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CHAPTER NINE

Cognitive Functioning in the Baby Boomers: Longitudinal and Cohort Effects

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SIGNIFICANCE OF COGNITIVE FUNCTIONING IN BABY BOOMER COHORTS

Middle age is a particularly important developmental period currently in our society given that the baby-boomer cohorts (b1946–1964), the largest birth cohort in U.S. history, are now in midlife. The boomer cohorts represent approximately one third of the total U.S. population, approximately 76 million people (U.S. Bureau of Census, 2002). Baby-boomer families account for approximately 48% of U.S. families (MetLife Mature Market Institute, 2003). A portion of these cohorts will be in middle age through the first quarter of this century (2024). The leading edge baby-boomer cohorts (1946–1955) will enter old age in 2011.

Recent policy debates have focused on whether Social Security and health coverage programs such as Medicare will remain viable when the Baby Boomers reach retirement ages (Kotlikoff & Burns, 2004). The age at which full Social Security benefits are paid has been raised and further increases in age eligibility are being discussed (Crystal & Shea, 2002). For example, raising the retirement age by three years would reduce benefit costs and increase taxes paid by workers such that concern regarding looming deficits in Social Security would be erased over the next 75 years. Such a fix depends in part on the assumption that the next generation is able to work to later ages than prior cohorts due to the slowing of the rate of aging, including cognitive aging (Schaie, 2005).

As these huge baby-boomer cohorts reach old age, it will be critical from both an individual and societal perspective for this generation to maintain an independent lifestyle. Maintenance of mental competence and prevention or delay of cognitive deficits are critical to independent functioning. The prevalence of dementias, such as Alzheimer's disease (AD) vary by age group, but increase with age, and the percentage of persons affected by AD doubles every decade beyond age 65 (Arking, 1998). Thus understanding the early antecedents in midlife of cognitive decline and dementia has important public health implications. Public health data indicate that if the onset of AD, for example, could be delayed in the population by 5 years, the prevalence of the disease would decline by one half (Brookmeyer, Gray, & Kawas, 1998).

The focus of this chapter is on cognitive functioning in midlife of the boomer cohorts. In the first part of the chapter, we briefly review prior research on cognition in midlife, noting the limitations in research, including the emphasis on normative or average levels of functioning with little attention to individual differences in developmental trajectories in middle age. We also briefly review the debate in the literature on cohort differences in human intelligence over the past thirty years, with special consideration of the *Flynn effect* (Flynn, 1984, 1987, 1999). Flynn and colleagues have argued that "massive IQ" gains on the order of 5 to 25 points have occurred in the post World War II cohorts—which in the U.S. represents the Boomers. Although data from 14 nations have been cited in support of this position, the U.S. data focus on the 1950s cohorts. In the second part of the chapter we present data from the Seattle Longitudinal Study (SLS; Schaie, 2005; Willis & Schaie, 2005) regarding both cohort differences and longitudinal developmental trajectories for the boomer cohorts. In the third part of the chapter, we review literature on possible factors associated with longitudinal change and cohort differences in cognitive functioning in the boomer cohorts. Particular attention is given to historical events impacting the boomer cohorts directly or indirectly through their parents' generation. We present a model adapted from Bronfenbrenner (1986; Bronfenbrenner & Crouter, 1983) for the study of domains of influence on cognitive functioning, illustrated by findings relevant to the boomer cohorts.

PRIOR RESEARCH ON MIDLIFE COGNITION AND ON BOOMERS IN YOUNG ADULTHOOD

Limitations of Prior Midlife Cognitive Research

It is ironic that currently there may be a greater variety of theories or conceptual models of midlife development (Staudinger & Bluck, 2001; Moen & Wethington, 1999; Whitbourne & Connolly, 1999; Rosenberg, Rosenberg, & Farrell, 1999) than there are longitudinal data sets against which to evaluate such theories. The paucity of literature on midlife cognition, for example, was

illustrated by a literature search for studies of memory in middle age, conducted by Dixon and colleagues (Dixon, de Frias, & Maitland, 2001) for the first handbook on midlife development (Lachman, 2001). The authors reported that an average of 5 articles containing midlife participants were published annually during the past 20 years. However, virtually none of these studies was focused primarily on midlife, but were identified because they included a middle age group. Moreover, the vast majority of studies were cross-sectional in design (Bachman & Nilsson, 1985). The authors concluded that there is little evidence of programmatic research on memory in midlife with different authors employing alternative sets of tasks as well as utilizing diverse definitions of middle age.

The paucity of longitudinal data specifically targeting middle age is due in part to limitations in the design of many past aging studies (Dixon et al., 2001). The traditional extreme age group comparative design (young adults compared with old adults) of many cognitive aging studies in the past few decades (A. D. Smith & Earles, 1996) has resulted in serious design limitations for building a life-span perspective of adult cognitive development. Comparison of only two age groups implies the assumption of a linear trajectory of change, with performance in midlife assumed to fall midway between young adulthood and old age. Given only two data points, nonlinear forms of developmental trajectories could not be tested. Moreover, the assumption that the extreme groups differed primarily as a function of age was problematic, since the old and young also differed on other variables related to cognition, such as in health, job status, sensory deficits, and educational attainment.

More recent studies (Craik & Jennings, 1992) have involved research designs that included a group in middle age. However, often the age range for the midlife group has been considerably larger than the age ranges for the young or older groups, since later adulthood is now segmented into young-old, old-old, and very old age. Moreover, cohort comparisons of midlife adults when at the same chronological age may be particularly important. A number of life-span developmentalists (Baltes, 1987; Schaie, 1984; Staudinger & Bluck, 2001) have proposed that midlife is the period most heavily impacted by sociocultural events, rather than biological events, given that puberty is past and the biological decline of old age is only at an early stage.

Focus on Cognitive Stability and Normative Performance in Midlife

Trait theories such as those concerned with personality (Costa & McCrae, 1980, 1993; McCrae & Costa, 1984) or intelligence (Schaie, 1996, 2005) have depicted midlife as a period of considerable stability with relatively little intra-individual change occurring, at least when studied at the aggregate level (see also Martin & Zimprich, 2005).

Ability performance has been reported in longitudinal studies of psychometric intelligence as representing a flat plateau with little change in slope in midlife. These findings have been interpreted to indicate that there is considerable intra-individual stability in the middle years (Dixon, de Frias, & Maitland, 2001; Schaie, 1984, 1996; Willis & Schaie, 1999). With the exception of perceptual speed which exhibits early age-related decline, longitudinal studies have reported that normative decline on most abilities does not occur until the mid-sixties, which is considered young-old age and beyond midlife. The study of stability in personality or ability traits has focused primarily on possible change in the level of functioning with less examination or concern regarding slope.

Recently, however, there has been increasing interest in studying individual differences in both level and slope. An aggregate or mean level approach to study of cognition is likely to mask the subgroups of individuals that exhibit either positive or negative slope trajectories in midlife. In this chapter we utilize data from the Seattle Longitudinal Study to explore individual differences in trajectories of cognitive change during midlife and discuss possible factors associated with variability in change trajectories.

