Cognitive Functioning and Vitality among the Oldest Old: Implications for Well-Being

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Abstract
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JENNIFER A. MARGRETT, BENJAMIN T. MAST, MARIA C. ISALES, LEONARD W. POON, AND JISKA COHEN-MANSFIELD

ABSTRACT

This chapter clarifies and differentiates changes in cognitive functioning among the oldest old at the group and individual levels. Cross-sectionally, the oldest old demonstrate normative differences of being more physically and cognitively frail compared to younger groups. More variation and successful aging is observed at the individual level. Some oldest-old individuals can perform at the same levels as adults 20 to 40 years younger. Recent literature has recognized that the concept of cognitive vitality transcends the absence of dementia or dementing processes. We seek to clarify the concept of cognitive vitality because it has not been well defined in the literature either theoretically or operationally. This chapter addresses the following questions: 1) What is cognitive vitality and how does it contribute to the well-being of older adults? 2) What factors or resources contribute to cognitive vitality among the oldest old? and 3) What new directions can be identified for future research?

COGNITIVE FUNCTIONING AND VITALITY AMONG THE OLDEST OLD: IMPLICATIONS FOR WELL-BEING

Lay people and professionals alike fall prey to aging stereotypes and myths (Ory, Hoffman, Hawkins, Sanner, & Mockenhaupt, 2003), namely that cognitive decline is inevitable and there is nothing we can do about it. Empirical research has focused on comparing the cognitive performance of younger and older adults, often noting “deficits” in older adults’ abilities without taking into account context and potentially meaningful qualitative differences in older adults’ approaches to cognitive problems (e.g., Marsiske & Margrett, 2006). The tendency to focus on the negative aspects of cognitive
Cognitive Functioning and Vitality among the Oldest Old

Aging does not provide a comprehensive picture of normative aging and prevents the promotion of cognitive health and vitality in older adulthood. The increased heterogeneity in the functioning of the oldest old and the increasing prevalence of dementia in very late life provide challenges as well as opportunities to study successful aging and resiliency. In this chapter, we address the following questions: (a) What is cognitive vitality, and how does cognitive vitality contribute to the well-being of older adults? (b) What factors or resources contribute to cognitive vitality among the oldest old? and (c) What new directions can be identified for future research?

CONCEPTUALIZING COGNITIVE HEALTH AND VITALITY IN LATER LIFE

To clarify terms used throughout this chapter, we differentiate several related concepts. First, we refer to cognitive functioning as performance-based indicators of cognitive ability or skill. Cognitive aging refers to documented changes in cognitive functioning that occur throughout adult development and aging. Normative, or typical, changes are distinguished from nonnormative changes such as dementia. Cognitive health is used as a more global term to describe the spectrum of aggregate cognitive functioning, which can range from no impairment to mild cognitive impairment and more severe impairment evident with dementia. Finally, cognitive vitality is a construct that incorporates both cognitive functioning and other skills and disposition and is related to the successful application of cognitive skills in one’s everyday environment. In the following section, we further differentiate the terms.

COGNITIVE VITALITY: EXPANDING COGNITIVE HEALTH

Cognitive health is used as a global term to describe an individual’s collective cognitive functioning. Parallels can be made between definitions of physical and cognitive health. For instance, the World Health Organization (1948) defined health as “a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity.” Following similar logic, Walter-Ginzburg, Shmotkin, Eyal, & Guralnik (2008) proposed that cognitive health among older people should be defined as a state of mental well-being and vitality, not merely the absence of dementia or dementing processes. A definition of cognitive health proposed by the Critical Evaluation Study Committee of the National Institutes of Health Cognitive and Emotional Health Project is also consistent with this philosophy (Hendrie
Both groups propose moving beyond dichotomous distinctions (e.g., absence or presence of dementia) to an expanded conceptualization of cognitive health.

Cognitive vitality extends the concept of cognitive health by considering the application of cognitive skills and resources to day-to-day living. Walter-Ginzburg et al. (2008) argue that cognitive vitality is a construct separate from dementia and can be distinguished as “the ability to exploit cognitive resources for active information processing and interaction with the environment in practical everyday activities” (p. 7). Hendrie et al. (2006) defined cognitive health in later life “as the development and preservation of the multidimensional cognitive structure that allows the older adult to maintain social connectedness, an ongoing sense of purpose, and the abilities to function independently, to permit functional recovery from illness or injury, and to cope with residual functional deficits” (p. 13). In the latter definition, adaptation and competence can be inferred, as well as maintenance of psychosocial functioning and well-being. Also implied in this definition is resilience or the ability to achieve a “good outcome in spite of serious threats to adaptation or development” (Masten, 2001, p. 227). The oldest old certainly face their share of adversities (e.g., loss of family and friends to disease and death, role loss through retirement and ageism) and threats (e.g., trauma, socioeconomic challenges, presence of genetic and environmental dementia risk factors) to well-being and functioning. Many of the oldest old achieve and maintain physical and cognitive vitality despite varying levels of adversity and the presence of risk factors.

