported. However, the validity of self-reported morbidity (e.g., Katz et al., 1996; Simpson et al., 2004) as well as physical activity (Armitage & Conner, 2001; Sallis & Saelens, 2000) has been demonstrated in numerous other studies. Results for physical functioning were mixed: Some studies demonstrated a good agreement between self-reported and performance-based measures of functional limitations (e.g., Coman & Richardson, 2006) and others concluded that self-reported measures and performance-based assessments are complementary, but do not measure the same construct (Hoeymans, Feskens, van den Bos, & Kromhout, 1996). In addition, while the present study focused on disentangling age and cohort effects, it did not take into account other important factors. Several studies illustrated the association between personality and SRH (e.g., Löckenhoff, Terracciano, Ferrucci, & Costa, 2012). In the present study, however, personality traits (e.g., neuroticism, extraversion, openness; Costa & McCrae, 1985) could not be considered, as they were not assessed in the DEAS. Previous studies, however, suggest that personality gains in importance for SRH in older age (Duberstein et al., 2003) and shows strong associations with well-being (e.g., DeNeve & Cooper, 1998; Steel, Schmidt, & Shultz, 2008). Finally, in the present study, we only considered a general indicator on SRH while we were not able to additionally consider SRH as seen by respondents in comparison to people of the same age.

Outlook

According to the present findings, contemporary middle-aged adults seem to have a broader concept of their own health than earlier-born cohorts. In particular, they seem to place more importance on emotional well-being. Future generations of older adults may benefit from this historical change in the general conceptualization of health. For them, adjusting to age-related physical declines might become easier than for the older population today provided that they are able to counterbalance negative with positive emotional states. Moreover, the increasing awareness and decreasing stigmatization of mental health problems open up opportunities of treatment and, thus, increasing levels of SRH in future older populations. In this regard, however, the process of medicalization has to be

monitored with a critical eye. Thus, the self-definition of distressed emotional states as medical problems has also the potential to burden SRH of older adults in later-born cohorts. Furthermore, if subsequent generations of older people tend to incorporate more strongly emotional states into their SRH, optimistic persons might rate their health as more robust than should be reasonably inferred based on medical examinations. This could lead to insufficient health-related behavior and health care utilization, which would be detrimental for their health. Thus, the well-known finding that SRH predicts functional health, illness, and mortality has repeatedly to be replicated with participants from later-born birth cohorts. The historically changing meaning of SRH might also change its predictive power. Previous studies already showed that SRH seems to be a stronger predictor of mortality in younger than in older age groups (Benyamini, Blumstein, Lusky, & Modan, 2003; Franks, Gold, & Fiscella, 2003). Therefore, it might be worth looking at the association between SRH and mortality in different birth cohorts in more detail.

Moreover, because the social-comparative SRH has been shown to be particularly important for the maintenance of good SRH in old age (Löckenhoff et al., 2012), future studies should examine whether later-born birth cohorts apply social-comparative evaluations in the same way as earlier-born birth cohorts. Furthermore, personality might also be subject to cohort effects as recent findings suggest. Billstedt and colleagues (2013) found that later-born cohorts were more extraverted than those born earlier when they were in the same age. Therefore, it may be fruitful for future studies to consider both age and cohort effects regarding the associations between SRH, personality, and well-being. Finally, future studies should not only consider which factors influence SRH but additionally, how the developmental context shapes the relationships. By examining age and cohort effects we considered two moderating factors. However, due to the strong relationship between education and health (e.g., Lynch, 2003), the expectation about what is good health might not only differ (and change) according to age but additionally according to educational status.

Conclusion

Our longitudinal study is in line with previous studies in showing that reweighting of what constitutes the subjective evaluation of health may be the key mechanism by which older adults maintain high levels of SRH despite losses in physiological and functional capacity: While physical functioning lost in importance for SRH with age, psychological well-being indicators gained in importance. However, our findings go beyond previous studies in pointing out that the changing importance of different SRH predictors not only depends on age-related, but on cohort-related changes, as well. This study, for the first time, disentangled the importance of both age and cohort effects in the shifting meaning of self-evaluations of health. This finding is striking, and it illustrates what is otherwise overlooked if we longitudinally consider age-related changes: Depressive symptoms and positive affect do not only gain in importance for SRH as people age, but they also gain in importance for SRH in later-born birth cohorts.

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CHAPTER 4

Predictors of Self-Rated Health: Does Education Play a Role Above and Beyond Age?

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Abstract

Objectives: Previous studies have demonstrated that while health factors lose importance for the individual conceptualization of self-rated health (SRH) with advancing age, subjective well-being (SWB) factors gain in importance. The present study examined whether this age-related pattern differs between educational groups.

Method: Longitudinal data of adults aged 40 years and older of the German Ageing Survey was used (*N* = 6,812). The role of education in age-related changes in the predictive value of different health and SWB facets for SRH was investigated with a cross-lagged panel regression model.

Results: Physical conditions were a stronger predictor in lower than in higher educated individuals while the association did not change with age. In contrast, positive affect and life satisfaction only gained in importance with advancing age for higher educated individuals. Negative affect was an equally strong predictor independent of education, and loneliness had a stronger association with SRH in people with low or middle education compared to those with high education while the associations did not change with age.

Discussion: The findings highlight the importance of considering the multidimensionality of SWB and the educational background of individuals for the study of SRH and indicate possible limits to adjustment to age-related declines in health.

Keywords: aging, education, longitudinal, self-rated health, subjective well-being

Introduction

Self-rated health (SRH) is known to predict major changes in health outcomes such as future morbidity (Fayers & Sprangers, 2002), physical and cognitive functioning (Bond, Dickinson, Matthews, Jagger, & Brayne, 2006), and mortality (Benyamini & Idler, 1999; Idler & Benyamini, 1997)—beyond the objective health status. This finding is striking, because SRH is mostly measured with a single item that asks how a person evaluates his or her current state of health. To better understand the important role of SRH for future health and longevity, several studies have examined what people include when they self-rate their health. These studies showed that SRH is based on physical health status up to old age (Galenkamp et al., 2013; Manderbacka, Lundberg, & Martikainen, 1999) but also on subjective well-being (SWB) factors such as positive affect (Benyamini, Idler, Leventhal, & Leventhal, 2000), life satisfaction (Siahpush, Spittal, & Singh, 2008), negative affect (Segerstrom, 2013), and loneliness (Nummela, Seppänen, & Uutela, 2011). Several studies have shown that the association between different factors and SRH change with advancing age. However, the question is whether this age-related change of predictor strength for SRH can be generalized to all aging individuals. In particular, there are several theoretical reasons to assume different patterns in different educational groups. The present study examines whether educational differences influence the strength of the association between both physical conditions and SRH and various SWB indicators and SRH and if the age-related change in the importance of different SRH predictors is conditional on education.

Age-Related Predictors of SRH and the Potential Role of Education

The changing importance of predictors for SRH is often explained by a "response shift" (Rapkin & Schwartz, 2004; Sprangers & Schwartz, 1999). Theoretically, a response shift encompasses various cognitive processes such as changes in internal standards, values, or the reconceptualization of a construct admitting stability in SRH despite serious decline in the objective health. In other words, the frequently observed stability in SRH despite worsening objective health status can be accomplished by reweighting the factors constituting SRH. In general, health factors have been shown to lose while SWB factors gain in importance for SRH with advancing age (French,

Sargent-Cox, & Luszcz, 2012; Schnittker, 2005; Shooshtari, Menec, & Tate, 2007). Which factors gain and which factors lose in importance for SRH may, however, be dependent on social comparisons with the peer group. According to the process of individual health evaluation proposed by Jylhä (2009), social comparisons play a crucial role in the self-evaluation process of the own health status as people tend to rate their health in comparison to same-aged peers and also in comparison to what they think is normal. The question for the present study is whether differential educational effects exist in the context of the age-related change in the importance of different SRH predictors?

Higher education has been associated with better health in general and better SRH in particular (Leopold & Engelhartdt, 2013). Educational differences in health have been explained by the availability of psychological resources. The Reserve Capacity Model (Gallo & Matthews, 2003) states that higher educated individuals have more pronounced resources available (Schöllgen, Huxhold, Schüz, & Tesch-Römer, 2011). These resources might attenuate the negative effect of worse health on SRH, which is why health factors might be less important for SRH in higher educated individuals than in lower educated individuals. Furthermore, SWB should be less important for SRH in higher than in lower educated individuals as higher education is accompanied by better health. Therefore, higher educated individuals have no "need" to compensate for poor health by emphasizing the importance of SWB for a stable and good SRH—in middle age at least.

Apart from having better health in general, the onset of age-related decline in health tends to start later in higher educated individuals than in lower educated individuals (Herd, Goesling, & House, 2007; Zajacova, Montez, & Herd, 2014). Furthermore, the social network tends to be homogenous in terms of social status (McPherson, Smith-Lovin, & Cook, 2001). Hence, it is probable that individuals will compare themselves more within their own educational group. Thus, in higher educational groups, deteriorating health at age 50 could constitute an unexpected development, while in lower educational groups, the same phenomenon at this age may be well perceived as comparatively normal. Reweighting of SRH predictors might start earlier for lower than for higher educated individuals. Specifically, as the onset of the age-related decline in health begins on average later for higher educated individuals (Herd et al.,

2007), health factors should start losing and SWB should start gaining in importance for SRH with a later onset in higher educated individuals.

The Present Study

Our goal in the present study was to examine the role of education in the changing importance of physical conditions and SWB predictors of SRH with advancing age. We used physical conditions as a proxy for physical health status as physical health has been shown to be the main determinant for SRH (Manderbacka et al., 1999). As we were mainly interested in the changing role of SWB for SRH with advancing age, we considered SWB with four predictors so as to be able to detect possible differential effects regarding emotional (positive and negative affect), cognitive (life satisfaction), and social (loneliness) SWB facets. This allowed us to distinguish between positive (positive affect, life satisfaction) and negative facets of SWB (negative affect, loneliness). This is important, as positive indicators of SWB have been shown to be more strongly related to SRH than negative indicators (Benyamini et al., 2000; Winter, Lawton, Langston, Ruckdeschel, & Sando, 2007) and previous studies have emphasized the increasing importance of positive SWB indicators for SRH in old age (Benyamini et al., 2000).

In summary, our research questions and corresponding hypotheses read as follows:

1. Do we detect the same age-related pattern for the changing importance of physical conditions and SWB for SRH as previous studies mentioned above?
   - Physical conditions should lose in importance for SRH with advancing age.
2. SWB predictors should gain in importance for SRH with advancing age. Are educational differences a factor in the strength of association between physical conditions, SWB and SRH?
   - Physical conditions should be on average less important for SRH in higher educated individuals compared to lower educated individuals.

- SWB predictors should be on average less important for SRH in higher educated individuals compared to lower educated individuals.

3. Are there any educational differences in the age-related pattern of the changing importance of physical conditions and SWB for SRH?
   - Physical conditions should start to lose in importance for SRH with a later onset for higher educated individuals.
   - SWB predictors should start to gain in importance for SRH with a later onset for higher educated individuals.

Methods

Design and Sample

The present study used data from the German Ageing Survey (Deutscher Alterssurvey; DEAS). DEAS is an ongoing cohort-sequential nationally representative study of community-dwelling older individuals living in Germany. Every 6 years a new baseline sample is drawn by means of national probability sampling and is systematically stratified by age, gender, and region (former West or East Germany; Engstler & Motel-Klingebiel, 2010). Besides the baseline sample, all other participants who agreed to be reinterviewed, are also included every 6 years (panel sample). Data for the present study came from two baseline samples (1996, 2002) and their corresponding follow-up occasions (1996–2002–2008, 2002–2008). We excluded individuals with missing information on education (n = 6). All in all, 6,812 individuals aged 40–87 years were analyzed (4,077 individuals provided data for one measurement occasion, 1,998 individuals were measured twice, and 737 individuals took part on all occasions).

Measures

Self-Rated Health

The dependent variable in the present study was SRH. SRH was assessed in 1996, 2002, and 2008. We measured SRH by a single item asking “How would you rate your present state of health?” Participants were asked to rate their

global health on a 5-point scale ranging from “very good” (1) to “very bad” (5). This item was recoded, so that higher values indicate better SRH.

Physical Conditions

We used a checklist of 11 different self-reported physical conditions (e.g., “cardiac and circulatory diseases”, “bad circulation”, “joint, bone, spinal or back problems”, “respiratory problems, asthma, shortness of breath”, “stomach and intestinal problems”, “cancer”, “diabetes”, “gall bladder, liver or kidney problems”, “bladder problems”, “eye problems, vision impairment”, “ear problems, hearing problems”). For each person, a sum score was computed with higher values indicating more self-reported physical conditions.

Subjective Well-being

Positive and negative affect, life satisfaction, and loneliness were used to cover different facets of SWB. We used the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) to assess positive and negative affect. Participants were asked to indicate the extent to which they experienced 10 different positive (e.g., “excited”, “inspired”) and 10 different negative emotional conditions (e.g., “distressed”, “nervous”) during the past few months on a 5-point scale ranging from “very slightly or not at all” to “extremely”. Life satisfaction was assessed with the Satisfaction with Life Scale (SWLS; Pavot & Diener, 1993). Participants were asked to indicate the extent to which they agree with five general statements (e.g., “In most ways my life is close to my ideal”) on a 5-point scale ranging from “strongly agree” to “strongly disagree”. The scale was recoded so that higher values indicate higher life satisfaction. We used the loneliness scale from De Jong Gierveld and Van Tilburg (2006) to assess loneliness. Participants were asked to indicate for six statements (e.g., “I miss having people who I feel comfortable with”) the extent to which these statements apply to their situation on a 4-point scale ranging from “strongly agree” to “strongly disagree”. Higher values on this scale indicate higher levels of loneliness. The internal consistency of all four SWB scales at each measurement occasion was good (all Cronbach’s Alphas > 0.81).

Education

Education functioned as the grouping variable in the present study. We used the ISCED (International Standard Classification of Education; UNESCO, 2006) to assess education. The ISCED coding combines information regarding school education and professional education and distinguishes between three groups: low (without completed vocational training, *n* = 977; 14.3%), middle (with completed vocational training and/or high school diploma, *n* = 3,879; 56.9%), and highly educated individuals (e.g., graduation from a technical school, vocational academy, school of business administration or university, *n* = 1,956; 28.7%).

Control Variables

As we used data from two different waves in the present study, we included a respective dummy variable in all analyses (1 = “baseline interview in 1996”, 0 = “baseline interview in 2002”). Region (33.7% Eastern Germany, 66.3% Western Germany) and gender (48.8% female, 51.2% male) were used as controls as the baseline DEAS samples are disproportionally stratified according to these variables.

Data Analyses

We were especially interested in change with advancing age. Thus, chronological age and not change over measurement occasions constituted the time scale of the analyses. In order to do this, we constructed eight age groups, each age group with an age range of 6 years. Therefore, each participant was only included once in each age group because the longitudinal distance between the three measurement points also equaled 6 years. The age range of the sample for the present study spanned 47 years (40–87 years). After the age of 87, the data were too sparse to allow for statistical modelling.

