Late Life Potential

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Late Life Potential and Cohort Differences in Mental Abilities

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The expression of creative behavior and accomplishment in late life is necessarily contingent upon the maintenance of a high level of intellectual functioning into advanced old age. Although average declines in mental abilities with advancing age have been reliably established, there remains much controversy as to patterns of individual differences in such decline. Moreover, such individual differences may be particularly profound in persons at high ability levels. In addition, previous research (Schaie, 1983, 1988a; Schaie & Hertzog, 1983) has demonstrated differential cohort trends over time that are likely to influence the proportion of individuals of advanced age who may remain capable of significant late life accomplishments, and which may impact upon the ability of older individuals to take advantage of recent technological developments.

Extensive research on adult intelligence has shown that there have been marked generational shifts in levels of performance on tests of mental abilities (Flynn, 1984; Parker, 1986; Schaie, 1983; Willis, 1985). The usual empirical findings have been that later-born cohorts appear to be advantaged when compared with earlier cohorts at the same ages. This phenomenon has been explained by arguing that increased educational opportunities, improved life styles including nutrition, and the conquest of childhood disease have enabled successive generations to reach ever higher ability asymptotes (cf. Schaie, 1984), similar to the secular trends of improvement for anthropometric and other biological markers (Shock et al., 1984). Although linear trends have been found for some variables, there seems to be contrary evidence suggesting that such trends may have been time-limited and domain- or even variable-specific.

Recent reports of the performance of high school students on college admission tests such as the SAT suggest that there has been an ebb and flow on such high school measures of mental ability levels. Reexamination of our own data on adults from the Seattle Longitudinal Study (SLS), moreover, suggests that cohort patterns are far from uniform across abilities. That is, positive cohort gradients are not necessarily found for all abilities, and nonlinear cohort patterns cannot simply be dismissed as sampling aberrations, but may represent complications introduced by countervailing contextual trends that have an impact on mental abilities.

Accurate descriptions of patterns of cohort change in mental ability are important because they provide a foundation for gaining a better understanding of the manner in which productivity and competence shift over time in our society. Such data are also needed to understand how cohort differences in performance can lead to erroneous conclusions from age-comparative cross-sectional studies (cf. Schaie, 1977, 1988c; Baltes, Cornelius, & Nesselroade, 1979). Because of the changing demographic composition of the population, it is of particular interest to assess differences in performance level at comparable ages for individuals representing eras that are characterized by differential fertility rates (e.g., contrasts of the pre-baby boom, baby boom, and baby-bust generations). Cohort shifts at older ages, moreover, are directly relevant to policy considerations regarding the maintenance of a competent work force that will contain increasing proportions of older workers as mandatory retirement becomes the relic of a biased past.

Most previous estimates of cohort shifts have resulted from the comparison of no more than two successive cohorts (e.g., Schaie & Strother, 1968; Schaie & Labouvie-Vief, 1974). With the completion of data collection for the fifth wave of the Seattle Longitudinal Study, it is now possible to estimate seven-year cohort shifts that are less sensitive to sampling variations by basing cohort difference estimates over at least four common age levels for seven successive cohorts. The first issue to be addressed, therefore, is the estimation of cohort trends across and within gender for seven-year birth cohorts with average birth years from 1889 to 1959; virtually the full range of adults now alive. Second, time-lag data will be reported over as many as five cohorts, seven years apart from each other, for samples with average ages (in seven-year intervals) ranging from 25 to 81 years. We will then inquire into some contextual factors that may help us project where these cohort trends may go in the proximal future. Some methodological issues will next be considered. And finally, implications will be examined for forecasts of late life potential in future generations.

Design of the Study

The empirical data brought to bear on the above issues represent the initial tests of 3,413 persons (males = 1,621; females = 1,792) who participated in the five waves of the Seattle Longitudinal Study. All were community-dwelling adults randomly selected from each seven-year age stratum of the membership of a metropolitan health maintenance organization. These data were collected in 1956 (ages 22-70; *N* = 500), 1963 (ages 22-77; *N* = 997), 1970 (ages 22-84; *N* =705), 1977 (ages 22-84; *N* = 612), and 1984 (ages 22-84; *N* = 599). Numbers of participants by cohort and gender are reported in Table 1A. Similar frequencies ordered by chronological age and gender are provided in Table 1B. All participants were in good health when tested, and were representative of the upper 75% of the socioeconomic stratum. For the total data base, educational levels averaged 13.27 years (range: 4-20 years), and occupational status averaged 6.25 on a 10-point scale using census classifications ranging from unskilled labor to professional.

