

- Berkowitz L 2001 Affect, aggression, and antisocial behavior. In: Davidson R J, Scherer K, Goldsmith H H (eds.) *Handbook of Affective Sciences*. Oxford University Press, Oxford, New York
- Bettencourt B A, Miller N 1996 Sex differences in aggression as a function of provocation: A meta-analysis. *Psychological Bulletin* **119**: 422–47
- Catalano R, Dooley D, Novaco R, Wilson G, Hough R 1993 Using ECA survey data to examine the effects of job layoffs on violent behavior. *Hospital and Community Psychiatry* **44**: 874–79
- Crick N R, Dodge K A 1996 Social information-processing mechanisms in reactive and proactive aggression. *Child Development* **67**: 993–1002
- Dollard J, Doob L, Miller N, Mowrer O, Sears R 1939 *Frustration and Aggression*. K Paul, London
- Geen R G 1998 Aggression and antisocial behavior. *Handbook of Social Psychology* Vol. 2, 4th ed. McGraw-Hill, New York
- Lindsay J J, Anderson C A 2000 From antecedent conditions to violent actions: A general affective aggression model. *Personality and Social Psychology Bulletin* **26**: 533–47
- Miles D R, Carey G 1997 Genetic and environmental architecture of human aggression. *Journal of Personality and Social Psychology* **72**: 207–17
- Nisbett R E, Cohen D 1996 *Culture of Honor: The Psychology of Violence in the South*. Westview, Boulder, CO
- Olweus D 1979 Stability of aggressive reaction patterns in males: A review. *Psychological Bulletin* **86**: 852–75
- Patrick C J, Zempolich K A 1998 Emotion and aggression in the psychopathic personality. *Aggression and Violent Behavior* **3**: 303–38
- Reiss Jr A J, Roth J A (eds.) 1993 *Understanding and Preventing Violence*. National Academy Press, Washington, DC
- Straus M 1980 Social stress and marital violence in a sample of American families. *Annals of New York Academy of Science* **347**: 229–50
- Tedeschi J T, Felson R B 1994 *Violence, Aggression and Coercive Actions: A Social Interactionist Perspective*. American Psychological Association, Washington, DC
- Toch H 1992 *Violent Men: An Inquiry into the Psychology of Violence*. American Psychological Association, Washington, DC
- Zelli A, Dodge K A, Lochman J E, Laird R D 1999 The distinction between beliefs legitimizing aggression and deviant processing of social cues: Testing measurement validity and the hypothesis that biased processing mediates the effects of beliefs on aggression. *Journal of Personality and Social Psychology* **77**: 150–66

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Aging and Education

This article focuses on educational issues in adulthood, particularly in middle adulthood and older age. First, global demographic changes in the age structure of societies are discussed with particular emphasis on implications for education. The second section focuses on change and stability in cognitive development in

adulthood, as well as the long-term effects of early education on later life and cognitive training in adulthood. Finally, current and future trends in education for adults and the aged are discussed, including efforts to promote lifespan and global learning and the potential for utilization of scientific and technological advances in adult education.

1. Demographics of Aging and Education

Growth in the world's population, as well as changes in the age structure of societies will impact the nature of education as well as the demographic characteristics of the learner. As the proportion of adults in middle and later part of the lifespan increases, the number of adult learners will increase, as will the diversity of this group of learners.

1.1 The Shifting Age Structure

During the twentieth century, the population of the world has grown substantially in both developed and developing countries. Developing countries, particularly the regions of Latin America, Asia, and Africa, are increasingly accounting for the vast majority of growth in the world population (US Census Bureau 1999). These countries face the greatest increases in population, yet have substantially fewer resources in terms of health, technology, and education. The population growth witnessed in developing countries is in contrast to many developed nations in Europe which are below population replacement (i.e., the number of deaths is greater than the number of births; US Census Bureau 1999).

