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Adult Personality and Psychomotor Performance: Cross-sectional and Longitudinal Analyses

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Results are presented from cross-sectional and longitudinal analyses of data from the Test of Behavioral Rigidity for 3,442 subjects over the age range from 22 to 84 years. Data are presented on the Behavioral Flexibility, Attitudinal Flexibility, and Social Responsibility questionnaire scales, as well as on performance score measures indexing Associational Flexibility, Instructional Set Flexibility, Copying Speed, and Associational Speed. Data on these scales were obtained for 5 samples examined 7 years apart (1956, 1963, 1970, 1977, and 1984). These data permit analyses of birth cohort differences and rate of change within the same individuals, as well as successive samples drawn from the same cohort over as long as 28-year periods. Results of the analyses confirm the presence of substantial generational differences, with generally only limited change over time within cohorts.

CONSIDERABLE attention has been given to generational differences in level and rate of age changes in the study of adult behavioral development. This work has been limited largely, however, to the assessment of cognitive functioning, where cross-sectional findings have often portrayed inflated age decrement because of positive intellectual gains across successive cohorts (cf. Schaie, 1983; Schaie & Hertzog, 1986). Much less work has been done on generational differences in personality development. In a study of the personality trait of social responsibility, Schaie and Parham (1974; Schaie, 1982) were able to show significant secular trends (period effects) and cohort differences, but virtually no age-related effects.

In a broader coverage of the personality spectrum, Schaie and Parham (1976) examined age changes over 14 years on a number of personality dimensions obtained by an item-factor analysis of the Test of Behavioral Rigidity (Schaie & Parham, 1975). Here, too, it was found that apparent socially undesirable age differences shown in cross-sectional data were often an artifact of substantial generational shifts in attitudes and personality traits, but that there was remarkable longitudinal stability for most traits. Substantial stability over time in many adult personality traits has also been reported by McCrae and Costa (1984) and in the Bonn Longitudinal Study (cf. Schmitz-Scherzer & Thomae, 1983). In addition, modest longitudinal age changes and cohort differences have been reported for performance measures of flexible personality styles and psychomotor performance, which are essential components of performance measures of personality (Schaie, 1983).

Our own reports of estimated cohort gradients have generally depended upon computing differences between successive cohorts at two common age levels (Schaie, 1980, 1983). Such two-point estimates may be particularly sensitive to perturbations caused by sampling variations. With the completion of data collection for the fifth wave of the Seattle Longitudinal Study, we are now in a position to estimate 7-year cohort shifts that are less sensitive to sampling variations by basing our estimates over at least four common age levels for seven successive cohorts. With the exception of the Schaie and Parham (1974, 1976) studies, personality data from the Seattle Longitudinal Study have been primarily reported at the latent construct level for the derived factors of Motor-Cognitive Rigidity, Personality-Perceptual Rigidity, and Psychomotor Speed. This study, by contrast, presents results for the original subscales contained in the Test of Behavioral Rigidity for 3,442 subjects over the age range from 22 to 84 years.

The Test of Behavioral Rigidity includes traditional questionnaire-type personality scales [most similar to those found in the California Personality Inventory (Gough, 1957)], performance measures of personality styles [derived from the older perseveration literature (Chown, 1959)], and measures of psychomotor speed (cf. Witt & Cunningham, 1979). The primary objective of this study is first to consider the effect of birth cohort differences on our measures. Second, we will consider how the differential performance of successive cohorts results in the substantial discrepancies in the estimation of age patterns seen in cross-sectional (across-cohorts) data, within-cohort independent samples data, and longitudinal (within-subjects) data.

METHOD

Subjects. — The data reported here represent the initial tests for 3,442 persons (males = 1,628; females = 1,814) who participated in the five waves of the Seattle Longitudinal Study. All participants were community-dwelling adults who were randomly selected from each 7-year age stratum of the membership of a metropolitan health maintenance organization. The initial 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 = 628). Numbers of initial participants by study wave are reported in Table 1. 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 occupa-

Table 1. Number of Study Participants First Assessed at Various Ages

Age	Time of Test					
	1956	1963	1970	1977	1984	Total
25	76	100	71	56	83	386
32	70	122	65	62	56	374
39	71	150	84	74	70	449
46	65	155	87	69	65	441
53	70	143	89	77	66	445
60	72	122	80	73	79	426
67	76	127	91	73	82	449
74	—	78	88	70	75	311
81	—	—	50	58	52	161
All	500	997	705	612	628	3,442

tional status averaged 6.25 on a 10-point scale using census classifications ranging from unskilled labor to professional.

At each successive assessment point, retrievable subjects from all earlier waves of the study were retested. Data are, therefore, reported also on within-subject age changes over 7 years on 2,257 study participants.

Measures. — Throughout the study, subjects have been assessed with the first five primary mental abilities (Schaie, 1985; Thurstone & Thurstone, 1941), the Test of Behavioral Rigidity (Schaie & Parham, 1975), and a demographic information form. In this study, we focus on the personality and psychomotor performance data derived from the Test of Behavioral Rigidity.

The Test of Behavioral Rigidity was developed as part of an inquiry concerned with determining the dimensions of behavioral rigidity (Schaie, 1955, 1958). The test consists of three parts, resulting in eight measures as follows:

The *Capitals Test* was adapted from Bernstein's (1924) study of quickness and intelligence, and is representative of the earliest "functional" approach to the study of rigidity and perseveration. In the first part of this test, subjects copy a paragraph of writing following the model wherever lowercase or uppercase letters are indicated. In a second part, subjects recopy the paragraph, but now must substitute lowercase for uppercase in the original and vice versa. A total of 2½ minutes is allowed for each part of the test. The total number of words copied under the standard condition provides a measure of "Copying Speed." The ratio of the number of words in the perseveration-inducing condition to that in the standard condition yields a measure of "Instructional Set Flexibility" (i.e., the ease responding under conditions that are counterintuitive and/or inducive of negative transfer or perseveration).

