

Psychological Vitality in the Oldest Old

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INTRODUCTION

Depending on country, culture, birth cohort, and idiosyncratic factors, the post-retirement period in the twenty-first century could extend

over 20–40 years of an individual's life. Life expectancy after age 65 has increased and more people are surviving to the ninth and tenth decades (Vaupel, 2010). Population demographers categorize those women and men who survive

beyond the average life expectancy for their age cohort as the *oldest old* (He & Muenchrath, 2011). The chronological age used to identify entry into this age category varies but it generally ranges between 80 and 85. Unlike any other age strata, the oldest-old population is characterized by a unique excess of women over men, relatively high levels of comorbidity, dementia, institutionalization, and excess consumption of medical services.

Although research typically focuses on the less desirable outcomes associated with living a long life, not all of the oldest old have dementia nor are they disabled or fully dependent on others for assistance in the basic activities of daily life. Christensen, McGue, Peterson, Jeune, and Vaupel (2008), for example, reported that 30–40% of Danish nonagenarians born in 1905 were independent from age 92 to 100. A focus shift to instead characterize the subgroups of the oldest old that do not meet clinical thresholds (e.g., for dementia) would inform us about heterogeneity of functioning in the oldest old and the potential for long-lived individuals to maintain autonomy, be socially engaged, enjoy life, and adapt to health challenges.

Scope of the Chapter

This chapter was motivated by the challenge to shift focus. We review research published in the decade from 2004 to 2014 in order to evaluate contemporary evidence and scenarios about psychological functioning and well-being in the oldest old. Given the absence of defined evaluative cutoffs for psychological functioning (e.g., analogous to definitions of dementia and disability), we use the term *psychological vitality* to describe functionally desirable profiles in psychological domains as they are observed in the oldest old and at the end of life. Earlier reviews (Baltes & Smith, 2003) used the term *psychological mortality* to describe the inverse status, namely a loss of functional vitality. They characterized advanced old age as a life period that tests the limits of adaptive capacity.

We adopted the concept of psychological vitality rather than using more well-established concepts such as optimal, active, robust, and successful aging, because researchers agree that the established concepts are complex and may need to be expanded to be appropriate for the oldest old. For example, McLaughlin, Connell, Heeringa, Li, and Roberts (2010) estimated that only 2.2% of participants over age 85 in the Health and Retirement Study (HRS 1998–2004) met the Rowe and Kahn (1997) criteria for successful aging (i.e., low probability of disease and disease-related disability, high cognitive and physical functional capacity, and active engagement with life). There is consensus, however, that concepts such as successful aging encompass components and processes that contribute to adaptive capacity and resilience in very old age.

This chapter begins with a brief description of the characteristics and life histories of the oldest old observed in contemporary research and a discussion of research challenges associated with this population. We then consider cross-sectional and longitudinal reports about five domains of psychological vitality after age 80: non-pathological cognition, personality, self-related functioning, social connections, and subjective well-being. After reviewing this material, we conclude with a brief discussion of current knowledge gaps about the *psychological vitality* in the oldest old and directions for future research.

WHO ARE THE CONTEMPORARY OLDEST OLD?

The oldest-old men and women observed in 2014 (aged 85+) were born in the years from 1898 to 1929. This age group comprised 1.8% of the US population in 2010 (Older Americans, 2012). The average life expectancy after age 85 for men was 5.9 years and for women 7 years.

Thirty-two percent were married, 12% were in poverty, 14% were in long-term care facilities, and 67% of those living in the community required assistance with multiple instrumental activities of daily life.

The oldest old in 2014 also share a set of period- and cohort-specific characteristics. On average they have a lower level of education compared with subsequent cohorts and they were exposed to formative historical events in their first 30 years of life (e.g., WWI, the Spanish Flu epidemic, the 1930s Depression, WWII, access to penicillin). These birth cohorts have also been exposed to macro-level medical, technological, and societal changes that have had major effects on their lives throughout midlife and into old age. Of course, within these cohorts of the contemporary oldest old there are large individual and subgroup differences in life and health histories and variation in the onset age for chronic illness and disability.

The majority of large panel studies of the oldest old that include several indicators of non-pathological psychological functioning are located outside of the United States. Although the Health and Retirement Study (HRS), which encompasses the AHEAD cohort born prior to 1923, collected measures of memory, dementia, and depression from its inception in 1992–1993, it is only since 2006 that coverage of psychological functioning has been extended and added to the longitudinal protocol. Studies elsewhere that include the oldest old vary in scope, panel size, and duration. Some (e.g., the Berlin Aging Study (BASE), Australian Longitudinal Study of Ageing (ALSA), and German Socio-Economic Panel (SOEP)) include multiple domains whereas others assess only a few (e.g., Origins of Variance in the Oldest-Old (OCTO), Lothian 1921 cohort). Furthermore, there are studies that focus specifically on subgroups of the oldest old (e.g., centenarians).

