

**Social Context and Cognitive Performance in Old Age**

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## Social Context and Cognitive Performance in Old Age

### Introduction

Recent years have seen extensive discussions by life-span oriented developmental psychologists devoted to the importance of context in the study of behavioral development (e.g. Bronfenbrenner, 1979; Baltes et al., 1979; Schaie, 1978). The initial thrust of such discussions was directed primarily to the question of the generalizability from laboratory studies to field situations, or from the information gleaned from non-representative convenience samples to broader populations and policy issues. The focus of concern, however, soon shifted to the more fundamental question whether contextual parameters, usually defined as social structures, might have direct causal impact on the direction and rate of behavioral development (cf. Gribbin, Schaie, & Parham, 1980). A related issue is the question whether changes in the population parameters for selected developmental processes may in turn have direct consequences for changes in social structure. There is a paucity of empirical studies by psychologists that have explicitly included social context as part of their experimental design. Perhaps the most noteworthy substantive area, however, in which at least a beginning has been made, is the study of age changes and age differences in adult cognitive development (cf. Schaie & Willis, 1984).

One major structural context that has been investigated by developmental psychologists is the effect of birth cohort membership upon cognitive performance with advancing age (cf. Schaie, 1984a, 1986a; Schaie & Hertzog, 1986). More specifically, differential structural attributes of successive birth cohorts with respect to the distribution of educational characteristics, income, occupational and health status, have been related to individual performance differences and to developmental trajectories. Some attention has in the past been given to the impact of health status as expressed by specific disease entities (Hertzog, Schaie, & Gribbin, 1978), and to the long-term effects of cognitive styles and family status (Gribbin, Schaie, & Parham, 1980; Schaie, 1984b). In the present paper I will examine data from my work on adult intellectual development that speak to the possible impact of the cohort flow in certain demographic characteristics upon age-related changes in cognitive performance. I will then discuss some more specific findings that assess differential age changes in intellectual performance in the context of structural factors such as characteristics of individuals' work environment prior to retirement, and to other indicators of the individual's microenvironment. Finally, I will indulge in some speculations upon the possible effects upon social structures of historical changes in adult cognitive development (e.g., the maintenance of cognitive competence to later ages and positive interventions to reverse cognitive decline).

### Nature of the Data Base

The data to be discussed come from the Seattle Longitudinal Study (SLS), a multi-wave panel study that uses as its population frame the membership of a metropolitan health maintenance organization (cf. Schaie, 1983). All 3413 participants at first test were community-dwelling adults who were randomly selected from each seven-year age stratum included in each panel. These data were collected in 1956 (N = 500; ages 22 to 70), 1963 (N = 997; ages 22 to 77), 1970 (N = 705, ages 22 to 84); 1977 (N = 612, ages 22 to 84), and 1984 (N = 599; ages 22 to 84). Numbers of participants by cohort and gender are reported in Table 1. All participants were in good health when tested, and were representative of the upper 75 per cent of the socio-economic stratum. For the total data base educational levels averaged 13.27 years (range: 4 to 20 years), and occupational status averaged 6.25 on a ten point scale using census classifications ranging from unskilled labor to professional.

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Throughout the study, subjects have been assessed with the first five primary mental abilities (Schaie, 1985, in press; Thurstone & Thurstone, 1941), the Test of Behavioral Rigidity (Schaie & Parham, 1975), and a demographic information form. 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 were added). In this presentation we restrict our discussion to four primary abilities: 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; and Number, the ability to manipulate number concepts, as measured by checking simple addition problems. We will examine observed changes within the context of the following demographic variables: Education, Income, Occupation, Age at first marriage, number of children, age when first child was born, changes in living quarters, job changes, occupational changes. Also included in our data base are the anthropometric measures of height and weight, and ratings of general life satisfaction and adjustment.

#### **Cohort Progressions of Cognitive Abilities**

The design for our analyses of cohort differences in cognitive abilities represents an independent random sampling model, where each cohort at each age measured is assessed by means of a separate sample, thus controlling for possible effects of testing, reactivity and experimental mortality (Schaie, 1965,

1973, 1977). 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 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. Similar estimates were obtained also 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.

### Initial Results

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 four abilities of Verbal Meaning, Spatial Orientation, Inductive Reasoning and Number and are presented in Figure 1. It will immediately be noted that the gradients differ in slope and shape. Inductive Reasoning comes closest to showing a linear positive cohort progression. Even here there are diversions from linearity, with relatively steep increments up to the 1931 cohort and far slower and decelerating increment 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 an 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.

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Insert Figure 1 about here  
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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

subsamples upon which the cohort estimates are based 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 four abilities of interest.

