2 The Aging Brain and Changes in Daily Function

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"Neurocognitive frailty" may be the biggest threat to successful aging (Park & Reuter-Lorenz, 2009). This frailty includes longstanding and in some cases subtle brain injury, declines in the number of dopaminergic receptors, volumetric shrinkage in many brain structures, lower white matter densities, increasing numbers of infarcts and lacunae, and spreading neurofibrillary plaques and tangles. The border between progressive neurodegenerative disease (such as Alzheimer's), normal age-related change, and compensatory neuronal remodeling in the face of such change is hard to draw.

Brain and behavior researchers now recognize that the "decline framework" for age-related change in neural activation is too simple. More productive is an "adaptive brain" approach, in which the brain responds to internal and external environmental change (Sugiura, 2016). Park and Reuter-Lorenz (2009) make a persuasive case for continuous functional reorganization and repair as the brain responds to neural insults. This reorganization is most clearly visible in increased frontal activation with age, which supports cognitive function in the presence of pervasive changes in brain integrity.

How these sorts of changes affect daily function is less clear than the more direct effects of brain injury or neurodegenerative disease. It is unclear how engagement in daily activity and social participation change in the setting of brain aging. It is important as well to examine ways to promote activity and engagement in the setting of brain aging. In this chapter, we take up these issues by examining high functioning cohorts of older people to determine change in daily function in people who do not meet criteria for cognitive impairment and disability.

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Investigating Brain Aging Apart from Brain Injury or Neurodegenerative Disease

The functional consequences of brain aging are not simply the result of depletion in brain capacity but rather reflect homeostatic processes. As Park and Reuter-Lorenz (2009) point out, "people generally function remarkably well even into advanced old age, and do so even in the presence of a great deal of pathology as discovered at autopsy." In their view, "the puzzle for cognitive neuroscientists is not so much in explaining age-related decline, but rather in understanding the high level of cognitive success that can be maintained by older adults in the face of such significant neurobiological change." This adaptation is ongoing across the lifespan and is independent of neurodegenerative disease. Park and Reuter-Lorenz's "scaffolding theory of cognitive aging" examines recruitment of new brain circuitry, evident in greater bilateral activation and increased activation of frontal areas, to meet the demands of cognitive tasks.

Just as brain aging is complex, so are its effects on daily function. In the absence of neurodegenerative disease, how does brain aging, and in particular, age-related reorganization of cognition, affect daily activities and social participation?

Cognitive changes with age are well documented. These include declines in processing speed, working memory, and long-term memory (which begin in young adulthood), but stability in verbal ability (which is more a measure of accrued knowledge than a cognitive mechanism). Behind these changes lie alterations in underlying functions, such as declines in perceptual speed, executive control (inhibitory dysfunction), and sensory acuity. Research examining the effect of these broad changes on daily function is less common than studies of daily function among people with neurodegenerative disease or frank brain injury.

To examine the effects of age-related changes in the brain on daily function in the setting of normal aging, this chapter examines cohorts of older adults from two studies that completed neuropsychological tests as well as detailed self-reports and performance assessments of daily function. We limited analyses to participants who were cognitively normal on full neuropsychological batteries or cognitive screening assessments. To rule out other sources of functional limitation, we limited analyses to participants who reported no disability in the activities of daily living (ADL). Thus, we define samples that are free of obvious neurodegenerative disease and also mostly high functioning. The latter allows us to rule out, to the extent possible, other sources of functional limitation.

In this way, we can get a first look at the effects of normal brain aging on daily function. Key contrasts include first, differences in function by age, and second differences in function associated with variation across the range of normal cognitive performance. Function outcomes include performance measures of efficiency and safety in performing household tasks; measured assessment of strength, speed, and motor skill; self-reports of difficulty with instrumental household tasks, such as light cleaning and shopping; and self-reports of social participation. Thus outcomes include a broad selection of measures covering impairment, activity, and participation.