RESEARCH ISSUES

There are a multitude of complexities to consider when studying the oldest old. A primary concern is the generalizability of research findings due to sampling and mortality selection processes. Not all adults aged 85+ are willing and/or able to engage in research. In this population, issues related to vision, hearing, physical functioning, cognitive decline, frailty, and distance-to-death all play a role in restricting participation. Given this, we argue that more attention should be paid to using actual research participation as a basic indicator of vitality in the oldest old. Being able to participate in a study is a broad indicator that the individual has sufficient ability and vitality to engage with the outside world. In addition, participation as an indicator of vitality could be scaled by the physical and psychological demands of the particular study. For example, the ability to participate in a half-hour telephone interview is less taxing than engaging in an hour-long in-home interview, which is then less taxing than traveling to a location outside of the home for an interview or completing a mail or web questionnaire without assistance.

Although many recognize the problem of selection processes in studies of the oldest old, it is more difficult to deal with this problem. Cross-sectional studies typically have little information about selective participation. One important direction for future work is to increase cross-sectional analyses of population-based samples and include adjustments for non-response bias. Comparisons of the impact of participation estimates in population-based samples of the oldest old to those that currently exist with convenience samples could inform theories and guide the design of new studies about psychological vitality in the oldest old.

Longitudinal studies have additional constraints to consider. They deal with the same issues of initial sample selectivity at baseline,

but must also address selective attrition. Currently, it is common practice for longitudinal studies of all types to report attrition rates and descriptive comparisons of those who remained in the study versus those who dropped out. Typically such comparisons reveal that sample attrition is linked to death, poor health, frailty, and lower baseline cognitive and other psychological functioning, all facets integral to understanding psychological vitality.

An important theoretical consideration in designing longitudinal studies of aging is the number of measurement occasions and the time interval between those occasions to appropriately capture change. These decisions should be made with reference to theory about fluctuations and change in key variables of interest. Considering this, paired with evidence that the oldest old are an extremely heterogeneous population, future research should consider shorter intervals between waves and include bursts of assessment when following this population over time. In particular, more frequent measurement of the domains typically considered to be relatively stable before age 85 may be informative. Some studies, for example, choose to measure crystallized abilities such as vocabulary and factual knowledge less frequently than fluid cognitive abilities such as speed or memory because research has shown that knowledge and facts are relatively stable in old age compared to reliable declines in performance on fluid tasks. The rates of change in these domains, however, may be different than those in younger age groups. Depending on the domain of functioning, individual differences in variability (fluctuations) could also be markers of either adaptation or loss of vitality in the very old. In addition, because it is well-established that longitudinal studies of the oldest old experience high rates of attrition, having more frequent measurement occasions and measurement bursts will contribute more information to model functional change prior to attrition. Studies suggest that greater variability

and steeper decline in functioning are important predictors of subsequent death-related and non-death attrition.

DOMAINS OF PSYCHOLOGICAL VITALITY

Psychological vitality in later life is observed within and across many domains and dimensions of functioning. Here, we review research since 2004 on cognition, personality, self-related functioning, social connections, and subjective well-being. In each domain, we ask: (i) which characteristics predict longevity; (ii) what is known about the level and heterogeneity of functioning of the oldest old on these characteristics; and (iii) does functioning in the domain change after age 80?

Cognition

Cognitive functioning is a well-known indicator of maintaining independence and survival in older adults (Ryan & Smith, 2009). Several mechanisms may underlie this association, including proposals that cognition is a resource for better health behaviors and physical functioning, better availability of resources linked with cognitive function and educational attainment (such as better health care over the life course), and underlying biological links which pair cognitive decline with terminal decline in old age. We briefly review research published since 2004 about dimensions of cognition associated with survival in the oldest old, the importance of differentiating cognitive status versus rate of decline, and heterogeneity of cognitive functioning in the oldest old.

Level Versus Change in Cognition and Survival

Research on cognition encompasses a wide array of dimensions, processes, and measures, ranging from conceptualizations of crystallized

and fluid abilities, IQ, and dementia. This breadth alone challenges efforts to synthesize the associations of cognition with vitality and survival in the oldest old. One approach is to examine multiple components of cognition in a single study, such as Ghisletta, McArdle, and Lindenberger (2006) who examined links between cognitive performance and 13-year survival with a sample of 70–103-year-olds in the Berlin Aging Study. This study included three fluid measures (perceptual speed, memory, fluency) and a measure of verbal knowledge. When examining the impact of these measures in separate models on survival, results indicated that the level of cognitive function was a significant predictor of survival over and above age and gender. However, when all four cognitive domains were included in a single model, none retained significance. The authors posit that, in this longitudinal study of the oldest old, the association between cognitive performance and survival is more general and not explained by any single domain. These findings are also supported by studies which examine individual cognitive domains. Terrera, Piccinin, Johansson, Matthews, and Hofer (2011) focused on links between memory performance and survival in a sample of the oldest old from the OCTO-Twin Longitudinal Study of Aging and found a similar pattern in that the level of memory was positively associated with likelihood of survival. Similarly, Deary, Whiteman, Starr, Whalley, & Fox (2004) found that intelligence measured at age 11 was significantly associated with survival to age 76. Unfortunately, this study did not include participants who had aged into the oldest old.