Throughout the study, subjects have been assessed with the first five primary mental abilities (Thurstone & Thurstone, 1941; Schaie, 1985), the Test of Behavioral Rigidity (Schaie & Parham, 1975), and a demographic information form. In this chapter our discussion will be limited to the five primary ability measures: Verbal Meaning (the ability to comprehend words, a measure of recognition vocabulary); Spatial Orientation (the ability to mentally rotate objects in two-dimensional space); Inductive Reasoning (the ability to infer rules from examples that contain regular progressions of information); Number (the ability to manipulate number concepts, as measured by checking simple addition problems); and Word Fluency (the ability to recall words according to a lexical rule). All measures were standardized to *T* scores (*M* = 50, *SD* = 10) based upon the entire set of study participants.

All subjects were tested in small groups in sessions which, for the first three waves, lasted about two hours; for the fourth wave about three hours, and for the fifth wave in two sessions of 2 1/2 hours each (necessary because multiple markers of the abilities and other additional measures had been added).

The design of this study is an independent random sampling model, where each cohort at each age is assessed on a separate sample, thus controlling for possible effects of testing, reactivity, and experimental mortality (Schaie, 1965, 1973, 1977, 1988c, 1988d). Raw cohort differences were obtained by taking the differences between means for each pair of cohorts at all common age levels (four for comparisons of the seven cohorts born between 1896 and 1938; three for those involving cohorts born between 1889 and 1945; two for the 1952 cohort, and one for the 1959 cohort). Cohort difference estimates were then obtained by averaging across all estimates to avoid undue weighting in terms of differential sample sizes.

TABLE 3.1A
First-time Participants in the Seattle Longitudinal Study Classified by Cohort and Gender

Cohort		Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Total
1889	M	28	39	26	—	—	103
	F	38	39	24	—	—	101
	T	76	78	50	—	—	204
1896	M	35	64	46	28	—	172
	F	37	63	42	31	—	173
	T	72	127	88	59	—	346
1903	M	35	58	42	37	24	196
	F	35	64	49	33	28	209
	T	70	122	91	70	52	405
1910	M	35	62	38	35	39	209
	F	30	81	42	38	37	228
	T	65	143	80	73	76	437
1917	M	36	79	40	35	40	230
	F	35	76	49	38	42	240
	T	71	155	89	73	76	437
1924	M	33	71	44	40	36	224
	F	37	79	43	37	43	239
	T	70	150	87	77	79	463
1931	M	38	52	34	32	33	189
	F	38	70	50	37	33	228
	T	76	122	84	69	66	417
1938	M	—	42	28	37	26	133
	F	—	58	37	36	39	170
	T	—	100	65	73	65	303
1945	M	—	—	31	29	31	91
	F	—	—	40	33	39	112
	T	—	—	71	62	70	203
1952	M	—	—	—	28	27	55
	F	—	—	—	28	28	56
	T	—	—	—	56	55	111
1959	M	—	—	—	—	18	18
	F	—	—	—	—	36	36
	T	—	—	—	—	54	54

TABLE 3.1B
First-time Participants in the Seattle Longitudinal Study Classified by Chronological Age and Gender

Mean Age	Males	Females	Total
25	157	200	357
32	169	205	374
39	209	239	448
46	216	225	441
53	210	235	445
60	202	224	426
67	219	230	449
74	161	151	312
81	78	83	161
Total	1621	1792	3413

Similar estimates also were obtained separately by gender. Cohort gradients were then constructed by cumulating cohort difference estimates across the cohorts available for analysis. One-way ANOVAs examined the significance of time lags at specific ages from 25 to 81 years.

Empirical Findings

Estimation of Cohort Gradients

Differences between successive cohorts as expressed in *T* score points (1/10 *SD*) were cumulated from the oldest cohort born in 1889 up to the most recently measured cohort born in 1959 for the five abilities of Verbal Meaning, Spatial Orientation, Inductive Reasoning, Number, and Word Fluency. These cumulative cohort gradients are presented in Figure 1. It will immediately be noted that the gradients differ markedly both in slope and shape. Inductive Reasoning comes closest to showing a linear positive cohort progression. Even here there are departures from linearity, with relatively steep increments up to the 1931 cohort and far slower and decelerating increments thereafter. Nevertheless, the cumulative increment across the currently available population is well in excess of a population standard deviation. The next most substantial pattern of positive increment across successive cohorts is shown by Verbal Meaning. After an initial modest dip, this ability rises by about 2/3 *SD* until the 1924 birth cohort, followed by another modest dip. There is a further rise to an asymptote attained by the 1945 and 1952 cohorts, once again followed by another modest dip. Spatial Orientation also shows a basically positive cohort progression, but with a much flatter and variable profile. This ability reaches an initial asymptote after a 1/3 *SD* rise for the cohorts from 1910 to 1931. A further rise to a new peak of approximately 1/2 *SD* above the base cohort occurs in 1938, which is followed by a drop to the earlier asymptote in 1952, but with recovery to the higher level by the most recent cohort.

