The Crown of Life Dynamics of the Early Postretirement Period
Annual Reive of Gerontology
Volume 26, 2006

CHAPTER 7

A Coconstructionist View of the Third Age:

The Case of Cognition[1]

Sherry L. Willis and K. Warner Schaie

In this chapter, we propose a coconstructionist model for the study of development within the Third Age using cognition as the sample case. In the first part of the chapter, we focus on the predecessors of cognitive development during the Third Age that occur in young adulthood and midlife. A coconstructionist view of cognition includes the identification of sets of neurobiologic and sociocultural influences whose role in affecting cognitive change during the Third Age will be considered. Two life span perspectives inform our model: The dual intelligence perspective proposed by Horn and Cattell (1967) and subsequently discussed by Baltes and colleagues, and second, the recent Coconstructionist perspective proposed by Baltes and colleagues (Baltes, 1997; Li, 2003; Li & Freund, 2005).

[1] Research described in this chapter was supported by grants AG008055 and AG024102 from the National Institute on Aging. The collaboration of members and staff of the Group Health Cooperative of Puget Sound, the source of our study participants, is gratefully acknowledged.

LIFE SPAN PERSPECTIVE OF DEVELOPMENT

A central task of life span psychology is to understand the interactive and dynamic nature of contextual and individual influences on development (Baltes, 1997; Li & Freund, 2005; Schaie, 2005). This dynamic interaction between individual and contextual influences leads to considerable variability in development—inter-individual differences in intra-individual change. Although inter-individual variability in intra-individual change is a tenet of the life span perspective, most cognitive aging studies have focused primarily on the *normative* pattern of cognitive change over a given age range.

Variability in intra-individual development becomes even more complex when studied over historical time, in identifying cohort differences in variability in intra-individual change. Given the challenges of examining cohort trends in intra-individual change, most research has been limited to a comparison of at most two cohorts at a single developmental period, such as the Third Age and on one or two cognitive domains. Moreover, these studies have focused on normative patterns of cohort differences in cognition and thus have not addressed variability in the pattern of individual differences in intra-individual change that would be expected to occur across cohorts. We also consider here how cognition in the Third Age has changed over historical time.

THE COCONSTRUCTIVE PERSPECTIVE

Both neurobiologic and sociocultural influences on development have long been recognized. Coevolutionary theorists (Dunham, 1991; Tomasello, 1999) maintain that both biologic and cultural evolution has occurred and that recent, cohort-related advances in human development in domains such as intelligence can be attributed largely to cumulative cultural evolution. Cultural activities impact the environment, thereby influencing mechanisms such as selection processes, and thus allowing humans to codirect their own evolution (Dunham, 1991). Baltes' coconstructionist approach imposes a life span developmental perspective on coevolutionary theory and provides principles regarding the timing of the varying contributions of neurobiology and culture at different developmental periods and across different domains of functioning. Three principles are proposed regarding the relative contributions of biology and culture influences across the life span:

1. The beneficial effects of the evolutionary selection process occur primarily in early life and are less likely to optimize development in the latter half of life.

2. Further advances in human development depend on ever-increasing cultural resources. From a historical perspective, increases in cultural resources have occurred via cumulative cultural evolution and have resulted in humans reaching higher levels of functioning. At the individual level, increasing cultural resources are required at older ages for further development to occur or to prevent age-related losses. The implication then, for the Third Age, is that cultural resources become increasingly important.
3. In very old age, the efficacy of increasing cultural resources is diminished because decline in neurobiologic functions.

The Dual Intelligence Perspective

Baltes and colleagues have proposed that the coconstruction perspective can be applied to the dual component model of intelligence. Cattell and Horn originally described a hierarchical model of psychometric intelligence involving two superordinate domains of fluid and crystallized intelligence. *Fluid intelligence* involves cognitive processes heavily influenced by neurobiology, whereas *crystallized intelligence* develops from experience and culture-based knowledge. Fluid intelligence is hypothesized to develop and decline earlier in the life span, whereas the more culture-based crystallized abilities are maintained into old age. Within the Cattell–Horn framework, psychometric abilities, such as inductive reasoning, spatial orientation, and memory processes, were considered more fluid-like, whereas verbal, numerical, and social knowledge skills were crystallized. In relation to the current study, it is important to note that the Cattell–Horn model deals primarily with intra-individual change and offers no hypotheses regarding secular trends in intelligence other than as relate to the differential impact of neurobiologic and sociocultural influences on fluid versus crystallized intelligence. Within the coconstructionist perspective, limited discussion has occurred of the impact of increasing cultural advances on secular trends in cognition.

Culture and Cognition

In a recent theoretic paper, Li (2003) proposes a triarchic view of culture involving three aspects of culture that are related to the coconstructionist perspective: resource, process, and developmental relevancy. Culture as social resources involves the knowledge, values, and material artifacts accumulated by a society and transmitted to future generations; these resources continue to develop and change through cumulative cultural evolution (Tomasello, 1999). Expanding upon Li's triarchic view of cultural domains, we view accumulated cultural resources as being represented by structural variables such as educational level, occupational status, and ability level. These variables reflect the individual's acquisition and accumulation of cultural knowledge and skills that occur primarily during the first half of adulthood.

Culture as ongoing social process involves the routines, habits, and performances of the individual in daily life that take place in the individual's proximal developmental context and that are shaped by the shared social reality at the moment (Li, 2003). We view the individual's current activities in domains such as health behaviors, cognitive engagement, and the complexity of one's work tasks as aspects of social dynamics that impact cognitive functioning and cohort differences in cognition. The third component of developmental relevancy suggests that the impact of particular cultural resources and processes on an individual is partially determined by the individual's developmental stage, which others have termed the *developmental niche* (Gauvain, 1998). Consideration of the developmental niche associated with the Third Age has not been studied but deserves further exploration. The current study is concerned with aspects of culture associated with cumulative resources and current processes or practices.