The *Opposites Test* was newly constructed along lines suggested by Scheier and Ferguson (1952). The test contains three lists of simple words, selected to be at approximately a third grade educational level. Subjects are asked to write antonyms for the words in the first list and synonyms for the words in the second list. In the third list, subjects are asked to respond with an antonym to words printed in lowercase letters and with a synonym to words printed in uppercase letters. Two minutes are allowed for each of the three lists. The total number of responses made to the first two lists gives a measure of "Associative Speed." Two measures of "Associational Flexibility" are obtained. The first is the proportion of correct responses under the perseveration-inducing condition. The second represents the ratio of the number of correct responses under the perseveration-inducing condition to the number produced under the standard condition.

The *TBR Questionnaire* consists of 75 true or false items. These items involve three distinct scales: A 22-item "Attitudinal Flexibility" scale adapted from the California Personality Inventory (Gough, 1957); a 44-item "Social Responsibility" scale adapted from Gough, McCloskey, and Meehl (1952; Schaie, 1959); and a 9-item "Behavioral Flexibility" scale adapted by Guttman scaling of a measure first used by Lankes (1915).

Of these measures, the Attitudinal Flexibility, Behavioral Flexibility, and Social Responsibility scales represent traditional true and false personality inventory scales. The Instructional Set Flexibility and Associational Flexibility measures represent performance measures of flexible personality styles, and the Copying Speed and Associative Speed measures represent indices of the efficiency of the subjects' psychomotor performance.

Procedure. — All subjects were tested in small groups in sessions that, for the first three waves, lasted about 2 hours, for the fourth wave lasted about 3 hours, and for the fifth wave involved two sessions of 2½ hours each (necessary because multiple markers of the abilities and other additional measures had been added). The Test of Behavioral Rigidity questionnaire was frequently administered on a take-home basis.

Method of analysis. — The basic 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, 1988). 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. Cohort gradients were constructed by cumulating cohort difference estimates across all cohorts available for analysis, using the earliest (1889) cohort as the base.

Cross-sectional age differences were obtained by averaging across all subjects of the same age regardless of time of measurement. Within-cohort age changes were estimated by taking differences between the means of independent random samples of members of the same cohort assessed at successive times of measurement. Similar to the procedure used for the estimation of cohort differences, we then averaged across all estimates for each 7-year age interval. Longitudinal (within-cohort) age gradients were constructed by cumulating the average age change estimates using the youngest age group as the base. Longitudinal (within-

subjects) age changes were estimated by aggregating age changes across all individuals followed over the same 7-year age range regardless of the time period over which they were assessed. The latter data, of course, do not control for practice or experimental mortality. They do, however, provide a direct estimate of age change occurring in the same individuals, averaged over four 7-year time periods.

Because of the large number of subjects, and the wide age and cohort range covered, omnibus tests result in highly reliable effects for age and cohort by design definition; they are consequently of little interest and are therefore not reported. Both cohort and age change findings depend on the analyses of successive pairings of cohorts or time points within cohort. While we have reported at each observational point where appropriate, the reader should be cautioned that it is the magnitude of the cohort difference or the age change over each pair of observations that is of critical interest. Thus, it is inappropriate to conduct an omnibus repeated measures analysis for the longitudinal age comparisons, because such a comparison would confound age and cohort. Instead, we estimate the statistical significance of differences separately within each cohort.

To permit comparisons across the different measures, all raw scores were standardized and converted to *T*-score form ($M = 50$, $SD = 10$) based on the entire set of participants at first test.

RESULTS

Cohort Gradients

As indicated in "Methods of Analysis," unweighted mean differences as expressed in *T*-score points (1/10 *SD*) were computed between all successive pairs of cohorts. Omnibus tests of these differences show highly significant cohort differences for all variables except Instructional Set Flexibility (see Table 2).

Differences between successive cohorts were cumulated from the oldest cohort born in 1889 up to the most recently measured cohort born in 1959. Virtually all of the resulting cohort gradients shown in Figure 1 have a positive shape, with later-born cohorts showing more flexible attitudes and behaviors, as well as higher levels of psychomotor speed performance. It will be noted that, over the 70 years monitored (representing approximately the average life span in industrialized countries), flexibility increases by approximately .8 standard deviations for the questionnaire measures of Attitudinal and Behavioral Flexibility, by approximately 1 1/4 standard deviations for the measures of Associative Flexibility and Psychomotor Speed. Instructional Set Flexibility, however, remains virtually flat across the range of cohorts studied. On the other hand, there is a modest, but statistically significant, decline in self-reported Social Responsibility. It is of interest to note that the questionnaire measures of Flexibility and the measure of Associative Speed level off for the "baby boom" cohorts; indeed, there appears to be some evidence of a possible negative trend in flexibility for these cohorts.

Construction of the kind of cohort gradients presented here requires a "rolling" comparison at the ages at which data are available for each cohort (e.g., the second and the third oldest cohorts are compared at ages 60, 67, 74, and 81, while the third and the fourth cohorts are compared at ages 53, 60, 67, 74, and so on). We can obtain further information on the time-lag at each of the ages monitored over the five successive samples for which data are available. Significant positive shifts across successive cohorts ($p < .01$) occurred at all but the oldest age for the measures of Copying Speed, Associative Speed, and Instructional Set Flexibility. Similar positive shifts occurred for the measures of Associative Flexibility except for the youngest and oldest ages. For Attitudinal Flexibility, significant positive shifts were observed for ages 39 through 74 and for Behavioral Flexibility for ages 39 to 60. Significant negative shifts were observed for Social Responsibility at ages 25 and 53.