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The most regular pattern represented for the total sample by Inductive Reasoning also pertains separately for women. The implications of the 1959 cohort drop is not clear; it might be sampling fluctuation 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 magnitudes 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 of all, note the greater increment from base for the women. A linear positive is observed until a peak is reached for the 1917 cohort. From then on there is successive decrement terminating below base level, interrupted only by a temporary plateau from the 1931 to the 1945 cohort. By contrast, the men reach an asymptote already in 1910. This is followed by a "stairstep" decrement until 1945, followed by modest recovery for the two most recent cohorts.

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 from 53 to 74 (cf. Ryder, 1965; Schaie, 1965). An alternate manner of studying cohort change is to consider only the data available for successive cohorts at a specific age. This is a time-lag analysis, very similar to that conducted for college aptitude tests, and is relevant to the question whether

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significant changes have occurred that would permit the judgment that performance levels at a given age have increased or declined as a function of shifts in population characteristics. Table 2 provides the relevant data from this analysis.

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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 age 25 to 74. A statistically significant trend was found for Spatial Orientation only at age 25, although 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 at ages 60 and 67. Magnitudes of positive time-lags over a 28 year 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.

#### Implication of Findings

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 a 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 be non-continuous. 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. Nesselroade, 1983; Schaie, 1984a, 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).

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 at mid-life and those in early old age is no greater than the

amount of training gains demonstrated for older adults who had not experienced age-related decline (Schaie & Willis, 1986b; Willis & Schaie, 1986). It seems reasonable then to assume, that the cohort-related aspect of the older persons intellectual disadvantage when compared with younger peers could readily be compensated for by modest interventions, whether serendipitously engaged in by individuals who are aware of their own obsolescence, or by environmentally programmed 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 person's work life.

### **Impact of Contextual Variables**

The observed differential cohort profiles now raise the question whether we can identify contextual variables 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, 1983). Table 3 shows the contextual variables that have significant regressions upon the ability measures of interest in this study (based on the 1970 panel). 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. In both instances, education, income, and multiple occupational exposure are identified as salient contextual variables. These variables also appear for Number, but only Income accounts for a substantial proportion of variance. In addition, age at first marriage appears to be of contextual relevance for Verbal Meaning, while age at birth of first child and physical height are relevant to Spatial Orientation.

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Figure 3 shows cohort patterns for several of the contextual variables. Those that seem most directly related to the crystallized abilities, education and income, show almost linear positive cohort gradients; albeit less steep for education than for the inflation-confounded income measure. But just as for the

ability measures, there are contextual variables that have much more complex profiles. Frequency of occupational change, for example, actually declined slightly until the 1938 cohort, but thereafter showed a steep rise; this in contrast to our other mobility measure, change in living quarters, which showed a rising cohort trend throughout. Family status variables also show complex cohort patterns. Thus age at first marriage steadily fell until the 1931 cohort, and has since been rising, while age of first child attained an initial peak for the 1910 cohort, then followed the pattern for age at first marriage, but showed a steep drop for the most recent cohorts.

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Insert Figure 3 about here  
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Considering the interrelation of ability and contextual variables, it is my contention that many of the irregularities in the cohort progression for the ability measures might 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. The question arises, of course, whether changes in the contextual parameters have been instrumental in leading to the

observed shifts in cognitive performance levels, or whether changes in ability parameters have contributed to the shifts in contextual variables. We will explore this matter a bit further later on, but first want to turn to some further evidence of a more microenvironmental nature that speaks to the impact of context on cognitive aging.

We have thus far addressed data that compares population parameters at successive points in time. Such data appear relevant for broad structural characteristics, but are less relevant when we wish to understand more specific environmental impacts on development in specific sub-sets of individual and in particular when we wish to distinguish between general impact of social change and individual development (Schaie, 1982a). For this purpose, I will examine data on a small subset of panel members followed from 1977 to 1984 for whom we studied the effect of job characteristics on cognitive abilities and intellectual flexibility (Dutta, Schulenberg, & Lair, 1986).

#### **Effects of Job Characteristics on Cognitive Aging**

The central idea of the analysis to be presented stems from the work of Kohn and Schooler (1983) regarding the consequences of complex work environments on psychological functioning in middle-aged men. In particular, we were interested in a test of Schooler's (1984) thesis that complex environments may systematically reinforce cognitive efforts that will generalize to



other situations. Such a test is complicated further, however, by the fact that individuals who function at a high level, and in particular those who display flexible cognitive styles, may well be expected to actively create complex environments for themselves and thus sustain their level of intellectual functioning. Indeed, indicators of cognitive flexibility in midlife have proved to be moderate predictors of intellectual functioning at later ages (Schaie, 1984b).