Those studying cognition from a broad coevolutionary perspective propose that advances in cognition as would be represented in cohort and generational effects are primarily caused by an accumulation of cultural resources and knowledge across time. This perspective has been largely nondevelopmental. It is concerned primarily with secular trends in level of cognition, but with little consideration of how culture impacts developmental change. Dickens and Flynn (2001) have proposed that the individual's environment is largely matched to his or her IQ level. Through a *multiplier effect*, an individual with a higher IQ either seeks or is selected for a more stimulating environment, thus leading to further increases in IQ. The impact of small environmental changes could result in significant IQ gain because of the multiplier effect. By a similar process, a social multiplier effect can occur if intellect increases by a small amount for many persons in a society and leads across time to further reciprocal interactions between ability and environment. Increase in a person's IQ is thus influenced not only by his or her environment but also by the social multiplier effects occurring for others with whom they have contact. The question remains of what determines the domain of development or cognition that is impacted by culture and environment. Drawing upon Darwin's work, Flynn suggests that an *X Factor* may determine those aspects of development that are impacted by the environment (Dickens & Flynn, 2001). The X Factor need not be inherently related to the developmental domain impacted. For example, introduction of specific programming on television (e.g., Olympics) might increase public attention and participation in a given sport, which then leads to increased physical fitness. The X Factor here is television or specific TV programming. In the Schaie model (Schaie, 2005), the X Factor is represented as a period effect.

In a related coevolutionary approach, Tomasello and others (Dunham, 1991; Tomasello, 1999) have proposed mechanisms for the social transmission of cultural knowledge. Humans have evolved forms of social cognition, unique to humans, that have enabled them not only to create new knowledge and skills but, more important, to preserve and socially transmit these cultural resources to the next cohort/generation. Cultural learning thus involves both social transmission of cultural knowledge and resources developed by one person, and also sociogenesis or collaborative learning and knowledge creation.

REVIEW OF THE LITERATURE ON SELECTED SOCIOCULTURAL INFLUENCES

In the following sections, we briefly review relevant literature documenting cohort trends in cognition and consider those sociocultural influences relevant to the Third Age and that have been found to account for inter-individual differences in intra-individual cognitive change. We draw upon Li's and others' (Gauvain, 1998; Tomasello, 1999) conception of culture to focus on two sociocultural domains: accumulated cultural resources and concurrent culture-based activities. Expanding on Li's triarchic view of cultural domains, we view accumulated cultural resources as being represented by structural variables such as educational level, occupational status, and ability level. These variables reflect the individual's prior acquisition and accumulation of cultural knowledge and skills. In contrast, the second component of the triarchic view of culture focuses on current activities, habits, and beliefs of the individual that are shaped by concurrent social dynamics and processes. We view the individual's current activities in domains such as health behaviors, cognitive engagement, and the complexity of one's work tasks as aspects of social dynamics that impact cognitive functioning in the Third Age and possible cohort differences in cognition. With regard to neurobiological influences, we focus on the two domains of chronic diseases and of biomarkers, shown in the literature to impact cognitive change in adulthood.

Secular Cohort Trends in Cognition

For several decades, an intensive debate has been ongoing on the nature and directionality of cohort differences in cognition. Cross-sectional data from several Western societies indicate the occurrence of "massive IQ gains on the order of 5 to 25 points in a single generation" (Flynn, 1987, p. 171). The *Flynn effect* has been documented primarily for post–World War II cohorts born during the 1950s. The leading-edge baby boomers have just begun to enter the Third Age. This massive cohort gain has been documented most clearly for fluid abilities, rather than crystallized abilities. Relatively little rationale has been offered for why fluid rather than crystallized abilities would show these positive trends for post–World War II cohorts. In contrast, cross-sectional reports on college admission tests indicate negative cohort trends for certain birth cohorts of young adults (Wilson & Gove, 1999). Likewise, Alwin (Alwin & McCammon, 2001) and Glenn (1994) reported negative cohort trends in verbal ability.

To examine cohort-related shifts in the domains of intelligence impacted by culture, an extensive database of multiple cohorts studied over the same developmental ages is needed, such as is present in the Seattle Longitudinal Study (SLS; Schaie 2005). Studies, such as Flynn's, highlight some of the serious limitations in prior cohort studies of cognition—focusing only on level, rather than developmental change in cognitive functioning, on a limited number of cohorts, over a single age period, and with no consideration of cohort-related differences in trajectory patterns (see for example, Schaie, Willis, & Pennak, 2005).

Sociocultural Influences: Accumulated Resources

Educational Level

Educational level is the most consistent nonbiological predictor of both cognitive level and rate of change in prior longitudinal studies and meta-analyses (Albert et al., 1995; Anstey & Christensen, 2000). Moreover, education predicts cognitive change not only in old age but also throughout adulthood (Lyketsos, Chen, & Anthony, 1999). Consistent with coconstructionist and Dual Intelligence approaches, education is reported to most consistently predict change in crystallized abilities, memory, and mental status, and is less consistently predictive of change in fluid abilities and speed. The effects of education on cognitive change remain when controlling for factors such as age, gender, race, and health. In the MacArthur study of successful aging, education best predicted change in cognition (Albert et al., 1995).

Secular trends in education are well documented. Educational attainment, particularly in post secondary education has increased significantly across birth cohorts in the first half of the twentieth century. In 2000, 15% of 65+ elders had attended college, compared to almost 50% of baby boomers. Hauser and Featherman (1976) report a total increase of about 4 years of education from birth cohorts 1897 to 1951. Intergenerational differences in schooling peaked among men born shortly after World War I, and a deceleration has occurred across more recent cohorts. Intergenerational differences between successive generations, approximately 20 to 30 years apart, range from 2 to 4 years

Occupational Status and Work Complexity

Major historical changes in the U.S. workforce have occurred across cohorts. Currently, 20% of workers are in professional occupations, compared with 7% in 1950, whereas farmers have decreased from 10% in 1950 to 0.6% today. The median age of retirement is now 62 years, with only 18% of men 65+ working, compared with 46% in 1950. Women's work participation has increased, with 52% of women aged 55–64 years working compared with 27% in 1950.

Occupational experience is related to the maintenance of cognitive abilities at older ages. Avolio and Waldman (1990) report that occupational status moderates the relationship between age and cognitive ability, with a negative relationship for unskilled workers, but they find no relationship for skilled workers. Salthouse (1990) reported that architects preserved higher levels of spatial ability later in the life span when compared with nonarchitects of similar ages. Historical shifts in work organization have resulted in fewer hierarchical levels and increased worker self direction along with more responsibility for a broader range of tasks. As a result, job complexity has increased. Job conditions involving self-directed, substantively complex work are associated with increased intellectual flexibility and self-direction (Schooler, 1998). Recent findings indicate that the reciprocal relation between substantively complex work and cognition are even stronger in older men than was found in younger men (Schooler, Mulatu, & Oates, 2004). Schooler's work also suggests age/cohort differences in work complexity; older workers, on average, were found to do less substantively complex work.