Age Effects

Next, we examined the consequences of the highly significant generational differences for our understanding of age

Table 2. Mean Cohort Differences in *T*-Scores

Cohorts	Behavioral Flexibility	Attitudinal Flexibility	Social Responsibility	Instructional Set Flexibility	Associational Flexibility 1[a]	Associational Flexibility 2[a]	Copying Speed	Associational Speed
	d	*d*	*d*	*d*	*d*	*d*	*d*	*d*
1889 vs 1896	.95	−.56	−.54	−1.25	1.32	.68	−1.99*	−.64
1896 vs 1903	1.57*	1.89*	.11	.94	.99	1.08	−.50	.94
1903 vs 1910	−.43	.52	−.61	1.24	3.27***	1.71*	1.99*	3.23***
1910 vs 1917	1.34	2.16**	−.52	−.20	2.02**	1.88**	.82	1.66*
1917 vs 1924	1.06	1.04	.16	1.26	1.64*	2.10**	.77	1.63*
1924 vs 1931	.63	−.46	−1.45*	.66	.12	1.36	.92	−.02
1931 vs 1938	1.84*	1.60*	1.95*	.39	1.39	2.18**	3.32***	2.68***
1938 vs 1945	1.06	1.92*	−2.73*	−.22	.41	.61	3.78***	2.07*
1945 vs 1952	.54	1.13	−.92	.70	.79	1.08	−1.50	−.17
1952 vs 1959	−.28	−1.24	1.91	−1.83	−.07	1.00	5.24**	.09
Cumulative 1889 vs 1959	8.28***	8.00***	−2.64*	1.69	11.88***	13.68***	12.85***	11.47***

Note. Positive differences indicate gain for more recent cohort; negative differences indicate drop for more recent cohort.
[a]Associational Flexibility 1 = proportion correct; Associational Flexibility 2 = proportion of standard performance.
*$p < .05$; **$p < .01$; ***$p < .001$.

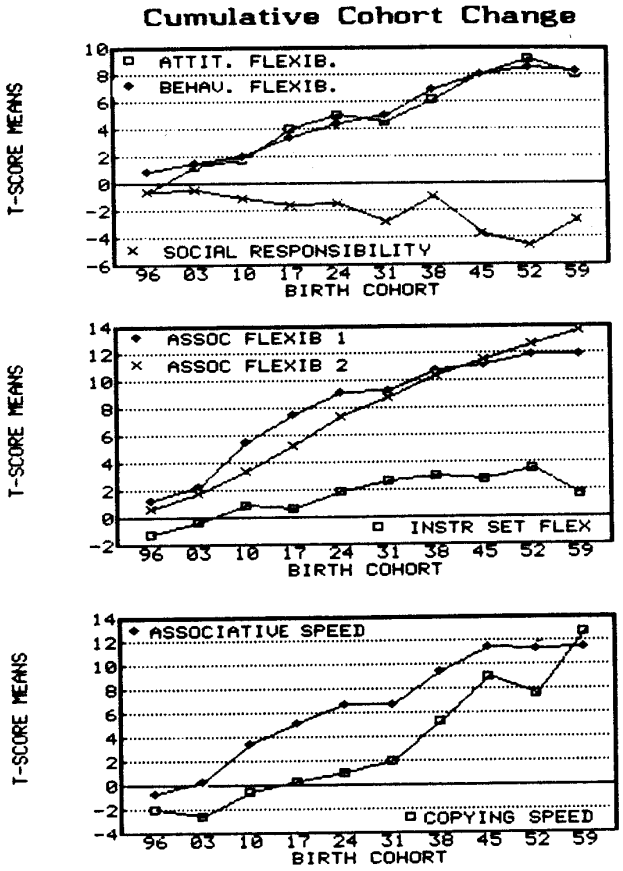

Figure 1. Cumulative cohort changes for the raw scores from the Test of Behavioral Rigidity from a base cohort born in 1889. Attit. Flexib. = Attitudinal Flexibility; Behav. Flexib. = Behavioral Flexibility; Assoc. Flexib. 1 = Associational Flexibility, proportion correct; Assoc. Flexib. 2 = Associational Flexibility, proportion of standard performance.

patterns in the personality traits and psychomotor performance here examined. Three different estimates of age patterns are available. The first is a cross-sectional one that compares age difference findings for individuals of different ages, but measured at the same point in time. The second is a within-cohort longitudinal estimate, based on independent random samples, drawn from the same cohort at successive ages over time, and the third is based on changes observed within the same individuals over time. All comparisons are made over a 7-year interval.

Cross-sectional data. — To obtain maximally stable data, we averaged scores across all five occasions of measurement. The cross-sectional data are reported in Table 3. As would be expected from the widely differing cohort gradients, these cross-sectional age differences differ markedly across the variables studied. Social Responsibility has a virtually flat profile after an initial positive difference of about 1/3 *SD* to age 39; the oldest subjects still rate themselves as more socially responsible than the youngest. However, negative age differences (favoring the younger subgroups; $p < .01$) were found for all measures of flexibility. The magnitude of these differences from the youngest to the oldest group range from approximately 3/4 *SD* for Behavioral Flexibility and Instructional Set Flexibility to 1 *SD* for Attitudinal Flexibility, and approximately 1.5 *SD* for the measure of Associational Flexibility. The measures of Copying and Associative Speed show similarly large magnitudes of negative age differences.