The concept of cognitive vitality in late life has the potential to help researchers frame the analysis of the full spectrum of cognitive health in later life (Walter-Ginzburg, Shmotkin, Blumstein, & Shorek, 2005). However, the notion of vitality, and cognitive vitality in particular, has not been well explicated in the literature either theoretically or operationally. This premise underlying the concept of cognitive vitality is consistent with the components of successful aging outlined by Rowe and Kahn (1998), who suggested that being disease-free may be an advantageous precursor but not a sufficient indicator of successful aging. Explicit in the definition of cognitive vitality is a focus on the real-world application of cognitive skills, which fits well with the framework of the everyday-cognition approach. The everyday approach is thought to add value to the study of cognitive aging (Allaire & Marsiske, 2002), as it emphasizes the ecological validity of assessment strategies and the identification of the higher-order cognitive skills needed to navigate the actual day-to-day life of an older adult (for recent reviews, see Marsiske & Margrett, 2006; Thornton & Dumke, 2005). What is
not clear from the literature is which benchmark to use to determine success in an everyday setting (Marsiske & Margrett, 2006). Perhaps this is the most difficult issue surrounding cognitive vitality, particularly in very late life, given altered goals and expectations and range of cognitive functioning. Is cognitive vitality possible across the spectrum of cognitive health (i.e., age-related cognitive aging with no impairment through dementia)?

We propose that cognitive vitality be viewed as a construct that incorporates both cognitive functioning and other skills and disposition and is related to successful application of cognitive skills in an individual's unique everyday environment. Although it is sometimes difficult to tease apart antecedent from consequence, as we discuss later in the chapter, cognitive vitality is related to multiple dimensions of well-being and the overall ability of older adults to adapt, achieve competence, and be resilient. As such, an individual is not limited to one static category of cognitive vitality. Cognitive vitality may fluctuate on the basis of changing individual (e.g., physical health, affect) and environmental (e.g., social support) factors. In our view, cognitive vitality is related to but does not totally overlap with other indicators of functioning and well-being. For example, an individual may exhibit poor physical functioning, yet be cognitively vital.

In this chapter, we focus primarily on cognitive vitality as the day-to-day successful application of cognitive functioning, primarily in the framework of normative cognitive aging. From this perspective, a cognitively vital individual is one who has sufficient cognitive functioning to perform the tasks required by the person’s age group in the context of his or her unique living conditions. However, among the oldest old, the spectrum of cognitive health encompasses cognitive functioning, which reflects no impairment as well as varying levels of impairment ranging from mild impairment to dementia. In this book, Cohen-Mansfield discusses the concept of successful aging in the context of dementia. In Chapter 4, she describes “successful” dementia as the lack of physical or mental discomfort with some sense of contentment and well-being despite decreased cognitive function. From Cohen-Mansfield’s perspective, it can be inferred that vitality in general is the totality of functions that the person manifests, including social capabilities and initiative, which allow him or her to function beyond what could be expected by his or her level of cognitive functioning alone (J. Cohen-Mansfield, personal communication, November, 12, 2009). For instance, cognitive vitality speaks to the fact that, with cognitive deficits, one may be able to navigate vitality in social and other activities, through social graces, overlearned skills, and even newly learned skills usually involving procedural memory (J. Cohen-Mansfield, personal communication, November,
TABLE 11.1. Theoretical relation between cognitive health and vitality

<table>
<thead>
<tr>
<th>Cognitive health</th>
<th>Cognitive vitality</th>
</tr>
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<tbody>
<tr>
<td>Low Low</td>
<td>“Vulnerable” (A)</td>
</tr>
<tr>
<td></td>
<td>Low cognitive functioning</td>
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<tr>
<td></td>
<td>Decreased well-being</td>
</tr>
<tr>
<td>High Low</td>
<td>“Successful Dementia” (B)</td>
</tr>
<tr>
<td></td>
<td>Low cognitive functioning but more</td>
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<td></td>
<td>successful navigation within their</td>
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<td></td>
<td>environment</td>
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<tr>
<td></td>
<td>Higher well-being than Group A</td>
</tr>
<tr>
<td></td>
<td>Vitality may buffer future decline</td>
</tr>
<tr>
<td>High High</td>
<td>“At Risk” (C)</td>
</tr>
<tr>
<td></td>
<td>Individual likely performs</td>
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<tr>
<td></td>
<td>satisfactorily in their</td>
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<td></td>
<td>particular environment,</td>
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<td></td>
<td>however, he or she may be</td>
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<td></td>
<td>at risk and potentially less</td>
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<tr>
<td></td>
<td>able to adapt</td>
</tr>
<tr>
<td>High High</td>
<td>“Cognitively Vital” (D)</td>
</tr>
<tr>
<td></td>
<td>Likely to be highly engaged</td>
</tr>
<tr>
<td></td>
<td>Individual is likely to be more adaptable</td>
</tr>
<tr>
<td></td>
<td>Vitality may buffer future changes</td>
</tr>
</tbody>
</table>

12, 2009). From this perspective, cognitive vitality can be achieved in the context of dementia.

Table 11.1 depicts the theoretical juxtaposition of cognitive health status and cognitive vitality and builds on a previous discussion of resilience (Martin, MacDonald, Margrett, & Poon, 2010). As depicted in Table 11.1, the four groups are expected to vary in functional level and well-being, as well as in their ability to adapt to future changes. In general, cognitive vitality may serve as a protective or compensatory mechanism, potentially buffering against further decline for individuals experiencing either normative or nonnormative cognitive changes (i.e., Groups B and D, those achieving successful dementia or cognitive vitality, respectively). Conversely, low cognitive vitality may be as a risk factor for decline among both groups as well (Groups A and C, those groups described as vulnerable and at risk, respectively).