Cognitive Stimulation and Engagement

Engagement in cognitively stimulating activities has been linked to a reduction in the risk of dementia (Katzman, 1993; Scarmeas, Levy, Tang, Manly, & Stern, 2001). The Religious Orders Study (Wilson, D'Agostino, Levy, Belanger, Silbershatz, & Kannel, 1998) reported that a 1-point increase in cognitive activity score was associated with a 33% reduction in Alzheimer disease (AD) risk (see also Verghese et al., 2003). However, most studies of cognitive engagement have occurred in the old, with the criticism that findings are caused by a preclinical decline in engagement associated with AD. Engagement studies are needed in young and middle adulthood, when development of cognitive reserve should occur. Historically, there have been dramatic increases in access to cognitive stimulation via media; households with TV increased from 9% in 1950 to 98% today; cable TV increased from 2% in 1965 to 68% currently.

Health Behaviors

Health behaviors are included as sociocultural influences because these behaviors are acquired through socialization and are highly related to education (Markus, Ryff, Curham, & Palmersheim, 2004). The impact of health behaviors such as exercise, smoking and alcohol consumption on maintenance of cognitive ability in the Third Age has been mixed (Anstey & Chritensen, 2000). Colcombe and Kramer (2003 reported fitness effects to be selective, with aerobic fitness training having a greater positive impact on tasks associated with executive control. In the MacArthur successful aging study (Albert et al., 1995) strenuous daily physical activity was a significant predictor of positive cognitive change. A paucity of studies exist on cigarette smoking and cognition. Obesity has been associated with atherogenesis, hypertension, and diabetes and was found to increase the risk for cognitive decline or AD (Sarkisian, 2000). Recent studies indicate that a U- or J-shaped curve may describe the relationship between the level of alcohol use and cognitive functioning (Hendrie, Gao, Hall, & Hui, 1996). Some studies find the association between cognition and moderate drinking stronger for women than for men. The MIDUS midlife study found educational differences in health behavior practices, with college-educated participants reporting a higher rate of exercise and lower rates of smoking (Markus, Ryff, Curham, & Palmersheim, 2004), suggesting positive cohort trends in health behaviors.

Neurobiological Influences: Chronic Disease

We focus on the chronic diseases of hypertension, cardiovascular disease (CVD), and diabetes not only because of their strong association with fluid abilities, but also because of their high prevalence in adulthood.

Hypertension

Hypertension is associated with poorer cognitive performance at all adult ages, primarily on fluid-type tests (e.g., attention, learning, memory, executive functions; Elias, D'Agostino, Elias, & Wolf, 1995; Waldstein & Elias, 2001); crystallized abilities are less affected. Chronic hypertension is associated not only with level of cognition but also with accelerated longitudinal decline (Elias, Robbins, Elias, & Streeten, 1998; Knopman et al., 2000). Hypertension impacts cognitive decline in young adults as well as the aged (Elias, Elias, Robbins, & Budge, 2004). In a 20-year longitudinal study, cognitive decline was 12.1%

greater for hypertensives compared with normotensives. Prospective cohort studies report that the higher blood pressure is in midlife, the lower the level of cognitive functioning in late middle and old age (Swan, Carmelli, & LaRue, 1996). Moreover, antihypertensive therapy has increase two- to threefold in recent cohorts, and consideration of the impact of long-term antihypertensive therapy on the relation between hypertension and cognition is critical in longitudinal studies (Elias, Robbins, Elias, & Streeten, 1998).

Cardiovascular Disease

Atherosclerosis contributes to mild but consistent deficits in cognitive performance in midlife and old age (Waldstein & Elias, 2001). Community-based studies of dementia (Lim et al., 1999) have found that cerebrovascular pathology often co-occurs with AD pathology. Up to 45% of community-based incident dementia cases with autopsy-proven AD have co-occurring cerebral infarctions (Lim et al., 1999). In cases with vascular disease, less AD neuropathology is necessary for similar severity of clinical dementia, especially at earlier stages of the disease (Esiri, Nagy, Smith, Barnetson, & Smith, 1999). However, to date, most of this evidence comes from cross-sectional studies with few longitudinal studies relating cognitive performance and atherosclerosis.

Diabetes

Case control studies of type 2 diabetes in older adults have found cognitive impairment, most commonly for fluid-type abilities of learning and memory (Hassing et al., 2004). Large-scale epidemiologic studies support the findings of case control studies, but most have been cross-sectional. An exception is the Framingham Health Study, reporting evidence of a causal relationship between diabetes and cognitive dysfunction (Elias, Elias, D'Agostino, Silbershatz, & Wolf, 1997). The duration of diabetes was related to poorer performance on verbal memory and abstract reasoning tests.

Neurobiological Influences: Biomarkers

The negative effects of apolipoprotein E (Apo-E e4) and homocysteine are most closely related to fluid-type abilities. An indirect relation to fluid ability occurs also for C-reactive protein, given its link to CVD.

Apo-E

Accumulating evidence suggests that the greatest significance of Apo-E e4 is not as a risk factor for AD, but its association with a lower level of fluid-type cognitive performance across the life span and with age-related decline in cognition (Hofer et al., 2002; Riley et al., 2000). Early effects of Apo-E e4 on brain morphometry and cognitive performance have been found as early as age 12 and have been replicated in young and middle adulthood (Reiman et al., 2005). For nondemented older adults 65+ years, the Apo-E e4 allele was associated with lower scores on fluid of ability measures: Mini Mental State Examination (MMSE; Alstiel, Greenberg, Marin, Lantz, & Mohs, 1997), learning and memory (Bondi et al., 1995), and psychomotor speed (Yaffe, Cauley, Sands, & Browner, 1997).

Apo-E e4 genotyping also plays a modifier role with respect to other risk factors. After adjusting for lipids and other risk factors, the ApoE e4 genotype is the strongest genetic determinant for coronary heart disease in both men and women (Wilson, Myers, Larson, Ordovas, Wolf, & Schafer, 1994). ApoE e4 is a risk factor for atherosclerosis (Hofman et al., 1997), coronary heart disease (Wilson et al., 1994; Wilson et al., 1998), and hypertension (Warden & Thompson, 1994). It promotes increased levels of circulating cholesterol (Escargueil-Blanc, Salvayre, & Negre-Salvayre, 1994).