A very different pattern is shown for Number. Here a peak of about 1/3 *SD* above base is reached by the 1910 cohort at a level that is maintained through the 1924 cohort. Thereafter an almost linear negative slope is found that continues through the most recent cohort, which is approximately 1/4 *SD* below the 1889 base. And Word Fluency actually shows a negative cohort gradient with a drop of approximately 1/2 *SD* by 1931 and 1938 cohorts with recovery to the level of the base cohort by the most recent cohort studied.

Gender Differences

It might be suspected that some of the irregularities in the cohort patterns described above could be a function of differential representations of men and women in the cohort estimates (see also Table 1A), that would have an effect if cohort by gender interactions occurred over all or part of the cohort range studied. Figure 2 therefore provides cohort gradients estimated separately for men and women for the five abilities of interest.

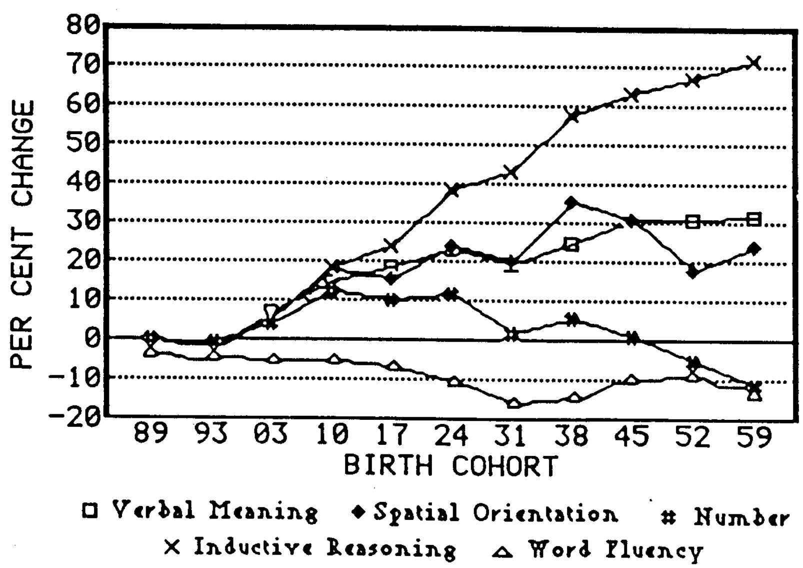

FIGURE 3.1. *Cumulative cohort differences from 1889 base cohort for the mental abilities.*