There is also evidence in recent studies of the oldest old that the rate of decline in cognitive performance is an important predictor of later survival (Alwin, McCammon, Wray, & Rodgers, 2008). One study applied latent profile analysis to examine patterns of memory, depression, and social integration over time

in a sample of the oldest old (Morack, Ram, Fauth, & Gerstorf, 2013). The identified trajectory group types were largely defined by differential rates of memory decline. Compared to the individuals identified as having *preserved system integrity*, those with *compromised memory* and *failing memory* had significantly higher rates of mortality over 8 years. In addition, recent evidence suggests that, beyond the rate of decline, patterns of intraindividual variability in cognitive performance are associated with survival. In a sample of the 70+ followed over 17 years, for example, greater within-person variability in reaction time was associated with increased risk of mortality (Batterham, Bunce, Mackinnon, & Christensen, 2014).

Heterogeneity of Cognitive Functioning in the Oldest Old

As discussed earlier in this chapter, selective survival is an inherent factor in studies of the oldest segments of the population and, as such, it places important caveats on any research which aims to understand psychological vitality in aging populations. Another important issue is that, although there has been a great deal of research on cognitive aging since 2004, there is less recent work that specifically examines the oldest old. Typically, studies include samples of the 65+ or 70+, with the oldest tail of the age distribution creeping over age 80. In those studies which do include an adequate sample in the 80+ range, often the oldest old are grouped together with all older adults, thereby making it impossible to know if associations differ in the young-old and oldest-old groups. Given differential survival selection processes in the oldest old who participate in research, it is perfectly reasonable to hypothesize that associations of cognition with survival may in fact be different among the young old and oldest old. This point is supported by a study by Hülür, Infurna, Ram, and Gerstorf (2013), which found that, when anchored against distance to death, there were no cohort

differences in the association of memory performance with survival. This suggests that the associations of cognition with survival in the oldest old may be qualitatively distinct from younger age ranges, considering that there is likely to be a larger proportion of the oldest-old population within their last years of life. Given survival selection effects, in addition to the potential for cohort effects related to differential life experiences, it is critical that future research on cognitive aging consider age-cohorts separately before generalizing associations across all older adults equally.

Another issue we encountered in this section relates to the measurement of cognition. While a wide variety of cognitive measures is used to characterize cognitive aging up to age 85, including multiple measures of processing speed, memory, decision making, and reasoning ability, most studies targeting the oldest old only include measures that screen potential dementia and clinically problematic functioning. These screens are known to be poor discriminators of performance within normal ranges. This bias toward using dementia-relevant measures is in part because rates of dementia and cognitive impairment are higher in the oldest old (Corrada, Brookmeyer, Paganini-Hill, Berlau, & Kawas, 2010). Several studies, for example, report that between 0% and 50% of centenarians and older do not have a diagnosis of dementia and score in the normal range on screening tests for suspected dementia (Calvert, Hollander-Rodriguez, Kaye, & Leahy 2006; Yang, Slavin, & Sachdev, 2013). In sum, it is clear that future work needs to specifically target the oldest old and to include a wide range of cognitive measures.

Personality Traits

Research on personality in old age encompasses both trait and social-cognitive perspectives. In this section, we review studies that link the Big Five traits and sub-facets to longevity

and report findings about levels and change in trait stability after age 80.

Trait Predictors of Survival

Roberts, Kuncel, Shiner, Caspi, and Goldberg (2007) conducted a comprehensive review of the magnitude of effects of personality traits on mortality in 34 studies that controlled for other known predictors, such as socioeconomic status, cognitive ability, gender, and health. High conscientiousness (especially the sub-facets of self-discipline and social dependability) is consistently found to predict longevity both in studies that examine early life predictors (Deary, Batty, Pattie, & Gale, 2008; Friedman, Kern, & Reynolds, 2010; Terracciano, Löckenhoff, Zonderman, Ferrucci, & Costa, 2008) and those that examine predictors after age 65 (Weiss & Costa, 2005). Conscientiousness is associated with engaging in health-protective behaviors during adulthood as well as other protective life course factors, such as career success, and social relationships. People who survive beyond ages 65 or 70 are thus likely to be positively selected for conscientiousness. Given this, the findings of Weiss and Costa (2005) that high conscientiousness continues to be predictive of survival in very old age are noteworthy. Furthermore, the men and women in the study by Weiss and Costa (2005) were all Medicare recipients with multiple functional limitations and relatively low education.