The Debate on Cohort Gains in Post World War II Cohorts in Early Life

There has been extensive debate on cohort differences in human intelligence over the past century and the interpretation of these differences, in both psychological and sociological literatures. While negative changes in cohort functioning have been supported by evidence on SAT declines and reports of negative cohort differences in verbal ability performance (Alwin, 1991; Glenn, 1994), the majority of evidence has focused on positive cohort changes (Flynn, 1984; Wilson & Gove, 1999). An extensive literature largely stimulated by the analyses of Flynn (1984, 1987, 1999; Dickens & Flynn, 2001) has argued that massive IQ gains on the order of 5 to 25 points have occurred in a single generation. Data from fourteen nations have been cited in support of this position (Flynn, 1987).

These assertions, however, have been based almost exclusively on differences found between two particular cohorts differing approximately thirty years in age—the massive cohort gains are reported for the post World War II cohort with most data cited for those born in the 1950s. From a U.S. perspective, it is immediately evident that these cohorts represent the Baby Boomers and their parent generation, sometime referred to as the Depression cohorts. Although data from a number of developed countries including Japan are cited, the data are largely limited to these two U.S. birth cohorts.

Flynn and colleagues have reported that the largest cohort differences in intellectual functioning have been found for what are commonly known as fluid abilities. Less or no cohort gains have been found for acculturated skills acquired through schooling and commonly known as crystallized intelligence.

The positive cohort trends reported by Flynn and colleagues are in contrast to reports of decline in scholastic aptitude test (SAT) scores. A number of explanations for declining SAT scores have been suggested, including a marked increase in the proportion of students taking the SAT (Hanford, 1991) and increases in social diversity and perturbations. In support of the SAT data, Alwin (1991) reported a decline in education-adjusted verbal test performance from the General Social Surveys that "confirms systematic declines in verbal test scores in cohorts born in the post World War II era, but reveals a trend beginning much earlier" (p. 635). Glenn (1994) further supported the negative cohort trends for verbal ability. Although negative changes in cohort functioning have been supported by evidence on SAT declines and reports of negative cohort differences in verbal ability performance (Alwin, 1991; Glenn, 1994), the majority of evidence has focused on positive cohort changes (Flynn, 1987; Wilson & Gove, 1999).

From a life-span perspective, the question arises as to whether these findings of "massive IQ gains" represent a phenomenon unique to a specific historical period and to the post World War II boomer cohorts or whether they are indicative of a long-term societal or evolutionary change. The data reported by Flynn and others are insufficient to address this question given the limited range of cohorts examined. In addition, the data reported are limited in that each cohort was studied at only a limited chronological period, typically in adolescence or young adulthood; it is unclear from the data cited by Flynn at what age or developmental period these cohort differences arose or whether these cohort differences persisted into middle and later adulthood.

At the same time the Flynn effect findings are of particular interest in studying cognition in the boomer cohorts. Consideration of the historical and cultural factors that may be associated with such cohort gains across successive generations is needed. From a life-span perspective, it is important to consider how these advantaged cohorts are functioning at later stages in the life course, such as midlife, compared to prior cohorts. There has been an ongoing debate in research on cognitive aging about whether individuals functioning at higher levels suffer less decline or whether cognitive decline occurs later in life.

COHORT AND LONGITUDINAL EFFECTS IN THE BABY BOOMERS AT MIDLIFE: FINDINGS FROM THE SEATTLE LONGITUDINAL STUDY (SLS)

In this section we present data from the Seattle Longitudinal Study on the baby-boomer cohorts. We first consider cohort trends for the Boomers. We examine cohort differences between the Boomers and earlier cohorts born in

the twentieth century. In addition, we consider the magnitude of cohort differences within the Boomer cohorts (1946–1964), which spans a twenty-year period. Second, we consider longitudinal or intraindividual change in boomer cohorts in midlife. Individual differences in developmental trajectories are shown, suggesting that although for most Boomers in midlife there is cognitive stability, there are subgroups of Boomers experiencing decline or growth in cognitive performance in middle age.

Cohort Differences in Level of Performance: Boomers Versus Prior Cohorts

Because of the sequential design of data collections in the Seattle Longitudinal Study (SLS), we have repeatedly recruited samples randomly drawn from successive birth cohorts and we test them at comparable ages (Schaie, 1996, 2005). Hence, it has been possible to compute cohort differences in performance level of successive cohorts averaged over several ages and thus to determine cumulative cohort trends for various mental abilities. In this section, we will summarize our findings on cohort differences in intelligence.

It is possible from data such as ours to estimate cohort differences in level of performance between any two cohorts by comparing the performance of successive cohorts over the age ranges for which both cohorts have been observed. The cohort effects estimated in this manner will, of course, be confounded with period effects, but if series of cohort differences are computed across the same time period, each estimate will be equally affected. In our case it is possible to generate twelve cohort differences for thirteen 7-year birth cohorts with mean birth years from 1889 to 1973. To obtain the most stable estimates available, the average level difference between any two cohorts is defined as the average of unweighted mean differences at all ages where observations are available for these two cohorts.

Partial Support for "Flynn Effect" Within SLS Data. The resulting findings are charted in Fig. 9.1. The vertical bars indicate the boomer cohorts (1946–1964) in the SLS. The post World War II cohorts relevant to Flynn effect data are the SLS birth cohorts 1945 and 1952 (Flynn, 1987). The earlier cohorts to whom the post World War II cohorts are compared would include the SLS birth cohorts of 1931 and 1938.

With respect to the purest measures of both fluid and crystallized intelligence, the trends in the SLS data broadly support the Flynn effect. There is an increase on the order of approximately one half a standard deviation (5.0 T-Score points) for fluid intelligence as measured by inductive reasoning from birth cohort 1931 to birth cohort 1952. Indeed inductive reasoning shows the strongest positive linear trend of any ability examined within the SLS study for