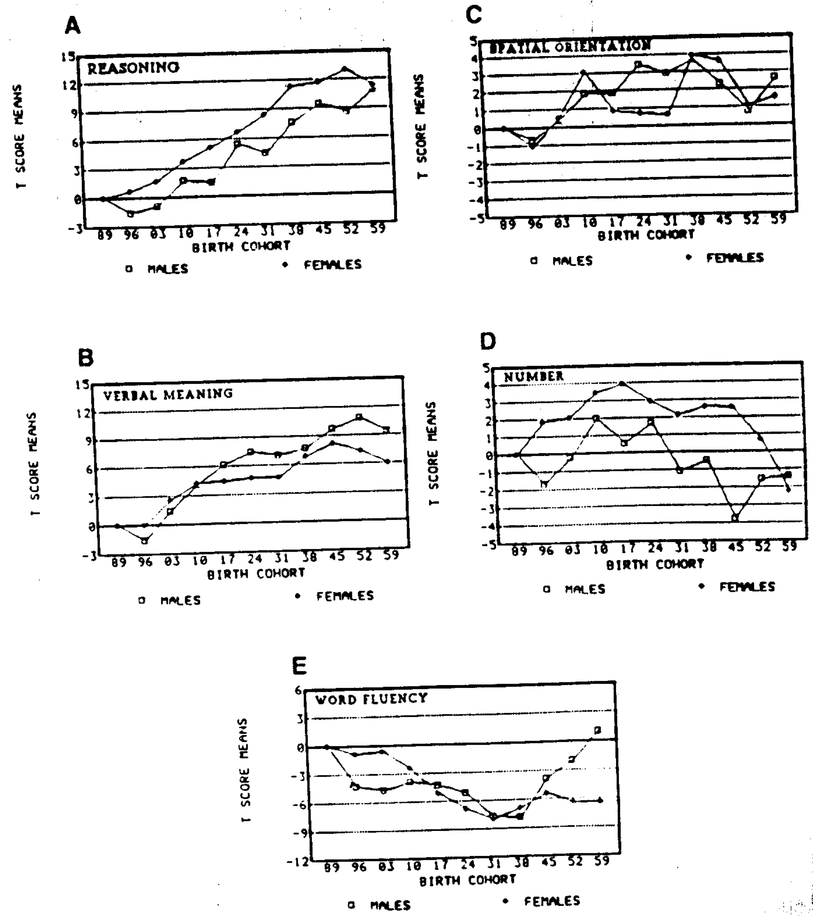

FIGURE 3.2. *(A-E). Cumulative cohort differences by gender for the mental abilities.*

The most regular pattern represented for the total sample by Inductive Reasoning also pertains separately for women. The implications of the 1959 cohort drop are not clear; it might be sampling fluctuations based on a single sample estimate. The cohort pattern for men is less regular, and seems to represent more of a "stairstep" profile. Nevertheless, it also maintains a clearly positive direction. It is interesting to note that there seems to be a lag effect, with magnitude of cohort difference for men representing that of women for the previous cohort.

Gender differences in cohort profiles for Verbal Meaning include the attainment of initial asymptotes by the 1910 cohort for females but not until the 1924 cohort for males. Similarly, negative change for the most recent cohorts is observed for females by 1952 but for males only by 1959.

Several interesting gender differences characterize the cohort progression for Spatial Orientation. The early asymptote for the total group actually conceals distinct gender-specific patterns. Positive cohort change continues for men actually to an asymptote attained for the 1924 through 1938 cohorts. For the women, however, an initial peak is reached for the 1910 cohort with a drop close to base for the 1917 through 1931 cohorts. This is followed by a steep rise in 1938 and 1945, after which point the male and female cohort gradients again converge.

There are also distinct patterns for Number. First, note the greater increment from base for the women. A linear positive slope is observed until a peak is reached for the 1917 cohort. From there on successive decrement occurs, terminating below base level and interrupted only by a temporary plateau from the 1931 to the 1945 cohort. By contrast, the men reach an asymptote already in 1910. From this peak there is a "stairstep" decrement until 1945, followed by modest recovery for the two most recent cohorts. Gender-specific cohort trends are also found for Word Fluency, the ability that shows the most negative cohort trends. Although both men and women reach a low point with the 1931 cohort, there is recovery above base for the men, while women remain at a level more than 1/2 *SD* below that of the earliest cohort assessed in our study.

Time-Lag Analyses

The data thus far discussed are based on cohort difference estimates that arise from data that for any set of two cohorts must cover age ranges that differ by at least seven years. For example, the difference between cohorts born in 1896 and 1903 is computed over the average ages 60 to 81, while the difference between cohorts born in 1903 and 1910 is computed over the average ages 53 to 74. An alternate manner of studying cohort change is to consider only the data available for successive cohorts at a specific age. This method involves a time-lag analysis that is very similar to the type of comparison usually conducted for college aptitude tests. Relevant to the question is whether significant changes have occurred as a function of shifts in population characteristics. Table 2 provides the relevant data from this analysis.

Positive cohort trends were found to be statistically significant at or beyond the 5% level of confidence for Verbal Meaning for all ages from 39 to 81 and for Inductive Reasoning for all ages from 25 to 74. A statistically significant trend was found for Spatial Orientation only at age 25, although

TABLE 3.2.
Scaled Means for the Primary Mental Abilities for Five Cross-Sectional Samples Assessed Seven Years Apart