We believe that cognitive vitality in the context of both normative and nonnormative cognitive age changes falls under the umbrella of successful aging. As discussed in the following section, normative and nonnormative cognitive changes in very late life each present unique theoretical, assessment, and prevention and/or intervention challenges. As we consider cognitive vitality among the oldest old, questions arise to how this concept fits in the context of normative (i.e., typical, age-related changes) and nonnormative (i.e., impairment and dementia-related) cognitive aging.
Although increased variation in normative cognitive functioning is observed in older adulthood (Morse, 1993; Nelson & Dannefer, 1992; Ylikoski et al., 1999), typical patterns of age-related changes in cognitive abilities are well documented. For instance, intellectual skills that are most related to culture and rely on accumulated knowledge and experience (e.g., verbal comprehension) tend to demonstrate growth through middle age and maintenance into the 70s (Schaie, 2005). In contrast, fluid abilities, considered more innate and biologically driven skills (e.g., memory, inductive reasoning), generally peak in the early 20s, followed by a gradual decline throughout adulthood (Schaie, 2005). Findings from a study conducted by Hagberg, Alfredson, Poon, and Homma (2001) suggest that such distinctions among cognitive abilities appear to remain important through very late life. In their study, centenarians' performance on fluid measures tended to be more homogeneous, thereby suggesting a possible floor effect with respect to these more age-sensitive abilities; however, centenarians demonstrated a greater range of performance on crystallized measures (Hagberg et al., 2001). Additional work examining the underlying structure of cognitive abilities in very late life (e.g., dedifferentiation of cognitive abilities; de Frias, Lövdén, Lindenberger, & Nilsson, 2007) is needed; however, we can expect that the nature of the cognitive task and the corresponding requisite cognitive abilities affect cognitive vitality among the oldest old. Differential patterns of cognitive aging may be evident on the basis of levels of prior functioning. One possibility is that cognitively vital older adults may demonstrate differential patterns of change in cognitive abilities as well as in the underlying cognitive structure. In addition, we can expect variation in cognitive task performance across cultural contexts as a result of the often experience-related nature of intellectual skills needed to navigate everyday life and achieve vitality. Thus, the operational definition and corresponding assessments of cognitive vitality need to be responsive to cultural context.

A second issue related to normative cognitive aging and vitality is the tendency toward accelerated cognitive decline close to death. There is empirical support suggesting terminal decline (evident approximately 3 years before death) and a more precipitous drop (evident within 1 year of death; see Bäckman, Small, & Wahlin, 2001; Berg, 1996), although some debate continues. Tendency toward accelerated cognitive decline before death likely contributes to the higher rate of cognitive impairment evident among the oldest old. As observed in some studies, the rates of terminal decline among
initially nonimpaired older adults are highly variable (Wilson, Beckett, Bienias, Evans, & Bennett, 2003). Additional empirical studies of cognitively vital oldest-old individuals may reveal differential rates of terminal decline and drop and shed light on the mechanisms underlying cognitive decline.

NONNORMATIVE COGNITIVE AGING AND VITALITY

One challenge when considering cognitive vitality concerns the borderline between normative and nonnormative aging, as well as their potential overlap and transition. Most models of cognitive vitality are focused on normal aging, often defined as the absence of significant cognitive decline such as that observed in dementia syndromes. Typically, the dementias of aging are defined as a significant decline in cognitive functioning from levels of premorbid functioning such that the decline is sufficiently severe to interfere with the person’s ability to function in his or her daily life (e.g., work, household tasks, relationships). Most individuals assessed for dementia have not had prior testing; thus, the determination of significant decline often relies on comparison to statistical norms of the person’s age; education; and for some tests, ethnicity or culture. In this approach, those older adults who have unusually low scores relative to matched norms (typically 1.5–2.0 standard deviations below the group mean) are considered impaired, particularly if this occurs in the context of limitations in daily functioning. Using this approach, many investigators seek to differentiate those individuals who are aging normally from those with nonnormative cognitive change (i.e., cognitive impairment). However, this simple dichotomy is challenged by apparent transition periods in which a person may be moving from normal aging cognition toward more significant nonnormative changes, which creates a problematic gray area. The most prominent of these proposed states is mild cognitive impairment (MCI), which is conceptualized as a mild, isolated deficit in one cognitive ability (or very mild impairment in multiple abilities) in the context of otherwise-normal functioning (Morris et al., 2001; Petersen et al., 2001; Petersen & Morris, 2005; Storandt, Grant, Miller, & Morris, 2002). Many view this as a transition state, a significant risk factor for more severe changes (e.g., Alzheimer's disease), and possibly even an early form of Alzheimer's disease (AD; Morris et al., 2001) on the basis of findings that MCI reflects AD pathology in many cases (Markesbery et al., 2006; Petersen et al., 2006).

The borderline and/or overlap between normative and nonnormative states is complicated by two additional findings. First, it has long been
suspected (and now supported by empirical data) that the underlying neuropathology of AD begins long before the first cognitive changes emerge at a level that would warrant clinical attention (Collie & Maruff, 2000). Second, cerebrovascular risk factors that are highly prevalent in the oldest old, including hypertension, diabetes, and heart disease, have been linked to subclinical cerebrovascular changes, which are also quite common in later life (Campbell & Coffey, 2001; O'Brien, 2006; O'Brien et al., 2003). Perhaps more important for our purposes, both of these underlying processes have been shown to affect cognitive functioning (Galvin et al., 2005; Gunning-Dixon & Raz, 2000; Schmitt et al., 2000). Neuroimaging studies have demonstrated that normally aging adults demonstrate changes in many brain regions, particularly in the prefrontal cortex and medial temporal lobe structures, and therefore the inclusion of individuals who have cerebrovascular risk factors such as hypertension or preclinical AD can magnify the level of change observed (Raz, 2005; Raz & Rodrigue, 2006; Raz, Rodrigue, & Acker, 2003).