Because of increasing educational exposure for successive cohorts, it was thought possible that the age differences could be inflated by these educational differences. Table 4 reports means and standard deviations of attained educational level by birth cohort. As would be expected, there is a highly significant increase ($p < .001$) in educational attainment for successive cohorts. We consequently adjusted the

Table 3. Cross-Sectional Age Patterns in *T*-Scores

Scale	Age								
	25	32	39	46	53	60	67	74	81
Behavioral Flexibility	52.6	52.1	50.9	51.5	49.8	50.1	47.2	45.6	45.4
	52.2	51.5	50.4	51.7	49.9	50.5	48.1	46.6	46.5
Attitudinal Flexibility	54.3	53.6	52.5	52.3	50.4	48.4	45.9	44.2	44.4
	53.5	52.3	51.4	51.8	50.2	48.8	47.3	45.7	46.0
Social Responsibility	47.7	49.6	51.0	50.7	51.1	51.0	50.0	48.8	49.3
	46.9	48.5	50.2	50.4	50.9	51.4	51.0	49.9	50.5
Instructional Set Flexibility	52.9	52.9	52.3	50.2	50.5	49.2	46.8	46.7	45.1
	52.5	52.2	51.8	49.8	50.5	49.5	47.5	47.6	46.0
Associational Flexibility 1[a]	54.5	54.5	53.2	52.4	51.1	48.6	45.3	43.9	40.5
	53.7	53.2	52.1	51.7	50.9	48.9	46.6	45.4	41.7
Associational Flexibility 2[a]	57.6	55.1	52.4	52.1	49.4	47.1	44.7	44.0	42.7
	57.3	54.0	51.4	51.6	49.1	47.4	46.0	45.5	44.0
Copying Speed	54.8	53.9	53.0	52.1	50.4	48.6	45.8	43.8	41.6
	54.7	52.4	51.9	51.6	50.2	49.2	47.4	45.5	43.0
Associational Speed	55.5	55.6	53.8	52.6	50.9	48.1	44.6	42.0	39.2
	54.9	54.2	52.6	52.0	50.8	48.6	46.1	43.5	40.2

Note. Top values are unadjusted *T*-scores ($M = 50$, $SD = 10$); bottom values are adjusted for age differences in educational level.
[a]Associational Flexibility 1 = proportion correct; Associational Flexibility 2 = proportion of standard performance.

Table 4. Years of Educational Attainment by Cohort

Birth Cohort	*N*	Mean	*SD*
1889	204	11.22	3.60
1896	346	11.10	3.39
1903	405	12.26	3.40
1910	436	13.04	2.93
1917	470	13.32	2.75
1924	463	14.17	2.78
1931	417	13.88	2.76
1938	303	14.56	2.60
1945	203	15.22	2.40
1952	110	15.12	2.27
1959	84	14.90	2.11

raw scores by removing the effects of differences in educational level and restandardizing. Means for the education-adjusted scores are reported in the second line for each variable in Table 3. Adjusting for education reduces age differences slightly, but does not materially affect the patterns reported above.

Longitudinal data. — We report both the independent samples (age changes within cohort) and repeated measurement data (age changes within individuals). Means for both times of measurement are shown in Tables 5 and 6. The magnitudes of the age contrasts (mean differences across 7

Table 5. Mean *T*-Scores for the Longitudinal Data (Repeated Measures of the Same Individuals)

Age Interval	Time of Measurement	Behavioral Flexibility	Attitudinal Flexibility	Social Responsibility	Instructional Set Flexibility	Associational Flexibility 1[a]	Associational Flexibility 2[a]	Copying Speed	Associational Speed
Ages 25 to 32	T1	53.11	55.10	48.23	53.58	54.55	57.31	55.34	56.31
(*N* = 135)	T2	53.71	55.29	50.25	54.47	55.20	58.07	55.89	56.78
Ages 32 to 39	T1	53.40	53.38	50.13	52.20	54.24	55.65	56.31	56.09
(*N* = 238)	T2	53.67	53.47	50.78	53.18	54.87	55.93	55.68	56.75
Ages 39 to 46	T1	51.56	52.85	51.39	51.00	53.92	53.31	55.90	54.89
(*N* = 341)	T2	52.10	53.03	51.85	53.10	54.45	53.44	53.38	55.11
Ages 46 to 53	T1	51.39	52.13	51.52	49.81	53.82	52.98	55.49	54.41
(*N* = 364)	T2	50.96	52.87	51.12	51.86	53.74	52.39	52.85	54.32
Ages 53 to 60	T1	50.31	52.05	52.19	49.64	52.55	50.57	54.18	52.59
(*N* = 407)	T2	50.76	51.41	52.37	51.67	53.29	51.39	50.77	52.36
Ages 60 to 67	T1	50.09	50.29	52.33	48.96	52.31	49.76	52.29	50.55
(*N* = 359)	T2	48.60	49.13	52.46	50.16	50.96	48.42	48.75	49.49
Ages 67 to 74	T1	47.21	47.18	51.84	47.35	48.34	46.06	48.49	47.01
(*N* = 284)	T2	46.33	45.63	52.11	46.63	46.56	45.09	45.18	45.40
Ages 74 to 81	T1	46.33	45.24	50.70	45.73	46.78	44.79	47.77	45.61
(*N* = 129)	T2	44.27	44.50	49.81	47.71	42.51	42.42	42.63	42.10

[a]Associational Flexibility 1 = proportion correct; Associational Flexibility 2 = proportion of standard performance.