Findings about the associations between longevity and other traits (neuroticism, extraversion, openness, and agreeableness) are less consistent. Mroczek and Spiro (2007), for example, found that neither level nor change in extraversion predicted 18-year survival among men over age 60, but level and change in neuroticism did. Whereas lower neuroticism was protective, higher neuroticism increased mortality risk by 40%. High neuroticism and low extraversion were associated with an increased risk of death in a Chicago sample aged over 65 ($M=75$ years at baseline; Wilson et al., 2005).

These associations were minimally reduced after adjusting for health factors, but reduced by more than 50% after controlling for levels of cognitive, social, and physical activity. Read, Vogler, Pedersen, and Johansson (2006) found that less extraverted individuals at age 83 had an increased risk of mortality over a 4-year period.

Optimism predicted all-cause and coronary heart disease-related mortality in an 8-year follow-up of 97,253 postmenopausal women aged 50–79 who participated in the Women's Health Initiative study (Tindle et al., 2009). A 10-year prospective study of Dutch men and women aged 65–85 also found that dispositional optimism was predictive of all-cause and cardiovascular mortality (Giltay, Geleijnse, Zitman, Hoekstra, & Schouten, 2004). In studies of older adults that include both men and women, there are suggestions that the predictive effects of optimism may interact with gender and age. Giltay et al. (2004), for example, found that the protective effect of optimism was somewhat higher in men than in women. The opposite gender effect was found in nonagenarians from the Danish 1905 Cohort Survey (Engberg et al., 2013). In this sample of the oldest old, optimism was protective for women, but was not significant for men.

Personality Profiles of the Oldest Old

Several studies of exceptional survivors report that centenarians are characterized by low neuroticism, high conscientiousness, and moderate levels of extraversion and agreeableness. In a nationwide study of 400 Greek centenarians (Tigani, Artemiadis, Alexopoulos, Chrousos, & Darviri, 2011), on average, men were found to be more optimistic than women. In this study, 78% of participants completed non-proxy interviews and optimism scores ranged from low to high. Participants in the study were relatively healthy: the sample represented approximately 25% of centenarians in the Greek population and excluded long-lived survivors with dementia and poor hearing.

Studies that compare the oldest old with younger groups (aged 60–80), however, typically find that extraversion, openness, and conscientiousness are lower in the oldest old. Terracciano, McCrae, Brant, and Costa (2005), for example, report age-comparative data on the NEO-PI-R for a subgroup of 190 oldest-old individuals who had participated in the Baltimore Longitudinal Study of Aging. Compared to people aged 70–79, those over 80 were, on average, 2.3 T-score points higher on neuroticism, 2.8 points lower on extraversion, 1.6 lower on openness, 0.6 lower on agreeableness, and 1.6 lower on conscientiousness. The authors caution that cohort differences may underlie these results. Consistent with these findings, Andersen et al. (2013) observed in the Long Life Study that levels of extraversion, openness, and conscientiousness for 1433 nonagenarians and centenarians (all without dementia) were, on average, 3 T-scores lower than those of their 60-year-old offspring ($n=2423$). They also report that the parent generation scored higher on neuroticism and lower on agreeableness.

Personality Change after Age 80

Studies about change in personality traits after age 80 are rare in contrast to the increasing number of such studies in younger life periods. Lucas and Donnellan (2011) examined 4-year stability and change in participants in the German SOEP. They found that compared to midlife age groups, 4-year stability was lower after ages 70 and 80, especially for conscientiousness. Indeed, the lower stability levels were similar to those found for adolescents and children. Mean levels of all of the Big Five traits declined over 4 years in participants over age 80. Mõttus, Johnson, and Deary (2012) modeled change in personality between ages 81 ($n=450$) and 87 ($n=209$) in follow-up studies of the Lothian 1921 Birth Cohort. They found relatively high 6-year stability (ranging from 0.78 to 0.89 for latent factors) and significant mean-level declines in extraversion, agreeableness,

and conscientiousness. Non-participants in the 6-year follow-up (54% of the baseline sample dropped out) had reported higher neuroticism at age 81 and were physically, functionally, and cognitively less able.

Findings about the impact of health on personality change are mixed. Möttus, Johnson, Starr, and Deary (2012) asked if change in personality was associated with cognition, physical fitness (e.g., strength), and functional limitations. They found that higher intelligence at age 79 and minimal change in physical fitness contributed to reduced decline in conscientiousness over time (i.e., greater maintenance) in the Lothian octogenarians. Individual differences in change in extraversion, agreeableness, and neuroticism, however, were not associated with these predictors. Berg and Johansson (2014), however, found that mean levels of extraversion decreased over 6 years in a study of Swedish octogenarians, and that steeper decline in extraversion was associated with impaired hearing.