In contrast to developed nations, the increase in middle age and aged adults in developing countries is occurring in just a few cohorts (i.e., generations). Developed countries, whose populations have aged more slowly, were able to adjust more gradually to demographic shifts and implement corresponding social agendas. In contrast, developing countries are aging before they have resources and social policies in place, forcing them to make major rapid social and policy changes to take into account population shifts.

1.2 Implications of Demography Shifts for Education and Aging

Successive cohorts of adults throughout the twentieth century have attained greater levels of formal education compared to previous cohorts. Gross enrollment ratios (i.e., percentage of the school-age population corresponding to the same level of education in a particular academic year) for participation in primary, secondary, and tertiary levels of education increased from 50 percent in 1970 to 63 percent in 1997

for the world as a whole (UNESCO 2000b). In developing countries this ratio has risen from 47 percent to 63 percent, compared to a shift of 72 percent to 85 percent for developed countries during the same time period (UNESCO 2000b). Country-specific data from the USA, mirrors the general trend for increased educational attainment for successive cohorts: 83 percent of adults over the age of 25 in 1998 had completed high school, and 24 percent had completed four years of college, compared with a rate of 25 percent and 5 percent, respectively, in 1940 (US Census Bureau 1998). Currently, American adults over the age of 64 are less likely than adults aged 35 to 64 years to possess a high school diploma; however, given cohort trends in postsecondary education, future cohorts of elderly will have increasing levels of education. While this trend is promising for future cohorts of elderly, particularly in developed countries, it also implies that current cohorts of elderly are seriously disadvantaged in educational attainment compared to current younger adult cohorts (US Census Bureau 2000).

Although the overall levels of education have risen for successive cohorts throughout the twentieth century, the gross enrollment ratios indicate that universal education is not present, even in the most developed countries. The number of expected years of formal education ranges in regions throughout the world from slightly more than one year in less developed countries to over 16 years in developed countries (UNESCO 1996). Current illiteracy rates throughout the world also indicate disparities between developing and developed countries. Developed countries in Europe and North America have very low rates of illiteracy (i.e., average = 1.4 percent) compared to developing countries (i.e., average = 26 percent); and the least developed countries in regions such as Africa and southern Asia (i.e., average = 49 percent), which are more economically challenged and have higher birth rates (UNESCO 2000a). As demonstrated by these statistics, vast differences in educational attainment exist between countries, as well as between cohorts within a country.

Groups such as older women and ethnic minorities, who are increasingly accounting for a greater proportion of the elderly, will be particularly affected, putting them at an even greater disadvantage. Despite advancements in the equity of educational opportunities, great disparities still exist for women, ethnic minorities, and the economically disadvantaged. Women's education during the twentieth century has improved tremendously, however, worldwide fewer girls attend school than boys and women comprise two-thirds of illiterate adults (UNESCO 1996). Educational equality has also been difficult for ethnic minorities within some countries.

With recent changes in population demographics, efforts to facilitate maintenance of independence and productivity in the elderly are gaining attention. It is projected that the number of elderly and their need for

support will steadily increase during the next 25 years throughout the world (US Census Bureau 1999). The shifting demographics will have repercussions on numerous policy initiatives, including length of work life and retirement age. Some countries have or are considering eliminating mandatory retirement, or are raising the standard retirement age. As workers remain in the work force to later ages, maintenance of cognitive abilities and issues of educational updating will gain attention.

2. *Changes in Cognition Across Adulthood*

The changes occurring in cognitive abilities throughout adulthood have important implications for the formal education of adults in middle and older adulthood as well as self-directed learning. The variable trajectories of cognitive ability throughout adulthood, as well as the long-term beneficial effects of early formal education and the potential for cognitive training in later adulthood are discussed below.

2.1 *Age-related Changes in Cognition*

A well-established approach to the study of adult cognitive ability has been the examination of higher-order dimensions of psychometric mental abilities, particularly fluid and crystallized intelligence (Horn and Hofer 1992). Fluid intelligence refers to abilities needed for abstract reasoning and speeded performance whereas crystallized intelligence refers to knowledge acquired through one's culture including verbal ability and social knowledge (Schaie 1996).