Mean Age	1956	1963	1970	1977	1984	d1[a]	d2[b]
			Verbal Meaning				
25	52.64	53.30	53.84	54.68	55.46	2.9	2.9
32	54.87	54.05	53.80	56.22	54.83	2.4	0.0
39	51.90	54.20	53.95	54.96	56.86	5.0**	5.0
46	53.36	51.73	54.86	52.49	57.36	5.6***	4.0
53	49.10	48.35	54.45	52.87	54.79	6.3***	5.7
60	44.45	46.84	52.30	50.64	52.46	8.0***	8.0
67	42.56	42.57	45.26	46.44	48.68	6.1***	6.1
74	—	39.66	39.85	40.88	44.32	4.7***	4.7
81	—	—	37.92	35.72	40.60	4.9***	2.6
			Spatial Orientation				
25	54.00	53.30	53.84	54.68	55.46	2.2*	1.5
32	54.95	54.16	57.28	55.98	54.02	3.3	–.9
39	51.96	53.16	53.84	54.78	53.10	2.8	1.1
46	51.12	51.76	54.73	52.72	53.82	3.6	2.7
53	47.28	48.99	50.82	51.00	49.51	3.7	2.2
60	46.16	48.14	48.85	47.65	48.08	2.7	1.9
67	44.10	44.22	43.77	46.98	43.97	3.2	–.1
74	—	41.97	42.16	41.68	41.72	.4	–.2
81	—	—	40.70	39.44	39.82	1.3	–.9
			Inductive Reasoning				
25	55.19	58.60	59.84	59.02	60.01	4.8**	4.8
32	55.67	56.02	58.14	57.72	58.86	3.2*	3.2
39	51.07	53.84	54.13	56.60	57.83	6.7***	6.7
46	51.68	50.07	53.56	52.61	56.18	6.2***	4.5
53	48.41	46.45	51.09	51.55	53.72	7.2***	5.3
60	42.63	44.83	49.52	48.31	50.97	8.4***	8.4
67	42.04	40.53	42.80	45.02	46.83	6.3***	4.8
74	—	39.86	39.51	40.82	44.16	4.7***	4.3
81	—	—	38.81	38.91	38.86	.1	.1

(continued)

TABLE 3.2. (cont'd)

				Number				
25	48.79	50.73	51.29	49.25	48.22	3.1	-.6
32	51.67	53.78	53.49	50.72	50.55	3.2	-1.1
39	51.25	54.31	52.37	51.17	48.83	5.5**	-2.4
46	53.58	53.01	55.46	48.07	51.52	7.4***	-2.1
53	52.80	50.66	54.74	51.80	48.99	5.7**	-3.8
60	47.58	49.64	55.20	50.42	49.50	7.6***	1.9
67	47.67	46.55	48.24	49.94	48.79	3.3*	1.1
74	—	44.33	44.90	44.64	46.91	2.9	2.9
81	—	—	41.35	42.07	41.73	1.1	1.1
				Word Fluency				
25	53.96	52.34	53.36	53.50	55.19	2.9	1.2
32	56.65	52.54	50.78	54.71	54.90	5.9**	-1.7
39	54.30	51.91	50.36	52.00	54.71	4.3*	.4
46	56.49	50.80	52.66	49.55	53.47	6.9***	-3.0
53	55.63	47.68	52.82	50.91	51.98	7.9***	-3.6
60	50.00	49.15	50.42	50.09	47.70	2.7	-2.3
67	47.95	44.64	44.12	47.68	46.95	3.8**	-1.0
74	—	44.66	41.54	43.07	44.78	3.3	0.1
81	—	—	42.46	41.82	41.24	1.2	-1.2

Note. Degrees of freedom: 25 = 4,352; 32 = 4,369; 39 = 4,443; 46 = 4,435; 53 = 4,440; 60 = 4,421; 67 = 4,445; 74 = 3,309; 81 = 2,158.

[a] Difference between lowest and peak level in *T* score points (1/10 *SD*).

[b] Difference between base and 1984 cohort.

**p* < .05; ***p* < .01; ****p* < .001.

all observed cohort differences were in a positive direction. As expected, more complex findings occurred for Number. Here statistically significant trends were observed for ages 39 through 53, but significant positive trends were found only at ages 60 and 67. Magnitudes of positive time lags over a 28-year period were as great as .8 *SD* for Verbal Meaning, .4 *SD* for Spatial Orientation, and .9 *SD* for Inductive Reasoning. Because of the curvilinear pattern for Number, maximum negative as well as positive time lags were small; they amounted to –.4 *SD* and +.3 *SD*, respectively. Statistically significant time lags are largely negative for Word Fluency, and attained magnitudes were found to be as great as .8 *SD*.

Because of the specific relevance to the topic under discussion in this chapter, trend lines were fitted for those ages where significant cohort differences had been observed. Slope coefficients indicating linear rates of positive or negative cohort shift over a seven-year interval are given in Table 3. As would be expected, linear trends occur primarily for Verbal Meaning and Inductive Reasoning. However, they can also be noted at certain ages for Number and Word Fluency. In general, the magnitude of cohort shift is greatest during late midlife and early old age.