Mplus (Muthén & Muthén, 1998–2010) was applied for all statistical analyses employing full information maximum likelihood (FIML) procedure to account for incomplete data. The FIML algorithm does not estimate missing data (in contrast to imputation approaches), but accounts more for missing values in model parameter estimates. By using all available data regardless of whether or not participants stayed in the study, potential differential sample

attrition effects were minimized. Monte Carlo simulations have shown that biases in parameter estimates due to sample attrition are less severe if all information available is considered rather than using complete case information only (Graham, 2009; Newman, 2003). All variables were *T*-standardized (*M* = 50, *SD* = 10) to obtain a common metric across variables. In a multigroup cross-lagged panel design (see Figure 4.1), we tested whether or not the cross-lagged regression weights of different predictors of SRH differed with advancing age and between educational groups (bold arrows in Figure 4.1). At the same time, we controlled for the reverse direction of causality (i.e., the influence of SRH). For reasons of parsimony, we assumed that possible changes of regression coefficients across age would be linear in nature, meaning that regression weights were allowed to change for every age group by the same amount. We employed separate models for each predictor to simplify the interpretation of the results (see Lindenberger & Pötter, 1998) and evaluated educational differences by using multigroup model constraints. For reasons of parsimony, we will report here only differences between two educational groups (low + middle vs. high education). Our analyses found no differences between the low and medium educational group.

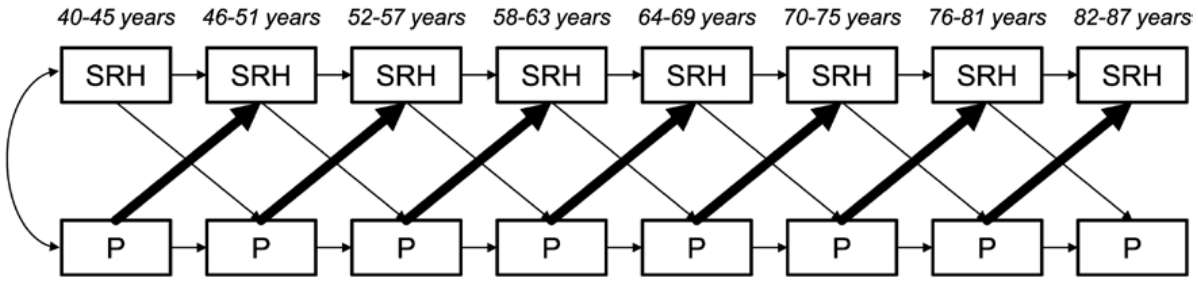

Figure 4.1 Illustration of the cross-lagged panel model to examine the changing influence of a predictor (P) on self-rated health (SRH). Bold printed arrows represent the influence of the predictor on SRH—the influence of interest for the present study. Thinner printed arrows represent present relationships in the model of subordinate interest for the present study. This model was employed parallel for two educational groups in one model and for each of the five predictors separately.

In all models, the dummy variable indicating cohort as well as gender and region were included as covariates. The inclusion of the sample stratification factors as covariates in the models nullifies the need for sample weights (Winship & Radbill, 1994). We used the root mean square error of approximation (RMSEA) and comparative fit index (CFI) to evaluate the model fit. Values of RMSEA close to 0.08 (or smaller) and CFI > 0.90 indicate an acceptable fit (Marsh, Hau, & Wen, 2004). Via X^2-difference-tests we compared nested models. The alpha level was set at 0.05.

Our baseline model (model 0) was the most restricted; the autoregressive paths and the average influence from the predictor at hand on SRH were freely estimated but set equal between both educational groups; the linear change across age of cross-lagged regression coefficients was set to zero for both groups. Before testing hypotheses, we examined whether all autoregressive paths should be freely estimated in both educational groups (model 1). A non-significant contrast between model 0 and model 1 indicated that the auto regression coefficients could be set equal between the educational groups.

In the following, we will describe our analytic procedure for the direction of interest for this study: from the predictor at hand to SRH. First, we released the coefficients predicting SRH in both educational groups in order to test whether the impact of a predictor varied across educational groups. Second, we tested whether the strength of a predictor varied by age. Specifically, we evaluated whether the linear change of cross-lagged regression coefficients across age differed from zero while being equal across educational groups. Third, we examined educational differences in age-related changes. Specifically, we freely estimated the linear change across age of cross-lagged regression coefficients in each group.

In the final model, non-significant model parameters were tested against zero for reasons of parsimony. Furthermore, if linear changes across age of cross-lagged regression coefficients had differed by education, we tested if the last cross-lagged path from the second oldest to the oldest age group could be set equal across educational groups. With this final test, we established if the predictor strength reached the same maximum in both educational groups.

A detailed description of all conducted model tests can be found in the appendix (A2).

Results

Descriptive statistics for the sample are displayed in Table 4.1. All final models fitted the data well: RMSEA was always < 0.03 and the CFI > 0.90. However, due to idiosyncrasies in the data we allowed for covariations between particular error variances. For all variables except negative affect (SRH, number of physical conditions, positive affect, life satisfaction, and loneliness), the auto regression coefficients could be set equal between educational groups.

Table 4.2 presents the cross-lagged regression coefficients from the youngest to the second youngest age group from each final model of the regression of SRH on the studied health and SWB predictors (left side) and the parameter for the proposed linear change of cross-lagged regression coefficients with advancing age, if appropriate (right side). With this information, it is possible to generate every regression coefficient for both educational groups for the cross-lagged paths of the model shown in Figure 4.1 by adding up the linear change. For example, the unstandardized regression coefficient for life satisfaction in the youngest age group (40–45 years) is b = 0.20 in the low and b = 0.06 in the high educational group (cf. Table 4.2). There is no age effect in the lower educational group (lin_{low} = @0, cf. Table 4.2) which means that the cross-lagged regression coefficient does not change over age. There is, however an age effect in the higher educational group: by adding 0.02 (=lin_{high}, cf. Table 4.2) this results in the unstandardized regression coefficient for the second youngest age group (46–51 years; b = 0.08) in the higher educational group and so on.

Table 4.1. Means (M), Standard Deviations (SD), and Number of Data Points (*n*) as a Function of Age Group and Education

Variables by education	*M (SD)*							
	Age group							
	40-45 years	46-51 years	52-57 years	58-63 years	64-69 years	70-75 years	76-81 years	82-87 years
Self-Rated Health								
Low	3.78 (0.79) *n* = 642	3.64 (0.82) *n* = 851	3.47 (0.84) *n* = 1,056	3.39 (0.85) *n* = 1,164	3.39 (0.82) *n* = 1,036	3.26 (0.83) *n* = 1,141	3.10 (0.89) *n* = 812	2.98 (0.90) *n* = 323
High	3.92 (0.66) *n* = 379	3.82 (.68) *n* = 525	3.72 (0.82) *n* = 576	3.59 (0.81) *n* = 552	3.60 (0.79) *n* = 430	3.50 (0.77) *n* = 364	3.25 (0.81) *n* = 269	3.02 (0.89) *n* = 107
Number of Chronic Conditions								
Low	1.37 (1.43) *n* = 624	1.77 (1.51) *n* = 793	2.15 (1.76) *n* = 987	2.55 (1.83) *n* = 1,091	2.71 (1.80) *n* = 968	3.15 (1.97) *n* = 1,076	3.53 (1.99) *n* = 769	3.87 (2.11) *n* = 297
High	1.25 (0.16) *n* = 358	1.56 (1.40) *n* = 487	1.83 (1.49) *n* = 527	2.19 (1.65) *n* = 515	2.47 (1.75) *n* = 406	2.98 (1.91) *n* = 344	3.47 (1.89) *n* = 253	3.97 (1.98) *n* = 99
Positive Affect								
Low	3.40 (0.60) *n* = 625	3.48 (0.59) *n* = 791	3.41 (0.59) *n* = 989	3.37 (0.58) *n* = 1,090	3.33 (0.60) *n* = 968	3.22 (0.66) *n* = 1,066	3.11 (0.71) *n* = 764	3.05 (0.71) *n* = 298
High	3.58 (0.53) *n* = 358	3.57 (0.54) *n* = 486	3.55 (0.51) *n* = 529	3.56 (0.52) *n* = 513	3.54 (0.51) *n* = 409	3.47 (0.56) *n* = 346	3.42 (0.58) *n* = 252	3.21 (0.62) *n* = 98

Life Satisfaction								
Low	3.60 (0.84)	3.67 (0.85)	3.67 (0.81)	3.74 (0.82)	3.81 (0.79)	3.80 (0.79)	3.72 (0.83)	3.76 (0.81)
	n = 625	*n* = 791	*n* = 990	*n* = 1,093	*n* = 969	*n* = 1,074	*n* = 771	*n* = 297
High	3.73 (0.71)	3.71 (0.78)	3.75 (0.78)	3.88 (0.74)	3.95 (0.67)	3.91 (0.73)	3.96 (0.73)	3.74 (0.84)
	n = 358	*n* = 486	*n* = 530	*n* = 515	*n* = 410	*n* = 348	*n* = 253	*n* = 97
Negative Affect								
Low	2.19 (0.56)	2.13 (0.58)	2.11 (0.54)	2.07 (0.53)	2.00 (0.53)	1.96 (0.53)	1.92 (0.53)	1.96 (0.55)
	n = 624	*n* = 792	*n* = 987	*n* = 1,090	*n* = 967	*n* = 1,064	*n* = 764	*n* = 295
High	2.16 (0.54)	2.15 (0.53)	2.13 (0.50)	2.02 (0.52)	1.93 (0.48)	1.91 (0.47)	1.88 (0.53)	1.93 (0.56)
	n = 358	*n* = 486	*n* = 529	*n* = 513	*n* = 410	*n* = 345	*n* = 253	*n* = 97
Loneliness								
Low	1.80 (0.57)	1.76 (0.59)	1.80 (0.59)	1.76 (0.59)	1.74 (0.55)	1.74 (0.58)	1.83 (0.64)	1.82 (0.68)
	n = 624	*n* = 792	*n* = 988	*n* = 1,094	*n* = 966	*n* = 1,073	*n* = 766	*n* = 297
High	1.72 (0.56)	1.72 (0.53)	1.72 (0.52)	1.71 (0.54)	1.70 (0.49)	1.70 (0.56)	1.69 (0.58)	1.83 (0.60)
	n = 358	*n* = 486	*n* = 532	*n* = 512	*n* = 407	*n* = 344	*n* = 255	*n* = 97

Note. In order to control for potential differential sample attrition effects, all reported parameters are adjusted using full information maximum likelihood procedure (FIML, see section “statistical analysis”).

Table 4.2 Cross-Lagged Regression Coefficients of the Youngest to the Second Youngest Age Group and Linear Change of Cross-Lagged Regression Coefficients from Age-Group Stratified Regressions of Self-Rated Health on Different Health and Subjective Well-being Predictors in Two Educational Groups

Predictor	Cross-lagged regression coefficients of the youngest to the second youngest age group *b*(*se*)		Linear change of cross-lagged regression coefficients *lin*(*se*)	
	b_{low}(*se*)	b_{high}(*se*)	lin_{low}(*se*)	lin_{high}(*se*)
Number of physical conditions	-0.23 (0.02)	-0.16 (0.03)	@0	
Positive affect	0.16 (0.02)	-0.01[a] (0.04)	@0	0.03 (0.01)
Life satisfaction	0.20 (0.02)	0.06[a] (0.02)	@0	0.02 (0.01)
Negative affect	-0.07 (0.02)		@0	
Loneliness	-0.12 (0.02)	@0	@0	

Note. Regression coefficients come from models regressing self-rated health on health and subjective well-being predictors separately. Displayed is only the regression coefficient of the youngest to the second youngest age group (*b*) as well as the linear change of cross-lagged regression coefficients (*lin*), if appropriate (otherwise "@0" indicates that the parameter at hand could be set to zero), according to education (with low = low education, high = high education). Regression coefficients are unstandardized with standard errors in parentheses. Unless otherwise indicated, coefficients differ significantly from zero ($p < .05$). [a] not significant at the $p < .05$ level

For number of physical conditions, releasing the parameter indicating the average influence on SRH for the higher educational group led to a significant change of the model fit (ΔX^2 = 7.87, Δdf = 1, p = .01). This indicates that the average influence of the number of physical conditions on SRH differed between the higher and the lower educational group. As can be seen in Figure 4.2a, the number of physical conditions was a stronger predictor for SRH in the lower than in the higher educational group. Estimating linear change across age of cross-lagged regression coefficients freely did not lead to a significant contrast between the models (ΔX^2 = 1.81, Δdf = 1, p = .18). Thus, contrary to our expectations, the influence of the number of physical conditions on SRH showed no age effect (Figure 4.2a).

For positive affect, releasing the parameter indicating the average influence on SRH for higher educational group led to a significant change of the model fit (ΔX^2 = 9.31, Δdf = 1, p = .002). This indicates that the general effect of positive affect on SRH differs between the higher and the lower educational group. Estimating the linear change across age of cross-lagged regression coefficients freely (being still equal across educational groups) also led to a significant contrast between the models (ΔX^2 = 6.11, Δdf = 1, p = .001). Educational differences regarding this age effect were also present. Releasing the parameter in the higher educational group led to a significant change of the model fit (ΔX^2 = 4.53, Δdf = 1, p = .03). As shown in Figure 4.2b and as expected, positive affect gained in importance for the prediction of SRH with advancing age—but in the higher educational group only. In the lower educational group, however, no age effect was present, contrary to our expectations. Instead, as can be seen in Figure 4.2b, positive affect showed a constant influence on SRH with advancing age (the parameter for the linear change across age of cross-lagged regression coefficients was not significant and could be set to zero; ΔX^2 = 0.75, Δdf = 1, p = .39). Additionally, the cross-lagged path from the second oldest to the oldest age group could be set equal between educational groups (ΔX^2 = 1.63, Δdf = 1, p = .20). This means that the impact of positive affect on SRH was the same for both educational groups in the oldest age group. The age-related development of reweighting the importance of positive affect “ended” at the same level for both educational groups.