Because of the issues presented in this section, such as the theory of terminal decline and the overlap between normative and nonnormative aging, the prevalence of dementia varies across studies. Age is the predominant risk for dementia; the prevalence rate of dementia among adults aged 71 and older is estimated to be 1 in 7 persons, increasing to approximately 37% among those aged 90 and older (Plassman et al., 2007). However, it is important to note that the prevalence of dementia is lower than society would lead us to believe. A study by Poon et al. (2010) found that 22.5% of centenarians had no dementia, another 16% had no dementia but did report some memory complaints, and 25.3% had mild cognitive impairment. About 25% of centenarians were estimated to be cognitively intact and functioning well in everyday life; they were not cognitively frail by any definition and should not be included in the general stereotype.

Clinico-pathological studies of preclinical AD have demonstrated that a substantial number of older persons display the pathological changes of AD (i.e., amyloid plaques and neurofibrillary tangles) but maintain relatively normal functioning (cognition and everyday functioning). Bennett, Schneider, Arvanitakis, et al. (2006) examined 134 older adults without cognitive impairment and observed that 37% had pathology consistent with AD and demonstrated poorer episodic memory than older adults without significant AD pathology (Bennett, Schneider, Arvanitakis, et al., 2006). An earlier study by Schmitt et al. (2000) yielded similar findings in that a substantial number of nondemented older adults had AD pathology on autopsy (11–49% met pathological criteria for AD, depending on classification
system used) and demonstrated poorer immediate and delayed recall at their last clinical evaluation when compared with those who did not have AD pathology (Schmitt et al., 2000). Galvin et al. (2005) studied 41 community-dwelling older persons without clinical evidence of dementia before death (i.e., normal cognitive functioning over repeated longitudinal neuropsychological assessments) and found that 34% had pathological evidence of AD on autopsy.

These findings raise two possibilities. First, if the participants had lived longer, they may have developed the cognitive changes reflecting the underlying dementia-related brain changes. Age is known to be the strongest risk factor for AD and other dementias, and therefore greater longevity among these samples may have led to the full expression of dementia. Second, as Schmitt et al. (2000) suggest, these findings may indicate that, for some older persons, the brain may be able to withstand or compensate for these underlying brain changes and thereby avoid significant cognitive impairment. The latter hypothesis could be linked to cognitive vitality.

These issues raise several questions. First, does the definition and measurement of cognitive vitality differ on the basis of normative versus nonnormative status? Given that age is the strongest risk factor for dementia, how should we consider normative versus nonnormative change in centenarians? Specifically, what levels of cognitive decline should be considered normative for centenarians? Second, if we consider cognitive vitality in the broad spectrum of cognitive health, what does cognitive vitality look like among the nonnormative older persons (see Chapter 4 for relevant discussion)? Third, what pathways lead to cognitive vitality among older adults experiencing normative and nonnormative cognitive changes? Furthermore, given that cognitive vitality is not simply avoidance of impairment and disease, how can persons with dementia best exploit and apply their remaining cognitive resources to their everyday settings and challenges? In the following section, we highlight challenges to the conceptualization and measurement of functioning and vitality among very old individuals.

ASSESSING OF FUNCTIONING AND VITALITY AMONG THE OLDEST OLD

Methodological Limitations

Stereotypical assumptions regarding cognitive aging are fostered by three tendencies within the field. First, most studies focus on cross-sectional findings that highlight age-group differences in cognitive performance. Such
studies exacerbate age-related differences as compared with longitudinal investigations, which focus on intraindividual (within-person) change and reveal a much more diverse array of cognitive outcomes in later life (Schaie, 1989). Second is the tendency to consider older adults’ cognitive performance in an acontextual fashion without considering factors such as the older adult’s environment, social partners, life experience, and motivation. A third limitation is that insufficient attention is paid to understanding successful cognitive aging and how it fits in the spectrum of cognitive health. Studies of very old individuals, who are likely to provide prime examples of successful development and adaptation, are rare. Recent studies suggest that the full range of cognitive functioning, even variation within the range of “normal,” should be considered in gerontological work. The meaning of variation in cognitive functioning is relevant to this chapter for two reasons. First, as a group, the oldest old demonstrate greater heterogeneity in cognitive functioning. Second, within-person cognitive variability (i.e., fluctuation in performance and/or functioning) is believed to be an important indicator of underlying neural functioning and cognitive integrity (Hilborn, Strauss, Hultsch, & Hunter, 2009; Hultsch, MacDonald, Hunter, Levy-Bencheton, & Strauss, 2000).

Classifications of Functioning in the Oldest Old

Heterogeneity of functioning must be kept in mind when investigating functioning among the oldest old. Contrary to the stereotypic impression that cognitive and physical frailty is true for all individuals in older age, reality can be different at the individual level. Consider, for example, the distribution of cognitive functions among 60-, 80-, and 100-year-olds. These distributions show considerable overlaps in the range of observed scores (Hagberg et al., 2001). That is, some 60-, 80-, and 100-year-olds perform at the same levels, whereas individuals in the two older age groups may outperform their younger counterparts. In the literature focusing on the oldest old, we highlight two examples of classification techniques.