Brain Aging in Older Adults with Normal Cognition and No Disability in the Activities of Daily Living: Effect of Age

The Sources of Independence in the Elderly (SITE) project was designed to investigate risk factors for disability, as well as factors associated with recovery from disability, in people aged 70 or older. We enrolled older people who resided in the community and who were likely to experience disability transitions. SITE respondents reported at least some difficulty with upper and lower extremity function, as indicated by reports of difficulty walking a quarter mile or carrying a bag of groceries. People who were living in assisted housing or receiving skilled nursing care were excluded. For this analysis, as mentioned earlier, we excluded people with mild cognitive impairment or dementia, as well as people reporting disability in the activities of daily living (as assessed by self-reported difficulty in eating, toileting, bathing, or dressing). Participants were categorized by age: 70–74, 75–79, 80–84, and 85+.

The exclusion of people with poorer cognition and ADL disability was effective in eliminating most age differences. The four age groups did not differ in number of chronic conditions, proportion with cluttered homes, or level of education.

Sampling and recruitment for SITE is described elsewhere (Albert et al., 2006). SITE participants were Medicare beneficiaries residing in Northern Manhattan, New York City in 2002–2004, with the last enrolled participants completing follow-up in 2006. The Columbia University Institutional Review Board approved the study protocol.

SITE participants completed a neuropsychological evaluation conducted by Spanish–English bilingual testers. Results from cognitive assessments were reviewed in a consensus conference, which was based on National Institute for Neurological Disease and Stroke-Alzheimer's Disease and Related Disorders Association criteria (NINDS-ADRDA). The assessment covered the domains of memory (Selective Reminding Test: total recall, delayed recall; and Benton Visual Retention Test recognition), language (Boston Naming Test and Boston Diagnostic Aphasia Examination: repetition and comprehension), and executive function (letter and category fluency). Test scores within each domain were converted to z-scores and summed to develop composite scores. Each composite was then converted to a T score using a regression procedure to adjust for age, gender, race–ethnicity, and education (Manly et al., 2005). We excluded all participants with scores 1 SD or below sample-based means in any domain.

Key outcomes for assessing daily function included the Assessment of Motor and Process Skills (AMPS), a gender-free, performance-based functional assessment that allows for the simultaneous evaluation of the quality of motor and processing abilities required for successful completion of complex and personal ADL tasks (Fisher, 2006). Motor skills are goal-directed actions a person undertakes to position one's body and task objects effectively, such as the ease or efficiency with which someone is able to sweep a kitchen floor. Process skills denote the person's ability to initiate and logically sequence the required actions for the execution of the task and draw upon cognitive abilities. Occupational therapists, who all completed the 5-day AMPS training program, conducted assessments.

Therapists rated observable motor (for example, body position, obtaining and holding objects, and moving self and task objects) and process (for example, sustaining and adapting performance) skills domains on the designated 4-point scale (competent, questionable, ineffective, deficit). AMPS software converts skill ratings into a logit score (range −3.0 to 4.0 for the underlying motor ability dimension, for example). Participants were observed performing 65 different IADL tasks. The most common tasks performed were cooking (making coffee or tea, preparing a sandwich, making a salad, preparing a beverage) and cleaning (sweeping and mopping) tasks.

For gait assessment, participants were asked to walk at their usual pace from a standing start on a 4-m course set up inside homes. Time to complete the walks was recorded by handheld stopwatch. The mean of two trials (seconds) was used to calculate speed.

Motor speed was assessed with the Grooved Pegboard and Moberg Pick-Up Tests. The pegboard test requires that people place 30 notched pegs into rows on the board so that the peg orientation aligns with the hole. The outcome is time in seconds required to place all 30 pegs. Because some participants were unable to place all pegs in the allotted time, we calculated a peg/s measure. The Moberg test was conducted with eyes open and involved moving a series of 15 small items (e.g., paperclip) across two compartments. We computed a similar object/s measure of speed.

