Cognitive Abilities in New Generations of Elderly People

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Introduction

One of the major objectives of the Seattle Longitudinal Study has always been the detection and monitoring of generational differences in cognitive abilities (1996c). In fact, the earliest methodological contributions were directly concerned with describing research designs that would allow disaggregation of cohort-related (generational) variance from age-related variances in understanding individual differences in adult development (cf. Schaie, 1965, 1967, 1977).

We begin our presentation by calling attention to the differences and similarities between the concepts of generation and cohort. We then briefly describe earlier contributions from the Seattle Longitudinal Study in charting cohort differences in performance level over the past half century. We will also describe generational differences in biologically related parents and their adult offspring. Finally, we present some new data on generational differences in rate of change obtained both from population samples and our family studies.

Sociologists' and Psychologists' Views of Generations

The concept of generational differences received considerable play in the early part of the century when the sociologist Karl Mannheim called attention to generational conflicts, particularly between adolescents and young adults and their parents. Indeed much of the literature on generational differences written by sociologists deals with issues of generational conflicts and transmission of values. Similar early concerns in psychology appear in the work of Charlotte Buehler centering on conflicts between adolescents and their parents. Among developmental psychologists hints of concern about possible effects of generational differences can be found in the work of Raymond Kuhlen (1940) who was the first in psychology to call attention to the fact that individuals age within the context of changing societies, implying the possibility that the timing of behavioral change might be important.

Generational differences began to resurface in the mid-sixties almost simultaneously in both the sociological and developmental psychology literature. Ryder (1965) suggested that the notion of cohort progression was an essential concept for the sociological study of change. This theme was further developed in its implication for social gerontology in a seminal volume by Riley, Johnson and Foner (1972). At he same time the senior author called attention to the fact that aging data obtained from cross-sectional and longitudinal data sets could not correspond with each other because cross-sectional age differences are confounded with cohort (generational) differences, while longitudinal age changes are confounded with time-of-measurement (period) differences. He specified a general developmental model that examined the formal nature of these relationships, placed them in the framework of quasi-experimental designs in psychology and education, and proposed strategies for collecting and analyzing data that might help obtain better estimates of the age factor (Schaie, 1965, 1967. 1977, 1984).

Generation and Cohort

The terms generation and cohort can be distinguished by noting that the former term often denotes successive groups in time where the second group could (but need not necessarily be) the biological offspring of the first group. By contrast, the term cohort defines an arbitrary definition of a point in time or range of time during which the members of the group enter the environment (by birth or other temporal entry). Hence the temporal distance between two generations will generally represent a time frame from 20 to 30 years, while cohort differences may and often do cover much shorter periods of time.

Generational and cohort differences have usually been studied in the context of groups of people (birth cohorts) entering the environment at the same point (or range) of calendar time. It should be stressed nevertheless that the temporal boundaries for generations can also be characterized by non-calendar definitions. For example, the initial group of workers hired for a new factory or the first faculty of a new educational institution would represent a generation (regardless of the individuals' calendar age), as would the initial membership of a newly formed club, or the first-time purchasers of homes in a new residential subdivision ((also see Schaie, 1994).

Previous Work on Generational Differences in Cognitive Performance in the Seattle Longitudinal Study

Generational differences were first studied by means of cohort-sequential designs as part of the analyses conducted for the third cycle of the Seattle Longitudinal Study (SLS; Schaie, 1995, 1996a; Schaie, Labouvie & Buech, 1973; Schaie & Labouvie-Vief, 1974). This study began in 1956 as a cross-sectional inquiry of the primary mental abilities over the age range from the 20s to the 70s. Longitudinal follow-ups have been conducted at 6 successive time points (seven years apart) in 1963, 1970, 1977, 1984, 1991, and 1998. At each of these time points new samples were assessed also over the age range from 22 to 84 years of ag. All study participants were community-dwelling members of a health maintenance organization and represent the upper 75% of the socioeconomic spectrum. Figure 1 shows the design of this study. In addition we have collected data on several hundred adult children and siblings of the original panel members

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Figure 1

Figure 2 shows cumulated generational differences for birth cohorts from 1907 to 1966 in seven-year intervals for five primary mental abilities: Verbal Meaning (recognition of the meaning of words); Inductive Reasoning (the ability to abstract rules and principles from reoccurring single instances); Spatial Orientation (mental rotation of objects in two-dimensional space); Numeric Ability (skill in the simple mathematical operation of addition); and Word Fluency (word recall according to a lexical rule).