In one approach focusing on physical conditions, centenarians in the New England Centenarian Study were categorized as “survivors,” “delayers,” or “escapers,” depending on when they experienced chronic disease (early in life [0–80], late in life [80–100], or near the end of life [after 100 years of age], respectively) (Evert, Lawler, Bogan, & Perls, 2003). Although more than 80% of centenarians had escaped or delayed the most serious of physical conditions such as stroke, fewer men (76%) and women (57%) demonstrated escape or delay of more common age-associated illnesses such
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as diabetes and hypertension. Research suggests that some centenarians have the means to cope with diseases that would have otherwise caused premature mortality. Building on the utility of such classifications, Gondo et al. (2006) identified phenotypes of exceptional longevity among Japanese centenarians using a multidimensional approach. In their study, three domains of functioning were characterized (i.e., cognitive, sensory, and physical) and subsequently contributed to an overall status designation. Cognitive functioning was assessed via the Clinical Dementia Rating scale (CDR; Burke et al., 1988) and the Mini-Mental Status Examination (MMSE; Folstein, Folstein, & McHugh, 1975). Hearing and visual acuity were used as indicators of sensory functioning and the Barthel Activities of Daily Living (ADL) index (Wade & Collin, 1988) assessed physical functioning. A continuum was developed to represent centenarians’ overall functional status across the three domains and descriptors of the broad designator included “fragile” (physical and cognitive deterioration), “frail” (either physical or cognitive impairment), “normal” physical and cognitive abilities, and “exceptional” physical and cognitive functioning. The majority of centenarians in this study were described as frail (55%) or fragile (25%), with a smaller number classified as normal (18%) and very few achieving exceptional status in both cognitive and physical functioning (2%). Relevant to the current discussion are individuals in the categories of normal (CDR ≤ .5, probably no dementia) and exceptional (CDR = 0, no dementia, and MMSE ≥ 21) who would likely be described as cognitively vital. As evidenced in these studies, rates of vitality depend on the operational definitions employed. We suggest that the concept of cognitive vitality be further delineated in three major ways, each of which affects assessment as well as promotion prevention and intervention efforts.

The first step is to expand the definition of cognitive vitality beyond neurobiological changes in the brain or cognitive function to include additional factors that influence cognitive health, such as social interactions, physical and functional status, cognitive and physical activity, mental health, and nutrition (e.g., Butler, Forette, & Greengrass, 2004; Fillit et al., 2002; Yevchak, Loeb, & Fick, 2008). These factors are all intricately linked to an individual’s cognitive functioning on a daily basis and ultimately to cognitive vitality. The next step in measuring cognitive vitality is accounting for normative changes associated with aging. Beginning when adults are in their 20s, continuous age-related declines have been found in regional brain volume, myelin integrity, cortical thickness, serotonin receptor binding, striatal dopamine binding, accumulation of fibrillary tangles, and concentration of brain metabolites (Salthouse, 2009). Still, there are neurobiological and
behavioral mechanisms that compensate for those declines, which will be discussed in further detail. Finally, the concept of cognitive vitality itself needs to be individualized to the personal circumstances of the older person. For example, cognitive vitality in a 100-year-old likely carries a different meaning than in a 60-year-old.

**RELATION OF COGNITIVE FUNCTIONING AND VITALITY TO WELL-BEING AMONG THE OLDEST OLD**

Previous chapters in this book have recognized that well-being is a complex concept that has a variety of definitions (see Chapter 4). However, it can be generally agreed on that well-being is a subjective measure that refers to optimal psychological experience and functioning, and that can include engagement, satisfaction, adjustment, and other attributes (Deci & Ryan, 2008). Because cognitive vitality is necessary for awareness of actions and appropriate interaction with one's surroundings, it is an integral component in the achievement of well-being. Indeed, as discussed in this chapter, cognitive vitality is the successful application of cognitive skills within one's own environment. Although cognitive vitality has not been explicitly examined in relation to well-being, the construct is akin to everyday, or applied, cognitive abilities that are discussed in the extant literature. Prior research has demonstrated that everyday measures of cognitive functioning (which are purported to be more contextual and ecologically sensitive) are related to important real-world outcomes, including ADL ability, cognitive decline, and mortality (for a discussion, see Margrett, Allaire, Johnson, Daugherty, & Weatherbee, 2010). Cognitive vitality can be considered both an important contributor to well-being and an important outcome (Martin et al., 2010). In the subsequent section, we highlight several resources that can promote cognitive health and vitality among the oldest old. As evident in this discussion, there is likely a synergistic relation between cognitive vitality and these factors.

**WHAT FACTORS OR RESOURCES CONTRIBUTE TO COGNITIVE VITALITY AMONG THE OLDEST OLD?**

The Georgia Adaptation Model (see Chapters 5 and 17) is used in this chapter as a framework for cognitive vitality. This model constitutes a network of adaptational predictors and outcomes integral to physical and psychological well-being in the oldest old. Among the various contributing factors, we believe that five factors are particularly germane to cognitive vitality: social
support, personality, mental and physical health, and nutrition. What is not defined in the model is the pattern of factors that is appropriate for each person. In other words, what is necessary and sufficient to be classified as cognitively vital? Rather than identifying a concrete Mini-Mental Status Exam or Global Deterioration Rating Scale cutoff point above which an individual would be considered cognitively vital, we propose that cognitive vitality can be encountered at any stage of cognitive functioning given the appropriate combination of mediating factors. For example, an individual can be physically impaired and still be considered cognitively vital. The degree of functional impairment would not affect the classification of cognitive vitality, which should be considered a continuous rather than a discrete variable. This caveat is also expressed by Kahn (2002) in response to criticism of the successful aging concept (Rowe & Kahn, 1998). Investigation of mediating factors, such as those described here, can inform prevention and intervention efforts.