Self-report measures included difficulty with instrumental activities (light housework, medications, light shopping) but also the Activity Card Sort (ACS) (Baum & Edwards, 2001). The ACS elicits functional status using photographs of older adults performing activities. Each photograph is labeled with the name of an activity. Thus, the photograph labeled "reading Bible" shows an older woman reading the Bible in her home. Activities range from such common tasks as "watch TV" to the more rare "playing a musical instrument." The original instrument contains 80 photographs of older adults performing activities in four broad domains: instrumental (e.g., grocery shopping and washing dishes), low-physical demand leisure (sewing and using a computer), high-physical demand leisure (swimming and gardening), and social (travel and dancing).

In our use of the ACS, respondents were asked to sort 39 photographs of high-frequency activities. From the larger set of photographs in the ACS, we excluded outdoor activities unlikely to be performed in an urban cohort, such as boating and hunting, as well as ADL tasks. We retained a few ACS tasks that appear in some IADL measures, including "do laundry," "managing investments," and "fixing things around the house." We administered the ACS using a Q-sort procedure. Respondents were given the full stack of labeled photographs and told to view each picture. They were then asked to divide the stack of photographs into two piles, a pile of activities they currently do not perform and a pile of activities they currently perform. Next, they were told to break up each pile into two separate piles. Respondents broke the pile of activities they reported they do not currently perform into a pile of "never performed" and a pile of "used to but no longer perform" activities. Respondents broke the pile of activities currently performed into a pile of "hard to do" and a pile of "easy to do" activities. The time frame was "today or the past 30 days." Respondents were allowed to move photos between piles before their ordering was recorded.

Table 2.1 Brain aging surrogates, by age: older adults with normal cognition and no disability in activities of daily living (ADL), *sources of independence in the elderly cohort*, $n=232$

	Age			
	70–74 ($n=73$)	75–79 ($n=73$)	80–84 ($n=50$)	85+ ($n=36$)
Performance tests				
AMPS Motor score** Process score	2.91 (1.1) 2.22 (0.8)	3.00 (1.0) 2.28 (0.7)	2.96 (1.1) 2.20 (1.0)	2.14 (1.4) 1.88 (0.8)
Grooved pegboard pegs/s**	6.30 (7.5)	6.31 (4.9)	7.34 (7.2)	11.0 (10.4)
Moberg pick-up item/s*	3.36 (1.4)	3.72 (2.5)	3.53 (1.4)	4.76 (4.2)
Grip strength, kg**	24.5 (8.6)	21.8 (7.7)	19.5 (6.7)	16.9 (5.7)
Gait, m/s***	0.88 (0.3)	0.81 (0.3)	0.79 (0.2)	0.64 (0.2)
Self-reports				
IADL difficulty, % Housework Medications Light shopping**	5.5 4.1 8.2	3.9 2.6 7.9	3.8 1.9 5.7	7.9 5.3 21.0
ACS, # tasks Tasks dropped+ Tasks difficult Tasks easy Adj function, %	10.0 (3.7) 2.1 (2.6) 19.9 (5.6) 61.9	10.0 (4.0) 2.2 (3.1) 19.3 6.4) 60.4	10.1 (3.6) 2.2 (2.3) 18.8 (4.9) 60.2	11.9 (3.8) 1.9 (1.9) 17.2 (5.3) 55.2

AMPS assessment of motor and process skills, ACS activity card sort
+ $p=0.052$, ** $p<0.01$, *** $p<0.001$ by one way ANOVA

As reported elsewhere (Albert, Bear-Lehman, & Burkhardt, 2009), we adjusted for lifestyle differences by computing an index that removes any activities respondents reported they never performed. “Adjusted daily function” in this sense can be defined as the proportion of activities people report they easily perform relative to the total number of activities they continue to perform. For example, a respondent who reported that she never performed 9 of the tasks and currently considers 15 of the remaining 30 tasks easy to perform would receive a lifestyle-adjusted function score of 0.50, 15/(39–9). This measure offers a number of advantages. It eliminates “never-did” activities and so adjusts for lifestyle differences; it includes activities no longer performed and so captures loss of activity; and it allows assessment of more complex activity profiles beyond the household and personal self-maintenance activities covered in standard IADL and ADL measures. It can thus be considered a measure of activity and social participation.