In the study to be described, we examined longitudinally over a seven-year period the impact of job characteristics on cognitive decline and intellectual flexibility of a sample of 73 adults (M = 42, F = 31) who were gainfully employed in 1977, at a mean age of 62.1 years. Their average educational level was 13.9 years, and average income in 1984 was \$19,878. This sample was broken into an early and a late retirement subgroup; those retired by 1981, and those who were still working or retired after 1981. Ages of the two groups did not differ significantly. Work characteristic scores were obtained from interviews conducted in 1977 with questions similar to those used by Kohn and Schooler (1983). These scores assessed the variables of job complexity, routinization and closeness of supervision. Measures of flexibility come from the Test of Behavioral Rigidity (Schaie & Parham, 1975, and involve the dimensions of Motor-cognitive Rigidity, Personality-perceptual Rigidity, and Psychomotor Speed. The measures of intellectual ability were as described earlier in this paper; an additional

weighted composite of Verbal Meaning and Inductive Reasoning (2V + R) as suggested by Thurstone (1958) served as an indication of educational aptitude.

A structural equations model was derived for the total sample and then tested simultaneously on the two retirement status groups using LISREL VI (Jöoreskog & Sörbom, 1984), with the three work characteristics, educational level, and the 1977 flexibility-rigidity and educational aptitude scores serving as exogenous variables, while the 1984 flexibility-rigidity and educational aptitude scores served as endogenous variables. The model estimated parameters for all correlations among the exogenous variables, the auto-regressive stability coefficients between the markers assessed in both 1977 and 1984, as well as for the cross-lagged coefficients between job characteristics and educational level, and the 1984 cognitive markers. The fit for this model was acceptable ( $\text{Chi}^2 = 26.05$ ,  $\text{df} = 18$ ,  $p < .10$ ;  $\text{GFI} = .920$ ). Most of the cross-lags were quite small, and a modified model set all but three of the cross-lags to zero, without loss of goodness of fit. The remaining significant cross-lags involve an inverse relationship between job complexity and 1984 educational aptitude for both groups. There is a positive cross-lag between motor-cognitive flexibility in 1977 and psychomotor speed in 1984, and a positive cross-lag between job complexity and motor-cognitive flexibility in 1984 in the late retirement, but not in the early retirement group.

The puzzling findings with respect to educational aptitude were examined further by a repeated measurement ANOVA for the two components of Verbal Meaning and Inductive Reasoning. In this analysis high/low work complexity and early/late retirement served as the independent variables. Results of this analysis showed that the high complexity group did decline more than the low complexity group, narrowing its earlier advantage over the low complexity group. However, the high complexity score did show less increment on motor-cognitive rigidity than did the low complexity group. Further light is shed by examining the significant interaction on Inductive Reasoning between retirement status and work complexity (see Figure 4). Note that the high complexity/late retirement group and the low complexity/early retirement group have remained virtually stable, while substantial decline is found both for the high complexity/early retirement and the low complexity/late retirement groups are substantial.

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This study seems to provide an important lesson that is both of theoretical and substantive importance. First, if we wish to understand the consequences of environmental impact on cognitive development it is going to become necessary to progressively disaggregate the exogenous influences under study, possibly to the extent of developing quite detailed typologies and even individual

case studies (cf. Schaie, 1986b). Second, the substantive findings suggest that the effects of job complexity upon the maintenance of cognitive function in old age may be bimodal in nature. That is, late continuation of one's work life is supportive of the maintenance of at least Reasoning ability, if the job is of sufficient complexity. By contrast, work continuation appears to be deleterious if the job performed is of low complexity. This finding, of course, would provide a rational basis for the often reported phenomenon that many professionals tend to continue work as late as possible, while blue color workers seek out early retirement.

#### **Some Concluding Thoughts**

The data that I have presented here suggest that there are substantial shifts in performance level for some but not all cognitive abilities across successive population cohorts. The magnitudes of such shifts are well within the range of reported age-related decline, which in turn for many individuals are in the range of gains that can be obtained by means of cognitive intervention. It is reasonable then to conclude that part of the disadvantage faced by older individuals when compared with their younger peers must be attributed to the fact that successive cohorts reached higher performance asymptotes. It should be noted, however, that this particular disadvantage may be a temporary one, albeit of particular concern with respect to those

now in the last third of their work life. That is, cohort progressions for those cognitive variables where they are most pronounced have clearly slowed, and in fact may be reversing for the late baby-boom cohorts. For some abilities, notably numerical skills, a negative cohort gradient has actually prevailed for several decades. Thus individuals reaching early old age in the next decade may be at less disadvantage, or perhaps being advantaged with respect to the immediately succeeding cohorts (cf. Schaie, 1982b; Schaie & Willis, 1986a). We have noted that the cohort differences in cognitive performance levels are paralleled, at least in our panels, by similar cohort differences in contextual exogenous and endogenous variables. Some of the cohort profiles, notably income and education, show linear positive increment, but others (change of occupation, age at marriage and birth of first child), are more curvilinear in nature.