Social support is a fundamental resource in the attainment and maintenance of cognitive vitality for the oldest old. A lack of engagement has been found to be an independent risk factor for cognitive decline among older adults. Data from animal studies demonstrate this pattern through increased synaptogenesis, neurogenesis, and capillary formation with environmental stimulation (Eriksson et al., 1998; Sirevaag, Black, Shafron, & Greenough, 1988). For individuals with Alzheimer’s disease, social support modifies the relationship between some measures of disease pathology, such as neurofibrillary tangles, to level of cognitive vitality. This provides evidence that maintaining social networks could provide a protective effect against Alzheimer’s disease (Bennett, Schneider, Tang, Arnold, & Wilson, 2006). Close relationships, in which partners spend significant time together, offer opportunities for (a) cognitive stimulation via interaction and activity participation, (b) the development and use of compensatory mechanisms beneficial to cognitive performance, and (c) provision of support. For married older adults, spouses influence each other’s cognitive functioning and vitality over time (Gruber-Baldini, Schaie, & Willis, 1995; Walter-Ginzburg et al., 2008). However, the social support received by the oldest old differs from that of younger cohorts in that it is reduced and primarily includes family members (see Chapter 12). It is almost normative that centenarians have lost their romantic partners and children; therefore, a reduction in social support is expected (Martin, Kliegel, Rott, Poon, & Johnson, 2008; see Chapter 12). Nonetheless, it is imperative that the oldest old maintain strong social networks because of the demonstrated risk related to cognitive decline and likely risk of decreased cognitive vitality.
Personality factors affect cognitive functioning, and ultimately cognitive vitality, among the oldest old via several mechanisms, including (a) interpersonal relations and the resulting ability to enlist social support, (b) openness to experience and thus novel situations and cognitive stimulation, (c) perseverance and preferred approaches to cognitive problems which may both be differentially effective, and (d) impact of personality on mental health (e.g., ability to cope with stress). These mechanisms are likely to vary across age group and context. For example, a study comparing personality predictors of cognitive performance among younger and older adults yielded differential results according to age and level of cognitive skill. For average-skilled younger (mean age = 34) and older adults (mean age = 69), extraversion and openness were predictive of selected cognitive abilities, albeit skill type and nature of the predictor varied across age group (Baker & Bischel, 2006). For older adults with exceptional cognitive skills (mean age = 71), openness was predictive of visual-spatial abilities, agreeableness was a negative predictor of crystallized (i.e., culturally reinforced) knowledge, and conscientiousness predicted short-term memory and auditory processing (Baker & Bischel, 2006). Relatively low neuroticism, high competence, and high extraversion have been found to be common in centenarians (Martin, da Rosa, et al., 2006). One study found that, in older adults, higher neuroticism was associated with poor decision making (Denburg et al., 2009). Recent studies conducted by Wilson and colleagues suggest that high conscientiousness may help protect older adults from cognitive decline and impairment (Wilson, Schneider, Arnold, Bienias, & Bennett, 2007), whereas chronic psychological distress associated with increased neuroticism may be detrimental to cognitive health (Wilson, Schneider, Boyle, et al., 2007). Coping mechanisms are also related to these personality factors among community-dwelling, cognitively intact persons. Centenarians were more likely to use cognitive coping mechanisms, such as creating a plan to reduce stress, than octogenarians but less likely to use active behavioral coping, such as formulating a plan and following it (Martin, Poon, et al., 1992). Centenarians were more likely to acknowledge problems than individuals in other age groups but less likely to seek social support as a coping strategy (Martin, Rott, Poon, Courtenay, & Lehr, 2001).

Mental health is another important factor related to cognitive vitality among the oldest old, although the relation between the two is likely complex and difficult to tease apart from synergistic effects with other influences such as personality, interpersonal relations, and engagement and/or activity. At the behavioral level, diminished mental health may lead to decreased social interactions and thus opportunities for cognitive engagement and
monitoring of cognitive health by social partners. Poor mental health, particularly depression, may also lead to lack of motivation and decreased processing speed. Indeed, previous research has shown that depressed older adults are at increased risk for cognitive impairment and dementia. Amnesic and executive deficits as well as neurocognitive impairment are trademarks of late-life depression. Using a neuropsychological assessment, Sheline et al. (2006) found that reduced processing speed led to deficits in episodic memory, language processing, working memory, and executive functioning. In Phases I and II (1988–1998) of the Georgia Centenarian Study, compared to younger, community-dwelling cohorts, centenarians reported more somatic but not affective symptoms. No clinical depression was found among the sample of cognitively intact, community-dwelling centenarians.

Fourth, according to the common cause hypothesis, physical and cognitive capabilities are highly interrelated among older adults (e.g., Anstey, Dear, Christensen, & Jorm, 2005; Lindenberger & Baltes, 1997). Beginning in young adulthood, suboptimal health and neurological risk factors affect cognitive health (Houx, Vreeling, & Jolles, 1991). These findings have been replicated in the oldest old; data from the Georgia Centenarian Study suggest that there is significant variability in the cognitive abilities of centenarians and that these cognitive differences are related to functional capacity (Mitchell et al., in press). Chronic conditions including cardiovascular disease and diabetes are linked to decreased cognitive functioning and increased risk of cognitive decline (e.g., Gorelick, 2005; Roberts et al., 2008). In addition, polypharmacy and the use of particular prescription medications can place older adults at greater cognitive risk (e.g., Starr et al., 2004). Health disparities in the prevalence and treatment of chronic conditions among ethnically and socioeconomically diverse groups can exacerbate these effects. Finally, intervention studies demonstrate the potentially beneficial effects of physical activity on cognitive functioning, although more work is needed to discern the specific mechanisms underlying this relationship and the most amenable cognitive skills (e.g., Poon & Harrington, 2006; Tomporowski, 2006).