Table 6. Mean *T*-Scores for the Within-Cohort Longitudinal Data (Independent Random Samples from the Same Cohort at Successive Ages)

Age Interval	Time of Measurement	Behavioral Flexibility	Attitudinal Flexibility	Social Responsibility	Instructional Set Flexibility	Associational Flexibility 1[a]	Associational Flexibility 2[a]	Copying Speed	Associational Speed
Ages 25 to 32	T1	52.57	54.43	47.52	52.92	54.37	57.26	53.88	55.27
(*N* = 606)	T2	52.58	54.20	48.79	52.80	55.90	56.13	55.33	56.36
Ages 32 to 39	T1	52.36	53.54	49.87	52.77	54.38	54.79	54.03	55.66
(*N* = 696)	T2	51.40	53.02	50.57	52.68	54.09	53.65	53.97	54.84
Ages 39 to 46	T1	50.09	51.91	51.05	51.89	52.53	51.70	52.49	53.02
(*N* = 754)	T2	52.34	53.24	50.47	50.36	53.07	53.13	53.18	53.51
Ages 46 to 53	T1	50.93	52.09	50.25	49.64	52.06	51.84	51.58	52.06
(*N* = 751)	T2	50.36	50.98	50.42	50.71	52.20	50.54	50.86	52.17
Ages 53 to 60	T1	49.47	50.28	51.64	50.14	50.64	48.77	50.27	50.56
(*N* = 733)	T2	50.78	49.24	50.97	49.48	50.12	48.54	48.76	49.44
Ages 60 to 67	T1	49.38	48.22	50.83	49.15	48.16	46.46	48.00	47.44
(*N* = 720)	T2	47.89	46.35	49.66	46.50	46.72	45.61	46.13	45.44
Ages 67 to 74	T1	47.12	45.02	50.10	46.67	43.88	43.64	45.30	44.00
(*N* = 678)	T2	45.61	44.32	48.67	46.83	44.07	44.13	43.80	42.10
Ages 74 to 81	T1	45.10	43.57	48.79	46.80	42.63	43.39	42.12	40.75
(*N* = 372)	T2	45.47	44.53	49.39	45.10	40.41	42.66	41.64	39.18

[a]Associational Flexibility 1 = proportion correct; Associational Flexibility 2 = proportion of standard performance.

years) between successive data points are provided in Table 7. The cumulative magnitudes of age changes within cohort as estimated from the independent samples from ages 25 to 81 are quite modest. They range from a slight (.2 *SD*) positive change on Social Responsibility and virtually zero cumulative change for Behavioral Flexibility to modest (1/3 *SD* to .6 *SD*) negative changes for the remaining variables. Statistically significant positive changes occurred up to age 46 for Behavioral Flexibility, Attitudinal Flexibility, and Associational Flexibility. Statistically significant negative changes were first noted in these data for Instructional Set Flexibility by age 46; for Copying Speed by age 60; and for Behavioral Flexibility, Attitudinal Flexibility, and Associative Speed by age 67.

Differences among measures in change across age is much greater for the estimates based on comparing the same subjects over time. These estimates range from a substantial (1 *SD*) increase in Instructional Set Flexibility and a slight (.2 *SD*) increase in Social Responsibility, to a modest decrease (1/3 *SD* to 1/2 *SD*) on all measures of flexibility and in Association Speed, but a very substantial decrease (2.1 *SD*) in Copying Speed. The results for the two different approaches to the estimation of population parameters from longitudinal data are generally quite comparable, but with some noteworthy discrepancies that can best be considered in conjunction with the even more noteworthy discrepancies from the age difference data described earlier. For the repeated measurement data, significant positive changes were noted for Social Responsibility to age 32; for Associational Speed to age 39; for Associational Flexibility to age 46; and for Instructional Set Flexibility to age 60. Statistically significant negative changes were first noted for Copying Speed by age 46; for Attitudinal Flexibility by age 60; and for Behavioral Flexibility, Associational Flexibility, and Associational Speed by age 67.

Age by cohort interactions. — It is of interest also to note whether age changes differ in magnitude for successive cohorts. This can be investigated most directly for the independent samples data by crossing the same two age intervals for all available cohorts covering those intervals. Requisite analyses of variance (ANOVAs) were computed for each successive 7-year comparison from ages 25 to 81 (see Table 8). Statistically significant age by cohort interactions ($p < .05$) were found for all intervals for the measures of Instructional Set Flexibility and Copying Speed. However, no such interactions were observed for Behavioral Flexibility or Associational Flexibility. For Copying Speed, significant interactions were found over the age range from 46 to 60; for Attitudinal Flexibility from ages 46 to 53 and from ages 74 to 81; and for Social Responsibility from ages 39 to 46, ages 53 to 60, and ages 74 to 81.