Homocysteine

Moderately elevated levels of total plasma homocysteine (tHcy) are associated with hypertension (Bots et al., 1999), myocardial infarction, total cholesterol (Nygard et al., 1995), coronary disease (Clarke et al., 1998), atherosclerosis (Bostom & Selhub, 1999; Nehler & Porter, 1997), stroke (Bostom & Selhub, 1999; Bots et al., 1999), carotid artery stenosis (Selhub et al., 1995), vascular dementia, and AD (Clarke et al., 1998). Studies of the relation of tHcy and cognitive functioning with appropriate vitamin status control (Selhub et al., 2000) indicate that higher tHcy levels were associated with lower scores for fluid-type spatial, reasoning, and memory ability in an old-age sample (Jensen et al., 1998). The Apo-E e4 genotype acts as a modulator of associations between tHcy, hypertension, and cognitive performance. Specifically, the magnitude of the effect of hypertension and tHcy on cognitive functioning (independently or in concert) may be greater for individuals who possess the ApoE e4 allele.

C-Reactive Protein

CRP, a protein produced by the liver, is elevated in the serum of persons with inflammatory illnesses (e.g., rheumatologic diseases, bacterial infections). Elevated CRP may be a risk factor for thromboembolic stroke (Curb et al., 2003), peripheral vascular disease (Curb et al., 2003), and carotid atherosclerosis

(Rincon, Stern, Freeman, O'Leary, & Escalante, 2003). Inflammatory responses have also been associated with dementing disease (McGeer & McGeer, 2001). The MacArthur Study of Successful Aging found elevated CRP was associated with higher overall mortality and slightly more physical decline among high functioning community dwelling persons aged 70–79 (Taafe, Harris, Ferurucci, Rowe, & Seeman, 2000).

Cholesterol and Cognition

In healthy adults, the impact of cholesterol concentration may vary by ability. Low serum cholesterol has been associated with better memory and crystallized intelligence (Muldoon, Ryan, Matthews, & Manuck, 1997). On the other hand, high serum cholesterol may be associated with optimal mental speed and mental flexibility. High serum cholesterol was associated with lessened decline in digit-symbol substitution test performance over 5 years in middle-aged twins (Swan, LaRue, Carmelli, Reed, & Fabsitz, 1992).

COHORT DIFFERENCES DURING THE THIRD AGE IN FLUID AND CRYSTALLIZED ABILITIES

In this section, we move from a review of prior literature and theories to an examination of empirical data on cohort differences in the Third Age. We provide some data on cohort differences in fluid and crystallized intelligence. We also provide examples of cohort differences in sociocultural influences that may explain, in part, the observed cohort differences in cognition. We cannot at this time provide similar cohort differences with respect to the neurobiologic influences, because cohort difference data in these influences are not as yet readily available.

Cohort differences in level and slope of intra-cohort trajectories for the Third Age can be examined in data from the SLS (Schaie, 2005; Schaie, Willis, & Pennak, 2005), over three median ages (60, 67, and 74). The SLS was begun in 1956 to assess longitudinal change and cohort differences across the adult life span. In this study, data are collected in 7-year intervals. Longitudinal data across the Third Age ranges are available thus far for five cohorts (median birth years: 1896, 1903, 1910, 1917, and 1924). These five cohorts passed through their Third Age from 1956 to 1970, from 1963 to 1977, from 1970 to 1984, from 1977 to 1991, and from 1984 to 1998, respectively. Data are available for two measures of fluid intelligence (Inductive Reasoning and Spatial Orientation) and for three measures of crystallized intelligence (Number, Verbal Meaning, and Word Fluency).

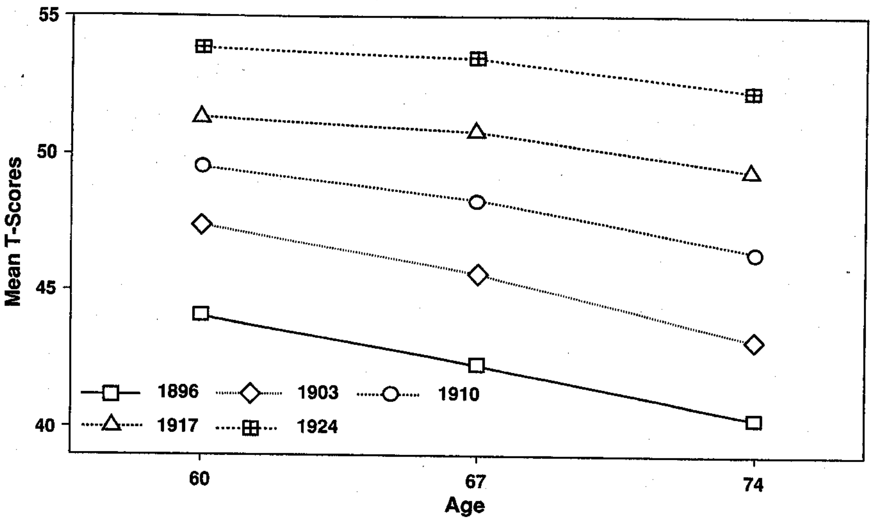

FIGURE 7.1 Cohort differences in trajectories across the Third Age for Inductive Reasoning.

Fluid Intelligence in the Third Age

Figures 7.1 and 7.2 show the different cohort trajectories for the two fluid abilities of Inductive Reasoning and Spatial Orientation.

Ability

What is most noticeable is the systematic increase in the level of performance for both abilities, amounting to more than 1 *SD* across the five 7-year cohorts over a 35-year period. Equally important, however, is the much more gradual decrease in slope, perhaps most noticeable by a flattening of the trajectory portion from age 60 to 67.

From the model proposed in the first part of the chapter, it might be hypothesized that advances in scientific knowledge of a neurobiological nature, including increases in medical knowledge and adoption of healthier lifestyles, is advantaging more recently born cohorts with respect to both level and slope for the fluid abilities.

Crystallized Intelligence in the Third Age

Similar findings are presented for the three crystallized abilities of Number, Verbal Meaning, and Word Fluency in Figures 7.3 to 7.5. Again, a substantial increment occurs in the level of performance across five successive cohorts at the same chronologic age range in the Third Age. However, changes in slope

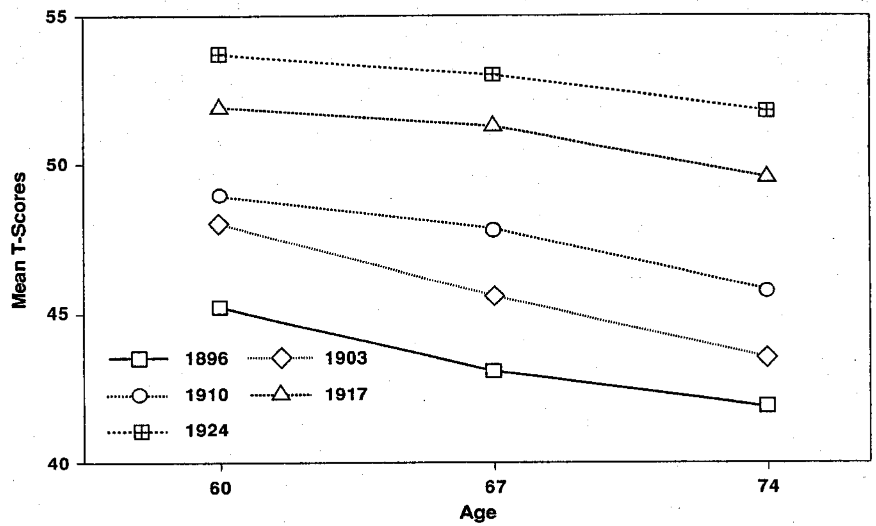

FIGURE 7.2 Cohort differences in trajectories across the Third Age for Spatial Orientation Ability.