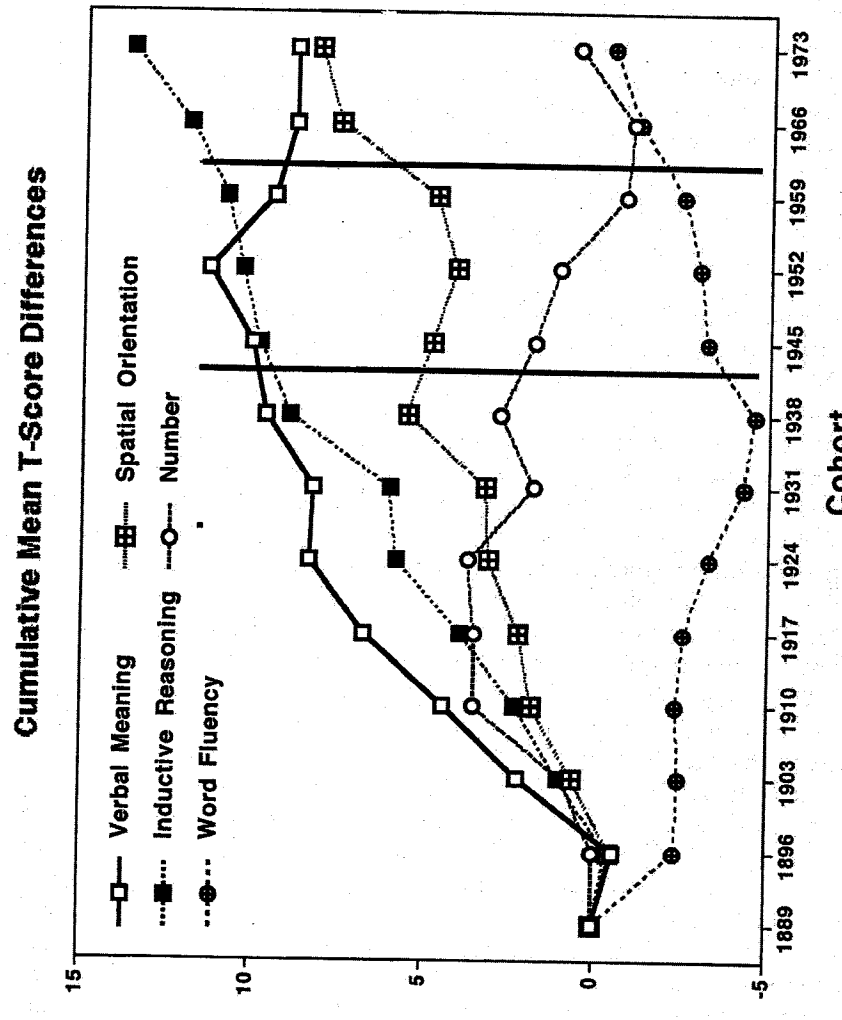

FIG. 9.1. Cumulative cohort differences for the primary mental abilities in the Seattle Longitudinal Study (from Schaie, 2005). Vertical lines indicate baby-boom cohorts.

these cohorts. The positive cohort trend for inductive reasoning continues in postboomer cohorts born in the 1970s, although the magnitude of cohort differences is reduced. In contrast, cohort differences over the same cohorts are more modest for the two crystallized abilities of verbal and number ability; magnitude of cohort differences between the 1931 and 1952 cohorts is 2.9 T-Score points for verbal. There is a significant negative cohort trend from the 1931 to 1959 cohorts for number ability of approximately 2.6 T-score points. For the fluid ability of spatial orientation, the cohort difference between the 1931 and 1952 cohorts is minimal although there is some evidence of increasing cohort differences between the 1931 cohort and cohorts born in the 1960s and 1970s. Thus, positive linear cohort trends from the 1931 to 1952 cohorts are only shown for inductive reasoning and verbal ability with a negative cohort trend for verbal ability in cohorts subsequent to 1952.

The Flynn Effect Compared With Earlier Cohort Gain. Flynn (1987) describes the differences between the 1930 and 1950 cohorts as representing massive cohort gains. However, when five distinct cognitive abilities are examined across thirteen rather than four cohorts, a much more complex picture of cohort differences is evident (Fig. 9.1). In contrast to the conclusions that would be drawn from data cited for the Flynn effect these SLS data indicate that there are systematic and substantial positive advances in cohort level for both crystallized ability (verbal meaning) and for fluid abilities (spatial orientation and inductive reasoning). Indeed, the cohort differences (1910–1931) for verbal ability over a comparable 21-year period are of almost equivalent magnitude to that for inductive reasoning. Moreover, although considerable attention has been given to the "massive IQ gains" for the post World War II 1950 cohorts, the SLS data suggest that the magnitude of cohort gains (at least for verbal and inductive reasoning) were greater for the cohorts born in the early 1900s than for the cohorts cited in the Flynn effect.

On the other hand, quite different patterns of cohort differences are observed for number and word fluency. Number ability shows positive cohort differences up to about the 1910 cohort. But then there is first a plateau and then a negative shift to a successive lowering of performance level. The 1924 cohort exceeds both earlier- and later-born cohorts on number ability; the boomer cohorts are therefore currently at a disadvantage in number ability when compared with the earlier cohorts. The 1950 cohorts (1952, 1959) are functioning one third to one half standard deviation below the 1924 cohort on number ability. Word fluency, by contrast, shows a concave pattern. A negative cohort trend prevails until the 1938 cohort, but improvement occurs for subsequent cohorts. For this ability, then, earlier cohorts have a slight advantage over the later-born ones; but beginning with the cohort born in 1945 there are successive positive cohort differences for this ability also.

Longitudinal Change in Midlife: Variability in Developmental Trajectories

In our prior research on midlife cognition within the SLS, we have focused on normative change in ability performance in middle age (Schaie, 2005; Willis, 1987, 1989; Willis & Schaie, 1999). That is, we have presented average estimates of cognitive change for all SLS participants studied over a given age range.

Figure 9.2 presents the typical finding of stability in cognitive performance in midlife (age 39 to 60 years) when data are aggregated across all SLS participants studied longitudinally over this age range. Performance is shown for six abilities: verbal meaning, spatial orientation, inductive reasoning, number, word fluency, delayed recall (Schaie, 1996, 2005). For these six mental abilities, the magnitude of change across the 14-year period is less than 0.2 standard deviation (SD) units. No statistically reliable age-related change is shown for any ability. Cognitive functioning at the aggregate level thus supports the position of life-span developmental theory that since both gains and loss occur in

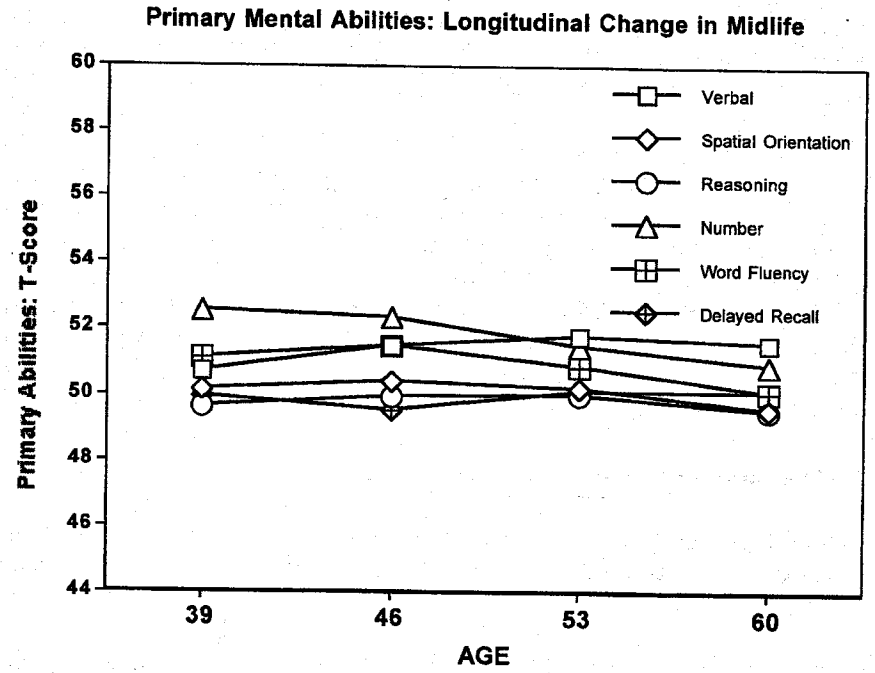

FIG. 9.2. Mean-level longitudinal change in midlife on primary mental abilities in the Seattle Longitudinal Study: all SLS cohorts with midlife data.

midlife, the relative balance of gains and losses in middle age may create the illusion of stability.