Results for this subset of high functioning participants in the SITE cohort are shown in Table 2.1. The four age groups of people with normal cognition and no ADL disability nevertheless differ in many of the functional outcomes. Performance declines with age across many functional domains, spanning both performance assessments and self-reports. The group aged 85+ stands out for poorer function relative to the other groups in both OT-rated performance and measures of motor speed. Other indicators, such as gait speed and grip strength, decline across the four age categories in more linear fashion.

Self-reports of declines in instrumental activities and daily participation are subtle and mostly do not differ across the age groups. Among instrumental activities, only difficulty shopping differed by age and only among those aged 85+. This is almost certainly due to greater prevalence of mobility disability. Activity Card Sort measures, such as adjusted function and number of easy and difficult tasks, by contrast, did not significantly differ across the age groups. Only the number of discontinued tasks differed, from 10 to about 12 in people aged 85+. While just about all self-report indicators showed greater disability with increasing age, differences were on the whole small.

This pattern of declining performance but mostly stable reported function among older adults with normal cognition and independence in ADL suggests compensation. It does not appear that older people in the cohort restricted activity or life space as a way of protecting function in the setting of declining performance. As the Activity Card Sort measure shows, activity and participation were mostly stable across age groups. Could compensation in this case reflect the adaptive brain discussed earlier? A productive hypothesis would suggest that older people without neurodegenerative disease show brain changes, such as remodeling of brain regions and increased activation, that blunt expected declines in function associated with declining speed, strength, and motor skill.

Brain Aging in Older Adults with Normal Cognition and No Disability in the Activities of Daily Living: Effect of Variation in Cognitive Performance

In 2010–2011 we enrolled a large group of seniors who completed Pennsylvania's Healthy Steps for Older Adults, a falls prevention program, and a comparator group of older adults from the same sites at the same time who did not complete the program. Both groups completed an in-person telephone baseline interview after providing informed consent, and all were followed up to a year in monthly telephone interviews to track falls and other indicators of function. The sample consisted of 1833 adults aged 50 years or older from senior centers across 19 Pennsylvania counties (Albert et al., 2014; Albert, Edelstein, et al. 2015).

Measures included self-reported medical conditions, measures of function and symptoms (adapted from the EQ-5D to assess disabilities in basic and instrumental activities of daily living, mobility, pain, and presence of symptoms of anxiety or depression; Kind, Dolan, Gudex, & Williams, 1998), assessments of physical performance (the Community Healthy Activities Model Program for Seniors [CHAMPS] physical activity measure; Stewart et al., 2001), falls in the preceding 12 months, self-rated balance, and memory performance.

To assess memory we used the Memory Impairment Screen-Telephone (MIS) (Buschke et al., 1999; Flatt et al., 2014; Lipton et al., 2003). The MIS involves registration of four unrelated words along with a semantic category cue. For example, respondents are asked to repeat "table" and "bingo." They are then asked, "Which is a kind of furniture?" "Which is a kind of game?" In this way, people associate a semantic category with the word to help in later recall. Inability to remember the word in the presence of the semantic category cue may indicate a dementia rather than simply poor working memory. After 3–4 min of distraction with other questions, respondents are asked to recall the four words. Respondents receive 2 points for remembering the word without the cue, 1 point if they require the cue, and 0 if they cannot retrieve the word even with the cue. Thus scores range from 0 to 8.