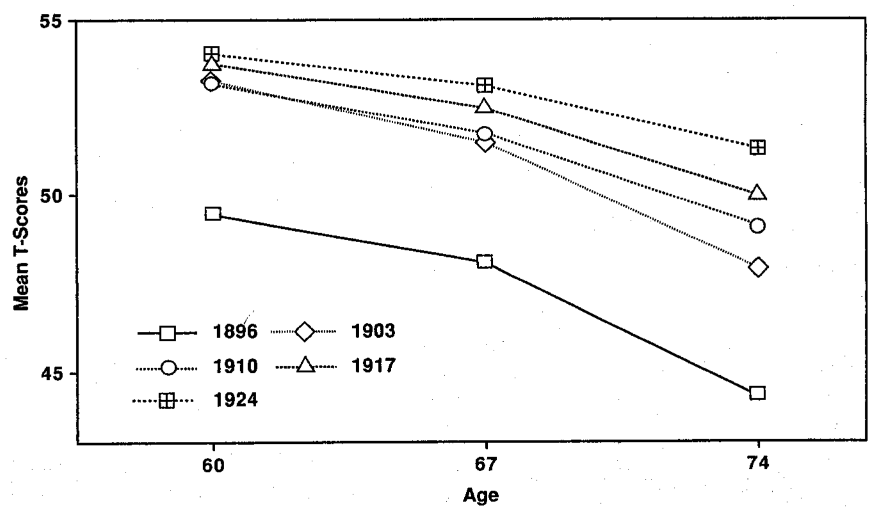

FIGURE 7.3 Cohort differences in trajectories across the Third Age for Number Ability.

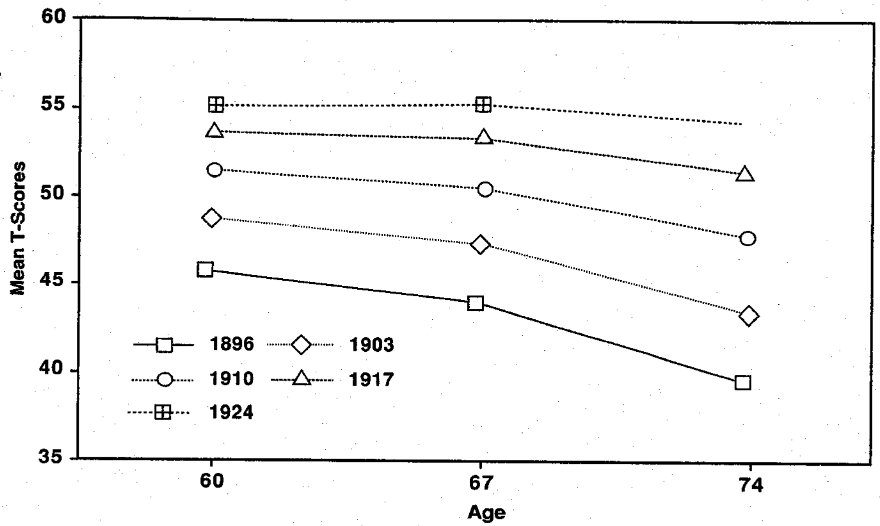

FIGURE 7.4 Cohort differences in trajectories across the Third Age for Verbal Ability.

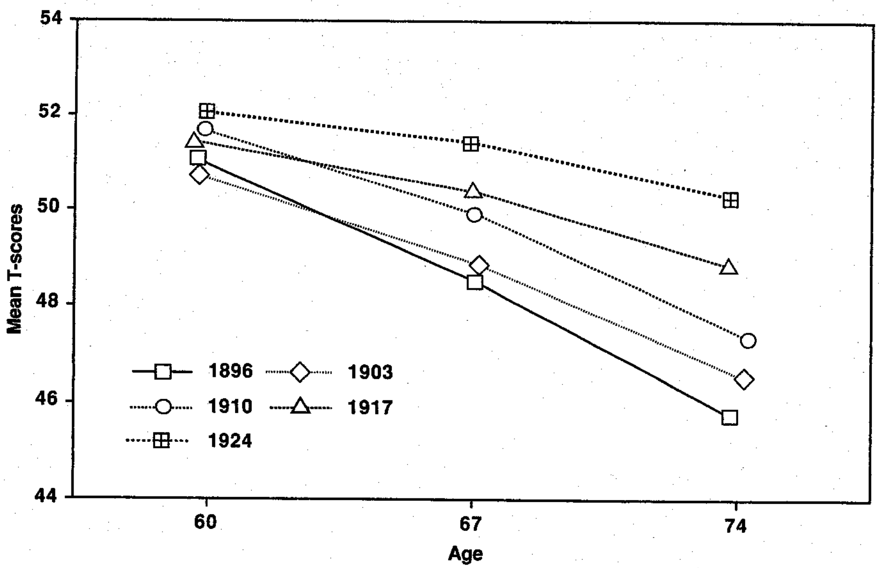

FIGURE 7.5 Cohort differences in trajectories across the Third Age for Word Fluency.

differ markedly from the pattern seen for the fluid abilities. Numerical ability (Figure 7.3), beginning with the cohort born in 1903, has reached a virtual asymptote at the beginning of the Third Age, but slopes (rates of aging) continue to flatten across successive cohorts. Verbal ability, on the other hand shows a pattern similar to the fluid abilities, showing positive cohort differences with respect to both level and slope of cognitive change across the Third Age. Word Fluency (Figure 7.5) shows a pattern similar to Number. However, for word fluency, the reduction in the rate of negative cognitive change across cohorts is even more dramatic than for Number. Average decline across the Third Age is reduced from ½ *SD* for the earliest cohort (mean birth year 1896) to a trivial 0.1 *SD* for the most recent cohort (mean birth year 1924).