Different Trajectories of Cognitive Change in Midlife

Life-span developmental theories, however, also maintain that there are individual differences in the experience of middle age (Martin & Zimprich, 2005; Schaie, 1989a, 1989b; Willis & Schaie, 2005). Individuals vary in the relative amount of gains and losses experienced in midlife. Variability in patterns of gains and losses becomes evident when subgroups of individuals varying in cognitive change trajectories are studied, rather than focusing on the mean or aggregate level (Schaie & Willis, 1993).

In this section we present new findings from the SLS, examining different patterns or trajectories of cognitive change across midlife for the Baby Boomer birth cohorts (1942–1948). We focus on three cognitive abilities studied in the SLS: number ability, memory recall, and word fluency (Thurstone & Thurstone, 1949). As shown in Fig. 9.2, all three abilities exhibit patterns of stability in midlife when examined at the aggregate or mean level. These abilities represent distinct domains of cognition. Number ability represents the crystallized intelligence domain, which in cross-sectional studies appears to be maintained into old age because of negative cohort differences, but which in longitudinal studies shows decline beginning in early old age (Schaie, 2005). Episodic memory, as represented by list learning recall (immediate and delayed) is one of the most widely studied abilities in cognitive aging (Hultsch, Hertzog, Dixon, & Small, 1998), showing age-related decline in the sixties; changes in this ability are most commonly associated with early stages of cognitive impairment and dementia (Albert & Killiany, 2001; Petersen, 2003). Word fluency is a measure of executive functioning representing higher order cognitive skills required for executing complex tasks of daily living (Lezak, 1995). In the SLS we have found midlife performance on both memory recall and word fluency to be predictive of neuropsychologists' ratings of cognitive impairment in old age (Willis & Schaie, 2005).

Development of Cognitive Change Trajectories

Midlife change in these abilities was studied over a 14-year interval, involving two 7-year intervals and three data points (ages 39, 46, 53). Ability change was examined at the individual level. Defining cognitive change trajectories required consideration of: level of performance at baseline (age 39, intercept) and rate of change over the 14-year period (slope). For each of the three abilities, participants were classified as having reliably declined (decliners), improved (gainers), or remained stable (stable) over the 14-year interval. The statistical criterion for the definition of individual decline or gain was one

standard error of measurement or greater over the 14-year period. Subjects were classified by defining a one standard error of measurement confidence interval about their baseline score (age 39; Dudek, 1979; Schaie & Willis, 1986; Willis & Schaie, 1986). If their score at age 53 fell below or above this interval, they were classified as having declined or gained, respectively. Standard errors of measurement (T-score units) for the three abilities were: number = 6; memory recall = 6; word fluency = 6. The proportions of participants classified as stable for number, memory recall, and word fluency were: 81%, 71%, 68%, respectively. The proportions classified as having declined or gained were: decline: 13%, 17%, 16%; gain: 6%, 12%, 16%, respectively. Thus, although Fig. 9.2 presents a normative pattern of stability across midlife, the above procedure indicates that 13 to 17% of individuals have declined on at least one of the three abilities from age 39 to age 53. Word fluency was the ability exhibiting the greatest proportion of individuals showing either decline (16%) or gain (16%).

Memory Ability: Cognitive Change Trajectories

Figure 9.3 presents age-related change for the memory recall ability for the three groups. At age 39, the group of decliners did not differ in performance level from the stable group but did differ from the performance of gainers; the stables

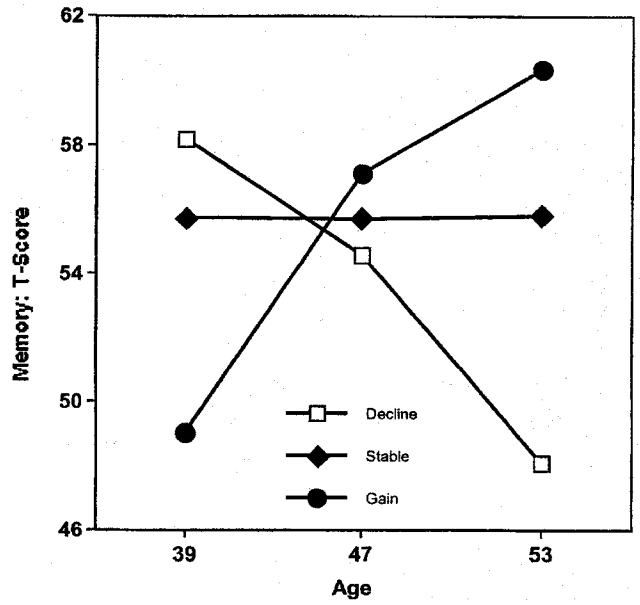

FIG. 9.3. Longitudinal change in memory recall in midlife: decline, stable, and gain subgroups.

also differed from the gainers. By age 46, the three groups did not differ significantly in level of performance. By age 53, the decline group exhibited 1 SD of change over the 14-year period, while the gain group showed 1.1 SD of gain.

Word Fluency: Cognitive Change Trajectories

Figure 9.4 presents age-related change for the word fluency ability for the three groups. The decline group differed from both the stable and gain group at age 39. The three groups did not differ in performance level at age 46. By age 53, the decline group had dropped over the 14-year period by over 1 SD unit, while the gain group had increased by 1 SD unit.

Number Ability: Cognitive Change Trajectories

Figure 9.5 presents age-related change in number ability for individuals classified as having remained stable, declined, or increased over the 14-year interval. At age 39, the decline and gain groups differed significantly in level; but neither group differed from the stable group. The groups did not differ at age 46. However, by age 53 the decliners had declined 1 SD over the 14-year period and the gain group had increased by 1 SD.

In summary, these data indicate that while there is indeed considerable stability in cognitive functioning when studied at the aggregate level, there are

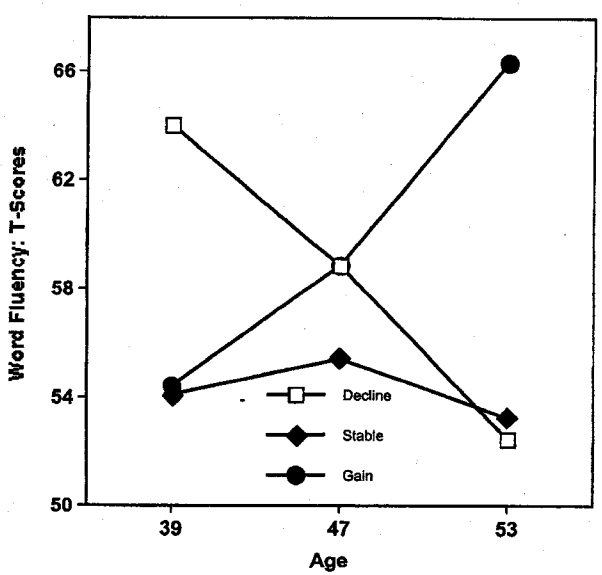

FIG. 9.4. Longitudinal change in word fluency in midlife: decline, stable, and gain subgroups.