Self-Related Beliefs and Self-Regulation

Self-related knowledge, beliefs, and processes are generally distinguished from personality traits and provide valuable additional insight into adaption to personal aging and changing life circumstances in very old age. Theory and research suggest that self-related functioning is less vulnerable to decline than cognition and contributes to resilience and thriving at least up to the early 80s. Since 2004, with the exception of several qualitative analyses of narrative interviews and studies of possible selves, most research on people over age 80 has focused on measures of self-perceptions of aging, valuation of life, personal control (mastery), and self-esteem. This trend is reflected in our review.

Self-Related Predictors of Survival

In contrast to the literature on personality traits, we were unable to find a review comparing multiple dimensions of self-related

predictors of survival into very old age. Instead, researchers typically analyze specific self-related constructs and, although findings are adjusted for covariates such as socioeconomic status, health and cognition, adjustments for (or comparisons with) other self-related beliefs or personality traits are rare.

Several studies report that positive self-perceptions of aging and the relative maintenance of these perceptions over time predict survival to age 80 and older. Using data from BASE, Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, and Smith (2009) found that baseline and relative longitudinal 4-year stability of positive self-perceptions of aging predicted subsequent survival 16 years later (M age = 85 at baseline; range 70–103 years). Average age at death in this study was 92 years. Furthermore, the 22% of decedents in the study who survived and were able to participate in at least four in-person interviews up to 6 years after baseline reported higher satisfaction with aging and feeling younger than their actual chronological age compared to other participants at baseline. These baseline comparisons and longitudinal change findings about self-perceptions of aging are consistent with research by Sargent-Cox, Anstey, and Luszcz (2014) in a 16-year Australian panel (M age 77 at baseline) and by Uotinen, Rantanen, and Suutama (2005) in a 13-year Finnish prospective panel (mean age = 73 at baseline, born 1904–23).

Prospective studies of population and midlife panels over many years suggest that perceptions of control of one's life (also called mastery or self-efficacy) are predictive of survival at least into the late 70s and 80s (Infurna, Ram & Gerstorf, 2013; Turiano, Chapman, Agrigoroaei, Infurna, & Lachman, 2014). In a large panel study of over 20,000 in the United Kingdom, Surtees, Wainwright, Luben, Khaw, and Day (2006) found that a high sense of mastery was associated with lower rates of mortality from all causes, cardiovascular disease, and cancer. They examined age-group-specific

associations and reported that the association was consistent in the 50–59, 60–69, and 70–80 age strata and across 2-year, 4-year, and longer follow-up periods.

Feeling useful to others, a belief associated with personal mastery, is also related to longer survival after age 70 (Gruenewald, Karlamangla, Greendale, Singer, & Seeman, 2007). Similarly, several analyses of large prospective studies find that people over age 70 who volunteer have a reduced risk of mortality (Okun, Yeung, & Brown, 2013). Furthermore, participants over age 70 in the RUSH Memory and Age Project (MAP) and Minority Aging Research Study (MARS) who reported a higher purpose in life had a substantially reduced risk of mortality over a 5-year period. Consistent with all of these studies, attrition analyses in some longitudinal studies of older adults reveal that individuals who live to age 80 and continue to participate in studies have higher self-esteem than dropouts and non-participants (Wagner, Hoppmann, Ram, & Gerstorf, 2015).

Characteristics of the Self-Related Beliefs of the Oldest-Old

After age 80, narrative self-descriptions are often characterized by reflections about the good and bad sides of a long life: they may contain a life review, expressions of surprise and thankfulness for having lived a long life, together with fears and worries about declining health and memory (Jeon, Dunkle, & Roberts, 2006). Hoppmann and Smith (2007) reported that hopes and fears about health dominated the possible selves generated by 129 women aged 85–100+ in BASE. Interestingly, they also found that women who had never had children mentioned more family-related themes than mothers, whereas the mothers addressed more friendship-related themes than the childless women.

Health also plays a central role in the self-perceptions of aging reported by the oldest old. However, on average they report feeling younger than their actual age. Kleinspehn-Ammerlahn

et al. (2008) estimated that at age 85 participants felt 13.5 years younger, whereas those aged 95 felt approximately 16.5 years younger. Similar discrepancies between actual and subjective age were found by Choi, Di Nitto, and Kim (2014) in subgroups aged 80–89 and 90+ in the National Health and Aging Trends Study (NHATS). Among 267 participants from the Swedish OCTO study, almost two-thirds of the 84- to 90-year-olds reported not feeling old (Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010).

Comparisons with the young old reveal that the oldest old on average report somewhat lower levels of perceived control and self-esteem (Lachman, Neupert, & Agrigoroaei, 2011). Orth, Trzesniewski, and Robins (2010), for example, estimated a difference in the level of self-esteem for a 60-year-old versus a centenarian to be -0.67 SDs. Using a sample that ranged from 65 to 85+ (baseline M age = 78), Krause (2007) found that the oldest participants were less likely to feel that they could control what happened in the social role that they most valued (e.g., as spouse, homemaker, or parent). Feeling able to actively engage in activities that provide a sense of competence, pleasure, and social contact contributes to a desire to live more years, a concept examined by Jopp, Rott, and Oswald (2008). They compared responses to items, such as *I have a strong will to live right now* and *I intend to make the most of my life*, given by people aged 65–79 and 80–94 from a locally representative community-dwelling panel in Germany. Only 40% of people over 80 ($N=353$) provided complete data for the analyses and while their overall scores on the measure tended to be lower than the younger group, individual differences within the oldest group were large. Poor health especially appears to challenge the capacity to remain strong-willed.