Longitudinal research examining cognitive development has revealed that mental abilities vary in their developmental trajectories across adulthood (e.g., the Seattle Longitudinal Study: Schaie 1996, the Berlin Aging Study: Smith and Baltes 1999). A substantial body of research in the USA has demonstrated that fluid abilities, such as inductive reasoning, peak in early middle adulthood rather than in adolescence as previously thought. Fluid abilities remain stable in middle age and first show reliable decline in the mid-sixties. In contrast, crystallized abilities, such as vocabulary, do not peak until middle age and show reliable decline later in the mid-seventies (Schaie 1996). Similar developmental trajectories in abilities have been reported in Canadian and European longitudinal research (Backman 2001).

Decline in cognitive ability prior to age 60 is usually considered to be associated with ensuing pathological changes, and universal decline on all markers of intelligence in normal elderly is not evident even by the eighties (Schaie 1996). Findings from Swedish longitudinal study demonstrate that even the oldest-old (i.e., a sample of individuals aged 84 and older), who do not exhibit cognitive impairment at

baseline assessment, demonstrate relative stability over a two-year period on several markers of cognitive ability (Johansson et al. 1992).

2.2 Cohort Differences in Cognitive Ability and Education

In addition to varying individual developmental trajectories, mental abilities also show different cohort trends as well. Some abilities show positive cohort trends with successive cohorts functioning at higher levels when at the same chronological age. Other abilities exhibit curvilinear or negative cohort trends. The two abilities showing the strongest positive cohort trends are inductive reasoning and verbal memory—both representative of fluid ability. Current cohorts of the elderly are thus at double disadvantage on these abilities due to relative early age-related decline on fluid ability, combined with strong positive cohort trends on these same abilities. More modest positive cohort trends have been shown for spatial and verbal abilities. In contrast, curvilinear cohort trends have been shown for numerical abilities with birth cohorts 1918–1920s showing higher functioning compared to earlier or later cohorts when at the same chronological age. There does however appear to be a slowing of these cohort differences, and it is estimated that during the first part of the twenty-first century the differences between cohorts will become smaller (Schaie 1996).

These cohort trends in abilities are multiply determined; however, increasing levels of education across cohorts as well as medical and health advances appear to have been strong influences. The impact of increases in educational attainment as well as shifts in educational practice toward discovery learning, procedural knowledge and metacognition may have contributed in particular to the strong positive cohort trends for inductive reasoning and verbal memory. A recent reduction in the magnitude of cohort differences in abilities may be related to a plateauing of the dramatic increases in educational attainment that occurred in the later part of the twentieth century. Alternatively, the slowing of cohort trends may reflect the decline in college-entrance exam performance reported for recent cohorts of young adults; these cohorts are now in their late twenties and thirties and are represented in longitudinal studies of adult cognition.

2.3 Lifelong Benefits of Early Formal Education

Some research suggests that the benefits of early formal education extend into adulthood. Although debate exists regarding the extent, as well as the mechanisms (i.e., compensatory vs. protective) by which early educational benefits continue to be manifested in later life, numerous cross-cultural studies

have found greater levels of formal education to be associated with decreased risk of cognitive impairment in later life (e.g., Kubzansky et al. 1998). Several scenarios for how early education benefits later cognitive functioning have been offered. First, greater education attainment in adolescence and young adulthood increases opportunities and access to further education through the remainder of the lifespan. Likewise, attainment of certain levels of education provides entry into particular career opportunities. A second less direct influence of early education on later cognition focuses on the increased financial and environmental resources available to those with higher educational attainment. Those with greater financial resources typically have access to better healthcare and social services, which may facilitate maintenance of cognitive functioning in late life. Finally, early educational attainment may result in a higher level of cognitive ability and thus a higher threshold of functioning from which decline occurs in later life. For example, level of education may not delay the onset of dementia; however, it appears that it may be related to a delay in its symptomatology.