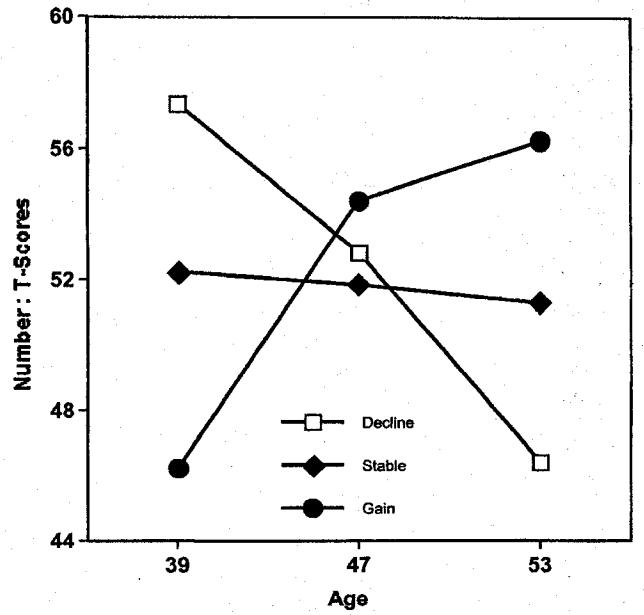

FIG. 9.5. Longitudinal change in number ability in midlife: decline, stable, and gain subgroups.

wide individual differences in patterns of cognitive change for subgroups of Boomers in midlife. For all three abilities examined, both decline and gain groups exhibited a change over the 14-year period of 1 SD or greater. These findings are limited by the fact that only the leading-edge Boomers have reached the 50s by 1998, the last wave of SLS data. Whether these patterns of individual differences in trajectories are manifest for all cohorts of Boomers must await further study as these individuals reach late middle age.

INFLUENCES ON COGNITION IN THE BABY BOOMERS: A CONCEPTUAL FRAMEWORK

From the point of view of life-span developmental psychology, we are interested in identifying those influences in the historical cultural context that might impact cohort differences, particularly for the boomer cohorts, in both the mean level and differential trajectories of mental abilities across adulthood. In Table 9.1 we propose a conceptual framework, adapted from Bronfenbrenner (1986; Bronfenbrenner & Crouter, 1983) for studying the major domains of influence that would provide possible mechanisms for cohort differences in intellectual performance. Although the Bronfenbrenner model is typically presented as a series of concentric circles, our framework is pre-

TABLE 9.1
Conceptual Framework for the Study of Development in Historical Context

Developmental Phase	*Mesosystem Contexts of the Individual*	*Exosystem Contexts of Significant Others*	*Chronosystem Single-Domain Transitions & Life Course on Cumulative Events*
Childhood	1) Family 2) Academic 3) Leisure/Social 4) Media	1) Parents 2) Extended family & friends	1) Single domain transitions, normative & non-normative 2) Life course/cumulative events (economic, political, social, etc.)
Adolescence	1) Family 2) Academic 3) Work 4) Leisure/Social 5) Media	1) Parents 2) Extended family, friends & colleagues	1) Single domain transitions, normative & non-normative 2) Life course/cumulative events (economic, political, social, etc.)
Young Adulthood	1) Family 2) Academic 3) Work 4) Leisure/Social 5) Media	1) Parents 2) Spouse or significant other 3) Extended family, friends & colleagues	1) Single domain transitions, normative & non-normative 2) Life course/cumulative events (economic, political, social, etc.)
Middle Age	1) Family 2) Academic 3) Work 4) Leisure/Social 5) Media	1) Parents 2) Spouse or significant other 3) Extended family, friends & colleagues	1) Single domain transitions, normative & non-normative 2) Life course/cumulative events (economic, political, social, etc.)
Young-Old Age	1) Family 2) Academic 3) Work 4) Leisure/Social 5) Media	1) Parents 2) Spouse or significant other 3) Extended family, friends & colleagues	1) Single domain transitions, normative & non-normative 2) Life course/cumulative events (economic, political, social, etc.)
Old-Old Age	1) Family 2) Academic 3) Work 4) Leisure/Social 5) Media	1) Spouse or significant other 2) Extended family, friends & colleagues	1) Single domain transitions, normative & non-normative 2) Life course/cumulative events (economic, political, social, etc.)

sented as a matrix (Schaie, Willis, & Pennak, 2005). This conceptual structure is necessary to make explicit multiple systems of influence at different developmental phases (childhood, adolescence, young adulthood, middle age, and old age) across the life span.

Three Environmental Systems

The framework (Table 9.1) includes three systems of influence at each developmental phase: Mesosystem, Exosystem, and Chronosystem. In the Bronfenbrenner model, after the family, the nearest and most direct environmental

system, the Mesosystem, is given first and primary consideration among the extrafamilial systems. However, given our primary concern with the impact of broad sociocultural events on cohort differences, equal or greater consideration is given to the Exosystem and the Chronosystem.

Mesosystem. The Mesosystem involves the principal contexts or environments in which individual development takes place. Given the focus on childhood, the family is considered the primary context of development in the Bronfenbrenner model. However, in our framework with a focus on adult development, we include the family as one of the facets of the environments within the mesosystem. Other environments experienced directly by the individual include work, leisure/social context, and more recently media or technology-based contexts. The relative impact of these various environments is expected to vary across the life course and to interact with the personal characteristics of the individual (Schaie & Achenbaum, 1993).

Exosystem. The Exosystem deals with environments that are not directly experienced by the target individual (i.e., external to the individual), but that represent important environments for significant others.

As the Kahn and Antonucci (1980) model of convoys of social support would suggest, the significant others in the individual's life would be expected to change across the life course, progressing from parents, to spouses and extended family, friends, and work colleagues. The external environments in the exosystem that impact individual development would thus vary across the life course as the significant others change. In the child literature, the parents' work environment has been shown to impact childrearing practices (Kohn & Schooler, 1983), occupational aspirations of the adolescent (Mortimer & Kumka, 1982), and curricular activities (Morgan, Alwin, & Griffin, 1979).

In the Bronfenbrenner model, the exosystem appears to focus primarily on the concurrent environments of significant others (e.g., parent's work environment) that may impact the developing individual. However, in our framework, we will also include transitions occurring across the adult lives of significant others that may influence the individual. For example, the father's educational or occupational experiences as a young adult that occur in a particular historical period have been studied as influences on subsequent intellectual functioning of the offspring (Hauser & Featherman, 1976).

Chronosystem. The Chronosystem is concerned with the changes and continuities over time in environments that impact the individual's development. Two dimensions of the chronosystem are considered. First, the simplest form of chronosystem focuses on domain-specific life transitions. Two types of transitions have been distinguished in the psychological and sociological literatures (Baltes, 1979; Riley, Johnson, & Foner, 1972): normative (school

entry, puberty, work entry, marriage, child bearing, retirement) and nonnormative (off-time death or severe illness, winning the lottery). These transitions are usually specific to a particular life domain (e.g., marriage, work) although there may be spillover to other domains. Also. these transitions are usually defined by a circumscribed relatively brief time period during which they occur.