Discussion

We have presented data that inform us that personality questionnaire and performance measures of personality styles and psychomotor speed are not immune from the generational shifts that have previously been documented in the ability domain. As would be expected, in the presence of such cohort effects, we found substantially discrepant findings in the age patterns presented from the analysis of cross-sectional, within-cohort independent samples, and repeated measures of longitudinal data. We must now examine the implications of the cohort findings for the interpretation of data on personality, psychomotor performance, and age. To do so, we have jointly graphed the information on age

Table 7. Longitudinal Age Changes in *T*-Scores

		25 to 32	32 to 39	39 to 46	46 to 53	53 to 60	60 to 67	67 to 74	74 to 81
N	(I)[a]	606	696	754	751	733	720	678	372
	(R)[a]	135	238	341	364	407	359	284	129
Behavioral Flexibility	(I)	+.3	−1.0	+2.3**	−.6	+1.3	−1.5*	−1.5	+.4
	(R)	+.6	+.3	+.5	−.4	+.4	−1.5**	−.9	−2.1*
Attitudinal Flexibility	(I)	−.2	−.5	+1.3*	−1.0	−1.0	−1.9*	−.7	+1.0
	(R)	+.8	+.1	+.2	−.3	−.6*	−1.2**	−1.6**	−.7*
Social Responsibility	(I)	+1.3	+.7	−.6	+.2	−.7	−1.2	−1.4	+.6
	(R)	+2.0**	+.6	+.4	−.4	+.2	+.1	+.3	−.9
Instructional Set Flexibility	(I)	−.1	−.1	−1.5*	+1.1	−.7	−2.6**	+.2	−1.7
	(R)	+.9	+1.0	+2.1**	+2.0**	+2.0	+1.2	−.6	+2.0
Associational Flexibility 1[b]	(I)	+.5	−.3	+.5	+.1	−.5	−1.4	+.2	−2.2
	(R)	+.6	+.6	+.6	−.1	+.8*	−1.4**	−1.8**	−4.2**
Associational Flexibility 2[b]	(I)	−1.1	−1.1	+1.4*	−1.3*	−.2	−.8	+.5	−.7
	(R)	+.8	+.3	+.1	−.6	+.8	−1.3**	−1.0	−2.4**
Copying Speed	(I)	+1.4	+.1	+−7	−.7	−1.5*	−1.9**	−1.5	−.5
	(R)	+.6	−.6	−2.5**	−2.6**	−3.4**	−3.5**	−3.3**	−5.1**
Associational Speed	(I)	+1.1	−.8	+.5	+.1	−1.1	−2.0**	−1.9**	−1.6
	(R)	+.6	+.7*	+.2	−.1	−.2	−1.1**	−1.6**	−3.5

[a] I = data from independent random samples of same cohort at successive ages; R = data from the repeated measurement of the same individuals.
[b] Associational Flexibility 1 = proportion correct; Associational Flexibility 2 = proportion of standard performance.
*$p < .05$; **$p < .01$.

Table 8. ANOVA of Within-Cohort Independent Random Samples

		25 to 32	32 to 39	39 to 46	46 to 53	53 to 60	60 to 67	67 to 74	74 to 81
Age									
N		606	696	754	751	733	720	678	372
					F-ratios				
Behavioral Flexibility	(A)	.01	1.61	14.60***	2.06	3.21	4.03*	3.54	.14
	(C)	.72	3.72*	3.43*	4.18**	5.28**	3.56*	5.56**	2.08
	(A × C)	.95	2.03	1.33	1.31	2.03	1.83	.63	1.18
Attitudinal Flexibility	(A)	.09	.57	3.69*	2.30	2.05	6.42*	.94	1.00
	(C)	2.69*	5.11**	6.76***	1.54	6.17***	8.82***	4.96**	2.80
	(A × C)	1.15	.55	1.87	4.94**	1.40	2.28	2.31	3.42*
Social Responsibility	(A)	2.28	.82	.61	.05	.84	2.20	3.26	.34
	(C)	8.01**	2.54*	2.87*	2.86*	1.11	.85	.54	.27
	(A × C)	.67	2.05	3.11*	2.36	6.51***	1.72	2.48	3.69*
Instructional Set Flexibility	(A)	.03	.13	4.99*	2.26	.76	11.30***	.04	1.89
	(C)	.87	.56	1.91	.57	.54	1.29	2.70*	3.28*
	(A × C)	9.64***	7.54***	5.84***	5.38***	2.66*	7.48***	8.84***	3.17*
Associational Flexibility 1[a]	(A)	1.81	.47	.95	.05	.49	2.97	.04	2.98
	(C)	2.79*	6.67***	10.57***	6.17***	8.42***	21.29***	9.52***	.54
	(A × C)	.36	3.22*	1.32	.37	1.39	1.73	.20	2.40
Associational Flexibility 2[a]	(A)	2.57	2.86*	4.66*	3.83*	.11	1.51	.50	.69
	(C)	4.15**	8.96***	14.67***	11.60***	9.73***	20.21***	6.30***	.51
	(A × C)	.20	.59	.57	1.75	2.10	1.71	.41	2.89
Copying Speed	(A)	3.37	.01	1.00	1.22	5.30*	9.84**	6.90**	.47
	(C)	7.66***	23.32***	16.30***	3.29*	5.46**	7.40***	13.44***	.41
	(A × C)	8.47***	5.24**	18.80***	31.73***	27.30***	18.94***	13.34***	7.49**
Associational Speed	(A)	3.04	1.80	.59	.03	2.68	8.06**	7.86**	3.35
	(C)	8.31***	12.91***	14.56***	8.70***	12.26***	16.55***	13.35***	.76
	(A × C)	.73	.43	.15	6.86***	4.10**	.32	1.09	.58

Note. (A) = age; (C) = cohort; (A × C) = Age-by-cohort interaction.
[a]Associational Flexibility 1 = proportion correct; Associational Flexibility 2 = proportion of standard performance.
*$p < .05$; **$p < .01$; ***$p < .001$.

differences and age changes (from Tables 3 and 6) for the three methods of estimating age patterns (see Figures 2 to 4).