Change in Self-Related Beliefs after Age 80

Since 2004, researchers have begun to compare late-life age-related and death-related change in self-related beliefs using data from several

longitudinal studies. In general, change associated with distance from death (terminal decline) appears to be greater than time-in-study and age-related change in very old age. However, the sources and extent of change associated with age- and death-related processes differ by the dimension and, regardless of the time metric used, there are typically substantial individual differences in the onset, shape, and rate of change.

Kleinspehn-Ammerlahn, Kotter-Grühn, and Smith (2008), for example, found that although satisfaction with aging declined over 6 years, the oldest old either maintained or slightly increased the gap between the age they felt and their actual chronological age over time. Change in subjective age was attenuated by chronic illness and loneliness. When Sargent-Cox, Anstey, and Luszcz (2012) examined the relationship between changes in satisfaction with aging and physical functioning over 16 years, they found that the relative maintenance of satisfaction with aging over time was protective of decline in physical functioning.

Kotter-Grühn and Smith (2011) reported that, for each additional year lived, individuals over age 85 made fewer plans for the future and were less optimistic. Similarly, Krause (2007) found that advancing age was associated with a decline in feelings of control over valued social roles and Gerstorf, Ram, Lindenberger, and Smith (2013) found significant quadratic age-related change in perceived control over desirable and less desirable outcomes. In contrast, Wagner et al. (2015) reported that self-esteem was stable up to the early 90s.

Kotter-Grühn et al. (2009) compared age- and distance-to-death models of change in satisfaction with aging and subjective age. They found that whereas the distance-to-death model was the best fit for decline in satisfaction with aging, a time-from-birth model best fitted subjective age. In other model comparison studies, average rates of decline in very old age are generally steeper over time-to-death than over age (e.g., perceived control; Gerstorf et al., 2013).

Social Connections

Social connections can be characterized in terms of frequency and quality of social contact with friends and family, social support and strain, social network size, social isolation, and loneliness. The quality of social connections is particularly important for the oldest old as individuals' social network sizes typically decline with age (Broese van Groenou, Hoogendijk, & Van Tilburg 2012; Shaw, Krause, Liang, & Bennett, 2007). While surviving to age 85 and over is an achievement, most long-term survivors are faced with inevitable losses to their networks, including spouses, siblings, friends, and sometimes even children. Over time, fewer age peers with shared knowledge of early life experiences and personal history survive. Coping with these losses and maintaining strong connections with remaining (typically younger) social network members is therefore an essential component of vitality for the oldest old.

There is ample evidence that older adults are motivated to maintain familial ties and that a great deal of their psychological and emotional well-being is derived from family (Charles & Carstensen, 2010). Not only does the maintenance of familial ties provide a sense of satisfaction and well-being to older adults, but it also can be instrumental in providing a source of informal care. Although evidence of the maintenance of family network connections in the oldest old is in line with this research, recent work has found that while earlier cohorts of the oldest old have few non-kin members in their networks, more recent cohorts show better maintenance of non-kin network members into late life (Stevens & van Tilburg, 2011; Suanet, van Tilburg, & Broese van Groenou, 2013). This is an important development, given recent evidence that the Baby Boomers are expected to have fewer traditional sources of informal care providers as they enter into late adulthood (Ryan, Smith, Antonucci, & Jackson, 2012). In

a related paper, [Vikström et al. \(2011\)](#) investigated the potential impact of childlessness on the oldest old. Using data from the ELSA, the authors found that, contrary to expectations, childless individuals did not differ on a range of psychological well-being indicators compared to those with children. In line with [Suanet, van Tilburg, and Broese van Groenou \(2013\)](#), it is possible that this cohort has developed fictive kin networks to supplant “gaps” in social and instrumental support associated with being childless, supported by research showing that time spent with friends is a critical predictor of survival ([Maier & Klumb, 2005](#)). These non-traditional social networks are likely to be more common with future cohorts of the oldest old, and an important marker of psychological vitality will be the extent to which such social networks are created and maintained.