Substantial positive and linear generational differences were observed for Verbal Meaning, Spatial Orientation and Inductive Reasoning. The 77-year gain amounted to more than 1 Standard Deviation. This gain is likely associated with the substantial increase in educational exposure occurring over this time period. The positive gain across successive generations in Inductive Reasoning may also be related to changes in educational practice from rote learning to the encouragement of discovery methods. Of course, the virtual conquest of childhood diseases and the adoption of more favorable life styles in successive birth cohorts may also be implicated. By contrast, Numeric ability seems to have peaked in the 1920s and has declined somewhat since then. For Word Fluency, we find a successive lowering of cohort level up to the 1931 cohort but improvement for subsequent cohorts (cf. Schaie, 1996b, Chapter 6; Willis, 1989)..

Figure 2

Comparisons from family studies of biologically related individuals involving parents and their adult offspring have yielded similar findings on generational differences in cognitive abilities. Figure 3 shows findings on tests of five primary mental abilities for the difference between parents and their adult offspring. The bars show the absolute mean difference in this large set of families. The hatched part of the bar represents an adjustment for the expected age difference between the older parents and their young-adult or middle-aged children. The solid part is the net difference. If there were no differences between generations the solid bar should be zero. As can be seen there are significant differences favoring the younger (offspring) generation on Inductive

Reasoning, Spatial Orientation, and Verbal Ability. On Number ability, it is again the older generation that is at advantage, while there is little difference on Word Fluency (Schaie, 1996a; Schaie, Plomin, Willis, Gruber-Baldini, & Dutta. 1992).

Figure 3

Rate of Change in Cognitive Abilities

The data just presented document successive changes in level of cognitive ability performance (mostly positive) that have occurred over the past century. The positive trends in certain abilities are quite encouraging, and initially may lead us to believe that at least on the basis of their levels of competence many more persons might be likely to continue productive lives to later ages. Given the increase of complexity of modern societies, however, the positive changes are of course essential to enable successive generations to cope with these changes.

A related question, however, may be of even greater importance. That is, what is happening to the rate of decremental age changes in cognition for successive generations. We have investigated this question for the age range from 60 to 81 years for two abilities (Inductive Reasoning and Spatial Orientation) for three cohorts born seven years apart (Figure 4), and for five cohorts over the age range from 60 to 74 (Figure 5)..While for both abilities there is a clear increase in level across the three cohorts at age 60, the rate of aging (i.e., the slope of the curves) appears to have slowed for Inductive Reasoning, but has remained about the same for Spatial Orientation. (cf. Schaie, 2000).

Figures 4 and 5

Rate of Change in Biologically Related Individuals

We believe that the most direct test of whether cognitive aging changes have slowed would be to compare persons with their adult offspring at approximately the same ages. We have recently been able to assemble a data set that meets this condition. The data set contains 496 subjects (248 parent-offspring dyads; 89, sons and 159 daughters. To obtain approximate age equivalence, we compare the 1970 and 1977 test scores of the parents with the 1990 and 1997 test scores of the adult offspring. In order to examine whether the generational differences differ by age level we further subdivided the data sets into three groups by average age of each pair as follows: up to 44 years of age (n = 62; M = 40.4, range 31-44); 45 to 59 years of age (n = 128; M = 51.8, range 45-59); and 60 years or older (n = 58, M = 65.5, range 60-82). We then conducted a repeated measurement ANOVA with 3 age levels x 2 Generations x 2 Occasions by 5 Test variables (Verbal Meaning, Spatial Orientation, Reasoning, Number and Word Fluency). Individuals are treated as replicates within parent-offspring dyads. Post-hoc tests of interaction effects use the most conservative Tukey LSD procedure. For easy comparison of the 5 test variables we standardized all raw scores to T-scores with a mean of 50 and Standard Deviation of 10 with respect to a larger sample of 4134 subjects' scores at first test administration.