Let us first consider the questionnaire measures (shown in Figure 2). For both Attitudinal and Behavioral Flexibility, the within-cohort and longitudinal gradients coincide closely and both diverge markedly from the cross-sectional gradient. This discrepancy is readily explained by the steep positive cohort gradients shown earlier for these traits in Figure 1. Age differences in Attitudinal and Behavioral Flexibility favoring young adults consequently do not represent substantial negative developmental changes, but rather represent primarily generational differences in level attained as part of the early socialization process. There seems to be modest change in a flexible direction in young adulthood, but moderately increasing rigidity as the sixties are reached.

A somewhat different pattern prevails for Social Responsibility. In the absence of a pronounced cohort trend, cross-sectional and longitudinal data coincide and present a flat profile across the adult life span. The within-cohort gradient implies a slightly negative trend that may reflect the effect of several small but significant age-by-cohort interactions favoring earlier-born cohorts. In addition, it seems clear that self-reported Social Responsibility after an early modest rise to the late thirties remains at a fairly stable level thereafter.

Substantial discrepancies were also found for our measures of personality style (shown in Figure 3). As a consequence of a slightly positive cohort gradient, the within-cohort findings are modestly above the cross-sectional data. What is most surprising, however, is the fact that the longitudinal gradient for Instructional Set Flexibility has a strong positive slope. Two factors may account for these results. The first involves the effects of practice in reversing instructions, which is controlled for in the cross-sectional and within-cohort estimates, but which confounds the longitudinal data. Additionally, the significant longitudinal decline in Copying Speed (see Figure 4) may spuriously result in higher ratios between performance under the two instructional set conditions when performance in both is relatively low. Note also that, on this variable, significant age-by-cohort interactions systematically favor the younger cohorts. We conclude then that the longitudinal estimate is inflated, and that the within-cohort estimate is the most realistic representation of developmental change on Instructional Set Flexibility, implying stability until age 60 and modestly decreasing flexibility thereafter.

Steep positive cohort gradients for the two measures of Associational Flexibility readily account for the discrepancies between the cross-sectional and longitudinal findings. The large cross-sectional age differences are again a function of earlier attained levels rather than massive shifts in adulthood. The first measure primarily indicates the effect of interference in terms of lack of accurate response under the

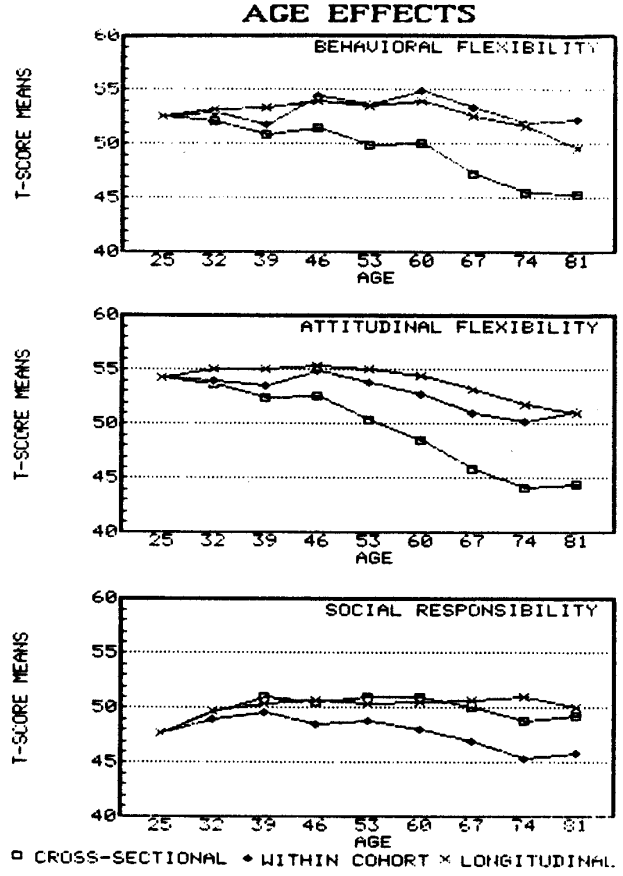

Figure 2. Cross-sectional, within-cohort, and longitudinal age effects for measures of behavioral flexibility, attitudinal flexibility, and social responsibility.

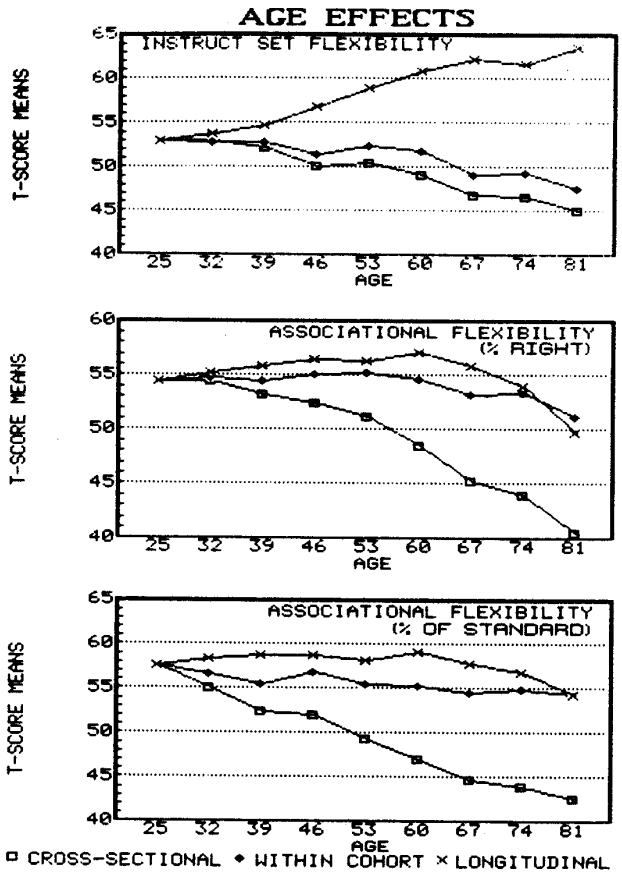

Figure 3. Cross-sectional, within-cohort, and longitudinal age effects for measures of instructional set flexibility and associational flexibility.

perseveration-inducing condition. For this measure, a developmental peak is reeached by age 60, with modest decline in flexibility (approximately ½ *SD*) thereafter. The second measure reflects the ratio of total correct responses under the perseveration-inducing condition as compared to the standard condition. Here, the within-cohort gradient is virtually flat, while the longitudinal measure again suggests a peak at 60 with modest decrease in flexibility thereafter.