The important question now arises whether cohort differences in demographic characteristics drive the observed cohort differences in mental abilities, or whether at least some of the observed demographic changes may actually have arisen as a consequence of genetic or environmentally-determined shifts in ability level in the population (cf. Riegel, 1976). To the extent that our time-lag analyses suggest shifts over the past 28 years to be particularly prevalent at certain ages but not others, it might be argued that the cross-cohort shifts in ability may represent a population process a la Featherman (1986). However,

our attempts at causal modeling of the relationship between contextual variables and mental abilities have as yet resulted primarily in the fitting of models that are reciprocal in nature (Stone, 1980). Exceptions thus far found are with respect to the effect of the endogenous variables of cardio-vascular and arthritic disease, and the above-described exogenous variable of work complexity.

It seems reasonable, nevertheless, to speculate that the substantial shifts in level and rate of cognitive performance in older adults is likely to result in substantial shifts in demographic indicators and other contextual indicators as well. For example, longer maintenance of cognitive ability will lead more people to seek further education past young adulthood resulting to age by cohort shifts in educational levels; more and more middle-aged and older people similarly through utilization of psychotherapy and other growth experiences are likely to enhance their level of flexibility. More able older people will seek out greater work complexity, and be eligible for economically more rewarding pursuits, leading to shifts in the age by cohort occupational as well as occupational change distributions. In addition, it is likely that the demonstration that much of the apparent intellectual adulthood may be experiential (cf. Schaie & Willis, 1986b) will lead to increased efforts on the part of community-dwelling elderly to seek out remedial and self-help programs. Nor should we disregard the effect upon public policy

and resulting changes in environmental contexts that result from the efforts of scientists such as ourselves to demystify the prevalent stereotypes about the aging process.

Our lack of success in explicating specifically what contextual variables may be implicated both in cohort differences and age changes in mental ability, quite likely must be attributed to the fact that we have yet to formulate sufficiently specific hypothesis that can be tested in carefully described subsets of the broader population. And further we have yet to understand fully the impact of the lagged occurrence of demographic shifts, their consequences for cognitive performance, and possibly resultant shifts in the demographic characteristics that have driven these changes in the first place. It is my hope that a number of inter-disciplinary efforts now in place will soon begin to provide us with new research paradigms that will permit more explicit study of this delicate interface between social context and individual development.

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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	82	470
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 2**  
**One-way Analyses of Variance for Cohort Differences**  
**at Specific Age Levels from 25 to 81 Years**  
**Measured in 1956, 1963, 1970, 1977 and 1984**

Age Level	Verbal			Spatial			Inductive			Number		
	Meaning			Orient.			Reasoning					
	<u>F</u>	d1 <sup>a</sup>	d2 <sup>b</sup>	<u>F</u>	d1	d2	<u>F</u>	d1	d2	<u>F</u>	d1	d2
25	.62	2.6	1.7	2.48*	3.9	2.9	4.37**	4.7	4.5	1.76	-3.2	-.8
32	1.00	2.5	-.1	1.71	3.0	-.6	2.81*	3.8	3.8	1.75	-3.1	-1.1
39	3.46**	5.0	5.0	.95	2.9	1.4	8.12***	7.3	7.3	4.37**	-5.3	-2.3
46	5.85***	5.7	4.0	2.20	4.0	4.0	6.89***	6.1	4.6	6.82***	-2.9	-2.0
53	10.95***	6.4	5.6	2.23	3.4	2.6	10.21***	6.6	4.9	3.58**	-5.3	-3.7
60	12.19***	8.1	8.1	.86	4.2	3.7	14.69***	8.6	8.6	5.91***	7.3	1.9
67	8.57***	6.2	6.2	1.90	3.9	1.5	10.56***	6.5	4.6	2.41*	4.2	2.0
74	5.43***	4.8	4.8	.48	1.5	1.5	9.08***	4.8	4.6	1.37	2.9	2.9
81	5.60***	5.0	3.0	.61	2.2	1.2	.01	.6	.6	.67	1.1	1.1

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.

\*p < .05, \*\*p < .01, \*\*\*p < .001, <sup>a</sup>Difference between lowest and peak level in T score points (1/10 SD); <sup>b</sup>Difference between base and 1984 cohort.