In contrast, a second dimension of the chronosystem deals with cumulative effects of an entire sequence of transitions or events occurring over a more extended time period in the individual's life (e.g., war, depression, technological advances). The impact of such historical or sociocultural life course events on individual development have been an important focus of the work of social psychologists such as Elder (1974), Stewart (2003), and to some extent Helson and Moane (1987). However, the developmental outcomes of interest in the prior work have primarily been factors such as well-being, and stability and success in work and marriage, rather than intellectual performance. Of critical importance is the expectation that the relative impact of these long-term historical or sociocultural events will vary depending on the developmental phase of the individual. Thus, the same historical event may result in very different outcomes for different cohorts experiencing the event at different developmental phases. For example, leading-edge Boomers experienced events such as the Vietnam War and Watergate as young adults, but experienced the 9/11 event in middle age.

It is assumed that long-term cumulative events primarily impact individual development indirectly as mediated by environmental factors in the mesosystem and exosystem and interact with the personal characteristics (e.g., personality, attitudes, life styles) of the individual who is a member of the cohort under investigation.

Influences on Cognition in Boomer Cohorts: Mesosystem, Exosystem, Chronosystem

Clearly, there is a wide range of contexts that impact intellectual functioning and possible cohort differences in intellectual performance. In a recent review of factors associated with cognitive change in 34 longitudinal studies, Anstey and Christensen (2000) concluded that education, hypertension, objective health status, cardiovascular disease and APO-E gene are the factors consistently related to cognitive change across adulthood. Although risk factors (e.g., disease, biomarkers) for cognitive decline have received far greater attention, there is growing recognition of the role of protective factors in cognitive maintenance and plasticity (Kramer & Willis, 2003). Protective factors are important not only as suggesting mechanisms for preventive interventions, but also are of interest due to the dramatic increase in the level of protective factors such as education and occupational status that have been experienced by recent cohorts such as the Baby Boomers, compared to earlier-born cohorts. In this section, we will focus on factors, such as education, occupation, and technology that are said to play a protective or enhancing role in development and maintenance of intelligence across adulthood.

Mesosystem: Educational and Occupational Influences

Education. Education has been shown to be the most consistent nonbiological correlate of both cognitive level and rate of change (Anstey & Christensen, 2000; Katzman, 1993). Educational level is associated with cognitive change not only in old age, but throughout adulthood (Farmer, Kittner, Rae, Barko, & Regier, 1995; Lyketsos, Chen, & Anthony, 1999). Education most often predicts change in crystallized abilities, memory and mental status, and is less consistently predictive of change in fluid abilities and speed. In the MacArthur study of successful aging, education was the best predictor of change in cognition (Albert et al., 1995). The effects of education on cognitive change remain when controlling for factors such as age, gender, race, and health.

Several explanations for the effect of education on cognitive change have been proposed (Albert et al., 1995; Katzman, 1993). One explanation maintains that education may serve as a proxy for factors such as health behavior, socioeconomic status, occupational hazards, or nutrition that affect cognitive change and covary with education. Alternatively, education may produce direct effects on brain structure, through an increase in number of synapses or vascularization (Greenough, Larson, & Withers, 1985).

It has also been hypothesized that education does not alter vulnerability to disease but rather delays the appearance of clinical symptoms by postponing the point at which a sufficient number of abnormalities have accumulated. Moreover, education's impact on brain structure may continue throughout life by instilling lifelong habits of mental stimulation that produce neurochemical or structural alternations in the brain that are themselves protective. Thus, although formal education is acquired early in life, the effects of education on brain function would be mediated by habits that are maintained throughout life.

A third proposition is that education may protect and preserve learning acquired through schooling, but does not affect the rate of biological decline. Greater expertise in crystallized knowledge would compensate for or disguise the rate of biological aging in the well educated. Since crystallized intelligence increases through most of adulthood and declines only in late life, the positive effects of education would be expected to increase progressively into midlife and old age (Christensen et al., 1997).

Some investigators have argued that the most parsimonious explanation for cohort differences in intelligence might be found in profound changes in educational processes and structures that have occurred over the past century (e.g., Alwin & McCammon, 2001). Hauser and Featherman (1976) report a total increase in the average length of schooling of about 4 years from birth years 1897 to 1951 based on 1973 OCG Survey data; they note that a gain of 4 years is likely an underestimate since the youngest cohort (birth cohort 1951) had probably not completed their education in 1973. Intergenerational differences between successive generations, approximately 20 to 30 years apart, range from 2 to 4 years. Hauser and Featherman (1976) note that intergenerational differences in schooling peaked among men born shortly after World War I (parents of the Boomers) and a deceleration has occurred across more recent cohorts.

The proportion of 17-year-olds in the U.S. who were high school graduates was highest (greater than 75%) during the 1960s and 1970s when Boomers were in elementary and secondary education, compared to 70% in 2000. The number of individuals enrolled in a degree granting institution of higher education grew from less than 3 million in 1949 to over 8 million in 1969. As noted by Eggebeen and Sturgeon (chap. 1, this volume), level of education of boomer cohorts by middle age far exceeds prior cohorts. In 2000, over 80% of boomers had completed high school, almost 60% had some college, over 25% had a college degree and 12% had advanced degrees (U.S. Bureau of the Census, 2004). Leading edge boomers were more likely to have continued their education immediately after high school (over 50%), whereas later Boomers were more likely to have entered work immediately after high school (50–60%). The incentive of a college deferment during the Vietnam War may have contributed to college enrollment among leading-edge Boomers. Those attending college immediately after high school were more likely to attain a college degree than those working immediately after high school. There are however, significant ethnic differences in educational attainment among the Boomers with Whites more than twice as likely to have college degrees than African Americans, at least for leading-edge Boomers. There is some evidence that ethnic differences in educational attainment diminished somewhat for trailing-edge Boomers.

Although Boomers were children during a period of high optimism, expectations, and dramatic economic expansion, the sheer size of the post World War II cohorts caused them to experience crowding throughout their lives. Enrollments in elementary and secondary schools increased by 41% between 1955 and 1975 (U.S. Bureau of the Census, 1991). They attended overcrowded elementary schools and suffered stiff competition for entry into college and afterward into the labor force (Easterlin, 1987). Interestingly, when midlife Boomers were interviewed regarding their high school experiences, they reported lack of computers and technology and racial/gender discrimination as

the major problems rather than overcrowded classrooms (AARP, 2003). Light (1988) and others have suggested that the experience of long-term social crowding has fueled the Boomers' desire for individualism. Faced with crowded schools, colleges and labor markets, Boomers have been portrayed as placing high value on individual recognition and distinction.

The Boomers, particularly the early Boomers, are also unique in being the first U.S. cohort to have access to television and subsequent electronic media from childhood onward. Boomers as children and adolescence experienced via television and in real time events such as the entry into space, presidential assassinations, and the civil rights movement. They were the first generations to encounter educational programming, such as *Sesame Street*, via electronic media. The entry of personal computers during the mid-1980s (when Boomers were in young adulthood) made them the first generation to experience computers and electronic communication in the workplace throughout their careers and adult lives.

Educational attainment early in life appears to have long-term outcomes for Boomers now in middle age—at least in terms of midlife Boomers' attitudes toward the future as old age approaches (AARP, 2002). Less educated middle-age Boomers express greater concern regarding finances and physical and mental health than college graduates; they also feel less empowered, and have a less positive outlook for the near-term future. Boomers without a college degree (27%) are more likely to feel there is little they can do to change important things in their lives than those with a college degree (10%). More Boomers without a college degree use words like "boring," "anxious," "uncertain" and "stressful" to describe their feelings about the near future, as compared to Boomers with college degrees who are more likely to use the term "fulfilling" to describe their feelings.