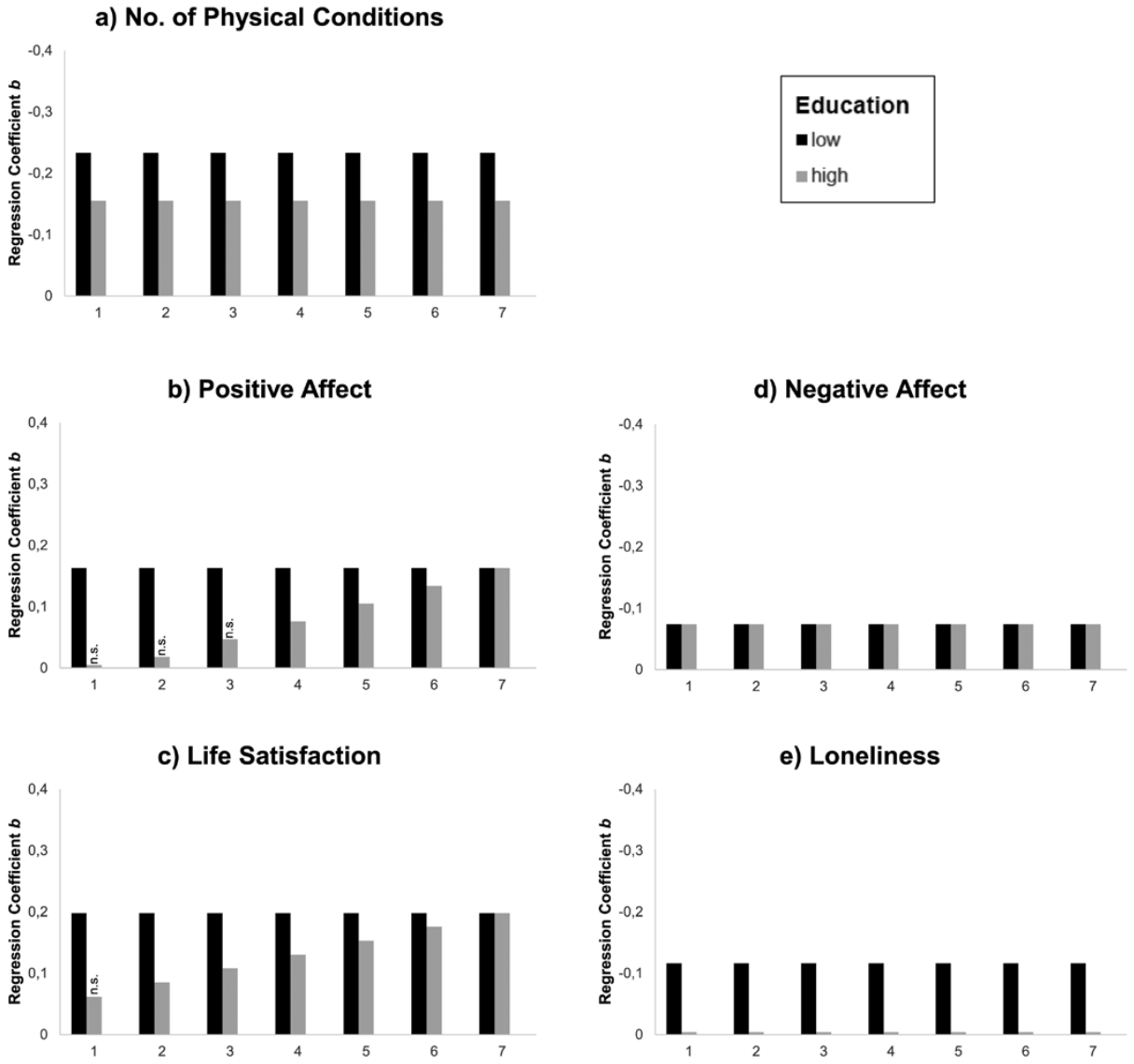

Figure 4.2 Unstandardized regression coefficients *b* of the models for the regression of self-rated health on number of physical conditions (a), positive affect (b), life satisfaction (c), negative affect (d), and loneliness (e) (c.f. Figure 4.1). The numbers on the *x*-axis symbolize the seven cross-lagged paths between the eight age groups [with 1 = regression of self-rated health (SRH) in age group 46–51 years on number of physical conditions/positive affect/life satisfaction/negative affect/loneliness in age group 40–45 years; …; 7 = regression of SRH in age group 82–87 years on number of physical conditions/positive affect/life satisfaction/negative affect/loneliness in age group 76–81 years]. The higher a bar the bigger the influence of the predictor at hand on SRH (direct comparisons between number of physical conditions, positive affect, life satisfaction, negative affect, and loneliness are not possible as the regression coefficients derive from five separate models). Unless otherwise indicated, coefficients differ significantly from zero ($p < .05$). n.s. not significant at the $p < .05$ level.

For life satisfaction, the same pattern of results emerged as for positive affect (Figure 4.2c). The general effect of life satisfaction on SRH ($\Delta X^2 = 7.48$, $\Delta df = 1$, $p = .01$) as well as the age effect differed between the higher and the lower educational group ($\Delta X^2 = 4.27$, $\Delta df = 1$, $p = .04$). As shown in Figure 4.2c, life satisfaction gained in importance for the prediction of SRH with advancing age in the higher educational group only, while having a constant influence on SRH in the lower educational group (the parameter for the linear change of cross-lagged regression coefficients is not significant and could be set to zero; $\Delta X^2 = 0.18$, $\Delta df = 1$, $p = .67$). Furthermore, the cross-lagged path from the second oldest to the oldest age group could be set equal between educational groups ($\Delta X^2 = 1.46$, $\Delta df = 1$, $p = .23$). This means that the impact of life satisfaction on SRH again leveled off at the same strength in both educational groups.

For negative affect, a different pattern can be seen in Figure 4.2d as compared to positive affect and life satisfaction—at least in the higher educational group. The average influence of negative affect on SRH did not differ between both educational groups. Furthermore, no age effect occurred in any educational group. Negative affect had a stable impact on SRH across all ages regardless of educational background.

For loneliness, almost the same result pattern occurred as for negative affect. However, this time releasing the parameter in the higher educational group denoting the average influence led to a significant change of the model fit ($\Delta X^2 = 15.05$, $\Delta df = 1$, $p < .001$). The average effect of loneliness on SRH differed between the higher and the lower educational group. However, no age effect implicated by a significant linear change of the cross-lagged regression coefficients was found. As can be seen in Figure 4.2e, loneliness had a stable influence on SRH over age and was a stronger predictor in the lower than in the higher educational group. In fact, loneliness did not influence SRH in the higher educational group. The parameter for the average impact on SRH across all age groups could be set to zero ($\Delta X^2 = 0.002$, $\Delta df = 1$, $p = .96$).

Discussion

In the present study, we examined the role of education in the changing importance of physical conditions and of several SWB indicators for SRH with advancing age. We used data from three different measurement occasions of a large representative longitudinal survey (DEAS) and considered two educational groups.

While the number of physical conditions was a stronger predictor in the lower than in the higher educational group, the association with SRH did not change with age. However, positive affect and life satisfaction gained in importance for the prediction of SRH—but only in the higher educational group. In the lower educational group, these two positive SWB indicators showed a stable impact on SRH. Negative affect and loneliness were significant predictors for SRH but these associations did not change with age—regardless of educational status. Furthermore, loneliness was a significant predictor of SRH in the lower, but not in the higher educational group.

The Role of Education for Physical Conditions as a Predictor of SRH

The number of physical conditions was more important for lower educated individuals than for higher educated individuals, which supported our hypothesis. The reserve capacity model states that higher educated individuals have more pronounced psychosocial resources available to cope with negative experiences (Gallo & Matthews, 2003). These resources might enable higher educated individuals to cope better with the negative effects of worsening physical health on SRH. Furthermore, higher educated people could have a lower average symptom severity, for example, due to a better access to medical care.

Contrary to our expectations and some previous studies (French et al., 2012), our findings suggest that the number of physical conditions is of stable importance for SRH across age. It is possible that this finding could be attributed to a truncated age range as we did not study people older than 87 years. Furthermore, small differences between single age groups might exist despite the non-significant trend over the whole age range. We also cannot make any statements regarding the severity of single conditions nor the composition of the whole sum. However, other studies also found no evidence for an age-related

decreasing impact of diseases on SRH (Galenkamp, Braam, Huisman, & Deeg, 2011). Some researchers noted that physical health remains the major determinant of SRH also in old age (Manderbacka et al., 1999). Our findings support this assumption. The number of physical conditions seems to be the strongest predictor of SRH relative to the SWB predictors studied (although direct comparisons between prediction strengths were not possible because the variables were analyzed in separate models).

The Role of Education for Various SWB Predictors of SRH

Substantial educational differences were observed regarding the SWB predictors of SRH. SWB itself is a multidimensional concept covering cognitive, emotional, and social facets, each of which can be of positive or negative value. As expected, in the higher educational group positive facets of SWB such as positive affect and life satisfaction gained in importance for SRH with advancing age. This supports the assumption that a shift in internal standards, values or the conceptualization of what health means (response shift; Sprangers & Schwartz, 1999; Rapkin & Schwartz, 2004) takes place during the aging process which leads to an increasing importance of positive SWB predictors for SRH.

The pattern for positive facets of SWB, however, could not be observed in the lower educational group. In the group of lower educated individuals, positive affect and life satisfaction were of a stable importance for SRH across all age groups. However, the same shift in internal standards or in the conceptualization of what health means might exist for the lower educational group as well. This shifting process might just start earlier in life for lower than for higher educated individuals as the lower educational group experience a decline in health status earlier in life (Herd et al., 2007). While our sample starts at the age of 40 years, it is possible that the shift of internal standards in lower educated individuals has already been completed at that age. In other words, positive SWB predictors such as positive affect and life satisfaction might have already gained their maximal importance for SRH before the age of 40 in lower educational groups. Alternatively, further changes after the age of 40 might have been so subtle in

the lower educated group that our statistical approach was not sensitive enough to capture them.

SWB consists of emotional, cognitive, and social facets. According to our results, a differentiation between positive and negative SWB facets is apparently sufficient in respect of age-related predictors of SRH. This differentiation is in line with previous studies that have shown that positive indicators of SWB were more strongly related to SRH than negative indicators (Benyamini et al., 2000; Winter, et al., 2007). In our sample, positive affect and life satisfaction seemed to have in general a stronger association with SRH than negative affect and loneliness (although a direct comparison is not possible due to the fact that our analysis approach used separate models for different predictors of SRH). Loneliness in particular was even unrelated to SRH in the higher educational group of our sample. Previous research has shown that social factors (e.g., social support) are of particular importance for health outcomes in older individuals with lower education (Schöllgen et al., 2011). In line with this research, social facets of SWB (loneliness) might also be of particular importance for SRH for lower educated individuals. Additionally, both loneliness and negative affect were of stable importance for SRH on a rather low level in contrast to positive affect and life satisfaction. This general pattern (positive SWB facets are more important for SRH than negative facets) suggests that response shift (Rapkin & Schwartz, 2004; Sprangers & Schwartz, 1999) also plays a role for SWB predictors of SRH. It seems that individuals, regardless of their education, incorporate favorable SWB components into their SRH, which helps them to maintain good SRH despite an increase in chronic conditions. Increasing independency between objective and subjective indicators with advancing age might be rather protective than debilitating (Shmotkin, Shrira, Eyal, Blumstein, & Shorek, 2014). A shift in the meaning of health could therefore be interpreted as a sign of successful adaptation.

To summarize, educational differences regarding the association between physical conditions and various SWB predictors of SRH with SRH exist and some of them also vary by age. This means SRH might not only constitute something different depending on age but also depending on educational status. Educational differences in relation to the strength and the age-related change in various SRH predictors might also explain why the association of SRH and mortality varies according to education (Beam Dowd

& Zajacova, 2007; Lee et al., 2007; Singh-Manoux et al., 2007). Educational differences in relation to the predictive qualities of SRH raise the question of whether SRH is a reliable indicator of objective health status. If SRH signifies something different depending on educational status as our findings suggest, objective health inequalities may be over- or underestimated. Hence, although SRH may often be used as "proxy" for a more comprehensive measure of objective health, comparisons between different population groups should be made with caution. Researchers should be aware of the different meanings of SRH in different groups.

Limitations

This study has several limitations. First, we used large scale survey data from the DEAS. The DEAS is a nationwide representative survey of the German population aged 40 years and older living in private households. Consequently, generalization of our findings to older adults living in institutions should be treated with caution. Second, due to data limitations, we were not able to consider functional health and depressive symptoms as additional variables in our study, although previous studies have pointed to their high importance for SRH, in particular with advancing age (French et al., 2012; Schnittker, 2005). Future studies examining different predictors for SRH in the context of education and age should additionally take these SRH predictors into account. Third, the complex analysis used in our study enabled us to examine longitudinal changes in predictor strength of SRH controlled for the influences of reversed causality (i.e., the influence of SRH on the predictor development). Unfortunately, our design restricted us to examining one variable at a time. Thus, we were not able to compare prediction strengths between predictors directly. Moreover, the methodological approach was ill-suited to include time varying covariates. This approach would have been particularly important for examining associations of SWB with SRH above and beyond the number of physical conditions. A further limitation concerns the self-reported nature of the number of physical conditions. Although the validity of self-reported morbidity has been demonstrated in numerous other studies (e.g., Katz, Chang, Sangha, Fossel, & Bates, 1996), the use of more objective health data in future studies would strengthen the findings. For future studies, it would also be

interesting to include other socioeconomic indicators. Education is one major socioeconomic indicator. However, although higher education leads to higher income and is also associated with occupational status it would be interesting to know if our findings are due to education itself or to socioeconomic indicators in general.

Conclusion

Our analyses focused on the hitherto neglected role of education in different age-related health and SWB predictors of SRH. Although education is something acquired relatively early in the life course, it has a major impact for outcomes in middle and later life. These findings may imply that intervention programs for increasing health in an aging population should differentiate between educational groups. Moreover, our results suggest that there might be limits to the extent to which aging individuals are able to reweight indicators of SRH. In other words, there might be limits to adapting to declining health and lower educated individuals may reach them earlier.

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CHAPTER 5

Response Shift is Present in Self-Rated Health After Serious Health Events

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Abstract

While health in general deteriorates with advancing age, the evaluation of the own health status remains rather stable in older adults. One underlying mechanism of maintenance of good self-rated health (SRH) might be response shift. Three types of response shift are discussed in the literature: recalibration (change in standards for good health), reprioritization (change in importance of single predictors), and reconceptualization response shift (omission/inclusion of single predictors). So far, little is known about how SRH changes in face of abrupt health decline. The present study, therefore, examines how serious health events affect SRH in the general older population and if response shift might explain how individuals are able to maintain stable SRH. The study uses longitudinal data of 1,764 participants (aged 65+ years) of the German Ageing Survey assessed at two measurement occasions three years apart. A latent difference score model was used to examine the impact of a serious health event on SRH. To test recalibration response shift, the study used the so-called then-test, while path analyses were used to examine reprioritization and reconceptualization response shift. In general, SRH deteriorated in the whole sample. As expected, SRH showed a stronger decline in people who experienced a serious health event. Findings provided support for two types of response shift. Regardless of the experience of a serious health event, individuals overestimated their health status in the retrospective evaluation as compared to the actual rating three years before (recalibration). Only in individuals who experienced a serious health event depressive symptoms and optimism gained in importance for SRH (reprioritization). In conclusion, older adults are able to maintain stable SRH by using two types of response shift to adjust to abrupt health decline: recalibration and reprioritization response shift.

Keywords: self-rated health, serious health events, response shift, longitudinal

Introduction

Self-rated health (SRH), that is the evaluation of the own health status, is a decisive predictor for future health outcomes such as mortality (e.g., Idler & Benyamini, 1997; Benyamini & Idler, 1999), physical functioning and cognitive health (Bond, Dickinson, Matthews, Jagger, & Brayne, 2006) as well as future morbidity (Fayers & Sprangers, 2002). Conversely, physical health is and remains the main determinant of SRH throughout the lifespan (e.g., Manderbacka, Lundberg, & Martikainen, 1999; Quinn, Johnson, Poon, & Martin, 1999) although numerous other factors predict SRH such as functional health, depressive symptoms (Schnittker, 2005; Spuling, Wurm, Tesch-Römer, & Huxhold, 2015), positive affect (Benyamini, Idler, Leventhal, & Leventhal, 2000; Pressman & Cohen, 2005), optimism (Steptoe, Wright, Kunz-Erbrecht, & Iliffe, 2006), and subjective age (Spuling, Miche, Wurm, & Wahl, 2013). With increasing age, physical health problems and functional limitations become more and more prevalent and it is therefore remarkable that SRH remains rather stable with advancing age: Although age-related declines in health status are reflected in a slight worsening of SRH, many older adults still rate their health as good (e.g., Jylhä, Guralnik, Balfour, & Fried, 2001). The ability to maintain good SRH reflects adaptation mechanisms which are referred to as ‘response shift’ (Sprangers & Schwartz, 1999; Rapkin & Schwartz, 2004). However, less is known about changes in SRH and adaptation mechanisms due to abrupt disruption of routines, for example due to serious health events (SHE), to distinguish it from rather continuous age-related changes without the experience of a SHE in the general older population. Studies that did examine effects of a SHE on SRH were mostly conducted in the clinical context and therefore only able to look at changes after a SHE without having data before the SHE (e.g., Benyamini et al., 2014; Hillen, Davies, Rudd, Kieselbach, & Wolfe, 2003). In these studies, SRH did change to some degree after the SHE in some studies while it remained rather stable in other studies. However, none of these studies could compare changes in SRH for older people with or without SHE in a non-clinical sample. Thus, this study aims at shedding more light on response shift-effects in the general older population in which both people with or without a SHE can be compared and in which health data are available which were assessed before a SHE had occurred.