**Table 3**  
**Beta Weights and Multiple Correlations for**  
**Contextual Predictors of Performance Level**  
**on Mental Ability Tests<sup>a</sup>**

Predictor	Mental Ability			Number
	Verbal Meaning	Spatial Orient.	Inductive Reasoning	
Education	.306		.249	.110
Income	.344	.304	.348	.349
Change of Occupation		.130	.140	.072
Change of Home			.138	
Age at Marriage	-.126		-.197	
Age at 1st child's Birth		-.133		
Height		.143		
Multiple Correlation	.568	.432	.611	.421

<sup>a</sup>Values are listed only for variables with regression coefficients that are significant at or beyond the 5% level of confidence.

**Author Note**

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**Figure Captions**

Figure 1. Cumulative cohort differences from 1889 base cohort for the mental abilities.

Figure 2. Cumulative cohort differences by gender for the mental abilities.

Figure 3. Cumulative cohort differences from 1889 base cohort for the contextual variables.

Figure 4. Interaction between work complexity and recency of retirement for performance on the Inductive Reasoning test.

# PMA COHORT CHANGES

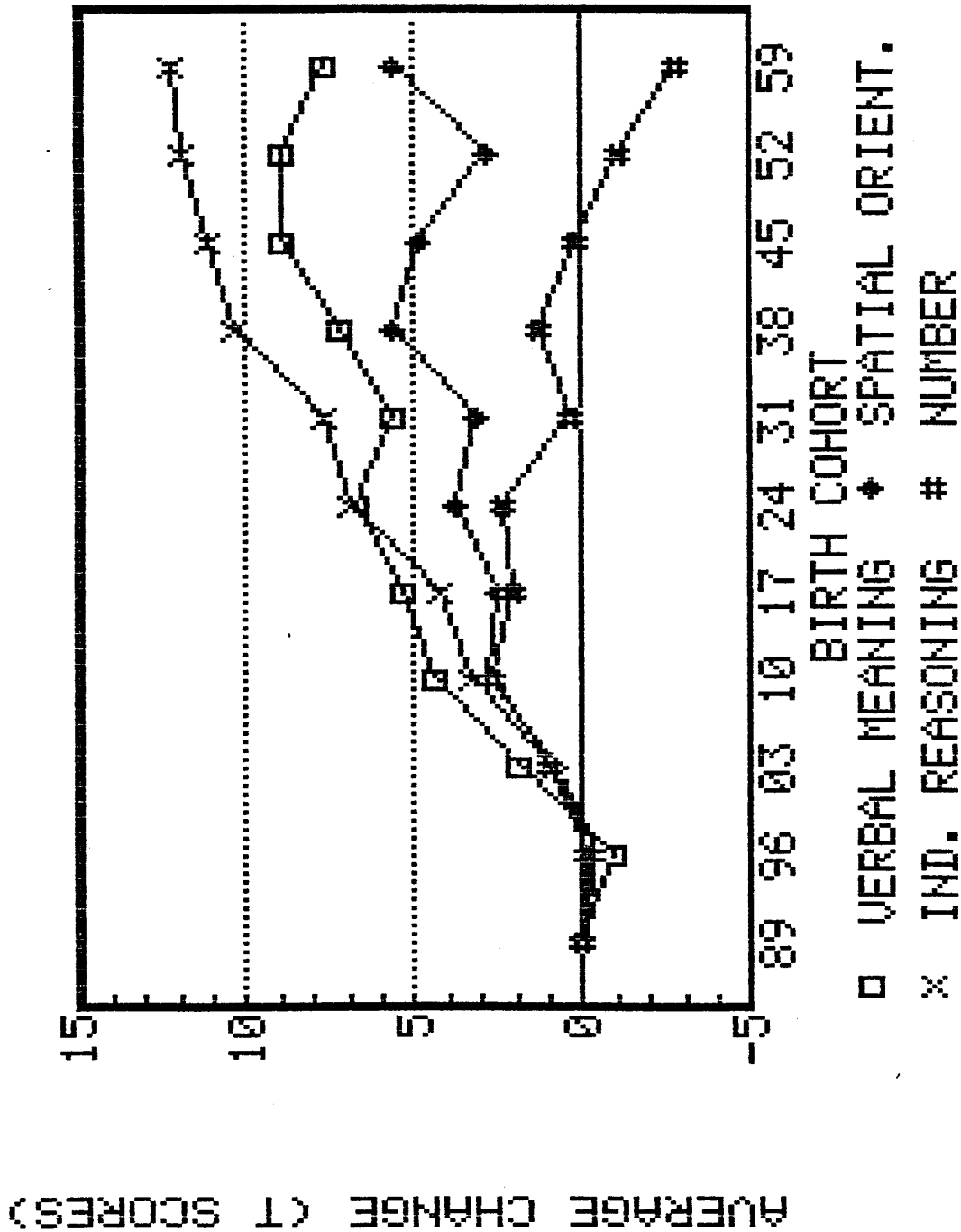
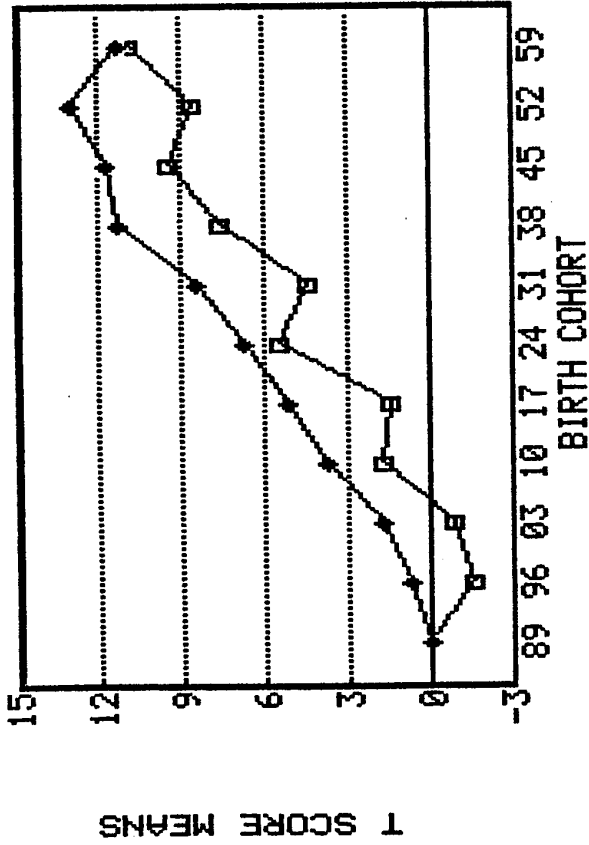
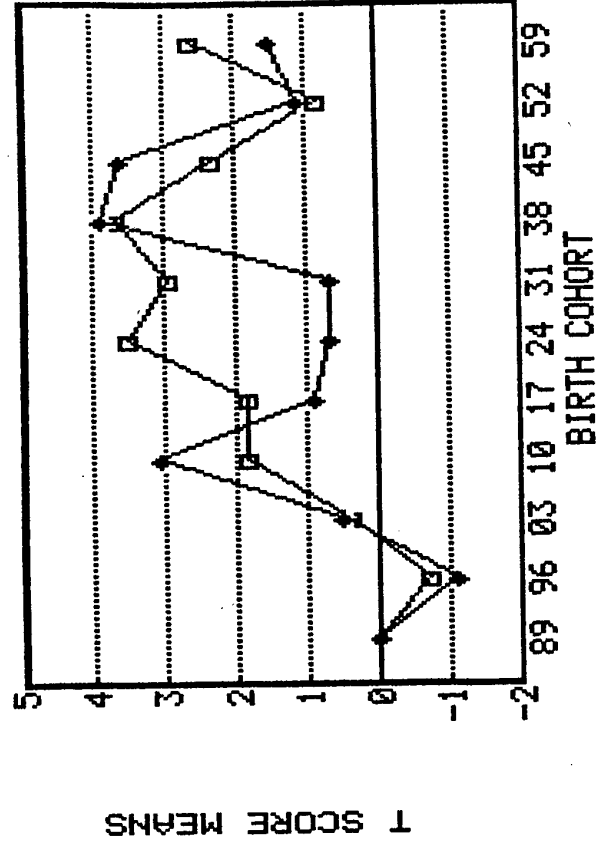