Occupation and Retirement. Given the higher educational attainment of the Boomers, it follows that Boomers are likely to attain higher occupational status in their work lives. Over 70% of male Boomers are employed full-time in midlife, compared to approximately 50% of female Boomers; somewhat more female Boomers are employed full-time in the trailing-edge cohorts (U.S. Bureau of the Census, 1991). In 2000, approximately 30% of Boomers were in managerial or professional positions, and 30% were in technical jobs. In contrast, approximately 10% were in service, 13% in craft, and 15% in operator/labor jobs.

For the past two generations of older Americans, retirement has been characterized as the golden years—a time of leisure and financial security, an endless vacation that begins in the early sixties. Median age of retirement currently is 62 years. However, for the boomer cohorts, work life is likely to continue to a later age, and retirement may well involve full-time or part-time

employment. The sheer size of the boomer cohorts is a strain on both Social Security and Medicare; moreover, employers are less likely to provide workers with traditional fixed-benefit pensions, and instead offer plans that depend on workers' own savings, like 401(k) accounts and give no guarantees. The rethinking of retirement is driven by both necessity and by changing attitudes. Surveys by AARP (AARP, 2002, 2003b) are finding that up to 80% of Boomers plan to do some sort of paid work into their 70s. They see continued participation in the work force as a way to help them stay mentally sharp and socially engaged, as well as financially more secure. The golden years concept of retirement no longer works economically or socially. Given these societal conditions and changing attitudes, an important issue is whether the workers are cognitively competent to work past the age of 62 and whether complex work environments can foster continue cognitive competence in the workers.

Schooler and colleagues have examined the effects of environmental demand, particularly in the work context, on adult cognition and have considered whether the work environment can continue to impact cognition in late middle age (Schooler, 1990, 1998; see also DeFrias & Schaie, 2001). Recent findings are particularly relevant to midlife cognition. The reciprocal relationship between substantively complex activities (work, leisure) and cognition has been examined longitudinally over three decades. Job conditions involving self-directed, substantively complex work increase intellectual flexibility and self-direction. Recent findings indicate that the reciprocal relation between substantively complex work and cognition are even stronger for men in late midlife than was found previously in younger men (Schooler, Mulatu, & Oates, 1999, 2004). Since professional/managerial and technical positions are most likely to involve cognitively complex work, it should be expected that a greater proportion of Boomers are in challenging work environments than experienced in prior cohorts. Schooler's work does suggest that there are age/cohort differences in work complexity; older age/cohort workers were found to do less substantively complex work.

Schooler and colleagues (Schooler, 1987; Schooler, Mulatu, & Oates, 2004) suggest that if technical and economic development in a society leads to more complex environments, including intellectually demanding work conditions, such increased environmental complexity should result in higher levels of intellectual functioning. Environmental complexity is defined by stimulus and demand characteristics; the more diverse the stimuli, the greater the number of decisions required, and the greater the number of factors to be taken into account in making decisions, the more complex the environment. Cognitively demanding complex environments stimulate higher intellectual functioning, and also greater valuation of self-direction and autonomy (Schooler, 1990). A self-directed, substantively complex environment impacts cognitive functioning, not only in young adulthood, but also in midlife and old age (Attwell, 1987; Schooler et al., 2004).

ExoSystem: Educational Influences of Parent Cohort

We now turn briefly to the exosystem to illustrate its importance in understanding boomer cohort differences in intellectual functioning. We will focus on educational experiences and attainment among parents of the Boomers, as this may impact educational aspirations and achievement of the Boomers.

Fathers' Background and Educational Attainment of the Children. There have been a number of studies examining key social background variables associated with final educational attainment (cf. Alwin & Thornton, 1984). Of relevance for this article is the fact that a number of these social background variables pertain to the parent's characteristics and thus would be considered in our framework in exosystem models.

The GI Bill. In several historical periods, federal funding was provided and targeted to select groups in the U.S. Since these targeted groups often represented particular birth cohorts, the cohort differences in educational attainment can be shown to be partially due to these economic interventions in educational funding. One of the most prominent examples is the postwar rehabilitation programs for veterans, known as the GI Bills (Laub & Sampson, 2005; Nam, 1964; Sampson & Laub, 1996). The fathers of the Boomers were members of the cohorts benefiting from the GI Bill and the expansion of higher education in the U.S. following World War II. Boomers were the first generation whose parents achieved some level of post secondary education. As a consequence, parental expectations that their children achieve some form of post secondary education first became normative in the boomer cohorts.

Further educational training was provided through GI Bills for veterans of World War II, the Korean War, and the Vietnam War. Study of the effects of the GI Bills on World War II veterans is of particular interest, because a greater proportion of the U.S. male population was involved in World War II than in the Korean or Vietnam wars. Parents of the Boomers would have been particularly affected by the GI Bill associated with World War II.

The effects of the GI Bill on post-secondary education were pronounced (Nam, 1964; Sampson & Laub, 1996). Almost half of all veterans of World War II and the Korean conflict used the benefits for education and training, and 82% of those veterans who had attended college before the war made use of GI benefits to continue their education. Approximately one third of veterans whose college work was interrupted by military service finished college or went on to graduate or professional school. For veterans who had just completed high school or had barely started college, one fifth went on to get a college degree and a larger proportion took at least some college work. In comparison, only 10% of those who were working at the time of military service acquired at least an academic year of schooling after the war. Sampson and Laub (1996) report that GI Bill training as well as in service schooling en-

hanced subsequent occupational status, job stability, and economic well-being, independent of childhood differences and socioeconomic background.

Moreover, the dramatic numbers of veterans on college campuses after World War II and the Korean War significantly altered academic protocol and curriculum in higher education. In 1947 7 out of 10 men enrolled in college or universities were veterans of World War II. Similarly, in 1956 one fourth of all male college students were veterans of the Korean conflict (Nam, 1964). These veterans not only challenged prewar assumptions of who could benefit from a college education, but also challenged the very definition of what higher education should offer. Feeling as though the war had delayed their entry into adult life, veterans demanded streamlined education and wanted the curriculum to be geared to real life, in contrast to the more traditional emphasis in higher education on liberal arts and humanities. These veterans pressed academia with the view that the main duty of the university was to train individuals for adult participation in the modern world and to be the vehicle toward a secure job in a large corporation (Vinocour, 1947).

In contrast, the impact on young women of World War II, the GI Bill, and associated trends in consumerism and heightened societal expectation is mixed and continues to stir debate. The image of Rosie the Riveter is seen as legitimatizing women's role in the workforce. Moreover, during the war women's enrollment in colleges increased and in some cases daughters received the college funds that would have been allocated for their brothers. However, as veterans, partly due to the GI Bill, flooded higher education, many colleges after the war sharply curtailed the number of women allowed into college in order to accommodate the veterans. Although the absolute number of women in higher education continued to increase, their numbers in relation to men declined (Clarke, Smith, Jobst, Refsum, Sutton, & Ueland, 1998). More importantly, there was a cultural trend toward urging women to devote themselves to domestic life upon the return of their soldier husbands. As noted by Eggebeen and Sturgeon (chap. 1, this volume), 96% of women born between 1920 and 1930 married, compared to 87% of women born between 1945 and 1949. Although debates on women's choices between marriage, career and college were common themes in the 1940s and 1950s, college typically was seen as taking a backseat to marriage and family. Hence, women who were young adults in the post World War II period began to produce what is now known as the baby-boom generations.