Self-Rated Health after Serious Health Events

The fact that a substantial amount of old aged individuals still rates their health as good (e.g., Jylhä et al., 2001) means that age-related declines in physical and functional health do not necessarily lead to an equally strong decrease in SRH as individuals rather adapt to these age-related health changes. One reason for stable SRH despite age-related health declines might be that in old age decreases in health status are expected to some extent (i.e. they are experienced as "on-time", Neugarten, 1996), and attributed to a normal aging process. However, abrupt health changes as a result of a SHE may present a stronger challenge to remain good SRH than less severe health changes, because they often imply longer times of medical treatment and recovery. Clinical studies have shown for example that in a sample of older people who experienced a myocardial infarction, almost 50% reported a decline in SRH (Benyamini et al., 2014); in another study on patients undergoing primary total joint replacement surgery for hip or knee osteoarthritis, less than one third reported no change in SRH over a six month period after the surgery (Perruccio, Badley, Hogg-Johnson, Davis, 2010). In contrast, SRH did not vary significantly over a three-year period after the experience of a stroke (Hillen, et al., 2003). Clinical studies, however, have normally no information on SRH before the experience of the SHE (and therefore assess this information retrospectively, i.e. after a SHE); moreover, clinical studies usually consider only one specific health event such as the occurrence of a myocardial infarction. In addition, data cannot be compared to a "no event" group. Only few longitudinal studies examined the general effects of various SHEs on SRH in the general (older) population (Diehr, Williamson, Patrick, Bild, & Burke, 2001; Wilcox, Kasl, & Idler, 1996; Wurm, Tomasik, & Tesch-Römer, 2008; Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). These studies have shown that on average the experience of a SHE leads to decreases in SRH, but that many older people report stable or even better SRH after the experience of a SHE. Wilcox and colleagues (1996), for example, conclude that changes in SRH after a SHE might rather indicate individual adaptation to the SHE than the actual impact of the SHE on the physical health status.

Response Shift and Self-Rated Health

Response shift is considered as a possible explanation for stable SRH despite the experience of a SHE. Response shift refers to various cognitive processes, which might help to maintain stable SRH despite declines in physical and functional health. According to Sprangers and Schwartz (1999) three types of response shift can be distinguished: recalibration, reprioritization, and reconceptualization response shift.

Recalibration response shift refers to a change in internal standards. This means that stable SRH during the aging process results in lowered standards for good health. SRH is not only rather stable during the aging process despite health declines (Jylhä et al., 2001), but there is often also no change in SRH when comparing SRH pre and post the SHE (Bernhard, Lowy, Maibach, & Hürny, 2001; Hillen et al., 2003; Yardley & Dibb, 2007). Several studies suggest that people tend to retrospectively overestimate their previous health assessment, which is noteworthy as a number of clinical studies used this question to assess SRH before a SHE. However, if people are directly asked for change in SRH, individuals indeed experienced a decline in health. For example, Hillen and colleagues (2003) showed that stroke patients tend to retrospectively overestimate their previous given health assessment. Likewise, Galenkamp, Huisman, Braam, and Deeg (2012) showed that individuals who experienced an incident chronic disease were more likely to retrospectively overestimate their previous given health assessment as compared to individuals who did not experience an incident disease in the same time period (mean follow-up: 3.6 years). This means, although SRH might be rather stable on an observable level, individuals might indeed experience a decline on a subjective level but adapt to this experienced health decline by lowering their standards for good health and consequently tend to retrospectively overestimate their previous health assessments. Therefore, if standards for good health decrease with age-related decreases in health (e.g., Galenkamp et al., 2012; Idler, 1993), recalibration response shift could be present for all aging individuals who experience age-related health declines but should be more pronounced in individuals who are faced with an abrupt health decline in form of a SHE.

Reprioritization response shift refers to changes in values or priorities. This means that stable SRH during the aging process despite worsening physical and functional health would be a result of reweighting predictors regarding their importance for SRH. There is indeed empirical evidence that health factors loose, while psychological well-being factors (such as depressive symptoms, positive affect) gain in importance for SRH with advancing age (e.g., Schnittker, 2005; Shooshtarie, Menec, & Tate, 2007; Spuling et al., 2015). This means, to maintain good SRH despite experiencing physical health declines, the individual weighting of factors that contribute to good SRH might change. Consequently, reprioritization response shift should be especially present in case of coping with strong health declines, that is, when individuals experience a SHE.

Reconceptualization response shift is an even stronger mechanism than reprioritization response shift and refers to a change in the definition of a concept. Concerning SRH this means, one predictor is associated with SRH at one point in time but is not significant at a later point in time (or the other way around). In this way, reconceptualization response shift is an extreme case of reprioritization response shift because predictors are not reweighted (reprioritization) but deemed irrelevant (reconceptualization). Consequently, also reconceptualization response shift should be rather present in individuals experiencing a SHE than in individuals without such an event.

Study Goals and Hypotheses

The goal of the present study was to investigate changes in SRH due to the experience of an abrupt health decline, that is, a SHE. We expected that participants experiencing a SHE would show a stronger decrease in SRH between two measurement occasions three years apart as compared to participants without a SHE during the same time period. Furthermore, we were particularly interested in the question whether the experience of a SHE would lead to stronger response shift in SRH and which of the three response shift types is present. We expected that participants experiencing a SHE show more likely recalibration response shift, which would be reflected in much more pronounced retrospective overestimations of SRH. With respect to reprioritization response shift, we expected that participants experiencing a SHE would also more likely show a

decreasing association between health predictors and SRH or an increasing association between psychological predictors and SRH over a three year period than participants who did not experience a SHE. For participants experiencing a SHE, some indicators for SRH might be predictive for SRH before the SHE but not important any more after the SHE or the other way around (reconceptualization response shift).

Materials and Methods

Sample

The study uses data from the German Ageing Survey (DEAS; Engstler & Motel-Klingebiel, 2010), an ongoing nationwide representative cohort-sequential survey of the German community-dwelling population aged 40 years and older starting in 1996. Every six years a new baseline sample is drawn by means of national probability sampling and is systematically stratified by age, gender, and region (former West or East Germany). Besides the new baseline samples, all previous participants who agreed to be re-interviewed are also included in data collection (panel sample). In 2011, only the panel sample was re-interviewed without drawing a new baseline sample. The present study uses longitudinal data from the most recent waves assessed in 2008 (T_1) and 2011 (T_2). We included those participants who were 65 years or older in 2008 and excluded those with missing information regarding the presence or absence of a SHE between T_1 and T_2 assessed retrospectively at T_2. This means, our analyzed sample comprises those participants who participated twice – both in 2008 and 2011 – and have valid data regarding the presence or absence of a SHE. However, participants may have missing information regarding the other variables either at T_1 or at T_2. Taken together, 1,764 participants were analyzed in the present study.

Measures

Self-Rated Health

We measured SRH on both measurement occasions (T_1 and T_2) by a single item asking “How do you assess your current state of health?” Response categories were “very good”, “good”, “average”, “bad”, and “very bad”. Higher values on this variable indicate better SRH.

Then-test. At T_2 (2011) participants were additionally asked for a retrospective evaluation of their health in 2008 (at T_1), using the same response categories as the original SRH item. We used this then-test *(*Schwartz & Sprangers, 1999*)* to assess recalibration response shift in SRH. The underlying assumption of the then-test is illustrated in Figure 5.1. The then-test assumes that SRH in 2011 and the retrospective evaluation of SRH for the year 2008 assessed in 2011 is rated according to the same standard and concept of health by the participants because both evaluations are assessed at the same measurement occasion (T_2). Hence, the difference between the then-test and SRH in 2011 (*adjusted effect*, Figure 5.1) may better reflect “true” change in SRH than the difference between SRH reported in 2008 and SRH reported in 2011 (*observed effect*, Figure 5.1). As a result, the difference between SRH in 2008 and the then-test in 2008 is considered an indicator for the *recalibration response shift effect* (Figure 5.1).

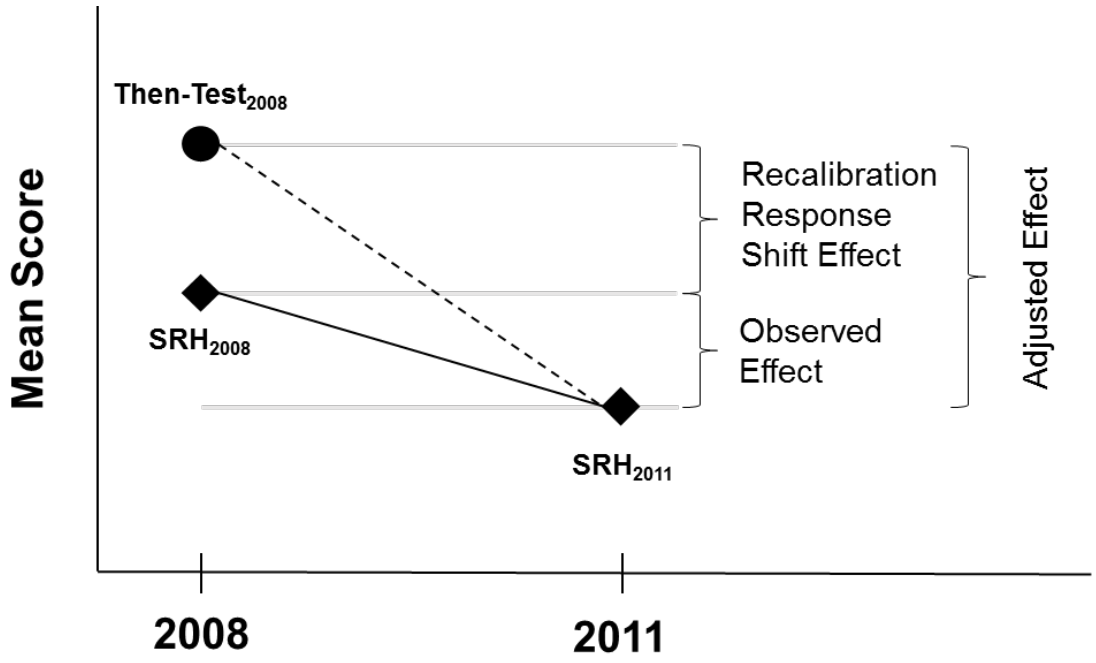

Figure 5.1 Schematic depiction of the relation between three different changes in SRH: observed effect (difference between SRH in 2008 and 2011), recalibration response shift effect (difference between SRH in 2008 and then-test), and adjusted effect (difference between then-test and SRH in 2011). SRH = self-rated health

Serious Health Event as Grouping Variable

At T_2, survey participants were asked retrospectively: "Have you had a serious illness or an accident in the last 3 years?" In cases where not only one but several illnesses or accidents had occurred, the interviewer asked the respondent to report on the most serious one only. Preliminary analyses showed no differences between the accident group and the group without a SHE in changes in SRH. Therefore, for the present study we used only illnesses as a SHE, as their consequences are possibly longer lasting than health changes due to accidents. All in all, 348 survey participants (19.73%) reported the occurrence of a serious illness (e.g., heart disease, lung disease, cancer, joint replacement) between 2008 and 2011. This variable was used as a grouping variable in our analyses with two groups: Respondents with a SHE during the last three years (group SHE = yes, n = 348) vs. respondents without a SHE (group SHE = no, n = 1,416). Individuals in the SHE = no group reported on average better SRH, less physical conditions, better functional health, less depressive symptoms, higher positive affect and higher optimism at T_1 as compared to individuals in the SHE = yes group (means for SRH and its predictors are displayed in Table 5.1).

Table 5.1 Sample Characteristics in 2008 and 2011 According to the Occurrence of a Serious Health Event between 2008 and 2011

Variable [Range]	Health Event = No		Health Event = Yes	
	2008	2011	2008	2011
Self-Rated Health [1-5]	3.55 (0.76)	3.48 (0.77)	3.24 (0.80)	2.94 (0.93)
Physical Conditions [0-11]	2.79 (1.84)	3.01 (1.90)	3.32 (1.91)	3.67 (1.91)
Functional Health [0-100]	81.67 (21.83)	77.53 (25.00)	75.23 (24.33)	65.48 (29.90)
Depressive Symptoms [0-45]	5.71 (5.26)	6.19 (5.51)	6.62 (5.39)	8.58 (6.72)
Positive Affect [1-5]	3.51 (0.52)	3.46 (0.52)	3.42 (0.51)	3.35 (0.53)
Optimism [1-4]	2.88 (0.55)	2.71 (0.34)	2.77 (0.55)	2.60 (0.39)
Subjective Age	-9.13 (6.98)	-8.51 (7.15)	-9.50 (8.16)	-7.86 (9.16)
(Felt Age – Chronological Age)				

Note. Sample characteristics are shown in means with standard deviations in parentheses.

Predictors of Self-Rated Health

All predictors of SRH were assessed on both measurement occasions. *Number of physical conditions* were measured with a checklist of 11 common and often chronic health problems (e.g., cardiovascular diseases, gastrointestinal diseases, diabetes, cancer). For each participant a sum score was computed with higher values indicating more self-reported physical conditions. *Functional health* was assessed with the physical functioning subscale of the SF-36 (Bullinger & Kirchberger, 1998). Participants were asked to indicate the extent of impairment in everyday activities (e.g., walking, climbing stairs, carrying shopping bags) due to current health status on a 3-point scale (1 = "yes, limited a lot", 3 = "no, not limited at all"). The scale was transformed to a range of 0-100 with higher values indicating better functional health. *Depressive symptoms* were assessed by the German version of the 15-item CES-D scale (Center for Epidemiological Studies Depression scale; Hautzinger, 1988). Participants were asked to indicate the frequency of several depressive symptoms (e.g., being sad, trouble sleeping) during the past week on a 4-point scale (1 = "rarely or none of the time", 4 = "most or all of the time"). A sum score was computed ranging from 0 to 45 with higher values indicating more frequent depressive symptoms. *Positive affect* was measured with the PANAS (Positive and Negative Affect Schedule; Watson, Clark, & Tellegen, 1988). Participants were asked to rate the intensity of 10 positive affective states (e.g., excited, inspired) during the past few months on a 5-point scale (1 = "very slightly or not at all", 5 = "extremely") with higher values indicating more positive affect. *Optimism* regarding one's future was measured with the Affective Valence of Future Time Perspective scale (Brandtstädter & Wentura, 1994). Participants were asked to indicate the extent to which they agree with five statements (e.g., "For me the future is full of hope") on a 4-point scale (1 = "strongly agree", 4 = "strongly disagree"). The scale was recoded so that higher values indicate higher optimism. Moreover, participants were asked about their felt age: "Forget your actual age for a moment: How old do you feel, if you had to express it in years?" *Subjective age* was measured as the difference between felt age and chronological age. Negative values indicate a younger while positive values indicate an older subjective age as compared with chronological age.