We followed MIS test guidelines and considered anyone with a score less than 5 to have a possible dementia. These people, 5 % of the sample, were dropped from the sample. Similarly, we excluded people reporting any self-care difficulty in the EQ-5D measures, also about 5 % of the sample. In this way, the sample is comparable to the SITE cohort, described earlier, though somewhat younger (mean age 75) with less mobility disability and rural as well as urban residence.

The key outcome for assessing the effect of subtle differences in cognition in the Falls Free PA cohort was the CHAMPS questionnaire. It assesses weekly frequency and duration of 40 different activities typically undertaken by older adults. In our analyses, we dropped low frequency activities, defined as those with less than 10 % of the sample performing in the last 7 days, and examined only reported participation rather than frequency or duration. Twenty-three of 40 CHAMPS activities met this criterion. In this way, we used the CHAMPS simply to give an indication of activity and participation.

Given the geographic dispersion of the sample, all measures were obtained via telephone. A total of 1521 participants were available for analysis at baseline. We compared participants with a score of 5, 6, 7, and 8 on the Memory Impairment Screen to assess the effects of differences in cognitive performance in a non-demented sample with no reported ADL disability.

As Table 2.2 shows, memory performance in this high functioning sample was significantly associated with participation in six of the 23 CHAMPS activities. These include tasks involving physical exertion (brisk walking, light strength training exercise, light gardening) and high cognitive demands (using computer, volunteer work) but also instrumental activities (light housekeeping). Increases in participation were mostly linear across the range of MIS scores for these activities.

However, many of the activities were not related to memory performance, including social participation (visit friends and family, go to senior center, attend church, attend club, attend concert), cognitive tasks (arts and crafts, play cards, read), and physically demanding activities (walk uphill, walk to do errands, walk for pleasure, ride a bike, stretching exercises, aerobics, conditioning exercises).

In this high functioning sample, even subtle differences in memory performance matter for daily function but, importantly, not across the full set of CHAMPS activities. This too may speak to neural compensatory activity. A potentially productive hypothesis would examine whether neuroimaging reveals differences in brain activity among people with similar memory performance who differ in level of social participation. Do more active, engaged older adults show different patterns of brain activation or differences in brain architecture? More extensive research is warranted, with better characterization of cognitive function. For example, it is possible that some of the lower scoring participants in the Falls Free PA cohort (scores of 5 or 6 on the MIS) may meet criteria for mild cognitive impairment.

Table 2.2 Brain aging surrogates, by cognitive status: older adults with normal cognition and no disability in activities of daily living (ADL), *falls free PA cohort*, $n=1521$

	Memory impairment screen score			
CHAMPS, % reporting in last week	5 ($n=204$)	6 ($n=420$)	7 ($n=505$)	8 ($n=392$)
Visit friends/family	87.3	90.0	91.3	91.6
Go to the senior center	76.0	73.6	73.1	76.3
Do volunteer work*	34.8	38.8	43.3	46.9
Attend church or church activities	73.5	73.6	76.0	76.8
Attend club or group meetings	15.2	18.6	18.2	21.2
Use a computer***	37.3	39.4	47.4	54.7
Arts and crafts	26.0	27.6	30.5	34.2
Attend concert, movie, lecture, sporting event	20.6	18.3	22.4	19.7
Play cards, bingo, board games	47.5	50.4	52.1	50.0
Read	87.3	87.8	91.7	90.5
Heavy work around the house	8.3	8.9	10.7	11.7
Light work around the house*	85.8	88.3	92.4	91.3
Heavy gardening	8.3	12.9	10.7	11.7
Light gardening*	26.0	32.8	35.9	38.1
Walk or hike uphill	26.5	22.4	28.7	28.1
Walk fast or briskly***	21.1	23.2	30.3	37.9
Walk to do errands	34.8	33.9	36.1	36.8
Walk leisurely for exercise or pleasure	47.5	51.7	54.7	50.5
Ride a bike or stationary cycle	13.7	13.2	13.7	13.8
Do stretching or flexibility exercises	63.2	62.9	66.3	59.1
Do aerobics or aerobic dancing	12.3	10.3	13.3	14.3
Light strength training**	25.5	26.9	36.5	34.4
General conditioning exercises	22.1	30.0	32.3	30.9