ChronoSystem: Historical Changes in the Educational System

The changes in educational structures and processes are embedded in historical events and sociocultural transformations. Hence, we will now turn to describing the historical framework that we hope will enrich our understanding

of cohort differences in intelligence. Major shifts in performance level across cohorts are likely to lag societal transitions, such as changes in access to the educational system, and dramatic changes following major societal upheaval (cf. Schaie & Elder, 2005). Although it is convenient to define cohorts in relatively brief time intervals, it may be necessary to examine differences between cohorts that are separated in time for longer periods, particularly where the separation includes major societal shifts.

In Table 9.1, the chronosystem component includes both single-domain transitions and cumulative life course transitions and events; we will provide illustrations primarily from the latter since these are most likely to reflect historical change. The most common measure of educational attainment is quantitative—the total number of years of schooling; however education involves both quantitative and qualitative aspects. Quantitative measures reflected in total years of schooling include the age range over which schooling is experienced and the density of the educational experience (school days/school year). Qualitative indicators focus on educational practice, including curriculum and pedagogy. We will begin by discussing the impact of historical changes in legislation and in public funding of education on quantitative indices of educational attainment.

Legislation on Compulsory Schooling. Two major forms of legislation originating in the early 1900s contributed to significant differences in educational attainment for cohorts born at various decades in the twentieth century. State legislation on the length of the school year and compulsory school attendance enacted during the early 1900s impacted not only the proportion of children in school, but also the intensity of the educational experience. The average length of the school year has increased by almost two months from cohorts born at the beginning of the twentieth century to the 1950 cohorts (U.S. Department of Education, 2002). The average length of the school year for cohorts at the beginning of the twentieth century was 140 days, compared to 170 days and 180 days for parents of the Boomers and Boomers, respectively. Moreover, compulsory school attendance legislation increased the average daily attendance of various cohorts. Daily attendance was approximately 65% among early twentieth century cohorts compared with 85% and 90% for Boomers' parents and Boomers themselves (U.S. Department of Education, 2002).

Time-Specific Federal Funding for Education

National Defense Education Act. In 1957 the Soviet Union launched Sputnik. The national panic generated by this event resulted in Congress passing a federal-aid-to-education bill, known as The National Defense Education Act of 1958. A major provision of the law involved a $15 million grant with the

provision of funds to identify talented students and encourage them to pursue higher education. In the 1957–1958 term alone, Congress proposed over eighty laws to establish programs that would seek out bright students and provide them with financial support for schooling. This focus on talented youth and the provision of educational funds to the gifted would have impacted primarily the Boomer cohorts.

Historical Change in the Educational Curriculum. Further support for extensive historical changes in curricula taught at different ages is shown in the recent work of Blair and colleagues (Blair, Gamson, Thorne, & Baker, 2005). Findings of this research are particularly relevant to the prior discussion of Flynn IQ effects, where the claim is made that IQ gain for the post World War II cohorts has been primarily in the fluid abilities. Blair and colleagues have documented cohort differences in the age at which students were introduced to visuo-spatial skills such as those traditionally taught in geometry. An 1894 college textbook included a problem that required the student to draw and cut out a two-dimensional triangle and to fold the triangle to develop a three-dimensional polyhedron. By 1955, this type of problem was included in seventh-grade textbook. By 1971 the same concept was being taught to third graders, and by 1991 a first-grade textbook included a simplified version of the concept.

SUMMARY

In this chapter we discussed the salience of cognitive functioning in the baby-boomer cohorts. These are the largest birth cohorts in U.S. history now members of the workforce who will soon enter retirement. Maintenance of cognitive competence in these cohorts is of individual and societal importance. Boomers report that they plan to continue in some form of paid work into their 60s and even 70s in contrast to prior generations that embraced the concept of the golden years. The Boomers report interest in continued work not only due to economic necessity but because they also recognize the need to remain mentally sharp.

The Boomers are also of interest in terms of their cognitive functioning since they represent the key cohorts described in the Flynn effect. Flynn and colleagues maintain that the post World War II cohorts showed massive cohort gain in IQ in adolescence and young adulthood compared to immediately-prior cohorts. Data from cohort-sequential studies such as the SLS provide partial support for the Flynn effect, but also show that equally large cohort gains in IQ were apparent earlier in the twentieth century; however, gain in the earlier birth cohorts involved crystallized as well as fluid intelligence. The boomer cohort functions at a higher aggregate level than any prior cohort based on fluid abilities. The question for the future is whether these

cognitive advantages in early life serve as a form of cognitive reserve as these cohorts reach midlife and enter old age, typically a time of cognitive decline (Wilson, Mendes de Leon, Barnes, Schneider, Bienias, Evans, & Bennett, 2002). Findings are mixed on the debate about whether aging is kinder to the initially more able.

Study of cognitive functioning in midlife has received relatively little attention within the adult development and aging literature. This is partially due to the common finding of stability in cognitive functioning in midlife, when studied at the aggregate level. There is, however, increasing recent interest and attention to study of variability in cognitive trajectories at various stages of the life span, including midlife. In this chapter we present preliminary data regarding cognitive trajectories of leading-edge boomer cohorts in midlife. Indeed, the majority of these cohorts show remarkable stability in cognitive functioning in the 40s and 50s, yet there is a small but important minority who exhibit dramatic change over at least 14 years in midlife. One group exhibits abnormally early decline in midlife on the magnitude of one standard deviation—a greater magnitude of decline than has been reported to occur normatively a decade later in the 60s. In contrast, another group exhibits remarkable plasticity in midlife, showing significant cognitive gain of almost a standard deviation. Further study of these groups who deviated from the normative pattern of cognitive stability in midlife is merited. There is growing evidence that preclinical cognitive impairment may begin in midlife for some individuals; future research should examine whether early behavioral or pharmaceutical interventions would be of benefit. Equally interesting are the individuals who continue to exhibit reliable gain in cognitive functioning into the 50s in midlife. The lifestyles of these individuals require further examination of factors that foster continued growth.

In the last section of this chapter we present a conceptual framework for studying three levels of influence on cognitive development—with particular focus on factors in midlife and of historical relevance to the boomer cohorts. Although the initial Bronfenbrenner model focused largely on the Mesosystem, we propose that in studies of adult development and cohort differences, the Exosystem and Chronosystem are of particular interest. We briefly review historical events in the childhood and young adulthood of the Boomers associated with educational opportunities and trends that may have impacted their cognitive development. Further study of such events is needed.

In summary, the boomer cohorts offer a unique opportunity to advance the study of cognitive functioning in adulthood and in midlife in particular. Given their historical and societal significance, much has and is being written on the unique sociocultural context in which they developed. This affords a special opportunity for social scientists to extend our understanding of the nature of cohort differences and their impact on individual development.

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PART FOUR

Functioning in Context