Control Variables

Age, region (Eastern and Western Germany), and gender were used as controls as the DEAS is disproportionably stratified according to these three variables. The inclusion of the sample stratification factors as covariates in the models nullifies the need for sample weights (Winship & Radbill, 1994). Education (three categories according to the International Standard Classification of Education, ISCED; United Nations Educational, Scientific, and Cultural Organization, UNESCO, 1997) was additionally considered as control variable because of the well-examined and strong relationship between health and education (e.g., Lynch, 2003).

Statistical Analysis

Statistical analysis was performed using SPSS 22 and Mplus 7.3 (Muthén & Muthén, 1998-2010). All variables were *T*-standardized (M = 50, SD = 10) to obtain a common metric across variables. Analyses used a multi-group approach to compare between two groups: participants who experienced a SHE between T_1 and T_2 (SHE = yes; n = 348) versus participants who did not experienced a SHE (SHE = no; n = 1,416). We used the RMSEA (root-mean-square error of approximation) and CFI (comparative fit index) to evaluate the model fit. Values of RMSEA close to .08 (or smaller) and CFI > .90 indicate an acceptable fit (Marsh, Hau, & Wen, 2004). Via X^2-difference-tests we compared nested models. The alpha level was set at .05.

Change in Self-Rated Health after a Serious Health Event

In a latent difference score model we first tested whether change in SRH between T_1 and T_2 is dependent on the presence of a SHE. The baseline model was the least restricted, meaning that every parameter was freely estimated in both SHE groups. In the next model we set the mean of the latent change score for SRH equal between both SHE groups. A significant X^2-difference-test between both models would indicate that the mean change in SRH differs between the SHE groups.

Recalibration Response Shift

We used independent *t*-tests to test whether mean differences for the observed effect (difference between SRH reported in 2008 and SRH reported in 2011), the recalibration response shift effect (difference between SRH in 2008 and the then-test in 2008), and the adjusted effect of SRH in 2008 and 2011 (difference between the then-test and SRH in 2011; c.f. Figure 5.1) differ between both SHE groups.

Reprioritization and Reconceptualization Response Shift

With a multi-group regression model we tested in a last step whether or not reweighting processes of SRH predictors between T_1 and T_2 exist (reprioritization and reconceptualization response shift). In the baseline model, SRH in 2008 was predicted by the six indicators measured in 2008, and SRH in 2011 was predicted by the same six indicators measured in 2011. SRH was allowed to correlate over time and the regression coefficients in 2008 and 2011 were all freely estimated. In the next models we tested whether the strength of the predictors for SRH were equal across groups (SHE versus no SHE) and time points (2008 versus 2011). In Model 1 we set the regression coefficients of the six predictors equal between both SHE groups in 2008. A non-significant X^2-difference-test between the baseline model and Model 1 would suggest that each predictor is equally important for SRH in 2008 across both SHE groups. In Model 2 we additionally set the regression coefficients for the six SRH predictors equal over time within the SHE = no group. A non-significant X^2-difference-test between Model 1 and Model 2 would suggest that each predictor is of stable importance for SRH over time for participants who did not experience a SHE between 2008 and 2011. In Model 3 we set the regression coefficients for the six SRH predictors equal over time within the SHE = yes group. A non-significant X^2-difference-test between Model 2 and Model 3 would suggest that each predictor is also of stable importance for SRH over time for participants who did experience a SHE between 2008 and 2011. In each step of the analyses, firstly, the regression coefficients of all six predictors for SRH were set equal simultaneously across groups or time, respectively. If in any of these comparisons a significant X^2-difference-test emerged, we tested all predictors step by step to identify which of the six regression coefficients varied significantly across groups or time points.

Results

The average age of respondents at T_1 was 72.47 years (*SD* = 5.33). 42.2% of the sample were female, 32.6% were living in Eastern Germany, and 11.7% had a low education. Additional descriptive statistics for SRH and its predictors are displayed in Table 5.1 for both measurement occasions and separated for the two SHE groups.

Self-Rated Health after a Serious Health Event

The baseline latent difference score model indicates that in both SHE groups SRH decreases between 2008 and 2011. The mean of the latent change score for SRH in the SHE = yes group is -3.96 and in the SHE = no group -0.84. Setting the mean of the latent change score for SRH equal between both SHE groups lead to a significant X^2-difference-test between models ($\Delta X^2 = 20.93$, $\Delta df = 1$, $p < .001$). This indicates that the mean change in SRH is significantly different between the SHE = yes and the SHE = no group. Experiencing a SHE therefore leads to a stronger decrease in SRH as compared to those people who did not experience a SHE between 2008 and 2011.

Recalibration Response Shift

Figure 5.2 shows descriptive statistics regarding the observed effect, the recalibration response shift effect, and the adjusted effect of SRH in 2008 and 2011 according to SHE groups. The *observed effect* refers to the difference between SRH assessed in 2008 and SRH assessed in 2011, cf. Figure 5.1). Even in participants who did experience a SHE, over 60% were in the group with stable or increasing SRH over time. However, the mean of the observed effect is negative in both SHE groups ($M_{SHE=yes} = -0.31$, $M_{SHE=no} = -0.07$) indicating a decrease in SRH between 2008 and 2011. The difference between both SHE groups is significant ($t(459.41) = 4.62$, $p < .001$) which implies a stronger decrease in SRH over time in participants who did experience a SHE.

Regarding the *recalibration response shift effect* (i.e. the difference between SRH assessed in 2008 and the then-test assessed in 2011, c.f. Figure 5.1), the findings show that the majority of participants who did not experience a SHE

between 2008 and 2011 retrospectively assessed their SRH in 2008 (then-test) similar to their assessment in 2008. However, the majority of participants who did experience a SHE were in the group who retrospectively overestimated their health (Figure 5.2). The mean of the recalibration response shift effect was positive in both groups ($M_{SHE=yes}$ = 0.37, $M_{SHE=no}$ = 0.18) indicating a retrospective overestimation of SRH on average in both groups. The difference between both SHE groups is again significant (t(461.96) = -3.17, p = .002). This means that participants who did experience a SHE were more likely to overestimate their health retrospectively than participants who did not experience a SHE.

The mean of the *adjusted effect* (i.e. the difference between the then-test and SRH assessed in 2011, cf. Figure 5.1) is negative in both SHE groups ($M_{SHE=yes}$ = -0.67, $M_{SHE=no}$ = -0.25). Again, the difference between both SHE groups is significant (t(422.41) = 6.43, p < .0015). Figure 5.2 shows that the shape of the graph also changed between the observed and the adjusted effect – especially in the SHE = yes group. While in participants who did not experience a SHE between 2008 and 2011 the vast majority is still in the group with stable SRH, now almost 60% of the participants who did experience a SHE are in the group with decreasing SRH.

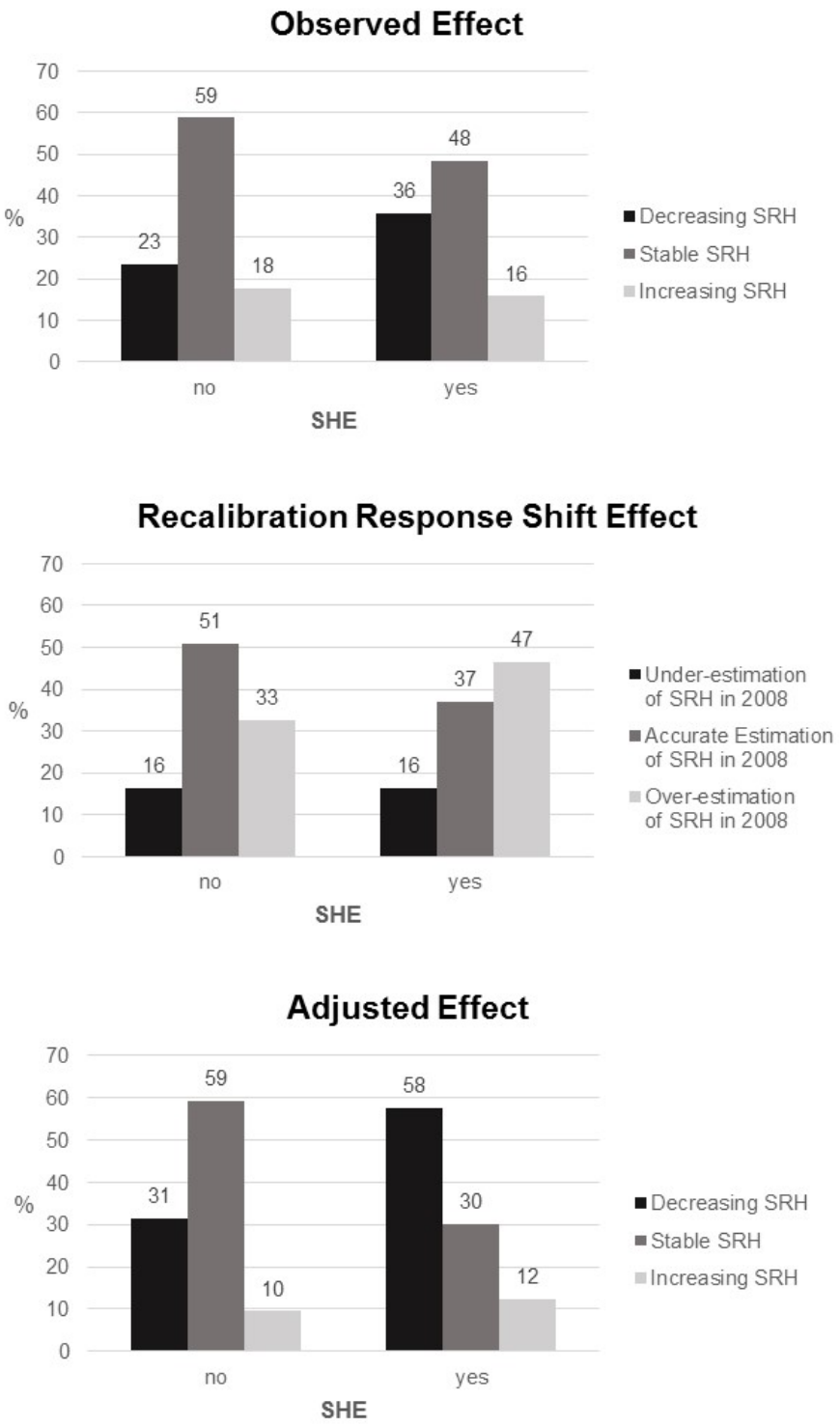

Figure 5.2 The bars show percentages for the three different effects regarding changes in self-rated health (cf. Figure 5.1) according to the experience of a serious health event between 2008 and 2011.

SRH = self-rated health, SHE = serious heath event, yes = group which did experience a SHE between 2008 and 2011, no = group which did not experience a SHE between 2008 and 2011

Reprioritization and Reconceptualization Response Shift

The final multi-group regression model fitted the data well with RMSEA = .04, CFI = .97. Regression coefficients for the final model are displayed in Figure 5.3. As expected according to previous studies, all selected predictors were significantly associated with SRH at both measurement occasions: less physical conditions, better functional health, less depressive symptoms, higher positive affect and optimism as well as younger subjective age were associated with better SRH in both SHE groups and at both measurement occasions. The X^2-difference-test between the baseline model and Model 1 was not significant ($\Delta X^2 = 4.61$, $\Delta df = 6$, $p = .595$) indicating no differences in the six predictors for SRH between both SHE groups in 2008. Furthermore, the X^2-difference-test between Model 1 and Model 2 was also not significant ($\Delta X^2 = 7.70$, $\Delta df = 6$, $p = .261$) indicating that each predictor had equal regression coefficients for SRH in 2008 and 2011 for participants who did not experience a SHE. However, there was a significant X^2-difference-test between Model 2 and Model 3 ($\Delta X^2 = 26.06$, $\Delta df = 6$, $p < .001$). This significant contrast suggests that at least one predictor changed in its importance for SRH over time in participants who did experience a SHE between 2008 and 2011. We therefore tested each of the six predictors separately. Setting the regression coefficients equal over time for physical conditions ($\Delta X^2 = 0.08$, $\Delta df = 1$, $p = .777$), functional health ($\Delta X^2 = 2.51$, $\Delta df = 1$, $p = .113$), positive affect ($\Delta X^2 = 0.13$, $\Delta df = 1$, $p = .718$), and subjective age ($\Delta X^2 = 3.22$, $\Delta df = 1$, $p > .073$) did not lead to a significant X^2-difference-test. However, setting the regression coefficients equal over time for depressive symptoms ($\Delta X^2 = 11.73$, $\Delta df = 1$, $p < .001$) and optimism ($\Delta X^2 = 6.73$, $\Delta df = 1$, $p = .01$) lead to a significant X^2-difference-test between the models. As can be seen in Figure 5.3, for participants who did experience a SHE between 2008 and 2011 both depressive symptoms and optimism were stronger predictors of SRH after the SHE as compared to before the SHE.

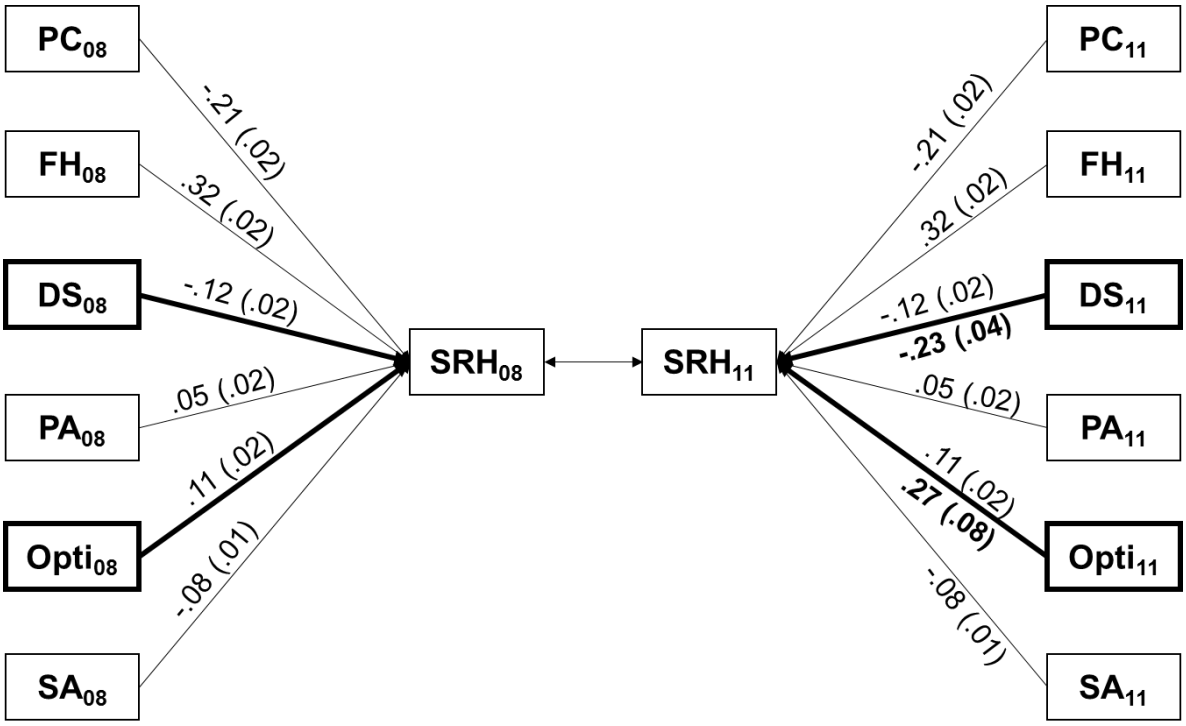

Figure 5.3 Unstandardized regression coefficients (with standard errors in parentheses) of the final multi-group regression model of self-rated health regressed on various predictors in 2008 and 2011. All parameters are significant at $p < .05$. If only one parameter is depicted, this means that there is no difference between both analyzed groups (i.e. participants who did or did not experience a SHE between 2008 and 2011). If two parameters are depicted on top of each other, numbers above the line refer to people who did not experience a SHE, numbers below the line to those who did experience a SHE. Group differences and differences between time points are additionally highlighted with bold lines. SRH = self-rated health, PC = number of physical conditions, FH = functional health, DS = depressive symptoms, PA = positive affect, Opti = optimism, SA = subjective age

Discussion

The present study examined changes in SRH after sudden health problems such as a SHE using longitudinal data from the 2008 and 2011 waves of the DEAS. For all participants SRH declined within this three-year period. However, the decline was stronger in those individuals who experienced a SHE during this period. In addition, results suggest that the experience of a SHE lead to two types of response shift: recalibration and reprioritization response shift. Although recalibration response shift was also present for individuals without the experience of a SHE, the effect was stronger in individuals who did experience a SHE as they showed much more pronounced retrospective overestimations of SRH. Furthermore, only participants experiencing a SHE put more emphasis on depressive symptoms and optimism to evaluate their health after the SHE as compared to before the SHE (reprioritization response shift). In contrast, the present findings provided no support for the presence of reconceptualization response shift.