EVIDENCE FOR COHORT DIFFERENCES IN SOCIOCULTURAL INFLUENCES

We have only recently begun to assess the evidence for neurobiologic markers of cohort differences in the occurrence and onset of chronic diseases and lifestyles that may be responsible for the positive cohort differences in cognitive trajectories for the fluid abilities (see, for example, Schaie, 2005, chapters 10 and 17), and we have not yet specifically examined them for the Third Age. Hence, we provide examples here only for selected sociocultural influences that particularly impact cohort differences for the crystallized abilities. For the cohorts for whom we have charted cognitive change across the Third Age, we therefore examine concomitant cohort differences in educational attainment and in level of occupational status.

Educational Attainment

From the earliest to the most recent cohort, a mean gain of 1.7 years of education (median gain = 1 grade level) occurred. More impressively, a substantial shift occurred in the proportion of individuals who had experienced at least some college education (Figure 7.6).

For the 1924 cohort, approximately 70% have experienced postsecondary education and only 30% have high school or less; this is in contrast to almost 50% of the 1896 cohort having only a high school education or less.

Occupational Status

Changes also have occurred in occupational structure likely to impact cohort differences in crystallized abilities. Figure 7.7 shows the proportion at each occupational status for each cohort starting age mean age 60 (range 58 to 62 years). As can be seen in Figure 7.7, no individuals in the earliest cohort

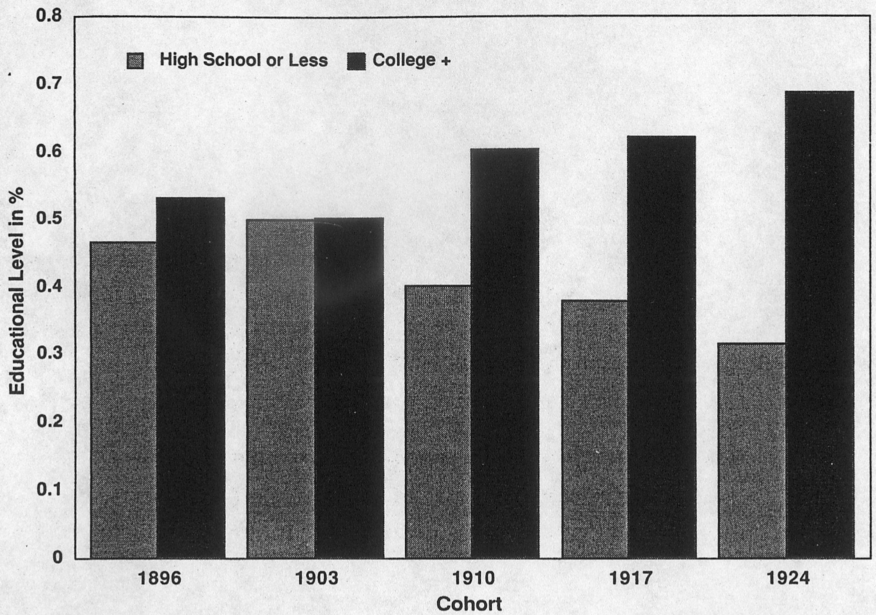

FIGURE 7.6 Cohort differences in the proportion of individuals with education of high school or less and those with college education.

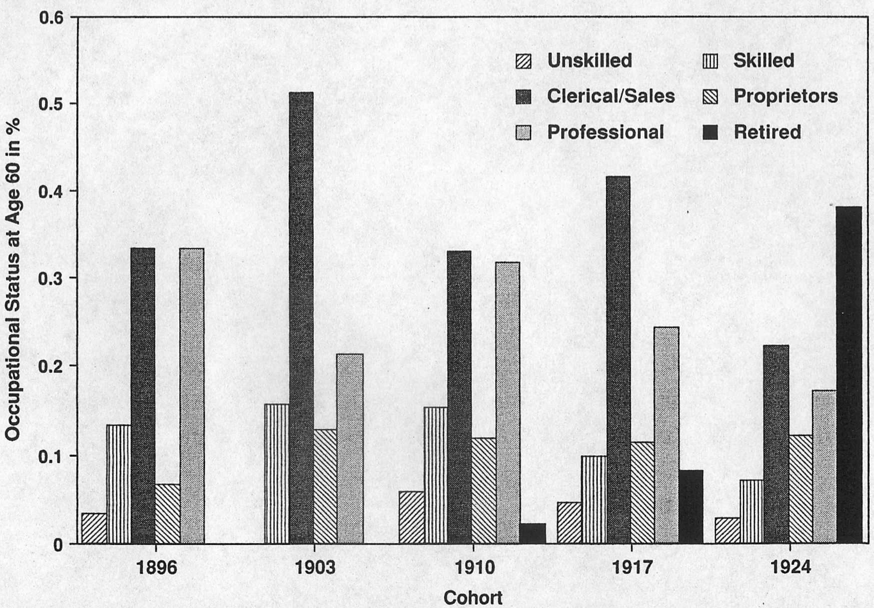

FIGURE 7.7 Cohort differences in the proportion of individuals by occupation group.

had retired by age 60, whereas more than a third of the 1924 birth cohort had already retired by that age. Clerical and sales maintained its status as the modal professional group, although declining in absolute magnitude. The decline in the proportion of professionals represents a period of "golden handshakes" for that occupational group, which has passed. Hence, we expect a greater proportion of working professionals as the next cohort group reaches the Third Age.

CONCLUSION

This chapter began by presenting a model for cognitive development during the Third Age that involves the integration of the coconstructionist approach to the study of human development with the Cattell–Horn theory of crystallized and fluid intelligence. We then examined the literature on the possible impact of neurobiologic and sociocultural influences on the development of cognition during the Third Age.

We then examined data from the SLS for five successive cohorts, with median birth years from 1896 to 1924, that show substantial cohort differences in cognitive change over the Third Age for successive birth cohorts. In general, only a modest average decline is noted from age 60 to 67, but decline accelerates from age 67 to 70. More important, however, is the finding of differential patterns for fluid and crystallized intelligence, with successive cohorts presenting increasingly flatter trajectories across the Third Age, suggesting that cognitive decline during the Third Age is (on average) becoming minimal. Examples of sociocultural influences favoring successive cohorts were also provided for educational level and occupational status.

We conclude by suggesting that cognitive function during the Third Age will become increasingly similar to that found in late middle age, assuming the continuation of favorable sociocultural and neurobiologic influences observed for the cohorts considered in this chapter.

REFERENCES

Albert, M. S., Jones, K., Savage, C. R., Berkman, L., Seeman, T., Blazer, D., et al. (1995). Predictors of cognitive change in older persons: MacArthur studies of successful aging. *Psychology and Aging, 10,* 578–589.