Social Connections of the Oldest Old

As is the case with much research on the oldest old, a great deal of work examining social connections is cross-sectional. This work is particularly important in that it provides essential baseline information about older adults' social networks and does not suffer the same selectivity issues inherent to longitudinal studies of the oldest old. [Ailshire and Crimmins \(2011\)](#) examined a nationally representative sample of older adults in HRS to determine how the oldest old (90+ in this study) compared to those in their 70s. Results found that the oldest old report more supportive relationships with family members compared to their younger counterparts. However, the oldest old were significantly more likely to feel lonely and socially isolated, possibly due to higher rates of widowhood. In another nationally representative sample of US adults, [Cornwell, Laumann, and Schumm \(2008\)](#) used the National Social Life, Health, and Aging Project to examine profiles of social connectedness by age. While only a portion of the participants were in their 80s, results confirmed previous findings that

increasing age is associated with smaller social networks. They report that there is increased frequency of network contact beginning in the late 70s, that more frequent network contact was associated with stronger social ties, and that the probability of weekly attendance of religious services, neighborly socializing, and volunteering all increase with age. The increased community engagement with increasing age into the early 80s needs to be viewed through the lens of positive selection, given that this analysis was cross-sectional.

When considering the cross-sectional work, the overall picture is of a complex constellation of social connections among the oldest old. While objective indicators of social isolation are more likely in this population due to widowhood and other cohort losses, there are also indicators that the oldest old have generally positive social experiences and retain non-kin members in their networks. These positive social profile attributes are an important indicator of psychological vitality, that in the face of difficult social losses and feelings of loneliness, individuals are resilient and able to retain positive experiences from their remaining network members.

Social Connection Predictors of Survival

The majority of research about social connections over time is focused on later survival, so we have combined these two subsections. There are a variety of pathways and mechanisms by which social connections are associated with survival in the oldest old. As mentioned above, social connections are an important source of social and instrumental support for older adults' daily lives. Not only does the maintenance of a social connection with family, such as grandchildren and great-grandchildren, motivate activity and produce pleasure for the oldest old, but it is also instrumental in providing sources of care for frail elders. Using a sample of Danish twins aged 75 and older, [Rasulo, Christensen, and Tomassini \(2005\)](#) found that

survival over a 6-year period was associated with having a spouse, reporting close ties with friends (for women only), and being close with the co-twin (for identical twins). This study is very useful in that it incorporated a longitudinal approach with a variety of social connection constructs, from objective measures such as frequency of contact to the quality of relationship ties.

There is a great deal of evidence linking social isolation and loneliness with increased mortality risk, which is important given the higher likelihood of being socially isolated or lonely in the oldest old (Step toe, Shankar, Demakakos, & Wardle, 2013). Typically, social isolation is considered an objective measure of an individual's social network size and frequency of contact with the network, whereas loneliness is the self-perception of being isolated from others. One challenge in reviewing this literature is that many studies focus on a broad age range and tend to consider linear age trends rather than considering the oldest old as a qualitatively distinct group. Although it may indeed be that associations of loneliness on mortality are consistent across age groups, we argue that the extent to which age groups within the oldest old are qualitatively distinct remains an open question. It may be that while loneliness is more frequent in the oldest old, due to social network losses, the fact that these losses are normative for this group may facilitate coping and accepting the deaths of close network members. There is still much that needs to be understood about the potential meaning and context differences in comparisons of the young old and the oldest old for constructs such as loneliness.

Subjective Well-Being

Subjective well-being is one of the central indicators of psychological vitality in late life. It reflects the remarkable adaptive capacity to remain satisfied with life and to sustain

a positive balance of positive versus negative affect even when challenged by illness, physical and cognitive decline, and social losses (e.g., widowhood, deaths of age peers). The literature since 2004 abounds with studies reporting that life gets better with age and that older adults are happier than midlife cohorts. However, most studies supporting these conclusions do not include the oldest old. In this section, we review research about selective survival associated with components of subjective well-being (e.g., life satisfaction, positive and negative affect) and levels and change in well-being in octogenarians, nonagenarians, and centenarians.

Subjective Well-Being and the Prediction of Survival to Age 80

There is robust evidence from long-term prospective studies that higher positive affect and satisfaction with life are associated with a reduced risk of mortality (Diener & Chan, 2011). In an extensive meta-analysis, Chida and Steptoe (2008) compared the sensitivity of 15 studies that sampled primarily participants over age 60, with a larger pool of population and lifespan studies. This revealed that higher subjective well-being had the strongest protective effect in the studies of older adults.

Findings from two studies of older twins suggest that the strong association between subjective well-being and survival continues after age 70. Sadler, Miller, Christensen, and McGue (2011) followed 3966 dizygotic and monozygotic Danish twins aged 70 and older for a median of 9 years. They found that higher life satisfaction reduced the risk of all-cause mortality and was independent of familial factors such as shared genes and common environment. Swedish octogenarians in the highest quartiles of satisfaction with present life had a twofold reduced risk of 10-year mortality compared to those in the lowest quartile (Lyyra, Törmäkangas, Read, Rantanen, & Berg, 2006). Dutta et al. (2011), however, reported that

although life satisfaction was associated with survival to age 85 in the Iowa EPESE study, it did not predict survival to age 94 for men or 97 for women.