Serious Health Events Effect Self-Rated Health

The finding that SHEs were associated with stronger decline in SRH provides additional support for the yet only few previous findings regarding changes in SRH after a SHE in the general older population (Wilcox et al., 1996; Diehr et al., 2001; Wurm et al., 2008). However, more than half of the participants in our study reported stable or even better SRH status over a three year period – regardless of the experience of a SHE. Stable SRH status (or fewer declines in SRH as expected) after a SHE might therefore indicate better adaptation abilities on the individual level. The results suggest that individuals adapt to SHEs by lowering their standards for good health as well as by reweighting factors constituting their health self-perceptions – that is, by using two out of three types of response shift (recalibration and reprioritization response shift).

Response Shift and Self-Rated Health

As expected, the recalibration response shift effect was stronger in individuals who did experience a SHE as compared to individuals without a SHE. However, the then-test revealed that on average participants tended to overestimate their

previous health retrospectively, regardless of the experience of a SHE – although this effect was, as expected, significantly more pronounced in individuals who experienced a SHE. That means that individuals also lowered their standards for good health in the studied time period if they did not experience a SHE. Due to age-related changes, they probably also experienced age-related health declines during the 3-year follow-up period although to a lower extent. In contrast, individuals who experienced a sudden and possibly more pronounced health decline due to a SHE needed to adjust their standards of good health to a larger extent, which is reflected in the significantly higher percentage of individuals who over-estimated their previous SRH within the retrospective then-test.

Furthermore, recalibration response shift was not the only adaptation process present in individuals who did experience a SHE. Different from Galenkamp and colleagues (2012), we found evidence for reprioritization response shift in individuals who did experience a SHE: depressive symptoms and optimism increased in importance for SRH in our sample while other health predictors (number of physical conditions and functional health) and psychological predictors (positive affect and subjective age) remained of stable importance for SRH. The different results in our study as compared to the results in the study of Galenkamp and colleagues (2012) might be due to different approaches how to measure health decline: in the present study we used the self-reported occurrence of a SHE while Galenkamp and colleagues (2012) stratified their sample by incidence of chronic disease. It seems that in the presence of a SHE, recalibration is not enough to adapt to the associated sudden health declines and stronger or at least other forms of adaptation are necessary with respect to maintaining rather stable SRH. In the present study, however, reweighting processes in form of an increasing importance for SRH were only present for depressive symptoms and optimism. Contrary to our expectations, functional health and especially positive affect remained of stable importance for SRH despite experiencing a SHE. This is different from previous research showing that during the aging process individuals adapt to age-related health declines which is reflected in an increased importance of depressive symptoms and positive affect and a decreased importance of functional health (e.g., Galenkamp, Braam, Huisman, & Deeg, 2011; Spuling et al., 2015, Spuling et al., 2015). However, the experience of an abrupt decline in health status such as a SHE might not be equivalent to the age-related and therefore partially expected process of declining health status over a longer time period. In case of

increasing importance of for example positive affect might help individuals to maintain rather stable SRH in the long run but in the presence of a SHE, psychological resources such as optimism might be more helpful to adapt to sudden health declines in the short run.

Irrespective of the occurrence of a SHE and in line with Galenkamp and colleagues (2012) we did not find evidence for reconceptualization response shift: all studied predictors were and remained significantly associated with SRH in 2008 and 2011. As recalibration response shift was present in all individuals and reprioritization response shift only in individuals who did experience a SHE, we suggest, that reconceptualization response shift is considered to be the strongest response shift type. The question in this context is also: how likely is it at all to find reconceptualization response shift? Maybe a SHE as measured in our study is not "strong" enough to lead to reconceptualization response shift; maybe we have studied the "wrong" predictors. We decided to examine the selected predictors in our study as previous studies repeatedly showed significant associations between them and SRH. This means our selection is biased to variables that proofed to influence SRH in diverse samples. Thus, future studies should include predictors which might be in particular related to SRH after the occurrence of a SHE such as control beliefs or self-regulation strategies.

Limitations and Future Directions

The DEAS is a nationwide representative survey of the German population aged 40 years and older living in private households. Consequently, generalization of our findings to older adults living in institutions should be treated with caution. In addition, due to our analytical approach we included only those participants in the sample who had a valid measure on the grouping variable (=experience of a SHE between 2008 and 2011 assessed in 2011). This means all participants assessed in 2008 who did not agree to be re-interviewed in 2011 (e.g., because of worsening health) were not included in the sample. Thus, it must be assumed that our sample is healthier than the general population and therefore the generalization of our finding should be done with caution due to possible attrition effect.

Furthermore, the experience of the SHE as well as the selected health predictors were self-reported. However, participants who experienced a SHE

showed stronger declines in SRH than participants without the experience of a SHE. Consequently, self-reported SHEs seem to assess personally relevant health events of the participants. Also, the validity of self-reported morbidity has been demonstrated in numerous other studies (e.g., Katz, Chang, Sangha, Fossel, & Bates, 1996). Still, the use of more objective health data for example regarding changes in health status in future studies would substantiate our findings.

Additionally, the evaluation of the then-test might also be accompanied with some problems. Some studies (e.g., Galenkamp et al., 2012) argue that one should only examine recalibration response shift if the presence of reprioritization and/or reconceptualization response shift can be ruled out as one would "compare apples and oranges". However, there are other studies (e.g., Schwartz, Sprangers, Carey, & Reed, 2004; Sprangers & Schwartz, 1999) – and we would rather agree with this line of research – which emphasize the interrelation between all three response shift types which would mean that various response shift types could occur at the same time. Recalibration response shift (meaning lowered health standards) for example would imply that the meaning of good health changed. This change in the meaning of health could similarly be a sign of reprioritization (or even reconceptualization) response shift.

Finally, we studied only a selection of SRH predictors. Future studies should definitely broaden the scope for example in the direction of control beliefs and self-regulation strategies to increase the probability to detect reconceptualization response shift.

Conclusion

Our study showed that self-reported SHEs have an effect on SRH in the general older population. Individuals thereby adapt to abrupt health declines in form of a SHE by two strategies: lowering their standards for good health (recalibration response shift) and reweighting factors associated with their health comprehension (reprioritization response shift). Stable SRH should therefore not mistakenly be interpreted in the way that abrupt health declines do not have an effect on individuals, but should rather be considered a sign of adaptation on the individual level to the abrupt disruption of the existing everyday life. Consequently, SRH status might not be the best measure to reflect actual physical and functional

deterioration and recovery after a SHE but should be complemented with additional information regarding the subjective evaluation of retrospective change in SRH or information from a then-test.

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CHAPTER 6

GENERAL DISCUSSION

Summary

The aim of the present dissertation was to examine how predictor patterns for self-rated health (SRH) vary with individual characteristics (age, education), historical context and critical life events. Especially for Research Question 1 (RQ1; age differences in predictor strength), it was important to apply a longitudinal design throughout all empirical chapters as cross-sectional age group-differences can arise for a number of reasons unrelated to age-related changes. For example, one possible alternative explanation would be cohort. However, disentangling age and cohort effects in this context (RQ2) have not been done before and is therefore a major strength of the present dissertation. Furthermore, it was examined whether age-related changes in predictor strength for SRH apply to all ageing individuals or if differences between low, middle, and high educated individuals exist (RQ3). The final question dealt with various response shift types in combination with SRH to answer the question, whether predictor strength for SRH changes during the experience of a serious health event (RQ4). The first part of this chapter provides a summary of the results of the present dissertation. The main findings are also displayed in Table 6.1.

Table 6.1 Summary of the Main Findings of the Present Dissertation

Research Question	Aim	Main Finding(s)	Conclusion
(1) Does predictor strength for SRH change with age? (Chapters 2, 3, 4)	Expand previous research on cross-sectional age group differences by a longitudinal approach	Physical conditions are of stable importance for SRH while positive affect, depressive symptoms, and life satisfaction gain in importance with advancing age	The meaning of SRH changes with age
(2) Does predictor strength for SRH change with cohort? (Chapter 3)	Disentangle age and cohort effects regarding changes in predictor strength for SRH	Depressive symptoms and positive affect gain in importance for SRH in later born cohorts	The meaning of SRH changes across cohorts
(3) Does predictor strength for SRH change with education? (Chapter 4)	Examine if age-related changes of predictor strength for SRH apply to all educational groups	Strong educational differences regarding general predictor strength for SRH (physical conditions) as well as regarding age-related changes (e.g., positive affect) exist	The meaning of SRH changes with education
(4) Does predictor strength for SRH change after the experience of a serious health event? (Chapter 5)	Examine the impact of abrupt health decline on predictor strength for SRH	Depressive symptoms and optimism gain in importance for SRH after the experience of a serious health event	The meaning of SRH changes after the experience of a serious health event

Chapter 2 focused on the question whether subjective age is a stronger predictor for SRH six years later in middle-aged (40-64 years) as compared to older-aged individuals (65 years and over; RQ1). While subjective age predicted SRH longitudinally, no differences between age groups regarding predictor strength were found. Subjective age thus seems to be an important resource for SRH across middle adulthood and old age.

Chapter 3 dealt with the question whether various health predictors and indicators of psychological well-being change in importance for SRH with age (RQ1) and across cohorts (RQ2). Seven age groups were constructed, each with an age range of six years, to match the longitudinal distance between two measurement occasions of the DEAS. Comparisons of cross-sectional age-group differences in prediction patterns and longitudinal changes in prediction patterns within age groups over time allow to disentangle age and possible cohort effects. Number of chronic conditions showed a constant negative association with SRH independently of age and cohort. In contrast, the positive association between physical functioning, exercise and life satisfaction changed longitudinally, indicating an age effect. While physical functioning loses in importance for SRH with advancing age, exercise and life satisfaction gain in importance. In addition to an age effect, depressive symptoms and positive affect showed also a cohort effect: the negative association between depressive symptoms and SRH as well as the positive association between positive affect and SRH became not only stronger across age groups but were also stronger among younger cohorts. The results imply that SRH might constitute something different depending on age and cohort: while physical functioning loses in importance for SRH with advancing age, psychological well-being indicators gain in importance – emotional facets of psychological well-being, namely depressive symptoms and positive affect, additionally increase in relevance for SRH across cohorts.

Chapter 4 focused on the question whether age-related changes of predictor strength for SRH (RQ1) differ for educational groups (RQ3). Using the possibility to construct an accelerated longitudinal design with the DEAS data, changes from 40 to 87 years were modelled. Although some information regarding age effects on SRH predictors were provided in Chapter 2 and Chapter 3, the analyses here were extended by taking other subjective well-being indicators into account (negative affect and loneliness in addition to positive affect and life satisfaction). Number of physical conditions showed a strong negative association with SRH but

the association did not change with age. However, number of physical conditions was a stronger SRH predictor in lower than in higher educated individuals. In contrast, positive affect and life satisfaction only gained in importance for SRH with advancing age for higher educated individuals while in lower educated individuals these positive subjective well-being facets showed a constant association with SRH across middle adulthood and old age. The considered negative subjective well-being facets were significant SRH predictors but did not change with age – regardless of educational status. Loneliness was a significant predictor of SRH in the lower, but not in the higher educational group. The results highlight the importance of considering the multidimensionality of subjective well-being and the educational background of individuals for the study of SRH and indicate possible limits in the adjustment to age-related declines in health.

Chapter 5 focused on the question whether predictor strength for SRH of health indicators and various psychological well-being predictors as well as psychological resources change after the occurrence of a serious health event (RQ4). The data was obtained from longitudinal participants of the DEAS that were 65 years and older. Three response shift types in combination with SRH were examined. The experience of a serious health event lead to two types of response shift: recalibration and reprioritization response shift. Individuals who experienced a serious health event showed much more pronounced retrospective overestimations of SRH (recalibration response shift) as compared to individuals without the experience of a serious health event. Furthermore, only individuals who experienced a serious health event put more emphasis on depressive symptoms and optimism to evaluate their health after the serious health event as compared to before the serious health event (reprioritization response shift). In contrast, the findings provided no support for the presence of reconceptualization response shift – regardless of the experience of a serious health event. This means individuals adapt to abrupt health declines such as a serious health event by two strategies: lowering their standards for good health (recalibration response shift) and reweighting factors associated with their health comprehension (reprioritization response shift).

Taken together, the findings of the present dissertation show that the meaning of SRH is socially constructed: the importance of several predictors for SRH change not only with age but differ also according to birth cohort and in specific societal groups such as different educational groups. Moreover, predictor

strength of some SRH predictors changes after the experience of a serious health event.

In the following, the findings of the present dissertation will be integrated into the theoretical and empirical context of several academic disciplines. Selected aspects will be elaborated in more detail against the background of response shift theory, theoretical models from lifespan development, and the field of coping theory. In addition, limitations of the present dissertation will be discussed and the chapter will close with an outlook to future research and will provide some practical implications.

Self-Rated Health and Response Shift Theory

Response shift is a well-studied cognitive process in the field of quality of life research in clinical studies. The present dissertation expands this line of research to SRH and focused especially in reprioritization response shift as one very important process to maintain good SRH despite age-related declines in physical and functional health status. The present dissertation demonstrated that reprioritization response shift in SRH depends on age, cohort, education and even occurs after the experience of abrupt health decline.