2.4 Cognitive Training Research with Adults

Given that fluid abilities show age-related decline beginning in the sixties and also that positive cohort trends for some fluid abilities place current elderly cohorts at a disadvantage, the question arises of whether behavioral interventions might be effective in remediating and/or enhancing cognitive performance in later adulthood. Educational interventions have traditionally focused on the earlier part of the lifespan when children are first developing mental abilities and skills. There has been less research on educational interventions in middle adulthood (except for work-related training) and even less study on cognitive interventions in later life. Outcomes from cognitive interventions later in the lifespan may be qualitatively different from those earlier in the lifespan (Willis and Schaie 1986). For older adults suffering cognitive decline, the intervention focuses on the possibility of remediating prior loss in level of ability. In contrast, for older adults who have not declined on an ability, the question is whether interventions can boost cognitive performance above prior levels. In order to examine these questions, longitudinal data on older adults, cognitive functioning prior to the intervention are needed in order to determine whether elders have declined or not on the abilities to be trained.

Since the 1970s, there has been a growing body of cognitive intervention research in later adulthood focusing on a variety of mental abilities, including memory, reasoning, and speed of processing (Camp 1999). Much of the research has shown that nondemented, healthy older adults can improve their performance as a function of brief educational train-

ing. Researchers have focused on different questions regarding the plasticity of cognitive functioning in later adulthood. A number of researchers have compared training gains for young adults vs. older adults. Due to cohort differences, younger and older adults were performing at different levels prior to training. Significant training effects have typically been found for both young and older adults; however, the cohort differences in level of performance remained after training (Willis and Schaie 1994); that is, older adults gained significantly from the intervention, but the training did not eliminate the cohort differences in level of performance. Baltes and co-workers have focused on a form of training known as 'testing the limits' in which older and younger adults were trained on the method of loci in list learning tasks, and then recall was assessed under increasing levels of speeded performance (Kliegl et al. 1989). Although both young and old showed significant training gains, the old showed less improvement when tested under highly speeded conditions.

In the context of the Seattle Longitudinal Study, Willis and co-workers have examined whether training on fluid abilities is effective for both older adults who have declined on the target ability and for those who have remained stable (Schaie and Willis 1986). Significant training effects have been shown for both stablers and decliners on two fluid abilities, inductive reasoning and spatial orientation (Willis and Schaie 1986). Seven years after training older adults trained on the ability were performing at a higher level than adults not given training on a specific ability (Willis and Schaie 1994).

While the cognitive training research appears promising, it is important to consider caveats to these findings. First, training effects have been found only with nondemented, community-dwelling elderly, not with demented patients. Second, while training effects have been demonstrated for multiple measures of the ability trained, training transfer is limited to the particular ability that was the target of training. That is training on a specific ability does not lead to significant enhancement on other primary abilities. Third, much of the training research has been conducted with young-old individuals who are White and of middle to upper socioeconomic status. Further research is needed regarding whether training effects can be demonstrated for the old-old and for minority elderly. One such study is currently being conducted by the US National Institute on Aging and National Institute of Nursing Research, which involves a multi-site clinical trial examining the effects of cognitive training for more representative groups of elderly (Jobe et al. 2000).

3. Trends in Education for Adults and the Aged

Educational systems are continually changing in response to the political, economic, and social forces that occur in countries throughout the world

(UNESCO 1996) and these forces are particularly influential in terms of adult education and vocational training. Two principal broad classes of educational trends relevant to adult learners are expected to continue during the first part of the twenty-first century, including the evolution of education into a system of lifelong learning and increasing utilization of science and technology.