Cohort gradients for contextual variables

The observed differential cohort profiles raise the question whether contextual variables can be identified that have differential impact on the abilities that we have studied and that also show differential cohort profiles. As a first step for such an examination, we examined concurrent regressions of the ability variables upon several contextual variables on which data have been collected throughout the longitudinal study (Schaie, 1986b).

TABLE 3.3

Slope Coefficients for Cohort Trends on the Primary Mental Abilities (in T-Score Points) [a]

Age Level	Verbal Meaning	Spatial Orientation	Inductive Reasoning	Number	Word Fluency
25		-1.195	.925		
32			.814		-.295
39	1.014		1.724	-.435	
46	.715		.994	-.856	-.826
53	1.534		1.335	-.675	-.566
60	1.987		2.021	.471	
67	1.615		1.615	.680	
74	1.506		1.425		
81	1.425				

[a] Values are listed only for variables with slope coefficients that are significant at or beyond the 5% level of confidence.

Table 4 shows the contextual variables that have significant regressions upon the ability measures of interest in this study. Indeed, as much as a third of the individual difference variance on some of the abilities does overlap with these variables. Note that the relationship with current contextual variables is greatest for Inductive Reasoning and Verbal Meaning, those abilities that show both the steepest and most linear positive cohort gradients. Income appears as the most salient variable for all abilities, except Word Fluency. The latter ability is most highly related to education, which turns out to be the second largest predictor as well for Verbal Meaning, Inductive Reasoning, and Number. Age at first marriage is inversely related to Verbal Meaning, Inductive Reasoning, and Word Fluency, and age at birth weights negatively on Spatial Orientation. Both occupational and residential mobility are predictive of high performance on Inductive Reasoning. The former variable also relates positively to Spatial Orientation and Number, while the latter is significant for Word

TABLE 3.4.
Beta Weights and Multiple Correlations for Contextual Predictors of Performance Level on Mental Ability Tests[a]

Predictor	Verbal Meaning	Spatial Orientation	Inductive Reasoning	Number	Word Fluency
Education	.306		.249	.110	.294
Income	.344	.304	.348	.349	.242
Change of occupation		.130	.140	.072	
Change of home			.138		.099
Age at first marriage	–.126		–.197		–.082
Age at first child's birth		–.133			
Height		.143			–.113
Multiple correlation	.568	.432	.611	.421	.455

[a] Values are listed only for variables with regression coefficients that are significant at or beyond the 5% level of confidence.

Fluency. Finally, physical height relates positively to Spatial Orientation, but negatively to Word Fluency.

Figure 3 shows cohort patterns for several of the contextual variables. Education and income show almost linear positive cohort gradients, albeit less steep for education than for the inflation-confounded income measure. An increase of five years of schooling was found from the cohort born in 1896 to that born in 1945, with an apparent asymptote reached for the latter cohort. A linear gradient was observed also for number of changes of living quarters, which increase by an average of two for the seven-year interval from the oldest to the most recently born cohort. But just as for the ability measures, there are contextual variables that have much more complex profiles. Frequency of change of occupations, for example, actually declined slightly until the 1938 cohort, but thereafter showed a steep rise. Family status variables also show complex cohort patterns. Thus age at first marriage steadily fell (by a total of four years) until the 1931 cohort, but has since risen by a little over one year. The age of birth for the first child parallels the marriage pattern only partially. For this variable an initial peak was attained by the 1910 cohort, the pattern then following that shown for age at first marriage until the 1945 cohort, followed by a steep drop for the most recent cohorts.

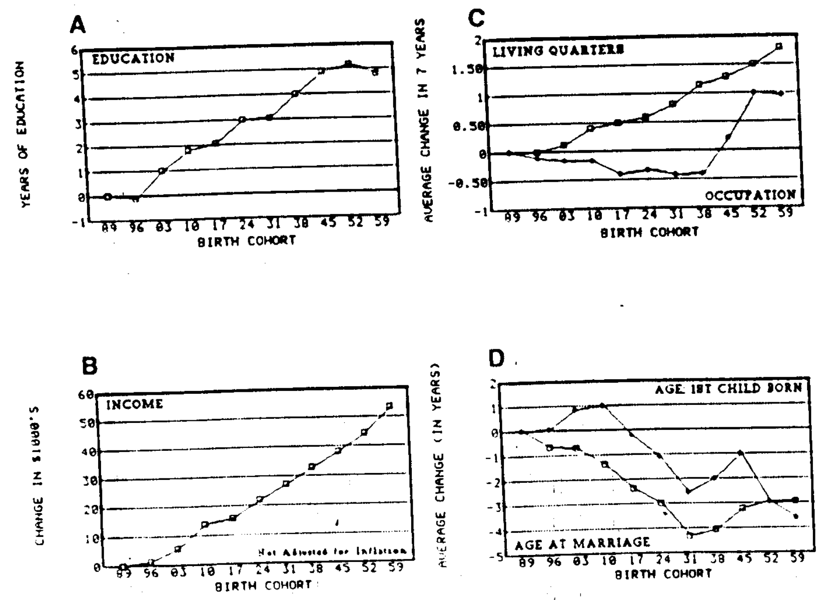

FIGURE 3.3. *(A-D). Cumulative cohort differences from 1889 base cohort for the contextual variables.*