Reprioritization Response Shift in Self-Rated Health Research

Based on previous research regarding changing predictor strength for SRH with *age*, it was assumed that in general health factors lose while psychological factors gain in importance for SRH with advancing age (e.g., Benyamini et al., 2000; French, Sargent-Cox, & Luszcz, 2012; Schnittker, 2005; Shooshtari, Menec, & Tate, 2007). The present dissertation refined this assumption with the rather unexpected finding, that physical conditions are an invariant predictor for SRH with a stable influence across middle adulthood and old age. Some small effects were in fact present when comparing extreme groups (youngest against oldest age group) but no overall trend could be observed. It might also be due to a truncated age range in the presented studies (age range ended in the 80s) that no age effects were present for physical conditions and that physical conditions indeed lose in

importance for SRH at the end of life. However, the presented findings rather support the very important role of physical conditions for SRH as the major determinant of SRH up to old age as some previous studies suggested (Manderbacka, Lundberg, & Martikainen, 1999; Quinn et al., 1999). In contrast, age effects as expected could be shown in physical functioning (with a decreasing association with age), exercise (increasing association with age) depressive symptoms, positive affect, and life satisfaction (all three with an increasing association). Social comparisons in combination with expectations regarding health and an age-related change in the definition of what good health is, might explain these findings. On the one hand, individuals tend to rate their health in comparison to age-peers and also in comparison to what they think is normal (e.g., Jylhä, 2009). As the probability to suffer from functional limitations increases with advancing age (Kriegsman, Deeg, & Stalman, 2004), functional limitations become so-called on-time events in later life and are therefore part of the normal ageing process and to some degree expected in older ages. Similarly, the amount of individuals who still exercise decreases with age (Shaw, Liang, Krause, Gallant, & McGeever, 2010). Consequently, older adults who still exercise stand out from their peers. On the other hand, good health might mean something different with advancing age. As depressive symptoms, positive affect, and life satisfaction gain in importance for SRH with advancing age, this pattern implies that the meaning of good health is more closely related to subjective well-being in older ages than to the actual health status.

In sum, age is simply an empty variable that can function as a proxy for changes in the actual health status. This would mean that the age-associated declines in physical and functional health lead to a changing understanding of what good health means. A changing definition of the meaning of health is then reflected in changing predictor strengths for SRH. This assumption was examined in Chapter 5 of the present dissertation. Here, reprioritization response shift only occurred in individuals who experienced a serious health event, meaning an abrupt health decline.

However, the meaning of health does not only change with advancing age (hence a worsening actual health status) but also across *cohorts*. Indicators of emotional psychological well-being, namely depressive symptoms and positive affect, are more important for SRH in later-born birth cohorts. Reprioritization response shift is therefore not only conditional on age but also conditional on

cohort. The reasons for cohort effects in this regard might lie in a changed definition of health in combination with a changed definition of diseases. On the one hand, the modern definition of health is broader and incorporates mental and social well-being as compared to early medical approaches defining health primarily as the absence of diseases (World Health Organization, 1948). On the other hand, definitions of diseases have widened tremendously during the last century – a process that is often called "medicalization". Medicalization means the reinterpretation of certain physical and mental conditions as medical problems. This medicalization process has not only led to an increase in prevalence rates but could have potentially increased overdiagnosis and overtreatment (Moynihan et al., 2012). As a consequence, medicalization could have increased the tendency of later-born cohorts to incorporate psychological well-being more strongly in their SRH in contrast to earlier-born cohorts.

Taken together, recent cohorts might have broader expectations regarding their health status than earlier-born cohorts (Jylhä, 2009) because of a changing definition of health in combination with a changing definition of diseases. It seems that later-born cohorts accept emotions and emotional psychological well-being as an important feature of their health.

The meaning of health does not only differ according to age and cohort but also depends on context. Although *education* is rather early acquired during the life course, it has lifelong implications. The present dissertation demonstrated that reprioritization response shift in SRH is also conditional on educational status. For example, life satisfaction and positive affect gained only in importance for SRH in higher educated individuals while these two SRH predictors were of stable and high importance in lower educated individuals across middle adulthood and old age. It seems that age-related changes in the meaning of health apply differentially to individuals according to their educational status. Consequently, SRH means something different at different points in life depending on education. As SRH is often used as an indicator for objective health status, objective health inequalities may be over- or underestimated. Comparisons between different population groups should therefore be done with caution and researchers should be aware of the different meanings of SRH in different societal groups.

In general, it seems that age-related reprioritization response shift in SRH works as follows: individuals incorporate favorable psychological indicators into

their SRH with advancing age and rather neglect negative indicators of health and psychological well-being which helps them in turn to maintain good SRH despite worsening physical and functional health. Physical conditions on the other hand maintain to be the major determinant of SRH up to old age.

Hierarchy of Response Shift Types

Although the present dissertation especially focused on reprioritization response shift, it is only one of three response shift types that need to be considered when studying SRH. The other two types are recalibration and reconceptualization response shift. The findings in Chapter 5 support the assumption that the three response shift types are interrelated. In contrast, some studies (e.g., Galenkamp et al., 2012) argue, that one should only examine recalibration response shift if the presence of reprioritization and/or reconceptualization response shift can be ruled out, as one would "compare apples and oranges". However, there are other studies (e.g., Schwartz, Sprangers, Carey, & Reed, 2004; Sprangers & Schwartz, 1999) – and the presented findings rather support this line of research – which emphasize the interrelation between all three response shift types which would mean that various response shift types could occur at the same time. Recalibration response shift (meaning lowered health standards) for example would imply that the meaning of good health changed. This change in the meaning of health could similarly be a sign of reprioritization (or even reconceptualization) response shift. Moreover, the presented findings point to the possibility of a hierarchy of response shift types, meaning that one type is stronger than the other. It is assumed that recalibration response shift is the weakest response shift type during the ageing process as recalibration response shift was also present during a three year time period in individuals without the additional experience of a serious health event (cf. Chapter 5). Reprioritization response shift on the other hand was only present in individuals who experienced an additional sudden health decline such as a serious health event. In the short studied time period of three years, the age-related health declines experienced in the whole sample did not elicit reprioritization response shift. When studying a longer time period or a larger age range as it was done in Chapter 3 and Chapter 4 reprioritization response shift could be observed as well. In contrast, reconceptualization response shift was not observed in any study of the present dissertation. As recalibration response shift

was present in all individuals and reprioritization response shift only in individuals who experienced an additional abrupt health decline such as a serious health event, reconceptualization is considered to be the strongest response shift type.

Self-Rated Health and Lifespan Development

The pattern that SRH is rather stable over the lifespan although physical and functional health decreases with advancing age implies that individuals adapt in some form or another to their experienced health losses. Consequently, changes in SRH or rather the stability of the construct represent a powerful adaptation process to age-related (health) losses. The present dissertation shed some light on the underlying processes explaining how rather stable SRH is possible despite age-related health losses.

The ability to adjust personal goals and standards (accommodative coping; Brandtstädter, 1989; Brandtstädter & Rothermund, 2002) might facilitate the maintenance of good SRH. The change in goals and standards for the meaning of good health during the ageing process is reflected in the change in importance of SRH predictors with age. To maintain good SRH despite worsening objective health status, the individual conceptualization of “good health” changes by reweighting different factors constituting the health self-perception. It seems that individuals incorporate favorable psychological well-being components into their SRH, which helps them to maintain good SRH despite the experience of physical and functional health losses.

Consequently, SRH is rather associated with health factors in younger ages and with indicators of psychological well-being in older ages. The increasing independence of objective and subjective indicators with advancing age might be rather protective than debilitating (Shmotkin, Shrira, Eyal, Blumstein, & Shorek, 2014). Consequently, a shift in the individual meaning of health over the lifespan could therefore be interpreted as a sign of successful adaptation. However, SRH reflects not only adaptation in older ages but apparently also in later-born cohorts. The findings in Chapter 3 show that indicators of emotional psychological well-being (depressive symptoms and positive affect) are more important to later-born cohorts as compared to earlier-born cohorts. The changing meaning of SRH across

cohorts might therefore reflect successful adaptation of future generations to changing living conditions in form of a societal change in values (Inglehart, 1997, 1997) and a societal change in the definition of health (World Health Organization, 1948).

As described in the previous paragraph, the process of reweighting factors of a self-reported construct such as SRH is one type of the response shift phenomenon (reprioritization response shift). Consequently, reprioritization response shift in SRH is an important adaptation mechanism during the ageing process and response shift in SRH should not be seen as a measurement error but as a possibility to describe individual adaptation. In this regard, reprioritization response shift in SRH concerns different predictors regarding the ageing process compared to after the experience of a serious health event. For example, positive affect gained in importance for SRH with advancing age (Chapter 3 and Chapter 4) but remained of stable importance in case of the experience of a serious health event whereas psychological resources such as optimism increased in importance for SRH (Chapter 5). Positive affect has been shown to be closely associated with health in general but also with SRH specifically (Pressman & Cohen, 2005). The pattern of findings in the present dissertation support the idea, that positive affect is more helpful for maintaining good SRH in the long run while optimism is more helpful in the short run.

Furthermore, adaptation to an age-related declining health status in form of reprioritization response shift in SRH seems to have limits. The extent to which ageing individuals are able to reweight SRH predictors to maintain good SRH seems to be restricted. The findings on differences with education presented in Chapter 4 imply that lower educated individuals may reach these limits earlier. It could be shown that positive affect and life satisfaction gained in importance for SRH after the age of 40 in higher educated individuals while both SRH predictors were of stable high importance for lower educated individuals. In this context it is assumed, that the shift in the meaning of health started with an earlier onset in lower educated individuals as the age-related decline in health status tends to start earlier in lower educated individuals (Herd, Goesling, & House, 2007; Zajacova, Montez, & Herd, 2014). Consequently, lower educated individuals are not only earlier in “need” to adjust to poor health by emphasizing the importance of positive well-being facets to maintain a stable and good SRH but they also reach the limits of adjustment earlier in life as compared to higher educated individuals.

Self-Rated Health and Coping

As described above, individuals adapt to age-related health losses with the help of reprioritization response shift. The present dissertation also examined how individuals cope with the experience of an abrupt health decline such as a serious health event regarding their self-evaluated health status. The findings in Chapter 5 showed that not only reprioritization response shift functions as a coping mechanism in case of the experience of a serious health event, but recalibration response shift also helps to maintain stable SRH after an abrupt health decline.

Furthermore, the Reserve Capacity Model (Gallo & Matthews, 2003) states that higher educated individuals have more pronounced resources available (Schöllgen, Huxhold, Schüz, & Tesch-Römer. 2011) to cope with negative experiences. The availability of resources is especially important to cope with deteriorating health over the lifespan and its consequences for everyday life. The present dissertation examined whether education as a proxy for the availability of resources is also associated with age-related changes in the importance of different SRH predictors. The findings presented in Chapter 4 suggest that physical conditions are indeed more important for SRH in lower educated individuals as compared to higher educated individuals. It seems that higher educated individuals have indeed more resources available to cope with the negative effects of worsening physical health on SRH.

Furthermore, age-related health declines show an earlier onset in lower as compared to higher individuals (Herd et al., 2007; Zajacova et al., 2014). This means individuals have to cope with a worsening health status at different points over the lifespan. Consequently the pattern regarding the changing importance of some SRH predictors is also conditional on education. Lower educated individuals are earlier in “need” to cope with poor health by emphasizing the importance of positive well-being facets such as positive affect and life satisfaction to maintain a stable and good SRH. This might explain why positive affect and life satisfaction are of stable high importance for SRH in lower educated individuals: while the DEAS starts at age 40, it is possible that the shift in the importance of these SRH predictors has already been completed at that age in lower educated individuals. In other words, positive affect and life satisfaction might have already gained their maximal importance for SRH before the age of 40 in lower educated individuals.

Interim Conclusion

SRH is not a direct reflection of the objective health status of a person, but SRH is socially constructed and dependent on various moderators. The present dissertation shows that the meaning of health does not only change with age, but also differs between cohorts and educational groups and additionally changes after the experience of a serious health event.

One consequence of a changing definition of health is that as emotions are incorporated more in SRH with age and across cohorts, future generations and older individuals might evaluate their health better than their actual health status based on medical examinations. This can lead to insufficient health-related behavior and health care utilization, which would be detrimental for their health. These deliberations might also answer the question: is good SRH despite bad actual health necessarily a good thing? Health optimists (better SRH than actual health) might be at risk. Pressman and Cohen (2005) argue, for example, that high levels of positive affect might be harmful in populations with serious illnesses as they are associated with underreporting of symptoms and may result in overoptimistic patients. Similarly, high levels of SRH despite poor objective health might be dangerous in the case of life threatening diseases where medical treatment is necessary to survive.

Furthermore, as the meaning of health changes with age, cohort, and education as well as after the experience of abrupt health decline, associations between SRH and other (health) outcomes might change as well. For example, the different meaning of health in different groups might explain why the well-known association between SRH and mortality varies with age (Benyamini, Blumstein, Lusky, & Modan, 2003; Franks, Gold, & Fiscella, 2003; Strawbridge & Wallhagen, 1999), and education (Beam Dowd & Zajacova, 200; Lee et al., 2007; Singh-Manoux et al., 2007). Moreover, as the meaning of health additionally changes across cohorts, the well-known finding that SRH predicts future health outcomes including mortality needs to be replicated repeatedly in future generations.

Limitations of the Present Dissertation

There are limitations to the present dissertation that need to be addressed. The generalization of the findings presented in the preceding chapters to older individuals living in institutions should be treated with caution. The DEAS is a nationwide representative survey of the German population aged 40 years and older living in private households at the time of their first interview. Consequently, the findings are not representative of older individuals who did not dwell in the community. The use of the prospective data set of a large representative survey is on the other hand a major strength of the present dissertation, as the results are of importance for a broad population. However, it can be assumed that survey participants – especially those who participate more than once in the survey – are on average healthier than participants who did not agree to be interviewed in the first place or to be re-interviewed in the following wave(s). This problem applies especially to analyses done in Chapter 5, as all participants assessed on the first measurement occasion who did not agree to be re-interviewed three years later were not included in the analyzed sample due to the analytic approach of this study (the experience of a serious health event was the grouping variable and information concerning the presence or absence of a serious health event was retrospectively assessed on the second measurement occasion). In all other chapters all available data was used regardless of whether participants remained in the study. The large amount of missing data was taken into account by applying the full information maximum likelihood procedure. By using all available data, potential differential sample attrition effects were minimized, as biases in parameter estimates are less severe if all information available is considered in contrast to using complete case information only (Graham, 2009; Newman, 2003). In addition, available-case analyses have substantially higher power than their complete-case counterparts (Graham, Cumsille, & Shevock, 2013).

Furthermore, health measures used in the present dissertation (number of chronic conditions, physical functioning, exercise, and the presence or absence of a serious health event) relied on self-reported data. The validity of self-reported morbidity (e.g., Katz et al., 1996; Simpson et al., 2004) as well as physical activity (Armitage & Conner, 2001; Sallis & Saelens, 2000) has been demonstrated in numerous other studies while results for physical functioning were mixed: some studies demonstrated a good agreement between self-reported and performance-

based measures of functional limitations (e.g., Coman & Richardson, 2006) and others concluded that self-reported measures and performance-based assessments are complementary, but do not measure the same construct (Hoeymans, Feskens, van den Bos, & Kromhout, 1996). In addition, participants who experienced a serious health event showed stronger declines in SRH than participants without the experience of a serious health event (c.f. Chapter 5). Consequently, self-reported serious health events seem to assess personally relevant health events of the participants. Still, the use of more objective health data would have strengthened the analyses and should be incorporated in future studies.

The selection of predictors studied in the present dissertation is a further limitation that needs to be addressed. For example, for number of physical conditions a simple sum score was used. Consequently, no statements regarding single conditions or regarding the composition of the whole sum can be made. Furthermore, due to data limitations, it was not possible to consider physical functioning and depressive symptoms as additional variables in Chapter 4. As previous studies underlined their high importance for SRH, especially in older age (French et al., 2012; Schnittker, 2005), both physical functioning and depressive symptoms were incorporated in analyses presented in Chapter 3 and Chapter 5. However, as both physical functioning and depressive symptoms were not included in the DEAS since the first measurement wave in 1996, the used analyses approach in Chapter 4 did not allow to include these SRH predictors into the analyses. Future studies examining different predictors of SRH in the context of education and age should additionally take these SRH predictors into account. Additionally, recalibration response shift was not observed in Chapter 5. It was discussed whether the selection of predictors used in the study might be one reason why there were no signs of recalibration response shift. Control beliefs and self-regulation strategies, which might be in particular related to SRH after the occurrence of a serious health event, should be included in future studies as they are not part of the DEAS instrument.