3.1 Lifespan Learning and Globalization of Education

Education is continually affected by societal changes, particularly in the work place. These changes have promoted the emergence of lifespan learning and the globalization of education. The current transition from industrial to post-industrial economies occurring in many countries (Beare and Slaughter 1993) and a general increase in economic interdependence has fostered an interdependent, global approach to education. The shift in many countries away from industry-oriented occupations necessitates changes in occupational training, evaluation of students from all countries compared to global criteria of competence, and increased creativity and flexibility in meeting future training needs (e.g., creation of new disciplines, increased interdisciplinarity; Beare and Slaughter 1993). Furthermore, the emergence of a more global consciousness and cohesive worldview has prompted educators across the world to foster global awareness and competence in students (Beare and Slaughter 1993, Miller 2000). Systems of higher education throughout the world have begun to converge as the result of emerging national and international educational organizations and the sharing of educational information, theory, and research. This however, could come at a cost for non-English speaking countries with limited technological availability, as they may not be able to remain up-to-date. As the composition of the adult learner population changes, the challenge for educators in the twenty-first century will be the necessity to strive for universal education especially for under-served populations including ethnic minorities, women, and the economically disadvantaged.

Initial formal education, continuing education throughout adulthood, and the creation of everyday learning environments will grow increasingly intertwined. Recent increases in the length of nonworking life and amount of free time during employment, have resulted in an increasing role for education throughout the lifespan (UNESCO 1996). On-the-job training and general and vocational education are becoming more intermixed due to the growing demands to compete in the world market. Economic prosperity, company viability, and employee productivity have become increasingly interdependent. The uncertainty of the world labor market has also highlighted the need for continuing education. An unmet demand for skilled

workers and rising unemployment of unskilled workers point to the need for adequate training (Pair 1998). Education in the workplace is becoming vital as lifelong learning is required to enable job-sharing among employees with comparable training and to support and promote the growth of new occupations; workers must be prepared for present employment positions as well as positions of the future (Pair 1998). Inequalities in initial training (i.e., early formal education) have great impact on subsequent adult and lifelong learning, highlighting the importance of early education as the time for initial training with increasing amounts of subsequent training and education throughout adulthood.

3.2 *Impact of Science and Technology on Adult Education*

Another major trend in education has been the pervasiveness of computers and the Internet in the last decade, which have increased both older adults' formal and informal educational opportunities. For example, the use of technology throughout the later part of the twentieth century in distance learning has increased older adults' educational access and opportunity. Although distance education has been available during the past century in a variety of countries (e.g., Thailand, Pakistan, and Venezuela), it is only in the very recent years that more interactive options have been available. Early correspondence study programs relied on communication through the mail (Miller 2000), however, long distance learning has become increasingly interactive as these programs have incorporated television, videos, computers, and in the last decade, e-mail and the Internet (Miller 2000). As a result of the Internet, the classroom has become an international one (Miller 2000). The use of technology promotes flexible learning and has the advantages of decreasing cost, improving quality, and broadening access to educational materials, perhaps leading to virtual universities in the future.

The full impact of science and technology on adult education is not yet fully known. Technology has increased educational opportunities for adult learners and can be used to create a more optimal learning environment (i.e., familiar settings, accommodations such as large print and audio presentation). However, middle-aged and older adults' comfort level and ability to adapt to rapidly changing technological advances may be a challenge. The relative lack of computer experience by middle-aged and older adults and age-related changes in working memory, processing speed, and visuomotor skills can be impediments to adults' computer task performance (Czaja and Sharit 1993). However, relaxation of task pacing constraints, attentive interface design, and training are likely to increase older adults' ease and efficiency with computer-related tasks (Czaja 2001).