Some comments are also in order for the measures of psychomotor response speed, which are part and parcel of any performance assessment of personality styles (see Figure 4). Positive cohort gradients occurred for both measures and, as a consequence, the within-cohort gradients reflect substantially less age-related decline in speed than would be inferred from the cross-sectional measures. For Associational Speed, the within-cohort and longitudinal gradients virtually coincide. For Copying Speed, however, the longitudinal gradient suggests even steeper decline in speed than was suggested by the cross-sectional age differences. This discrepancy can be reconciled when we note the effect of statistically significant age-by-cohort interactions favoring more recent cohorts at all age levels. The longitudinal gradients are based on data equally weighting all individuals. Greater decline in Copying Speed occurring for the earlier born and more heavily represented cohorts, therefore, has greater impact than in the within-cohort gradient that uses unweighted means in averaging across cohorts. Our data suggest significant but modest decline in response speed beginning by age 53 for Copying Speed and by age 60 for Associational Speed.

It should be further noted that the positive cohort trends for our psychomotor speed measures are in marked contrast to negative cohort trends that have been observed for measures of perceptual speed (Schaie, 1989). Since the cohort trends reported here are consistent with those shown for the personality style measures, it may well be that the psychomotor speed component observed in performance measures of personality reflects a response style rather than being an indicator of cognitive processing. The relationship between psychomotor and perceptual speed obviously requires further investigation.

Our detailed analysis of personality questionnaire and performance test personality style data has shown that substantial cohort effects can be found in this domain for some but not all measures investigated. The data presented here suggest specifically that there has been a substantial positive development toward more flexible personality styles, behaviors, and attitudes in successive generations

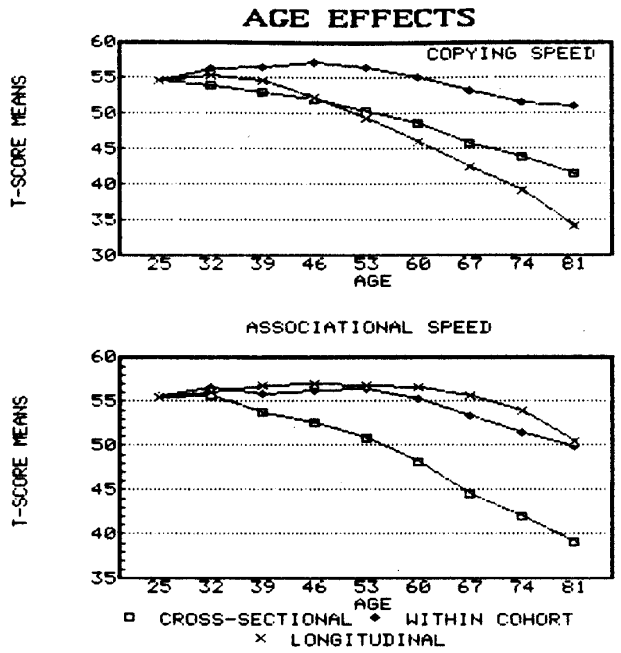

Figure 4. Cross-sectional, within-cohort, and longitudinal age effects for measures of copying speed and associational speed.

over the past 70 years. These generational differences have led us to assume erroneously that most individuals become substantially more rigid as they age. Our results suggest, therefore, that the inferences previously drawn from cross-sectional data regarding the life course of flexibility-rigidity are unduly pessimistic. While there is indeed some average drop in flexibility beginning in the sixties, it is much more modest in nature than was previously suggested. By contrast, examination of the trait of Social Responsibility shows a significant early increment, but then virtual stability into late life.

Most work on aging, personality, and performance styles in the past has relied heavily on cross-sectional data and has consequently identified large adult age differences. Work of a longitudinal nature, by contrast, suggests that these differences reflect largely generational shifts and that stability of the adult personality, at least from young adulthood into early old age, would seem to be the rule rather than the exception (cf. Kogan, 1990; McCrae & Costa, 1984; Schaie & Parham, 1976). Nevertheless, as our data show, age changes do appear for all of the flexibility measures (whether questionnaire or performance-based) as the sixties are reached, and more pronounced findings of age changes in at least some personality dimensions may be expected as older and older populations become available for systematic study. It seems reasonable to assume that flexible response styles and high levels of psychomotor performance are useful for adaptive behavior in complex settings. Our findings on the positive cohort trends reported for both attitudinal and performance measures of flexible response styles consequently bode well for future generations. The increasing level of flexible performance at similar ages for successive cohorts, moreover, suggests that future generations of at least the young-old should be capable of more adaptive responses to the challenges confronting them. On the other hand, we regrettably find that, while there is some modest increment in Social Responsibility from young adulthood to middle age, there has, if anything, been a downward trend across cohorts. Thus, we conclude that our results, as well, support those who see a societal trend of increasing individual adaptation, but lowered concern for the needs of others.

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