Implications of Cohort Differences for Late Life Potential

In trying to understand the data presented above, four different topics need to be covered. The first involves the question as to what meaning and significance is to be assigned to cohort differences in abilities. The second concerns the impact of contextual variables upon these cohort differences. Third, there are some methodological issues to be addressed that hopefully will direct further research efforts. And finally, we will consider more direct implications for late life potential.

Cohort Differences in Abilities

The findings reported here clearly indicate that previous discussions of the impact of cohort differences upon intellectual performance in adults have been too simplistic. It is no longer possible to hold that benign changes in health status, life styles, and education have generalized positive effects that will inevitably lead each successive generation to reach an asymptote that is greater than that achieved by its predecessor. Instead, we note that cohort progressions occur at different rates for different abilities, may show gender-specific pattern, and may be noncontinuous. For some variables positive cohort trends may reverse, even to the point that over a wide range of cohorts the most recent cohorts may perform at a level that could be lower than that shown at equivalent ages observed for much older cohorts.

It seems to follow that changes in socialization patterns and other environmentally programmed experiences differentially impact cohort progression as well (cf. Schaie, 1984, 1986a). Nevertheless, it does appear that positive cohort gradients are most likely to be found for those variables that are most directly affected by a steady increase in educational exposure, whether in terms of knowledge acquisition (as would be the case for a crystallized ability such as Verbal Meaning) or in the acquisition of problem-solving strategies (as would be true for the fluid variable of Inductive Reasoning).

We have previously shown that increasing the familiarity of test stimuli will reduce cohort differences in the face of differential educational exposure (cf. Gonda, Quayhagen, & Schaie, 1981). Similarly, positive cohort differences observed in this study might conceivably be attributable to differential familiarity with similar test stimuli prior to entry into our study.

It should also be noted that the increment of cohort differences has slowed markedly over the past two decades. Cumulative magnitudes of cohort differences between those now in mid-life and those in early old age are no greater than the amount of training gains demonstrated for older adults who had not experienced age-related decline (Schaie & Willis, 1986; Willis & Schaie, 1986). It seems reasonable, then, to assume that much of the cohort-related aspect of the older person's intellectual disadvantage when compared with younger peers could be amenable to compensation by suitable educational interventions.

Some practical consequences arise from the reliably observed upward shift of performance by successive cohorts at given ages. It is instructive to note that the largest gains (see Table 2) occur for the fifties and sixties. These gains are in excess of average estimates of period effects for the past 28 years (Schaie, 1983), and thus imply that past cross-sectional norms may significantly underestimate intellectual performance of individuals at late career stages. Such findings may be particularly important in correcting for the possible misuse of older cross-sectional data in age discrimination litigation and in the development of procedures for lateral career shifts in the latter part of a person's work life. On the other hand, very little gain across cohorts is observed once the eighties are reached.

Impact of Contextual Variables

Cohort patterns for the contextual variables also fail to show uniform progressions. Those that seem most directly related to the crystallized abilities—education and income—show almost linear positive cohort gradients. But other contextual variables have much more complex profiles. For example, the family variables (such as age at first marriage and age at first child) show curvilinear cohort patterns, as does frequency of occupational change.

Considering the interrelation of ability and contextual variables, it may well be that many of the irregularities in the cohort progression for our ability measures could be better understood by examining shifts in contextual variables occurring over the same time periods (see also Gribbin, Schaie, & Parham, 1980). That is, some of the "stairstep" phenomena seen in ability cohort profiles may represent fluctuations in sampling and/or general population characteristics on contextual variables that constrain the distribution of individual differences on mental abilities. In addition, gender differences in ability cohort gradients may also reflect shifts in women's occupational role and family formation preferences. A better understanding of these relationships may well permit more educated projections for cohort-related shifts in ability structure as well.