CHAMPS, community healthy activities model program for seniors, limited to activities with greater than 10 % of the sample reporting participation
* $p<0.05$, ** $p<0.01$, *** $p<0.001$ by X^2

Improving Daily Function Despite Brain Aging

Increasing research evidence supports volunteering and exercise as ways to blunt the effects of brain aging on daily function. Evidence for the effects of direct cognitive remediation is more equivocal. Improving sleep health may also promote brain health.

Volunteering

Older adults commit more hours to volunteering than any other age group (although more recent birth cohorts are less likely to volunteer than earlier cohorts). An important area for future research is the extent to which volunteering or continued work beyond current retirement ages may promote brain health and in this way reduce the likelihood of decline in daily function.

Research suggests that volunteering is associated with positive outcomes across a number of domains. In the psychosocial domain, it is associated with a reduction in depressive symptoms and improvements in life satisfaction and social support. In the physical domain, volunteering is associated with better overall health, reduced functional limitations, and lower mortality risk. While less research is available on the effects of volunteering on cognitive function, a randomized controlled trial of the effect of group volunteering in elementary schools, Experience Corps, reported improvements in memory and executive function (Carlson et al., 2008) and increased cortical and hippocampal brain volumes (Carlson et al., 2015).

Experience Corps randomized older adults who sought volunteering opportunities either to a supervised teacher's aid program in public elementary schools or to usual volunteer opportunities (Fried et al., 2004, 2013). Participants in the treatment arm were assigned as groups to work with children in kindergarten through third grade as tutors and teacher aids. Each volunteer served about 15 h per week, usually over 3–4 days, throughout the school year. Volunteers (who received small stipends) worked with students to promote reading and arithmetic skills, as well as problem solving and conflict resolution. The program aimed to improve children's academic performance, for example, by boosting school attendance, graduation rates, and performance on standardized tests, but also to improve older adult outcomes by simultaneously enhancing psychosocial, physical, and cognitive function.

The mechanisms for the hypothesized benefit of Experience Corps include physical activity, social engagement, and cognitive stimulation. Volunteer effort in schools with children should improve physical function, such as greater lower extremity strength and balance, leading to improvements in mobility. Greater social support through volunteering should improve physiologic parameters, such as insulin resistance and blood pressure, as well as psychosocial factors, such as self-efficacy. Finally, cognitive stimulation through preparation of lesson plans and interaction with children in the school setting should promote cognitive skills and brain remodeling and activation.

Results from this important randomized controlled trial are still emerging, but evidence is emerging for benefit in executive function and brain remodeling, mentioned earlier, as well as physical activity, as indicated by accelerometer step counts (Varma et al., 2016). Psychosocial benefits have been reported as well (Gruenewald et al., 2015). All told, this model of volunteering suggests that at least some of the negative effects of brain aging can be blunted through a careful program of behavioral activation.

Exercise and Physical Activity

Emerging evidence from epidemiologic and, more recently, neuroimaging studies suggest a role for physical activity in preserving cognitive function in old age (Erickson et al., 2011). As one review summarizes the evidence, "an evaluation of the physical activity [PA]-cognition link across the life span provides modest support for the effect of PA on preserving and even enhancing cognitive vitality and the associated neural circuitry in older adults, with the majority of benefits seen for tasks that are supported by the prefrontal cortex and the hippocampus" (Prakash, Voss, Erickson, & Kramer, 2015). Physical activity and exercise promote cardiorespiratory fitness, which in turn promotes larger hippocampal volumes and white matter integrity. Randomized exercise trials suggest that the volume of the hippocampus and prefrontal cortex remain pliable and respond to moderate intensity exercise over 6–12 months (Erickson, Leckie, & Weinstein, 2014). Still, caution is appropriate. A recent large randomized trial of exercise to promote walking speed, which demonstrated improvement in walking endurance, did not see benefits for cognitive performance (Sink et al., 2015). More research in this area is critical. One productive approach is evident in culturally tailored exercise interventions, such as the Rhythm Experience and Africana Culture trial (Lukach et al., 2016).