Alstiel, L. D., Greenberg, D. A., Marin, D., Lantz, M., & Mohs, R. (1997). Apolipoprotein E genotype and cognition in the very old. *The Lancet, 349,* 1451.

Alwin, D. F., & McCammon, R. J. (2001). Aging, cohorts, and verbal ability. *Journals of Gerontology: Social Sciences, 56B,* S151–S161.

Anstey, K., & Christensen, H. (2000). Education, activity, health, blood pressure and apolipoprotein E as predictors of cognitive change in old age: A review. *Gerontology, 46*, 163–177.

Avolio, B. J., & Waldman, D. A. (1990). An examination of age and cognitive test performance across job complexity and occupational types. *Journal of Applied Psychology, 75*, 43–50.

Baltes, P. B. (1997). On the incomplete architecture of human ontogeny: Selection, optimization and compensation as foundation of developmental theory. *American Psychologist*, 52, 366–380.

Bondi, M. W., Salmon, D. P., Monsch, A. U., Galaske, D., Butterns, N., Klauber, M. R., et al. (1995). Episode memory changes are associated with the APOE-e4 allele in nondemented older adults. *Neurology, 45, 2203–2206.*

Bostom, A. G., & Selhub, J. (1999). Homocysteine and arteriosclerosis: Sub-clinical and clinical disease associations. *Circulation, 99*, 2361–2363.

Bots, M. L., Launer, L. J., Lindemanas, J., Hofman, A., Witteman, J. C. M., Koudstall, P. J., et al. (1999). Homocysteine, and short-term risk of myocardial infarction and stroke in the elderly: The Rotterdam Study. *Archives of Internal Medicine, 159*, 38–44.

Clarke, R., Smith, A. D., Jobst, K. A., Refsum, H., Sutton, L., & Ueland, P. M. (1998). Folate, vitamin B22 and serum total homocysteine levels in confirmed Alzheimer Disease. *Archives of Neurology, 55*, 1449–1455.

Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Science, 14*, 25–130.

Curb, J. D., Abbott, R. D., Rodriguez, B. L., Sakkinen, P., Popper, J. S., Yano, K., et al. (2003). C-reactive protein and the future risk of thromboembolic stroke in healthy men. *Circulation, 107*, 2016–2020.

Dickens, W. T., & Flynn, J. R. (2001). Heritability estimates versus large environmental effects: The IQ paradox resolved. *Psychological Review, 108*, 346–369.

Dunham, W. H. (1991). *Coevolution: Genes, culture, and human diversity*. Palo Alto, CA: Stanford University Press.

Elias, M. F., Elias, P. K., D'Agostino, R. B., Silbershatz, H., & Wolf, P. A. (1997). Role of age, education, and gender on cognitive performance in the Framingham Heart Study: Community-based norms. *Experimental Aging Research, 23*, 201–235.

Elias, M. F., Robbins, M. A., Elias, P. K., & Streeten, D. H. (1998). A longitudinal study of blood pressure in relation to performance on the Wechsler Adult Intelligence Scale. *Health Psychology 17*, 486–493.

Elias, P. K., D'Agostino, R. B., Elias, M. F., & Wolf, P. A. (1995). Blood pressure, hypertension, and age as risk factors for poor cognitive performance. *Experimental Aging Research, 21*, 393–417.

Elias, P. K., Elias, M. F., Robbins, M. A., & Budge, M. M. (2004). Blood pressure-related cognitive decline: Does age make a difference? *Hypertension, 44*, 1–6.

Escargueil-Blanc, I., Salvayre, R., & Negre-Salvayre, A. (1994). Neurosis and apoptosis induce by oxidized low density lipoprotein occur trough two calcium-dependent pathways in lymphoblastoid cells. *FASEB Journal, 8*, 1075–1080.

Esiri, M. M., Nagy, Z., Smith, M. Z., Barnetson, L., & Smith, A. D. (1999). Cerebrovascular disease and threshold for dementia in the early stages of Alzheimer's disease. *The Lancet*, 354, 919–920.

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*, 171–191.

Gauvain, M. (1998). Cognitive development in social and cultural context. *Psychological Science, 7*, 188–192.

Glenn, N. D. (1994). Television watching, newspaper reading, and cohort differences in verbal ability. *Sociology of Education, 67*, 216–230.

Hassing, L. B., Grant, M. D., Hofer, S. M., Pedersen, N. L., Nilsson, S. E., Berg, S., et al. (2004). Type 2 diabetes mellitus contributes to cognitive change in the oldest old: A longitudinal population-based study. *Journal of the International Neuropsychological Society, 4*, 599–607.

Hauser, R. M., & Featherman, D. L. (1976). Equality of schooling: Trends and prospects. *Sociology of Education, 49*, 99–120.

Hendrie, H. C., Gao, S. J., Hall, K. S., & Hui, S. L. (1996). The relationship between alcohol consumption, cognitive performance, and daily functioning in an urban sample older Black Americans. *Journal of the American Geriatrics Society, 44*, 1158–1165.

Hofer, S. M., Christensen, H., MacKinnon, A. J., Korten, A. E., Jorm, A. F., Henderson, A. S, et al. (2002). Change in cognitive functioning associated with ApoE genotype in a community sample of older adults. *Psychology and Aging, 17*, 194–208.

Hofman, A., Ott, A., Breteler, M., Bots, M. L., Slooter, A., van Harskamp, F., et al. (1997). Atherosclerosis, Apolipoprotein E, and prevalence of dementia and Alzheimer's disease in the Rotterdam Study. *The Lancet, 349*, 151–154.

Horn, J. L., & Cattell, R. B. (1967). Age differences in fluid and crystallized intelligence. *Acta Psychologica, 26*, 107–129.

Jensen, E., Dehlin, O., Erfirth, E. M., Hagberg, B., Samuelson, G., Svenson, T., et al. (1998). Plasma homocysteine in 80-year olds: Relationship to medical, psychological and social variables. *Archives of Gerontology and Geriatrics, 26*, 215–226.

Katzman, R. (1993). Education and the prevalence of dementia and Alzheimer's disease. *Neurology, 43*, 13 20.

Knopman, D. S., Boland, L. L., Folsom, A. R, Mosley, T. H., McGovern, P. G., Howard, G., et al. (2000). Cardiovascular risk factors and longitudinal cognitive changes in middle age adults. *Neurology, 54* (Suppl. 3).