Finally, adequate nutritional intake affects both longevity and proper functioning of the brain. Okinawa, Japan, which has the highest prevalence of exceptionally long-lived individuals in the world, has a traditional diet consisting of low-calorie, plant-based, and mainly low-caloric-density foods such as green and yellow vegetables, soy, fish, and limited amounts of boiled red meat (Willcox, Willcox, He, Curb, & Suzuki, 2006). Studies have found that vitamins, lipids, and trace minerals can affect the risk of cognitive decline. Replicated studies have found that a high intake of
polyunsaturated and monounsaturated fats and fish were associated with lower risk of Alzheimer's disease. Epidemiological data show a protective role of the B vitamins, particularly B9 and B12, against cognitive decline. Data are still conflicting on the effect of antioxidant nutrients on cognitive functioning (Gillette-Guyonnet et al., 2007). A recent study indicated that oral administration of levocarnitine produces a reduction of total fat mass, increases total muscular mass, and facilitates an increased capacity for physical and cognitive activity by reducing fatigue and improving cognitive functioning (Malaguarnera et al., 2007).

The five resources mentioned here can function in concert only if older adults become active agents in their own cognitive aging. As proposed, a cognitively vital individual is one who exploits cognitive resources and interacts with the environment (Walter-Ginzburg et al., 2008). This assertion is consistent with Stine-Morrow's (2007) description of the active older adult who shapes his or her cognitive aging via the interactive effects of life experience, cultural context (e.g., societal stereotypes and expectations regarding cognitive aging), and learner choice and self-regulation (e.g., attentional allocation, activity selection). Emphasis on a highly active older adult highlights a principle from Rowe and Kahn's (1998) theory of successful aging in that high-level cognitive functioning is thought to be key to engagement in life and ultimately to successful aging. Indeed, prior empirical work supports the premise that a synergistic relationship exists between cognitive vitality and engagement (e.g., Bosma et al., 2002; Fratiglioni, Paillard-Borg, & Winblad, 2004).

**WHAT CONCLUSIONS AND NEW DIRECTIONS CAN BE IDENTIFIED FOR FUTURE RESEARCH?**

As we consider cognitive health in older age, several issues come to the forefront. First, the impact of ageist stereotypes is a poignant concern affecting later-life cognitive health (Stine-Morrow, 2007), where often the focus is on anticipated deterioration and the threat of dementia. Dementia is feared and typically viewed as an eventuality of old age (Ballenger, 2006; Cutler & Hodgson, 1996; Hodgson & Cutler, 2003, 2004). On an individual (personal) level, the tendency to focus on the negative aspects of cognitive aging may lead to diminished well-being; decreased propensity to engage in healthful behaviors; and as a result, ultimately poorer outcomes (Ory et al., 2003). As noted by Fillit et al. (2002), stereotypes and ageism reach beyond the individual and prevent promotion of cognitive health as a high-priority public policy initiative.
As a result, large-scale outreach efforts tend not to focus on prevention, instead directing efforts toward post hoc intervention, such as care for individuals with Alzheimer’s disease (see Kovacich, Garrett, & Forti, 2006). This leads to the second point: promotion of cognitive health must become a public policy priority that encompasses the entire spectrum of cognitive functioning, including both prevention and intervention efforts. Prior studies of older adults with normative age-related changes in cognition have demonstrated that cognitive training improves performance for both older adults who had previously demonstrated a decline as well as for individuals who had not declined (Kramer & Willis, 2002). Research is needed to understand the transition from normative cognitive aging to impairment and the efficacy of training along this spectrum. Insufficient empirical research has addressed training applications for individuals with mild cognitive impairment (Belleville, Bherer, Lepage, Chertkow, & Gauthier, 2008). In general, theoretical and methodological hurdles must be overcome to further formal methods of promoting cognitive vitality (Kramer et al., 2004) and develop best practices. Methods of prevention and intervention that are multimodal (Kramer & Willis, 2002) and that incorporate aspects of social, mental, and physical functioning are likely to be most efficacious (Park, Gutches, Meade, & Stine-Morrow, 2007; Studenski et al., 2006). Furthermore, prevention and intervention efforts must start earlier in the life span. For example, in terms of cardiovascular risk factors predictive of cognitive decline, midlife matters (Gorelick, 2005). Techniques need not be formal or direct to enhance cognitive health. Cognitive health among the oldest old can be promoted through informal means by building on and enhancing existing social networks (e.g., cognitive collaboration; Marsiske & Margrett, 2006) and activity participation (e.g., volunteerism, hobbies, church or synagogue attendance; Walter-Ginzburg et al., 2008).

A third unresolved issue is the assessment of cognitive vitality and how it can build on assessments of cognitive functioning. Relevant to the conceptualization of cognitive vitality among the oldest old is how competency, or successful cognitive functioning, is deemed in normative and nonnormative frameworks. Two overarching difficulties exist, namely distinguishing degrees of cognitive functioning and understanding the transition between normative and nonnormative cognition. Tests of normative cognitive aging often lack norms, thus making it difficult to assess cognitive performance relative to peers matched on important contributing characteristics such as age and education. In addition, multiple assessments are rare until a problem has been identified. In the absence of multiple assessments and appropriate norms, meaningful within-person change can be difficult to
detect, and the statistical methods to do so are debated. The meaning of performance change on a particular test is difficult to determine. For example, does a two-point decrease from pretest to posttest assessment constitute a reliable and valid (e.g., clinically or practically significant) change? What about when we consider the interval between assessments (e.g., 2 months vs. 2 years) and individuals’ baseline performance? Additional attention must be given to the meaning and consequences of intraindividual variability or change in cognitive functioning (e.g., Allaire & Marsiske, 2005). As mentioned herein, an individual’s degree of cognitive vitality likely fluctuates as well.