As expected from our previous work (Schaie, 1996b; Schaie et al., 1992, Willis, 1989), the main effects for generation is not significant because of the multidirectional nature of the generation effects. But there is a significant interaction between age-group and generation (F (df=2,245) = 5.51; $p < .01$), That is, there is an overall generational difference only at the oldest age level (60 years plus).

We next examine the significant overall interaction of generation by variable (F (df=4,980) = 34.10, $p < .001$). Significant effects in favor of the younger generation were found for Spatial orientation and Reasoning, an in favor of the older generation for number.

Of interest here are, of course, primarily the interactions involving generational differences and change over time, The overall interaction between generations and occasion (the rate of change) is highly significant (F (df=1,245) = 19.39; $p < .001$). There is a significant overall decline over 7 years in the older, but not in the younger generation. (See Figure 6). However, none of the higher-order interactions are significant, suggesting that rate of change is relatively uniform across age groups and variables. Nevertheless, it is instructive to examine the change patterns by generation for each variable, because the interface between rate of change and level of performance may be critical for the prediction of practical consequences of these change (see Figure

7). We also present this information separately for the oldest group in Figure 8, since generational differences appear to be most profound at ages above 60 years.

Figures 6, 7 and 8

Finally we should note that in normal populations age changes, albeit highly significant are quite modest and they do not tend to exceed 1/4 of a standard deviation over a seven year period except at quite advanced ages. Our last figure (Figure 9) presents these changes by age group and ability.

Figure 9

Conclusions and Implications

There have been dramatic shifts, at least in the United States, in the level of cognitive performance attained by successive generations on many abilities. These findings imply that today's older persons are at an advantage compared to earlier generations. Many of these gains, no doubt, have occurred because of medical advances and increases in educational exposure. These developments, however, have begun to level out, particularly for the "baby boom" cohorts, as well as the occurrence of some negative cohort differences. Hence, differences in performance levels between young adults and healthy older persons are likely to shrink even further.

The recognition that many older persons can continue to perform well in work situations has informed American policy that led to the abandonment of mandatory retirement. Ample evidence has accumulated to show that there is virtually no correlation between industrial productivity and chronological age. Other personal characteristics, such as health, individual motivation, and willingness to continue educational activities which counteract personal obsolescence have been shown to be far more importance predictors of job performance.

The average age of retirement in the United States has declined markedly during the past two decade. However, early retirement usually means retirement because of pension eligibility from one's primary employer, but not the person's permanent retirement from the work force. That is, most early retirees who are in good health do reenter the work force, although frequently at lower level's of compensation, working in part-time or temporary employment settings, or being self-employed.

The data we have presented suggest that not only has there been a significant increment in level of ability across successive generation, but also that the rate of aging decline has leveled off. Indeed successive generations tend to reach the asymptote of their cognitive performance levels at later ages, and decline more slowly.

In the United States, recognition of the demographic facts of the aging of the baby boomers, has already led to legislation that will postpone public pension eligibility for these cohorts from age 65 to age 67. Some interest has also been shown to index pension eligibility age to average life expectancy. Hence, cautious adjustment of pension eligibility may indeed be warranted.

In spite of this optimistic interpretation of our data, however, also suggest that it may be naive to raise pension eligibility ages indiscriminately. Our data on differential generational changes for different competencies suggest that many persons could well work longer in some but not necessarily in all occupations. Moreover, given the increasing frequency of chronic disease with advancing age, raising the age of retirement eligibility would probably increase the number of persons leaving the work force because of physical disabilities.

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