Fig. 1

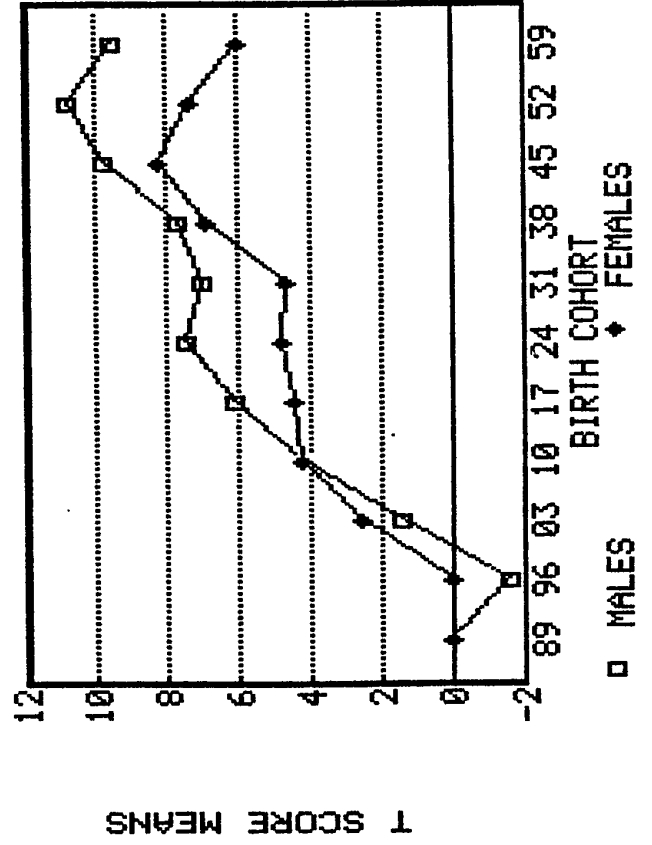
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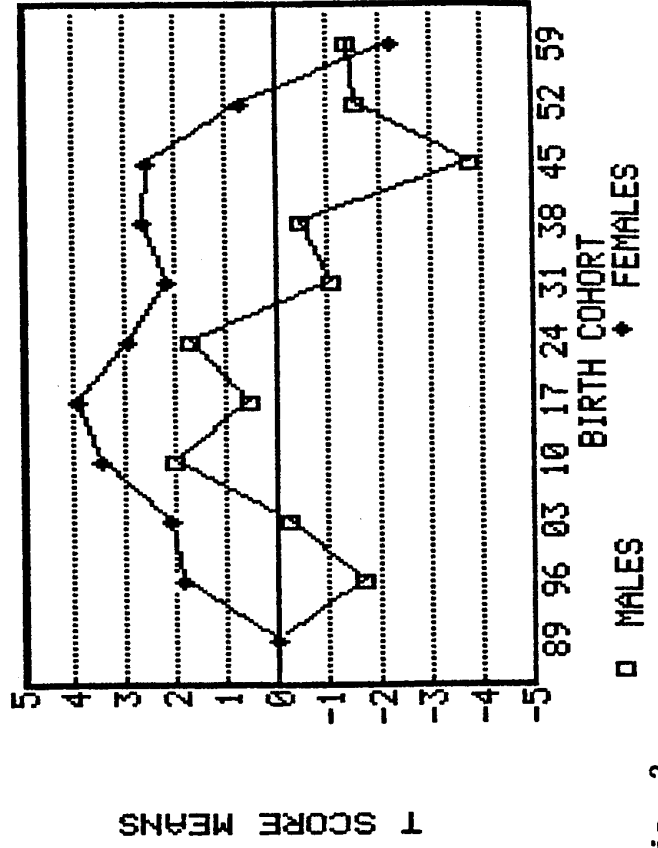
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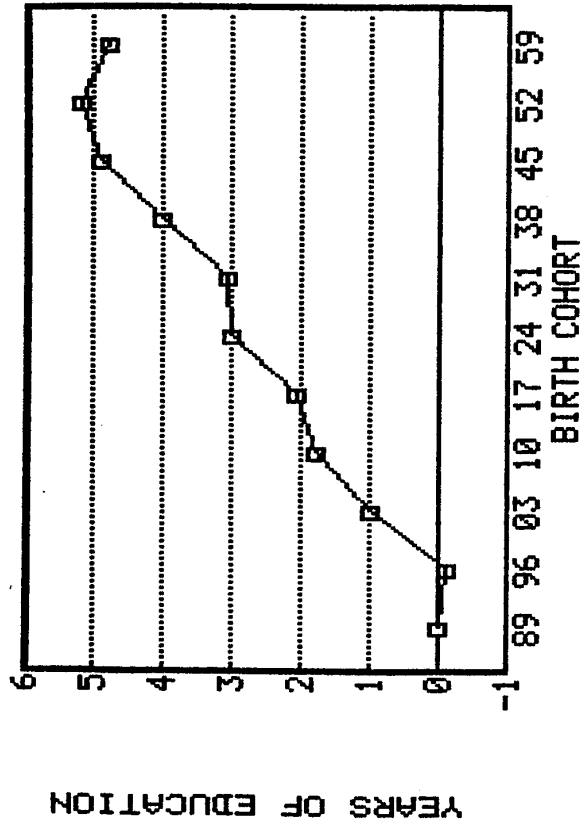
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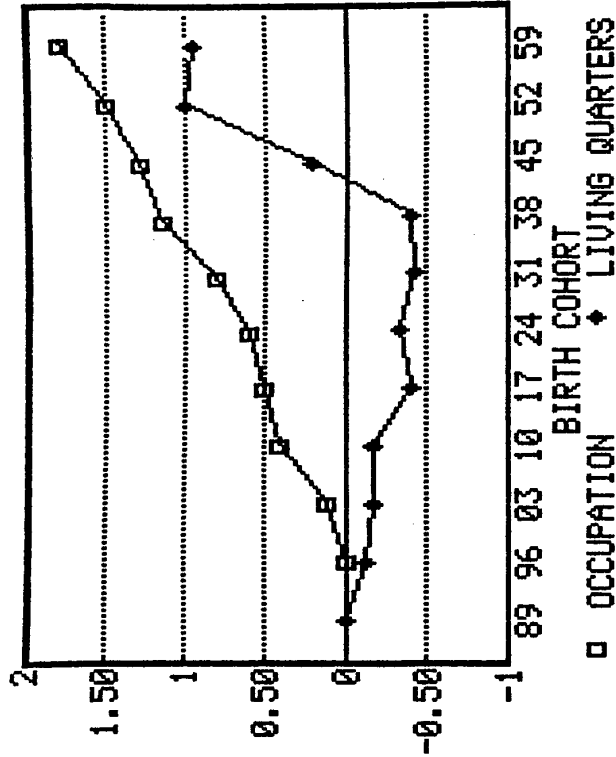