3.3 *Implications of Trends for Adult Education*

The emphases on lifelong and adult learning and the globalization of education, as well as the impact of science and technology have several implications for educators. First, education is increasingly taking place in contexts other than traditional educational institutions. This could be advantageous for adult learners as educational opportunities become more easily accessible and available in familiar environments. Second, education and access of knowledge will increasingly require competence in new technologies, which is likely to place adults and the elderly at a disadvantage compared to younger cohorts who tend to be more familiar with these technologies. Third, cohort differences and age-related change in higher order abilities such as inductive reasoning, working memory, and executive functioning may make older adults' use of new technologies particularly challenging. Finally, the rapidity of knowledge increase will require lifelong learning and adaptation, particularly in relation to work settings.

4. *Dynamic Between Aging and Education*

The dynamic between aging and education will continue to change as the composition of adults over the age of 60, is transformed, education takes a more global approach and encompasses learning throughout the lifespan, and technological advances continue to impact educational methods. Coming years will see an increase in the number of older women, the very oldest segment of the population (i.e., old-old: adults aged 80 and older), and greater diversity in the ethnicity and needs of the older adult population. Increased attention will be devoted to the maintenance and improvement of functioning in older adulthood, which can be aided by investment in early formal education as well as educational opportunities throughout the lifespan.

As the duration and nature of work and retirement change, the educational needs of current and future cohorts will also continue to change. Given the impact of technology in the workplace and the emergence of second careers and later retirement ages, the traditional conceptualization of the relationship between education, employment, leisure, and retirement is being reevaluated (Krain 1995, UNESCO 1996). In western cultures, individuals have typically received education and career preparation only in early childhood, worked at a career throughout early and middle adulthood, followed by retirement in older adulthood. Educational policies must increasingly address the growing number of work transitions, periods of unemployment, decreased period of transition prior to retirement, and increased part-time work after retirement. Future policies should include expansion of adult education, increased availability of lifelong

career-oriented education and training, and greater leisure-oriented education (Krain 1995).

See also: Adult Education and Training: Cognitive Aspects; Cognitive Aging; Education and Learning: Lifespan Perspectives; Education in Old Age, Psychology of; Lifespan Theories of Cognitive Development; Memory and Aging, Cognitive Psychology of

Bibliography

- Backman L 2001 Learning and memory. In: Birren J E, Schaie K W (eds.) *Handbook of the Psychology of Aging*, 5th edn. Academic Press, San Diego, CA
- Beare H, Slaughter R 1993 *Education for the Twenty-first Century*. Routledge, New York
- Camp C 1999 Memory interventions for normal and pathological older adults. In: Schulz R, Maddox G, Lawton M P (eds.) *Annual Review of Gerontology and Geriatrics, International Research*. Springer, New York, Vol. 18
- Czaja S J 2001 Technological change and the older worker. In: Birren J E, Schaie K W (eds.) *Handbook of the Psychology of Aging*, 5th edn. Academic Press, San Diego, CA
- Czaja S J, Shant J 1993 Age differences in the performance of computer-based work. *Psychology and Aging* **8**(1): 59–67
- Horn J L, Hofer S M 1992 Major abilities and development in adults. In: Sternberg R J, Berg C A (eds.) *Intellectual Development*. Cambridge University Press, Cambridge, UK, pp. 44–99
- Jobe J B, Smith D M, Ball K, Tennstedt S L, Marsiske M, Rebok G W, Morris J N, Willis S L, Helmers K, Leveck M D, Kleinman K 2000 *ACTIVE: A Cognitive Intervention Trial to Promote Independence in Older Adults*. National Institute on Aging, Bethesda, MD
- Johansson B, Zarit S, Berg S 1992 Changes in cognitive functioning of the oldest old. *Journal of Gerontology: Psychological Sciences* **47**(2): P75–80
- Kliegl R, Smith J, Baltes P B 1989 Testing-the-limits and the study of adult age differences in cognitive plasticity of a mnemonic skill. *Developmental Psychology* **25**: 247–56
- Krain M A 1995 Policy implications for a society aging well. *American Behavior Scientist* **39**(2): 131–51
- Kubzansky L D, Berkman L F, Glass T A, Seeman T E 1998 Is educational attainment associated with shared determinants of health in the elderly? Findings from the MacArthur Studies of Successful Aging. *Psychosomatic Medicine* **60**(5): 578–85
- Miller G E 2000 General education and distance education: Two channels in the new mainstream. *The Journal of General Education* **49**(1): 1–9
- Pair C 1998 Vocational training yesterday, today and tomorrow. In: Delors J (ed.) *Education for the Twenty-first Century: Issues and Prospects*. UNESCO, Paris, pp. 231–51
- Schaie K W 1996 *Intellectual Development in Adulthood: The Seattle Longitudinal Study*. Cambridge University Press, Cambridge, UK
- Schaie K W, Willis S L 1986 Can intellectual decline in the elderly be reversed? *Developmental Psychology* **22**: 223–32
- Smith J, Baltes P B 1999 Trends and profiles of psychological functioning in very old age. In: Baltes P B, Mayer K U (eds.) *The Berlin Aging Study: Aging from 70 to 100*. Cambridge University Press, Cambridge, UK, pp. 197–226
- US Census Bureau 1998 *Higher Education Means More Money*,