Cognitive Remediation

The effects of cognitive training on risk of dementia are controversial. Training improves tested abilities but may not transfer to other domains or enhance daily function. Commercial interests have a large stake in showing benefit, clouding research efforts. One early review reported the utility of cognitive training for reducing cognitive decline in normal aging (Hertzog et al., 2008), but evidence of the effectiveness of cognitive training in delaying difficulties in daily function has only recently emerged and results are equivocal. The largest and best conducted trial is ACTIVE, Advanced Cognitive Training for Independent and Vital Elderly, a large randomized controlled trial assessing the effects of three kinds of cognitive training (memory, reasoning, and speed-of-processing) on instrumental activities (IADL) (Ball et al., 2002). Ten years of follow-up are available (Rebok et al., 2014).

Results from ACTIVE suggest some benefit. At 10 years, 49.3 % of control participants reported the same or improved level of IADL difficulty as at baseline. Participants in all three cognitive training arms were more likely to report the same or improved IADL: memory arm, 61.6 %; reasoning arm, 60.2 %, speed of processing arm, 58.5 %. However, training did not lead to improvements in any of a series of performance-based measures of everyday function. The authors conclude, "the effects of cognitive training on daily function in this study were modest." Still, other studies using the ACTIVE trial have reported lower risk of auto accidents in the speed of processing treatment arm (Ball, Edwards, Ross, & McGwin, 2010; Edwards et al., 2009).

Sleep Health

Sleep disturbances may affect central nervous system restoration and in this way impair cognition and daily function (Cricco, Simonsick, & Foley, 2001). Indeed, sleep deprivation is often used as a model of dementia. However, recent reviews suggest that the association between normal sleep and cognition may be more complex because of the effects of multimorbidity, apnea, polypharmacy, variation in sleep architecture over the lifespan, and other factors (Scullin & Bliwise, 2015;

Yaffe, Falvey, & Hoang, 2014). It would be valuable to determine the sleep parameters with the greatest effect on cognition to target sleep health interventions and in this way improve cognitive function (Brewster, Varrasse, & Rowe, 2015). All in all, in older adults without extensive comorbidity, sleep does not change substantially with age and thus associations with cognition are less clear.

More complex trajectories linking sleep and impaired cognition have recently come to light. For example, the sleep-depression-dementia pathway suggests that depression is a brain insult, which, by affecting sleep, increases risk for cognitive decline (Cuijpers et al., 2015). If so, strategies to improve sleep may reduce the risk of depression and in this way maintain cognition and daily function.

Conclusion

In this chapter, we examined high functioning cohorts of older people to determine the extent of change in daily function with normal aging, that is, in people who do not meet criteria for cognitive impairment and disability. Older adults at greater ages and with subtle cognitive impairment show greater deficits in daily function but not uniformly. In many domains function is preserved. We conclude that this pattern of selective decline with preserved function overall reflects compensatory processes, which in turn suggest an adaptive brain. This is one more example of continual functional reorganization and repair as the brain responds to one particular set of neural insults, that is, aging.

We then turned to current research on efforts to blunt the effects of brain aging on daily function. Promising candidates include volunteering, physical activity and exercise, cognitive training, and improved sleep health. Each approach has some support for reducing the risk of cognitive decline and preserving daily function. However, in most cases effects are only small to moderate and in some cases remain equivocal. The safest conclusion at this point is a need to support cognition across the lifespan to preserve daily function in old age. This will require investment of resources for better early and mid-life educational, occupational, and neighborhood environments, as well as opportunities for continued cognitive engagement in late life.

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