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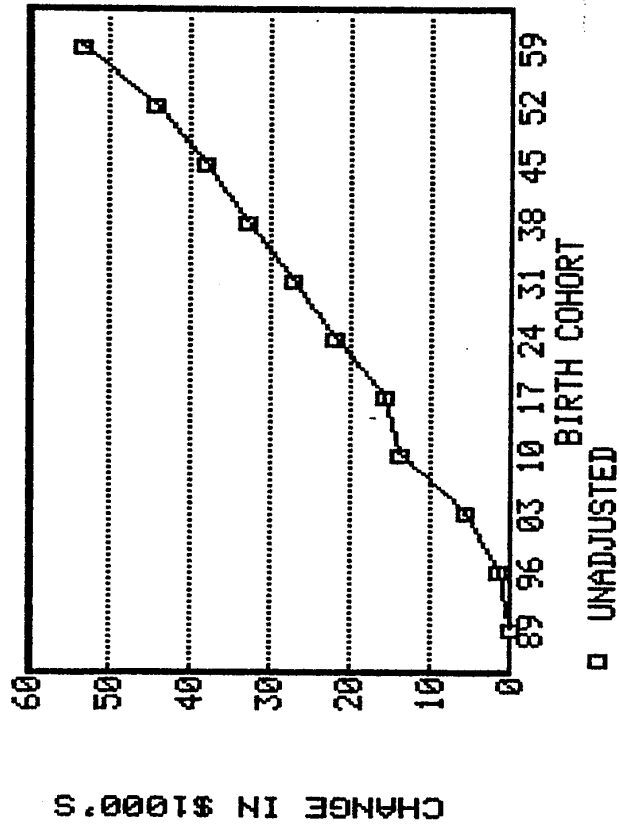
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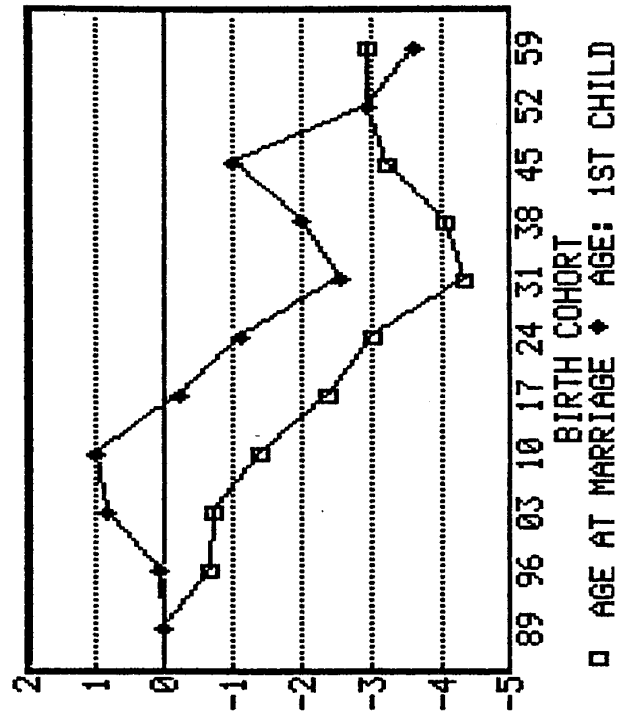
AVERAGE CHANGE IN 7 YEARS



COHORT CHANGES: INCOME



AVERAGE CHANGE (IN YEARS)



### COMPLEXITY AND RETIREMENT