Additionally, two more limitations concern the analyses design used in some chapters of the present dissertation. For example, in Chapter 3 and Chapter 4 it was not possible to compare prediction strengths between predictors directly. Due to the complex analysis design used in these studies it was necessary to examine one variable at a time. On the other hand, the used analysis model allowed for the

examination of longitudinal changes in predictor strength of SRH controlled for the influence of reversed causality. However, it was not possible to evaluate the associative strength of every predictor after controlling for every other predictor. Moreover, the methodological approach was ill-suited to include time varying covariates. This approach would have been of particular importance for examining changes in SRH in the 58-63-year-old group in Chapter 3 as this age group showed the most positive developments in all indicators, possibly due to retirement effects, as well as for examining associations of subjective well-being with SRH in Chapter 4 above and beyond the number of physical conditions.

Outlook to Future Research

The present dissertation examined the changing association between various health and psychological predictors and SRH. Number of physical conditions, functional health, and regular sports functioned as health predictors for SRH while depressive symptoms, positive and negative affect, life satisfaction, loneliness, subjective age, and optimism functioned as psychological predictors for SRH. Although a variety of indicators for SRH were considered in the present dissertation, there are many more SRH components. For example, social resources such as network size and social support might be especially important in times of health threats or within disadvantaged societal groups. Schöllgen, Huxhold, Schüz, and Tesch-Römer (2011) showed that social resources are especially important for health outcomes in older individuals with lower education. Social resources are also important indicators for SRH (Benyamini, 2011). In the present dissertation loneliness was considered as a social well-being facet (Chapter 4). However, expanding the analyses to further social resources (e.g., social support, network size) would be the next step to take. Likewise, subjective age functioned as an important indicator of images of ageing in Chapter 2. Other images of ageing such as health losses would enrich the findings of the present dissertation as well.

Age, cohort, and education were used as three important moderators regarding the association between SRH and various predictors. However, other moderators, for example gender or other indicators of socio-economic status such as income should be considered in the future as well. Gender is controlled for in

all analyses in the present dissertation, but may still serve as a moderator of SRH prediction patterns. Especially income might be important in times of functional health impairments as a consequence of a serious health event, for example. Education is indeed one major socioeconomic indicator. However, although higher education leads to higher income and is also associated with occupational status it would be interesting to know, if the presented findings are due to education itself or to socioeconomic indicators in general.

Besides the need to conclude additional moderators to examine the association between SRH and various predictors in future research, a different combination of moderators might be conceivable as well. The present dissertation examined age and cohort effects (Chapter 3) as well as age and educational effects (Chapter 4). However, the combination of educational and cohort effects might also be reasonable when studying age-related changes in predictor strength for SRH. As it is well-known that later-born cohorts have better health as compared to earlier-born cohorts due to improvements in medical care and the treatment and early detection of various diseases, it might be possible that the findings presented in Chapter 4 change across cohorts – especially when the changing meaning of health across cohorts is considered as well (Chapter 3).

Much is known about various components of SRH and the present dissertation expanded the knowledge about *which* predictors influences SRH to *how* predictors influence SRH differentially, always using a longitudinal perspective. However, SRH is also a powerful indicator for future health outcomes such as future morbidity (Fayers & Sprangers, 2002), hospitalization (Kennedy, Kasl, & Vaccarino, 2001) and, of course, mortality (e.g., Benyamini & Idler, 1999; DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Idler & Benyamini, 1997). As SRH has this powerful impact on other outcomes, one interesting question would be whether SRH can be altered. SRH might be altered indirectly via processes that affect SRH such as social comparisons or via interventions regarding single SRH components. However, is it reasonable to alter SRH? As SRH is an important indicator for individual adaptation abilities throughout the ageing process in general but also in face of abrupt health decline such as a serious health event, in my opinion, the answer should be: no.

Practical Implications

The results of the present dissertation lead to the conclusion that SRH is dependent on various moderators. The meaning of health is not only conditional on age but additionally on cohort and education. In other words health means something different to individuals dependent on how old they are, in which decade they were born and which educational background they have. Consequently, SRH is a highly interesting psychological construct, which in turn has practical implications for health monitoring in the general population, as SRH is often used as a proxy for a more comprehensive measure of objective health. However, the use of SRH in this context is doubtful in light of the results of the present dissertation, as it seems that different indicators such as age, cohort, and education influence the meaning of health. Hence, the changing conceptualization of SRH lead to the necessity to complement subjective health-evaluations with more objective health data such as medical charts or medical tests (e.g., lung function) when someone is interested in reporting health data.

Furthermore, SRH is often used as an indicator for health changes – usually by comparing SRH between different points in time. This comparison should be interpreted with caution. Stable SRH in this context should not mistakenly be interpreted as no change in physical or functional health. Stable SRH during objective health declines rather reflects adaptation abilities on the individual level. As shown in this dissertation (see Chapter 5), the majority of individuals reported stable SRH over a span of three years although they experienced abrupt health decline such as a serious health event (additionally to the normal ageing process in this time period). However, they adapt to this health decline in form of recalibration response shift (they lowered their standards for good health) and reprioritization response shift (optimism and depressive symptoms gained in importance for SRH). This means the use of SRH as proxy for objective health changes is doubtful as changes (or stability) in SRH rather reflect psychological adaptation abilities on the individual level.

Conclusion

SRH has not only various predictors but the association between these predictors and SRH changes with age (or physical health status, respectively), across cohorts and with education. This means that SRH is a concept undergoing constant change. Consequently, well-known associations between SRH and other outcomes (e.g., mortality) must be examined and confirmed repeatedly within individuals over time, across different birth cohorts, and in different societal groups.

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APPENDIX

A1: Mplus Code for Data Analyses for Chapter 3

```
!Exercise

variable:
names =     ID SRHt_02 SRHt_08 exert_02 exert_08…;
! SRH = Self-Rated Health; exer = exercise; “t” indicates a T-score
grouping is agegrdif(1=a 2=b 3=c 4=d 5=e 6=f 7=g);
! variable “agegrdif” contains the seven age groups of interest
useobservations = age_02 < 82;
! only individuals aged less than 82 years are included
usevar =    SRHt_02 exert_02
            SRHt_08 exert_08;


model:
!Structural Equation Model (SEM) for Self-Rated Health (SRH) 2002
SRHt_02 on  exert_02;
[exert_02];             ! mean value free to vary
!SEM for SRH 2008
SRHt_08 on exert_08;
[exert_08];             ! mean value free to vary
!Correlation between SRH in 2002 and 2008
SRHt_02 with SRHt_08;
```

```
model a:                !40-45 years in 2002
!SEM for SRH 2002
SRHt_02 on exert_02 (exer1);
[exert_02];
!SEM for SRH 2008
SRHt_08 on exert_08 (exer11);
[exert_08];
!Correlation between SRH in 2002 and 2008
SRHt_02 with SRHt_08;

model b:                !46-51 years in 2002
!SEM for SRH 2002
SRHt_02 on exert_02  (exer2);
[exert_02];
!SEM for SRH 2008
SRHt_08 on exert_08 (exer21);
[exert_08];
!Correlation between SRH in 2002 and 2008
SRHt_02 with SRHt_08;

model c:                !52-57 years in 2002
!SEM for SRH 2002
SRHt_02 on exert_02 (exer3);
[exert_02];
```

```
!SEM for SRH 2008
SRHt_08 on exert_08 (exer31);
[exert_08];
!Correlation between SRH in 2002 and 2008
SRHt_02 with SRHt_08;

model d:                    !58-63 years in 2002
!SEM for SRH 2002
SRHt_02 on exert_02  (exer4);
[exert_02];
!SEM for SRH 2008
SRHt_08 on exert_08 (exer41);
[exert_08];
!Correlation between SRH in 2002 and 2008
SRHt_02 with SRHt_08;

model e:                    !64-69 years in 2002
!SEM for SRH 2002
SRHt_02 on exert_02  (exer5);
[exert_02];
!SEM for SRH 2008
SRHt_08 on exert_08 (exer51);
[exert_08];
!Correlation between SRH in 2002 and 2008
SRHt_02 with SRHt_08;
```

```
model f:                    !70-75 years in 2002

!SEM for SRH 2002

SRHt_02 on exert_02 (exer6);

[exert_02];

!SEM for SRH 2008

SRHt_08 on exert_08 (exer61);

[exert_08];

!Correlation between SRH in 2002 and 2008

SRHt_02 with SRHt_08;


model g:                    !76-81 years in 2002

!SEM for SRH 2002

SRHt_02 on exert_02 (exer7);

[exert_02];

!SEM for SRH 2008

SRHt_08 on exert_08 (exer71);

[exert_08];

!Correlation between SRH in 2002 and 2008

SRHt_02 with SRHt_08;
```

model constraint:

new (ΔCS_{02}*0 ΔCS_{08}*0);

!Linear Function over age groups in cross-section 2002

exer2 = exer1 + ΔCS_{02};

exer3 = exer1 + 2*ΔCS_{02};

exer4 = exer1 + 3*ΔCS_{02};

exer5 = exer1 + 4*ΔCS_{02};

exer6 = exer1 + 5*ΔCS_{02};

exer7 = exer1 + 6*ΔCS_{02};

!Linear Function over age groups in cross-section 2008

exer21 = exer11 + ΔCS_{08};

exer31 = exer11 + 2*ΔCS_{08};

exer41 = exer11 + 3*ΔCS_{08};

exer51 = exer11 + 4*ΔCS_{08};

exer61 = exer11 + 5*ΔCS_{08};

exer71 = exer11 + 6*ΔCS_{08};

! Model 1:

! No change at all is allowed: ΔCS_{02} = ΔCS_{08} = ΔLS = 0

! All following three command lines are turned on

! If all three command lines are on, it would mean that regression coefficients are the same in every age group in both measurement occasions

ΔCS_{02} = 0;

ΔCS_{02} = exer11 - exer1; ! ≙ ΔLS

0 = ΔCS_{02} - ΔCS_{08};

! Model 2:

! ΔCS and ΔLS were allowed to vary as the same linear function: $\Delta CS_{02} = \Delta CS_{08} = \Delta LS \neq 0$

! Command line one is turned off

! If command line one is turned off, it would mean that regression coefficients change linearly to the same amount between age groups in the cross section (ΔCS) and within age groups in the longitudinal section (ΔLS)

$!\Delta CS_{02} = 0;$

ΔCS_{02} = exer11 - exer1; ! ≙ ΔLS

$0 = \Delta CS_{02} - \Delta CS_{08};$

! Model 3:

! ΔCS and ΔLS were allowed to vary as independent linear functions: $\Delta CS_{02} = \Delta CS_{08} \neq \Delta LS \neq 0$

! Command lines one and two are turned off

! If command lines one and two are turned off, it would mean that regression coefficients differ between age groups in the cross section (ΔCS) and within age groups in the longitudinal section (ΔLS)

$!\Delta CS_{02} = 0;$

$!\Delta CS_{02}$ = exer11 - exer1; ! ≙ ΔLS

$0 = \Delta CS_{02} - \Delta CS_{08};$

! Model 4:

! ΔCS in 2002 and 2008 as well as ΔLS were allowed to vary as independent linear functions: $\Delta CS_{02} \neq \Delta CS_{08} \neq \Delta LS \neq 0$

! Command lines one, two and three are turned off

! If command lines one, two and three are turned off, it would mean that regression coefficients differ between age groups in the cross section in 2002 (ΔCS_{02}) and 2008 (ΔCS_{08}) and within age groups in the longitudinal section (ΔLS)

!ΔCS_{02} = 0;

!ΔCS_{02} = exer11 - exer1; ! ≙ ΔLS

!0 = ΔCS_{02} - ΔCS_{08};

Available as Supplemental Material:

http://supp.apa.org/psycarticles/supplemental/a0039111/a0039111_supp.html

A2: Detailed Description of Data Analyses for Chapter 4

In a multi-group cross-lagged panel design (see Figure 4.1, Chapter 4) we tested whether or not the cross-lagged regression weights of different predictors of SRH differed with advancing age and between educational groups (bold arrows in Figure 4.1, Chapter 4). At the same time, we controlled for the reverse direction of causality (i.e., the influence of SRH). For reasons of parsimony, we assumed that possible changes of regression coefficients across age would be linear in nature, meaning that regression weights were allowed to change for every age group by the same amount. We employed separate models for each predictor to simplify the interpretation of the results (see Lindenberger & Pötter, 1998) and evaluated educational differences by using multi-group model constraints.

In all models, the dummy variable indicating cohort as well as gender and region were included as covariates. The inclusion of the sample stratification factors as covariates in the models nullifies the need for sample weights (Winship & Radbill, 1994). We used the RMSEA (root-mean-square error of approximation) and CFI (comparative fit index) to evaluate the model fit. Values of RMSEA close to .08 (or smaller) and CFI > .90 indicate an acceptable fit (Marsh, Hau, & Wen, 2004). Via X^2-difference-tests we compared nested models. The alpha level was set at .05.

Our baseline model (M0) was the most restricted: the autoregressive paths and the average influence from the predictor at hand on SRH were freely estimated but set equal between both educational groups; the linear change across age of cross-lagged regression coefficients was set to zero for both groups. Before testing hypotheses, we examined whether all autoregressive paths should be freely estimated in both educational groups. A non-significant contrast between the baseline model (M0) and the first model (M1) indicated that the auto regression coefficients could be set equal between the educational groups. In this case, M0 was used as baseline for the following model comparisons.

In the following, we will describe our analytic procedure for the direction of interest for this study: from the predictor at hand to SRH. Therefore, in the second model (M2), the average influence from the predictor at hand on SRH was still freely estimated but now allowed to differ between the lower and the higher

educated group. A statistically significant change of the model fit indicated, that the average influence from each predictor on SRH differed between the lower and the higher educational group. In this case, M2 was used as baseline for the following model comparisons.

In the third model (M3), the linear change of regression coefficients was still set equal between both educational groups but was now freely estimated. A statistically significant change of the model fit therefore indicated that the proposed linear change of regression coefficients differs significantly from zero in at least one of the education groups. In the fourth model (M4) the linear change of regression coefficients was again freely estimated but now allowed to differ between the lower and the higher educational group. A significant change of the model fit indicated that the linear change of regression coefficients differed between the lower and the higher educational group.

In the final model, non-significant model parameters regarding the average influence from the predictor at hand to SRH (loneliness) as well as regarding the linear change of regression coefficients (positive affect and life satisfaction) were tested against zero for reasons of parsimony. Furthermore, if linear changes across age of cross-lagged regression coefficients had differed by education (e.g., no change in low educational group, increase in high educational group as it was the case for positive affect and life satisfaction), we established if the predictor strength reached the same maximum in both educational groups. This means, we tested if the cross-lagged path from the second oldest to the oldest age group can be set equal between educational groups.

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Available as Supplementary Material:

http://psychsocgerontology.oxfordjournals.org/content/early/2015/08/21/geronb.gbv057.full

ERKLÄRUNG ZUR DISSERTATION

Hiermit versichere ich, dass ich die vorliegende Arbeit selbstständig verfasst habe. Andere als die angegebenen Hilfsmittel habe ich nicht verwendet. Die Arbeit ist in keinem früheren Promotionsverfahren angenommen oder abgelehnt worden.

_____

Svenja M. Spuling

Berlin, November 2016