Clinical assessments of nonnormative cognitive functioning and impairment have several advantages over tests of normative functioning. One clear advantage is the presence of norms that position individuals’ performance in context. Second, tests that distinguish the presence or absence of dementia are well documented. For example, the Mini-Mental Status Examination (MMSE) developed by Folstein et al. (1975) is a commonly used screening test that assesses several aspects of cognitive performance and provides a summary score reflecting overall mental status. Tests such as the MMSE may be useful in determining whether an older adult’s performance is above or below a cutoff, thereby suggesting whether or not the person is likely to have dementia. However, care must be taken when employing dichotomous distinctions. Sensitivity to degrees of variations and changes in the normative range may be lost. Brief batteries of tests such as the Consortium to Establish a Registry for Alzheimer’s Disease (CERAD) or Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) allow for evaluation of multiple cognitive abilities across a range of abilities while maintaining the advantage of age- and education-matched norms (Beeri et al., 2006; Duff et al., 2003; Randolph, Tierney, Mohr, & Chase, 1998).

As emphasized in this chapter, we believe that cognitive vitality is best viewed as a continuous variable based on multiple dimensions and that fluctuates over the short term on the basis of an individual’s available reserves and resources. Operational definitions may need to differ across age groups, and we might also add personal and cultural relevance, denoting that cognitive vitality encompasses the tasks an individual needs to accomplish in his or her context. It seems clear that, to move beyond assessment of cognitive functioning, we must encompass other features (e.g., social, dispositional, activity), not just purely cognitive functions. Conceptually, the framework of everyday competence (Willis, 1991, 1996), in which multiple antecedents and consequences of cognitive functioning are considered, provides a foundation from which to build. From the assessment perspective, activities
of daily living (ADLs) or similar multidimensional assessments of one's ability to navigate day-to-day life might be a good starting point. Walter-Ginzburg et al. (2008) describe a self-reported index of cognitive vitality for individuals without dementia that was developed in Israel. The index assesses abilities akin to higher-level instrumental activities of daily living. Their index comprised seven dichotomous (yes-no) items: "no problem identifying people," "can write or use small objects," "reads newspaper often," "attends movies, restaurants, concerts, or theater often," "writes letters often," "has no difficulty managing finances," and "has no difficulty using telephone." Individuals scoring low on the cognitive vitality scale had significantly more difficulty with ADLs at the second assessment. The correlation between the cognitive vitality scale and a measure used to assess cognitive impairment (i.e., an orientation-memory-concentration test by Katzman et al., 1983) was evaluated. Although significantly related, Walter-Ginzburg et al. (2008) argue that the two measures exhibited distinctiveness to be considered separate constructs. Using a sample of Japanese nursing-home and hospital residents, some of whom had dementia, Toba et al. (2002) created an objective index to assess vitality in the context of dementia. This scale was completed by raters who assessed the individual's ability to perform basic ADLs such as ambulation, communication, eating, and toileting. In their study, Toba et al. (2002) note the importance of vitality in predicting important outcomes including mortality. In the everyday cognitive literature, efforts continue to develop multidimensional measures that assess what older adults may be able to do in their day-to-day lives and that predict meaningful outcomes (see Marsiske & Margrett, 2006 for discussion). Two examples developed by Willis and her colleagues are particularly germane to the current discussion of cognitive vitality. The Everyday Problems Test (EPT; Willis & Marsiske, 1993) was designed to assess performance among individuals experiencing normative age-related cognitive changes. The test consists of actual stimuli from everyday life that mirror instrumental ADLs in several domains (e.g., transportation, medication). The Everyday Problems Test for Cognitively Challenged Elderly (EPCCE; Willis, 1993) is an analogous test designed to assess the application of everyday cognitive skills of cognitively impaired individuals. The two tests provide examples of measures that attempt to assess older adults' potential for real-world functioning in normative and nonnormative perspectives, are sensitive to issues of ecological validity, and are easily administered.

Additional theoretical and psychometric work is needed to develop the concept of cognitive vitality more fully. The assessment approaches
described herein highlight several important points for future research. First is consideration of the theoretical and practical implications of applying the concept of cognitive vitality to individuals without and with cognitive impairment. Theoretically, how do behaviors indicative of cognitive vitality differ from instrumental activities of daily living (IADL) performance by individuals without dementia and ADL performance by individuals with cognitive impairment and dementia? Reliance on IADL- and ADL-type assessments are likely not the most effective methods for capturing the richness of the concept of cognitive vitality. Theoretically, it is valuable to examine how subjective perceptions factor into assessment of cognitive vitality. How do performance- and behavior-based ratings relate to measures of meta-awareness? Finally, the results of previous studies indicate important correlates and possible contributors to cognitive vitality, such as age, gender, educational attainment, occupational status, physical conditions, and mental health (particularly depression).

CONCLUSIONS

Decrement is too often the focus in cognitive aging. Contrary to the stereotypical impression that cognitive and physical frailty is the norm in extreme old age and that dementia is inevitable, many of the oldest old function quite well. Successful cognitive aging, as indicated by cognitive vitality, is a concept that adds to our understanding of the full spectrum of cognitive health in later life. The literature suggests several resources that promote cognitive health and vitality among older adults, including social relationships, personality, mental and physical health, and nutrition. Future work must dispel myths about cognitive aging, improve assessment techniques related to cognition and functioning, and promote techniques to enhance cognitive health and ultimately vitality.

REFERENCES