Li, S.-C. (2003). Biocultural orchestration of developmental plasticity across levels: The interplay of biology and culture in shaping the mind and behavior across the life span. *Psychological Bulletin, 129*, 171–194.

Li, S.-C., & Freund, A. M. (2005). Advances in life span psychology: A focus on biocultural and personal influences. *Research in Human Development, 2,* 1–23.

Lim, A., Tsuang, D. Kukull, W., Nochlin, D., Leverenz, J., McCormick, W., et al. (1999). Clinico-neuropathological correlation of Alzheimer's disease in a community-based case series. *Journal of the American Geriatric Society, 47,* 564–569.

Lyketsos, C. G., Chen, L. S., & Anthony, J. C. (1999). Cognitive decline in adulthood: An 11.5-year follow-up of the Baltimore Epidemiologic Catchment Area Study. *American Journal of Psychiatry, 156,* 58–65.

Markus, H. R., Ryff, C. D., Curham, K. B., & Palmersheim, K. A. (2004). In their own words: Well-being in midlife among high school-educated and college educated adults. In O. G. Brim, C. D. Ryff, & R. C. Kessler (Eds.), *How healthy are we? A national study of well-being in midlife* (pp. 273–319). Chicago: University of Chicago Press.

McGeer, P. L., & McGeer, E. G. (2001). Inflammation, autotoxicity and Alzheimer disease. *Neurobiology of Aging, 22,* 799–809.

Muldoon, M. F., Ryan, R. C., Matthew, K. A., & Manuck, S. B. (1997). Serum cholesterol and intellectual performance. *Psychosomatic Medicine, 19,* 382–387.

Nehler, L. M., & Porter, J. M. (1997). Homocystinemia as a risk factor for atherosclerosis: a review. *Cardiovascular Surgery, 5,* 559–567.

Perry, I. J., Refsum, H., Morris, R. W., Ebrahim, S. B., Ueland, P. M., & Shaper, A. G. (1995). Prospective study of serum total homocysteine concentration and risk of stroke in middle-aged British men. *The Lancet, 346,* 1395–1398.

Riley, K. P, Snowdon, D. A., Saunders, A. M., Roses, A. D., Mortimer, J. A., & Nanayakkara, N. (2000). Cognitive function and Apolipoprotein E in very old adults: Findings from the Nun Study. *Journals of Gerontology: Social Sciences, 55B,* S69–S75.

Rincon, I. D., Stern, M. P., Freeman, G. L., O'Leary, D. H., & Escalante, A. (2003). Association between carotid atherosclerosis and markers of inflammation in rheumatoid arthritis patients and healthy subjects. *Arthritis & Rheumatism, 48,* 1833–1840.

Salthouse, T. A. (1990). Cognitive competence and expertise in aging. In J. E., Birren & K. W., Schaie (Eds.), *Handbook of the psychology of aging* (3rd Ed., pp. 310–319). San Diego: Academic Press.

Sarkisian, C. A., Liu, H., Gutierrez, P. R., Seeley, D. G., Cummings, S. R., & Mangione, C. M. (2000). Modifiable risk factors predict functional decline among older women: A prospectively validated clinical prediction tool. The study of osteoporotic fractures research group. *Journal of the American Geriatric Society, 4,* 170–178.

Scarmeas, N., Levy, G., Tang, M. X., Manly, J., & Stern, Y. (2001). Influence of leisure activity on the incidence of Alzheimer's disease. *Neurology, 57,* 2236–2242.

Schaie, K. W. (2005). *Developmental influences on adult intelligence: The Seattle Longitudinal Study.* New York: Oxford University Press.

Schaie, K. W., Willis, S. L., & Pennak, S. (2005). A historical framework for cohort differences in intelligence. *Research in Human Development*, 2, 43–67.

Schooler, C. (1998). Environmental complexity and the Flynn effect. In U. Neisser (Ed.), *The rising curve: Long term gains in IQ and related measures* (pp. 67–79). Washington, DC: American Psychological Association.

Schooler, C., Mulatu, M. S., & Oates, G. (2004). Occupational self-direction, intellectual functioning, and self directed orientation in older workers: Findings and implications for individuals and societies. *American Journal of Sociology, 110,* 161–197.

Selhub, J., Jaques, P. F., Bostom, A. G., D'Agostino, R. B., Wilson, P. W. F., Belanger, A. J, et al. (1995). Association between plasma homocysteine concentrations and extracranial carotid-artery stenosis. *The New England Journal of Medicine, 332,* 286–291.

Swan, G. E., Carmelli, D., & LaRue, A. (1996). Relationship between blood pressure during middle age and cognitive impairment in old age: The Western Collaborative Group Study. *Aging, Neuropsychology and Cognition, 3,* 241–250.

Taafe, D. R., Harris, T. B., Ferurucci, L., Rowe, J., & Seeman, T. E. (2000). Cross-sectional and prospective relationships of interleukin-6 and C-reactive protein with physical performance in elderly persons: MacArthur studies of successful aging. *Journals of Gerontology: Biological and Medical Sciences, 55A,* M709–M715.

Tomasello, M. (1999). *The cultural origins of human cognition.* Cambridge, MA: Harvard University Press.

Verghese, J., Lipton, R. B., Katz, M., Hall, C. B., Derby, C. A., Kuslansky, G., et al. (2003). Leisure activities and the risk of dementia in the elderly. *New England Journal of Medicine, 348,* 2508–2516.

Waldstein, S. R., & Elias, M. F. (2001). *Neuropsychology of cardiovascular disease.* Mahwa, NJ: Erlbaum.

Warden, B. A., & Thompson, E. (1994). Apolipoprotein E and the development of atherosclerosis. *Laboratory Medicine, 25,* 449–455.

Wilson, P., Myers, R. H., Larson, M. G., Ordovas, J. M, Wolf, P. A., & Schaefer, E. J. (1994). Apolipoprotein E alleles, dyslipidemia, and coronary heart disease: The Framingham Offspring Study. *Journal of the American Medical Association, 272,* 1666–1671.

Wilson, P. W. F., D'Agostino, R. B., Levy, D., Belanger, A. M, Silbershatz, W., & Kannel, W. B. (1998). Prediction of coronary heart disease using risk factor categories. *Circulation,* 97,1837–1847.

Wilson, J. A., & Gove, W, R. (1999). The intercohort decline in verbal ability: Does it exist? *American Sociological Review, 64,* 253–266.

Yaffe, K., Cauley, J., Sands, L., & Browner, W. (1997). Apolipoprotein E phenotype and cognitive decline in a prospective study of elderly community women, *Archives of Neurology, 54,* 1110–1114.