- Census Bureau Says*. US Census Bureau, on-line, CB98-221, <http://www.census.gov/Press-Release/cb98-221.html>
- US Census Bureau 1999 *World Population at a Glance: 1998 and Beyond. International Brief (IB)* US Census Bureau, on-line, IB/98-4, <http://www.census.gov/ipc/www/wp98.html>
- US Census Bureau 2000 *Aging in the United States: Past, Present, and Future*. US Census Bureau, on-line, <http://www.census.gov/ipc/prod/97agewc.pdf>
- United Nations Educational, Scientific and Cultural Organization (UNESCO) 1996 *Learning: The Treasure Within: Report to UNESCO of the International Commission on Education for the Twenty-first Century*. UNESCO, Paris
- United Nations Educational, Scientific and Cultural Organization (UNESCO): Institute for Statistics 2000a *Estimated Illiteracy Rate and Illiterate Population Aged 15 Years and Over*. UNESCO, on-line, <http://unesco.stat.unesco.org/staten/statistics/yearbook/tables/Table-II-S-1-Region.html>
- United Nations Educational, Scientific and Cultural Organization (UNESCO): Institute for Statistics 2000b *Gross Enrolment Ratios by Level of Education*. UNESCO, on-line, [http://unesco.stat.unesco.org/staten/statistics/yearbook/tables/Table-II-S-5-Region\(Ger\).html](http://unesco.stat.unesco.org/staten/statistics/yearbook/tables/Table-II-S-5-Region(Ger).html)
- Willis S L, Schaie K W 1986 Training the elderly on the ability factors of spatial orientation and inductive reasoning. *Psychology and Aging* **1**: 239–47
- Willis S L, Schaie K W 1994 Cognitive training in the normal elderly. In: Forette F, Christen Y, Boller F (eds.) *Plasticité cérébrale et stimulation cognitive*. Foundation National de Gérontologie, Paris, pp. 91–113

S. L. Willis and J. A. Margrett

Aging and Health in Old Age

1. Introduction: Living Longer and Better or Worse?

There are three different models describing how disability may change in the US population. First, with improvements in the treatment of some chronically disabling diseases (e.g., cardiac surgery in children with Down's syndrome so they can survive past age 40, i.e., through reproductive ages), it was hypothesized that the US would enter a period of a 'pandemic' of chronic diseases and disability (Gruenberg 1977, Kramer 1980). That is, it was expected that persons with chronic diseases, and the profound disabilities they can generate, would survive many more years raising the prevalence of chronic disability and the average amount of lifetime that could be expected to be lived in an impaired state (Verbrugge 1984).

A second perspective, due to Fries (1980) and Riley and Bond (1983), was that the time (age) to the occurrence of chronic disability could be increased independently of changes in life expectancy (time to death). Life expectancy was postulated to be able to increase only to 85 years of age (Fries 1980) with the