Some Methodological Considerations

There are several methodological caveats that need to be mentioned to place our findings into proper context. As is true for most existent longitudinal studies of cognitive functions, those of our data that permit adequate cohort comparisons are currently based on single markers of the latent constructs they represent. We are well aware of the fact that the stability of single markers across cohorts differing widely in age may be less than desirable (cf. Schaie, 1988b; Schaie & Hertzog, 1985), and in the most recent wave of the SLS have therefore switched to multiple markers. On the other hand, we have recently been able to demonstrate (by means of confirmatory factor analyses) that at least configural invariance pertains for the measures herein reported over the entire adult age range (Schaie, Willis, Jay, & Chipuer, 1989). Nevertheless, it would be important to replicate the cohort shift findings at the latent construct level. At that level it would then become more justifiable to regress ability constructs upon the social structural characteristics for which we have reported concomitant cohort shifts.

Direct Implications for Late Life Potential

There are a number of important inferences, however, that can be drawn at this time for what the cohort shifts in abilities described here portend for the proximal future. First, it is clear that the performance levels of successive cohorts during the young-old life stage (the sixties and early seventies) for certain abilities will continue to increase. On the other hand, there has been a leveling off of gains for more recent cohorts. One consequence of these developments is that age differences in performance between young adults and the young old will at least temporarily be reduced significantly. Using the values for rate of cohort change provided in Table 3, we can predict that over the next decade, the proportion of young-old who overlap with the mid-range of young adults on many abilities will increase by from 5 to 10%. Although this change may seem like a relatively small shift, it is important for several reasons. We have previously documented that until age 60 there is virtually complete overlap for distributions at successive seven-year intervals with that prevailing at age 25 (Schaie, 1988d). It is during the young-old period that we currently see a tendency for that overlap to diminish. The predicted increase in overlap would extend the age range where older persons, in general, would compete on equal terms with their younger peers, at least into the early seventies.

Of interest also are cohort shifts that lead to modifications of gender differences. These have been primarily in the direction of reducing such differences. For example, the cohort shifts described in this chapter have over the past half century led to a reduction of the male superiority in number skills, but also to a reduction of the female superiority in Word Fluency.

Although there has been a trend for ever earlier retirement, there has also been an increasing trend for at least part-time reentry of older persons into the labor force. An increasing number of individuals (particularly in professional work roles), moreover, have taken advantage of current legislation prohibiting age discrimination in employment and have insisted on retaining their jobs to later ages. The data provided here suggest that this trend will increase because of the projected reduction in the magnitude of age differences between young adults and those in early old age, and that related litigation will have a better chance of success because of the accretion of relevant factual data.

The projected reduction in cohort differences in ability between young and old adults is also likely to result in greater utilization of educational opportunities by older persons, and in conjunction with current shifts in demographic distributions, will lead to greater utilization of educational resources that provide training for second and third careers. Much of the retraining of older workers involves skills that require some of the very abilities that we have been monitoring (cf. Willis & Schaie, 1986). It is fortunate, therefore, that upward shifts in abilities across cohorts appear to occur particularly at those age levels that must be tapped, if we are interested in increasing the age range of high productivity within our population.

In addition to the positive inferences drawn from our data, there are also some negative ones. First, we need to note that the positive cohort shift is no longer apparent once the eighties are reached for any ability other than recognition vocabulary. Apparently, age-related changes do take their toll for most of us in very old age, and environmental interventions at this writing are not too effective in prolonging full functioning into quite advanced age. Second, the asymptote reached by recent cohorts in educational attainment, given the substantial correlations of the abilities with education, may suggest that the positive shifts in potential experienced in early old age by successive cohorts may consequently come to a halt by the end of this century.

Summary

We have examined updated data on cohort differences in the five primary mental abilities of Verbal Meaning, Inductive Reasoning, Spatial Orientation, Number, and Word Fluency for seven-year birth cohorts with average birth years from 1889 to 1959, as well as time-lag data over as many as five periods, seven years apart, for mean ages 25 to 81. Our data show differential cohort gradients: Steep positive and linear for Inductive Reasoning; modestly positive with occasional inversions for Verbal Meaning and Spatial Orientation; and curvilinear, but essentially negative, for Number and Word Fluency. We also noted that there were gender-specific aspects of cohort progressions, with men often lagging behind women in magnitude and direction of change. Time lags at specific ages were particularly significant in the fifties and sixties, and practical implications were considered. Cohort progressions for contextual variables involving income, education, mobility, and family formation characteristics were also examined and suggested as possibly offering a basis for understanding irregularities in the ability cohort gradients and in enhancing projections of cohort trends in mental abilities. We concluded by noting effects of these cohort shifts for late life potential and by raising some methodological cautions.

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