Level and Change in Subjective Well-Being after Age 80

Cross-sectional and longitudinal analyses consistently report decreases in life satisfaction after age 80. Berg, Hoffman, Hassing, McClearn, and Johansson (2009) found that differences in within-person change over 6 years were associated with time-varying factors such as loss of spouse, perceived quality of social network, and depressive symptoms. Using longitudinal data from large representative panels in Germany, England, and the United States, Gerstorff et al. (2010) determined that individual differences in late-life intraindividual changes in life satisfaction were better described using a distance-to-death rather than a distance-from-birth time metric. They identified transition points 3–5 years prior to death after which decline in life satisfaction accelerated. Models of age-related intraindividual decline in life satisfaction also were somewhat more pronounced in the oldest old than in people aged 70–84.

Although comparisons of centenarians and younger age groups (midlife and octogenarians) reveal no age differences in the percent of participants who report feeling currently as happy as in younger years (Jopp & Rott, 2006), these cross-sectional findings are not consistent with reports of longitudinal change. Gana, Saada, and Amieva (2015), for example, modeled 22-year change in a French community-based locally representative panel from Gironde and Dordogne (baseline age ranged from 75 to 92). They found a small but significant decline in the very old: fewer and fewer people report feeling happy with each year of life. Kunzmann (2008) proposed that decreases in positive affect are primarily associated with reductions in social involvement and cognitive decline. Similar to the research on life

satisfaction, affective well-being is also vulnerable to terminal decline (Palgi et al., 2014; Vogel, Schilling, Wahl, Beekman, & Penninx, 2013). Schilling, Wahl, and Wiegering (2013) found that the association between increased age and decline in positive affect was stronger than that with distance-to-death. Increases in negative affect in advanced old age, on the other hand, were substantially related to impending death.

CONCLUSIONS

What conclusions can be drawn from this cursory review of psychological functioning after age 85? Is there a new body of evidence about the prevalence and possibilities for psychological vitality late in life? We summarize our impressions in four main points.

First, in the five domains we reviewed, people who reach the age of 85 and enter the oldest-old group in the population are positively selected for a single and possibly a combination of psychological factors associated with vitality. For example, they may be conscientious and have high self-esteem, or be intelligent and optimistic. Here, we use the term positively selected to refer to the demographic fact that they have outlived 80% or more of their birth cohort and participated in research. There are likely many different combinations of psychological characteristics and associated biogenetic and social pathways that have contributed to and sustained survival to the mid-80s. We currently have information about some single characteristics but know little about combinations of protective factors.

Second, despite this positive selection, it appears that even the most psychologically vital individuals after age 85 are vulnerable to the challenges of physical and cognitive decline, illness, and social losses (Charles, 2010; Shmotkin et al., 2013). Many outlive their long-term partners, siblings, same-age friends, and even their children. Physical limitations

and reductions in energy and strength constrain and diminish psychological vitality. Comparisons of age-related and death-related trajectories of change observed in the very old suggest that processes that are associated with distance-to-death (terminal decline) gain in prominence. To date, we know little about the nature of these processes and the reasons for their differential impact across domains and people (Gerstorf & Ram, 2013). It is often assumed that physical and psychological decline are synchronous but the extent of this intertwine and the role of chance factors is not known. A better understanding of the complex interactions between mind and body in very old age will provide insight into intervention strategies. Current measures, however, may not be sufficiently sensitive to evaluate the range of the psychological vitality and adaptive capacity of the very old. Measures originally developed primarily to assess psychological competence, beliefs, and dispositions in early life likely underestimate the potential and vitality of the very old.

Third, we know little about the efficacy of interventions after age 85. To what extent is it possible to enhance psychological functioning in some or all of the domains we reviewed? Should some domains be prioritized? Furthermore, are there particular aspects of supportive caregiving and socio-environmental contexts that can be leveraged to enhance and sustain the psychological vitality of the oldest old?

Finally, to advance our knowledge about very old age, the field continues to need well-designed, longitudinal studies that focus on transitions from the 70s to the 80s and beyond, as well as transitions from psychological vitality to vulnerability and diminished capacity regardless of chronological age. Many studies that currently focus on specific functional transitions, such as from normal cognitive functioning to impairment and dementia, do not collect comprehensive biopsychosocial and life history protocols.

There has been, and continues to be, much “success” over the last 100 years with regard to extending the years of life beyond the seventh decade for many populations worldwide (Christensen, Doblhammer, Rau, & Vaupel, 2009). In our view, however, it remains an open question whether the psychological characteristics that likely contribute to and foster a long life can be strengthened and prolonged in the oldest old. Having more available information for current cohorts of the oldest-old would expand the set of scenarios about prospects for future cohorts to delay psychological morbidity. Should we expect an epidemic of cognitive decline and psychological dependency from 2030 onwards when the first surviving Baby Boomers move into their late 80s? Alternatively, will the majority in the expected large number of oldest-old Baby Boomers set new standards of psychological vitality in late life?

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